

z/OS
3.2

*C/C++
Runtime Library Reference*



Note

Before using this information and the product it supports, read the information in [“Notices” on page 2171](#).

This edition applies to IBM® z/OS® 3.2 (5655-ZOS) and to all subsequent releases and modifications until otherwise indicated in new editions.

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About this document

This document contains reference information that is intended to help you use the header files and functions provided by the z/OS C/C++ runtime to write C or C++ applications.

This document contains reference information about implementing programs that are written in C and C++, which is specific to z/OS C/C++ runtime and z/OS.

This document contains terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations are indicated by a vertical line (|) to the left of the change.

You may notice changes in the style and structure of some of the contents in this document; for example, headings that use uppercase for the first letter of initial words only, and procedures that have a different look and format. The changes are ongoing improvements to the consistency and retrievability of information in our documents.

Who should read this document

This document is intended for application programmers interested in writing C and C++ applications using the z/OS C/C++ runtime.

How to read syntax diagrams

This section describes how to read syntax diagrams. It defines syntax diagram symbols, items that may be contained within the diagrams (keywords, variables, delimiters, operators, fragment references, operands) and provides syntax examples that contain these items.

Syntax diagrams pictorially display the order and parts (options and arguments) that comprise a command statement. They are read from left to right and from top to bottom, following the main path of the horizontal line.

For users accessing IBM Documentation using a screen reader, syntax diagrams are provided in dotted decimal format.

The following symbols may be displayed in syntax diagrams:

Symbol

Definition



Indicates the beginning of the syntax diagram.



Indicates that the syntax diagram is continued to the next line.



Indicates that the syntax is continued from the previous line.



Indicates the end of the syntax diagram.

Syntax diagrams contain many different items. Syntax items include:

- Keywords - a command name or any other literal information.
- Variables - variables are italicized, appear in lowercase, and represent the name of values you can supply.
- Delimiters - delimiters indicate the start or end of keywords, variables, or operators. For example, a left parenthesis is a delimiter.
- Operators - operators include add (+), subtract (-), multiply (*), divide (/), equal (=), and other mathematical operations that may need to be performed.

- Fragment references - a part of a syntax diagram, separated from the diagram to show greater detail.
- Separators - a separator separates keywords, variables or operators. For example, a comma (,) is a separator.

Note: If a syntax diagram shows a character that is not alphanumeric (for example, parentheses, periods, commas, equal signs, a blank space), enter the character as part of the syntax.

Keywords, variables, and operators may be displayed as required, optional, or default. Fragments, separators, and delimiters may be displayed as required or optional.

Item type
Definition

Required
 Required items are displayed on the main path of the horizontal line.

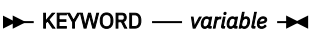
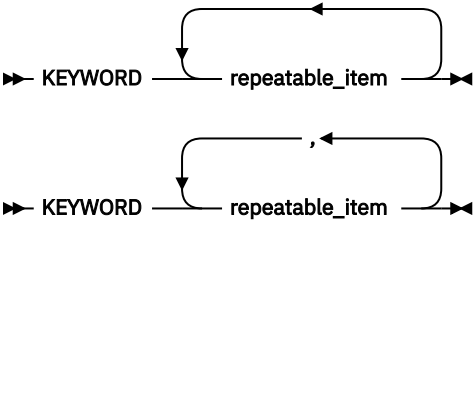
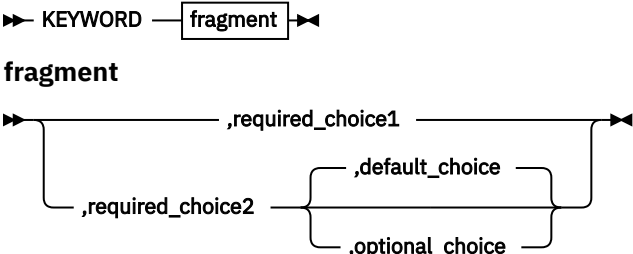
Optional
 Optional items are displayed below the main path of the horizontal line.

Default
 Default items are displayed above the main path of the horizontal line.

The following table provides syntax examples.

| Table 1. Syntax examples | |
|--|----------------|
| Item | Syntax example |
| Required item. Required items appear on the main path of the horizontal line. You must specify these items. | |
| Required choice. A required choice (two or more items) appears in a vertical stack on the main path of the horizontal line. You must choose one of the items in the stack. | |
| Optional item. Optional items appear below the main path of the horizontal line. | |
| Optional choice. An optional choice (two or more items) appears in a vertical stack below the main path of the horizontal line. You may choose one of the items in the stack. | |
| Default. Default items appear above the main path of the horizontal line. The remaining items (required or optional) appear on (required) or below (optional) the main path of the horizontal line. The following example displays a default with optional items. | |

Table 1. Syntax examples (continued)

| Item | Syntax example |
|--|---|
| Variable. Variables appear in lowercase italics. They represent names or values. |  |
| Repeatable item. An arrow returning to the left above the main path of the horizontal line indicates an item that can be repeated. A character within the arrow means you must separate repeated items with that character. An arrow returning to the left above a group of repeatable items indicates that one of the items can be selected, or a single item can be repeated. |  |
| Fragment. The fragment symbol indicates that a labeled group is described below the main syntax diagram. Syntax is occasionally broken into fragments if the inclusion of the fragment would overly complicate the main syntax diagram. |  |

Where to find more information

For an overview of the information associated with z/OS, see [z/OS Information Roadmap](#).

z/OS Basic Skills in IBM Documentation

z/OS Basic Skills in IBM Documentation is a Web-based information resource intended to help users learn the basic concepts of z/OS, the operating system that runs most of the IBM mainframe computers in use today. IBM Documentation is designed to introduce a new generation of Information Technology professionals to basic concepts and help them prepare for a career as a z/OS professional, such as a z/OS system programmer.

Specifically, z/OS Basic Skills is intended to achieve the following objectives:

- Provide basic education and information about z/OS without charge
- Shorten the time it takes for people to become productive on the mainframe
- Make it easier for new people to learn z/OS.

[z/OS Basic Skills in IBM Documentation \(www.ibm.com/docs/en/zos-basic-skills?topic=zosbasics/com.ibm.zos.zbasics/homepage.html\)](http://www.ibm.com/docs/en/zos-basic-skills?topic=zosbasics/com.ibm.zos.zbasics/homepage.html) is available to all users (no login required).

How to provide feedback to IBM

We welcome any feedback that you have, including comments on the clarity, accuracy, or completeness of the information. For more information, see [How to send feedback to IBM](#).

Summary of changes

This information includes terminology, maintenance, and editorial changes. Technical changes or additions to the text and illustrations for the current edition are indicated by a vertical line to the left of the change.

Note: IBM z/OS policy for the integration of service information into the z/OS product documentation library is documented on the z/OS Internet Library under [IBM z/OS Product Documentation Update Policy](http://www.ibm.com/docs/en/zos/latest?topic=zos-product-documentation-update-policy) (www.ibm.com/docs/en/zos/latest?topic=zos-product-documentation-update-policy).

Summary of changes for z/OS 3.2

The following content is new, changed, or no longer included in z/OS 3.2.

New

The following content is new.

September 2025 release

- [“strlen\(\) — Determine fixed-size string length” on page 1741](#)
- [“strcpy\(\) — Copy string, returning pointer to its end” on page 1716](#)
- [“strncpy\(\) — Copy fixed-size string, returning pointer to its end” on page 1717](#)
- [“strlen\(\) — Determine fixed-size string length” on page 1741](#)
- [“strsignal\(\) — Return string describing signal” on page 1754](#)
- [“wcsnlen\(\) — Determine fixed-size wide-character string length” on page 2006](#)
- [“wcpncpy\(\) — Copy wide-character string, returning pointer to its end” on page 1986](#)
- [“wcpncpy\(\) — Copy fixed-size wide-character string, returning pointer to its end” on page 1987](#)

Changed

The following content is changed.

September 2025 release

- Release updates are made to [“__librel\(\) — Query release level” on page 971](#) and [“__osname\(\) — Get true operating system name” on page 1176](#). [“uname\(\) — Display current operating system name” on page 1935](#) is also updated.
- [“strftime\(\) — Convert to formatted time” on page 1735](#).
- [“fopen\(\) — Open a file” on page 571](#)

Deleted

The following content is deleted.

September 2025 release

- None.

Summary of changes for z/OS 3.1

The following content is new, changed, or no longer included in z/OS 3.1.

New

The following content is new.

June 2024 refresh

New library functions:

- The [fdclosedir\(\)](#) function closes the directory that is associated with a file descriptor.
- The [fdopendir\(\)](#) function opens the directory that is associated with a file descriptor.
- The [getpwent_r\(\)](#) function gets user database entry reentrantly.
- The [syscall\(\)](#) function invokes indirect system calls.

February 2024 refresh

The [__authenticate\(\)](#) function authenticates the specified user's credentials.

September 2023 release

New header files:

- The [getopt.h](#) header file contains definitions for command-line option parsing functions.
- The [sys/epoll.h](#) header file contains definitions for I/O event notification facility functions.
- The [sys/eventfd.h](#) header file contains the definition for the [eventfd\(\)](#) functions.
- The [sys/inotify.h](#) header file contains definitions for monitoring file system event functions.
- The [sys/mount.h](#) header file contains definitions for mount and unmount file system operations functions.
- The [sys/prctl.h](#) header file contains definitions for operations on a process or thread.
- The [sys/random.h](#) header file contains definitions for random data operations, including declarations, constants, and structures.
- The [sys/xattr.h](#) header file contains definitions for extended attribute handling functions.

New library functions:

- The [accept4\(\)](#) function is used by a server to accept a connection request from a client.
- The [asprintf\(\)](#) and [vasprintf\(\)](#) functions are analogs of [sprintf\(\)](#) and [vsprintf\(\)](#), except that they allocate a string large enough to hold the output including the terminating NULL byte, and return a pointer to it via the first argument.
- The [__chatrat\(\)](#) and [__chatrat64\(\)](#) functions modify the attributes that are associated with a file.
- The [clone\(\)](#) function creates a child process.
- The [dprintf\(\)](#) function prints to a file descriptor.
- The [dup3\(\)](#) function duplicates an open file descriptor with flag setting.
- The [epoll_create\(\)](#) and [epoll_create1\(\)](#) functions open an [epoll](#) file descriptor.
- The [epoll_ctl\(\)](#) function controls the interface for an [epoll](#) file descriptor.
- The [epoll_wait\(\)](#) and [epoll_pwait\(\)](#) functions wait for an I/O event on an [epoll](#) file descriptor.
- The [eventfd\(\)](#) function creates a file descriptor for event notification.
- The [faccessat\(\)](#) function determines the accessibility of a file relative to directory file descriptor.
- The [fchmodat\(\)](#) function changes the mode of a file relative to a directory file descriptor.
- The [fchownat\(\)](#) function changes the owner and group of a file relative to the directory file descriptor.
- The [flock\(\)](#) function applies or removes an advisory lock on an open file.
- The [fstatat\(\)](#) and [fstatat64\(\)](#) functions get file status information relative to a directory file descriptor.
- The [futimesat\(\)](#) function changes the timestamps of a file relative to a directory file descriptor.
- The [getentropy\(\)](#) function fills a buffer with random bytes.

- The [`getopt_long\(\)`](#) function is a command-line parser that accepts long options, which begin with two dashes.
- The [`getrandom\(\)`](#) function obtains a series of random bytes.
- The [`getxattr\(\)`](#), [`lgetxattr\(\)`](#), and [`fgetxattr\(\)`](#) functions retrieve an extended attribute value.
- The [`inotify_add_watch\(\)`](#) function adds a watch to an initialized `inotify` instance.
- The [`inotify_init\(\)`](#) and [`inotify_init1\(\)`](#) functions initialize an `inotify` instance.
- The [`inotify_rm_watch\(\)`](#) function removes an existing watch from an `inotify` instance.
- The [`linkat\(\)`](#) function creates a link to a file relative to the directory file descriptor.
- The [`listxattr\(\)`](#), [`llistxattr\(\)`](#), and [`flistxattr\(\)`](#) functions list extended attribute names.
- The [`mkdirat\(\)`](#) function makes a directory.
- The [`mkfifoat\(\)`](#) function makes a FIFO special file.
- The [`mknodat\(\)`](#) function makes a directory or file.
- The [`nanosleep\(\)`](#) function specifies high-resolution sleep.
- The [`openat\(\)`](#) function opens a file relative to a directory file descriptor.
- The [`openat2\(\)`](#) function opens a file with more extensions.
- The [`pipe2\(\)`](#) function creates a pipe.
- The [`pivot_root\(\)`](#) function changes the root mount.
- The [`posix_memalign\(\)`](#) function reserves a block of storage and returns a pointer to the reserved storage in `memptr`.
- The [`prctl\(\)`](#) function operates on a process or thread.
- The [`prlimit\(\)`](#) function gets or sets the hard and soft resource limits of a specified process.
- The [`psignal\(\)`](#) function prints a signal description.
- The [`readlinkat\(\)`](#) function reads the value of a symbolic link that is relative to a directory file descriptor.
- The [`removexattr\(\)`](#), [`lremovexattr\(\)`](#), and [`fremovexattr\(\)`](#) functions remove an extended attribute.
- The [`renameat\(\)`](#) function changes the name or location of a file.
- The [`renameat2\(\)`](#) function changes the name or location of a file.
- The [`sethostname\(\)`](#) function sets the name of the host processor.
- The [`setns\(\)`](#) function allows for a thread to join a descendant namespace.
- The [`setxattr\(\)`](#), [`lsetxattr\(\)`](#), and [`fsetxattr\(\)`](#) functions set an extended attribute value.
- The [`symlinkat\(\)`](#) function creates a symbolic link to a path name.
- The [`syncfs\(\)`](#) function schedules specific file system updates.
- The [`umount2\(\)`](#) function unmounts a file system.
- The [`unlinkat\(\)`](#) function removes a directory or directory entry.
- The [`unshare\(\)`](#) function isolates a process from one or more of its namespaces.
- The [`utimensat\(\)`](#) function changes file timestamps with nanosecond precision.
- The [`wait4\(\)`](#) function waits for a child process to change state.

Changed

The following content is changed.

April 2025 refresh

- [`syscall\(\)`](#) — Invokes indirect system calls” on page 1792 is updated.

March 2025 refresh

Information about AT-TLS considerations is added to the EWOULDBLOCK return code for [read\(\)](#), [readv\(\)](#), [recv\(\)](#), [recvfrom\(\)](#), and [recvmsg\(\)](#).

March 2024 refresh

The [gethostid\(\)](#), [gethostname\(\)](#), [getsockopt\(\)](#), [sethostname\(\)](#), and [setsockopt\(\)](#) functions are changed for network support for IBM z/OS Container Platform.

February 2024 refresh

The [unistd.h](#) header file declares the [__authenticate\(\)](#) function.

September 2023 release

- The [mount\(\)](#) and [umount\(\)](#) functions supports different parameters and functions when both [_OPEN_SYS](#) and [_XPLATFORM_SOURCE](#) are defined.
- Two new file flags [O_CLOEXEC](#) and [O_DIRECT](#) are added for the [fcntl\(\)](#) function.
- The *type* parameter of [socket\(\)](#) specifies the type and flags of the created socket.
- The [stdio.h](#) header file declares more functions: [asprintf\(\)](#), [dprintf\(\)](#), [renameat\(\)](#), [renameat2\(\)](#), [vasprintf\(\)](#).
- The [sys/stat.h](#) header file declares more functions: [__chattrat\(\)](#), [__chattrat64\(\)](#), [fstatat\(\)](#), [fstatat64\(\)](#), [mkdirat\(\)](#), [mkfifoat\(\)](#), [mknodat\(\)](#).
- The [time.h](#) header file declares one more function: [nanosleep\(\)](#).
- Chapter 4, “Using high performance libraries,” on page 2085 is moved from z/OS XL C/C++ Programming Guide to this book.

Deleted

The following content is deleted.

September 2023 release

- The "XL C/C++ Macros" chapter is deleted.

Chapter 1. About z/OS C/C++ runtime library

z/OS C/C++ runtime library contains header files, macros, and functions to write C or C++ applications. Some of the header files and functions are required by various language standards, such as C and C++, some are for compiler or system-specific needs, and some are for additional functions.

AMODE 64 considerations

AMODE 64 restrictions are indicated as a dependency or as a restriction note. For example:

Restriction: This header file is not supported in AMODE 64.

Following are restrictions for AMODE 64:

- Hiperspace is not supported.
- The SPC facility is not supported.
- The following header files are not supported:
 - csp.h
 - ims.h
 - leawi.h
 - mtf.h
 - re_comp.h
 - regexp.h
 - spc.h
- The following feature test macros are obsolete:
 - _LARGE_FILES
 - _LARGE_MEMSee the feature test macro description for more details.
- The following feature test macros are not supported:
 - __LIBASCII
 - _OE_SOCKETS
- The following functions are not supported:
 - advance()
 - brk()
 - compile()
 - __console()
 - __csplist
 - ctdli()
 - fortrc()
 - __openMvsRel()
 - __pcblist
 - re_comp()
 - re_exec()
 - regcmp()
 - regex()

- sbrk()
- sock_debug_bulk_perf0()
- sock_do_bulkmode()
- step()
- tsched()
- tsetsubt()
- tsyncro()
- tterm()
- valloc()
- The following external variables are not supported:
 - __loc1
 - loc1
 - loc2
 - locs

Chapter 2. Header files

This part describes each header file, explains its contents, and lists the functions that use the file. The function descriptions are described in [Chapter 3, “Library functions,”](#) on page 91.

The header files provided with the z/OS C/C++ runtime library contain macro and constant definitions, type definitions, and function declarations. The header files fall into two categories:

- “C/C++ header files” on page 16: can be used with any of the IBM z/OS C/C++ compilers.
- “XL C++ header files” on page 83: can be used with the z/OS XL C++ compiler only.

Some functions require definitions and declarations from header files to work correctly. The inclusion of header files is optional, as long as the necessary statements from the header files are coded directly into the source.. You can use the `#include` directive to select header files to include with your application, for example, `#include <stdio.h>`.

The following header files are not supported in AMODE 64:

- `csp.h`
- `ims.h`
- `leawi.h`
- `mtf.h`
- `re_comp.h`
- `regexp.h`
- `spc.h`

Related information

For information about the `#include` directive, see [z/OS XL C/C++ Language Reference](#) and [z/OS XL C/C++ User's Guide](#).

Feature test macros

Many of the symbols that are defined in headers are "protected" by a feature test macro. These "protected" symbols are invisible to the application unless the user defines the feature test macro with `#define`, using either of the following methods:

- In the source code before including any header files.
- On the compilation command.

The compiler does not define or undefine these macros.

The following feature test macros are obsolete in AMODE 64:

- `_LARGE_FILES`
- `_LARGE_MEM`

See the feature test macro description for more details.

The following feature test macros are not supported in AMODE 64:

- `__LIBASCII`
- `_OE_SOCKETS`

Table 2 on page 4 summarizes the relationships between the feature test macros and the standards. 'Yes' indicates that a feature test macro makes visible the symbols that are related to a standard.

Feature test macros that do not apply to POSIX standards are not listed in this table.

Table 2. Feature test macros and standards

| Feature Test Macro | POSIX.1 | POSIX.1a | POSIX.2 | POSIX.4a | XPG4.2 | XPG4.2 Ext | SUSv3 | SUSv4 |
|--------------------------|---------|----------|---------|----------|--------|------------|-------|-------|
| _ALL_SOURCE | Yes | Yes | Yes | Yes | Yes | Yes | | |
| _ALL_SOURCE_NO_THREADS | Yes | Yes | Yes | | Yes | Yes | | |
| _OE_SOCKETS | Yes | Yes | | | | | | |
| _OPEN_DEFAULT | Yes | Yes | Yes | | | | | |
| _OPEN_SOURCE 1 | Yes | Yes | Yes | Yes | | | | |
| _OPEN_SOURCE 2 | Yes | Yes | Yes | Yes | Yes | Yes | | |
| _OPEN_SOURCE 3 | Yes | Yes | Yes | Yes | Yes | Yes | | |
| _OPEN_SYS | Yes | Yes | Yes | Yes | | | | |
| _OPEN_SYS_IPC_EXTENSIONS | Yes | Yes | | | Yes | | | |
| _OPEN_SYS_PTY_EXTENSIONS | Yes | Yes | | | Yes | Yes | | |
| _OPEN_SYS SOCK_EXT | Yes | Yes | | Yes | Yes | | | |
| _OPEN_THREADS | Yes | Yes | | Yes | | | | |
| _POSIX1_SOURCE 1 | Yes | | | | | | | |
| _POSIX1_SOURCE 2 | Yes | Yes | | | | | | |
| _POSIX_C_SOURCE 1 | Yes | | | | | | | |
| _POSIX_C_SOURCE 2 | Yes | | Yes | | | | | |
| _POSIX_C_SOURCE 200112L | Yes | Yes | Yes | | | | Yes | |
| _POSIX_C_SOURCE 200809L | Yes | Yes | Yes | | | | Yes | Yes |
| _POSIX_SOURCE | Yes | | | | | | | |
| _XOPEN_SOURCE | Yes | | Yes | | Yes | | | |
| _XOPEN_SOURCE_EXTENDED 1 | Yes | | Yes | | Yes | Yes | | |
| _XOPEN_SOURCE 500 | Yes | | Yes | | Yes | Yes | | |
| _XOPEN_SOURCE 600 | Yes | Yes | Yes | | Yes | Yes | Yes | |

The following feature test macros are supported:

_ALL_SOURCE

This feature test macro exposes the following namespaces: POSIX.1, POSIX.1a, POSIX.2, POSIX.4a draft 6, XPG4, and XPG4.2, as well as additions to z/OS UNIX drawn from Single UNIX Specification, Version 2.

In addition, defining _ALL_SOURCE makes visible a number of symbols, which are not permitted under ISO C/C++, POSIX, or XPG4, but which are provided as an aid to porting C-language applications to z/OS UNIX System Services. Extensions made visible with the following feature test macros are implicit in _ALL_SOURCE:

- _OPEN_SYS_DIR_EXT
- _OPEN_SYS_EXT
- _OPEN_SYS_IPC_EXTENSIONS
- _OPEN_SYS_MAP_EXTENTION
- _OPEN_SYS_PTY_EXTENSIONS
- _OPEN_SYS SOCK_EXT
- _OPEN_SYS SOCK_EXT2
- _OPEN_SYS SOCK_IPV6

If `_OPEN_THREADS` is not explicitly defined in the application, `_ALL_SOURCE` defines `_OPEN_THREADS` 1 except when any of the following are present:

- `_ALL_SOURCE_NO_THREADS`
- `_UNIX03_THREADS`
- `_XOPEN_SOURCE 600`

`_ALL_SOURCE` does not expose functionality that is first introduced in Single UNIX Specification, Version 3 under macro definitions `_XOPEN_SOURCE 600` or `_POSIX_C_SOURCE 200112L`, although it does tolerate interfaces made visible by defining `_OPEN_THREADS` to 2 or 3.

To stabilize the namespace, no future extensions, whether POSIX, XOPEN, or MVS, will expand the definition of `_ALL_SOURCE`. Any future enhancement requires new, explicit feature test macros to add symbols to this namespace.

`_ALL_SOURCE_NO_THREADS`

This feature test macro provides the same function as `_ALL_SOURCE`, except it does not expose threading services (`_OPEN_THREADS`).

`_IEEEV1_COMPATIBILITY`

In 1999, the C/C++ Runtime Library provided IEEE754 floating-point arithmetic support in support of the IBM Java group. The Java™ language had a bit-wise requirement for its math library, meaning that all platforms needed to produce the same results as Sun Microsystems' `fdlibm` (Freely Distributed LIBM) library. Therefore, Sun Microsystems' `fdlibm` code was ported to the C/C++ Runtime Library to provide IEEE754 floating-point arithmetic support. Subsequent to the C/C++ Runtime Library's 1999 release of IEEE754 floating-point math support, IBM's Java group provided their own support of IEEE754 floating point arithmetic and no longer use the C/C++ Runtime Library for this support.

Beginning in z/OS V1R9, a subset of the original `fdlibm` functions are being replaced by new versions that are designed to provide improved performance and accuracy. The new versions of these functions are replaced at the existing entry points. However, as a migration aid, IBM has provided new entry points for the original `fdlibm` versions. Applications that take no action automatically use the updated functions. There are two methods for accessing the original functions.

This feature test macro provides an environment for the following C/C++ functions:

- Do not include `<math.h>`.
- Include `<math.h>` and define the `_FP_MODE_VARIABLE` feature test macro.

Either of the two types of functions causes the application to be running in what is called "variable" mode regarding floating-point math functions that are called within the compile unit. See z/OS XL C/C++ Programming Guide for more details on the environment variable.

The second method is through a feature test macro that can be used by applications that do include `<math.h>` and do not define the `_FP_MODE_VARIABLE` feature test macro.

If the application conforms to the rules of the second method, then the feature test macro can be used to access the original `fdlibm` versions of the following functions:

```
acos(), acos(), asin(), asinh(), atan(), atanh(), atan2(),
cbrt(), cos(), cosh(), erf(), erfc(), exp(), expm1(), gamma(),
hypot(), lgamma(), log(), log1p(), log10(), pow(), rint(), sin(),
sinh(), tan(), tanh()
```

A recompile and relink of the application is required to access the original `fdlibm` versions.

`_ISOC99_SOURCE`

This feature test macro makes available all interfaces that are associated with ISO/IEC 9899:1999 except for interfaces requiring a compiler that is designed to support C99. This feature test macro also exposes the namespace that is normally exposed by the `_MSE_PROTOS` feature test macro, unless

`_NOISOC99_SOURCE` is defined. The `_ISOC99_SOURCE` feature test macro is not required when a compiler that is designed to support C99 is used.

Note: If both `_NOISOC99_SOURCE` and `_ISOC99_SOURCE` are defined before inclusion of the first header, new C99 interfaces are not exposed.

`_LARGE_FILES`

The `_LARGE_FILES` feature test macro enables certain functions to operate on MVS data sets and z/OS UNIX files that are larger than 2 GB and VSAM extended addressability data sets larger than 4 GB. When this feature test macro is selected, it must be used when the [long long data type support](#) is enabled.

The following functions are enabled to operate on z/OS UNIX files of all sizes by expanding appropriate offset and file size values to a 64-bit value:

```
creat(), fcntl(), fgetpos(), fopen(), freopen(), fseek(), fseeko(),
fsetpos(), fstat(), fstatat(), ftell(), ftello(), ftruncate(), getrlimit(),
lockf(), lseek(), lstat(), mmap(), open(), read(), setrlimit(),
stat(), truncate(), write()
```

The `_LARGE_FILES` feature test macro also enables the `fseeko()` and `ftello()` functions to operate on MVS data sets larger than 2 GB and VSAM data sets larger than 4 GB by expanding the parameter and return type width to 64 bits. The `fgetpos()`, `fopen()`, `freopen()`, and `fsetpos()` functions implicitly support operations on these sized data sets and therefore do not require the `_LARGE_FILES` feature test macro to be defined.

Note: Using `AMODE 64` obsoletes this feature test macro. Large files are automatically supported in the LP64 programming model, therefore automatically included for `AMODE 64 C/C++` applications. The c99 compiler defines the `long long` data type as a standard type by default.

Restriction: This feature test macro is incompatible with the `__LIBASCII` feature test macro.

`_LARGE_MEM`

This feature test macro is provided for `AMODE 31` applications that need access to `AMODE 64` values. Use of large memory support requires the [long long data type support](#).

Note: This feature test macro is obsolete in `AMODE 64`. Therefore, large memory support is automatic in the LP64 programming model, all behaviors regarding large memory are automatically included for `AMODE 64 C/C++` applications.

`_LARGE_TIME_API`

This feature test macro exposes new typedefs, structures, and functions so that an application can work with constructed calendar times up to and including the artificial limit of 23:59:59 on December 31, 9999 Coordinated Universal Time.

`__LIBASCII`

This feature test macro provides an ASCII-like environment for the following C/C++ functions:

```
access(), asctime(), atof(), atoi(), atol(), chdir(), chmod(),
chown(), creat(), ctime(), dlopen(), dlload(), dlqueryfn(), dynalloc()
ecvt(), execv(), execve(), execvp(), fcvt(), fdopen(), fopen(),
freopen(), ftok(), gcvt(), getcwd(), getenv(), getgnam(),
gethostbyaddr(), gethostbyname(), gethostname(), getlogin(),
getopt(), getpass(), getpwnam(), getpwuid(), getservbyname(),
getwd(), inetaddr(), inet_ntoa(), isalnum(), isalpha(), iscntrl(),
isdigit(), isgraph(), islower(), isprint(), ispunct(), isspace(),
isupper(), isxdigit(), link(), localeconv(), mbstowcs(), mbtowc(),
mkdir(), mknod(), mktemp(), nl_langinfo(), open(), opendir(),
perror(), popen(), ptsname(), putenv(), readdir(), regcomp(),
remove(), rename(), rexec(), rmdir(), scanf(), setenv(), setkey(),
setlocale(), setvbuf(), sprintf(), sscanf(), stat(), statvfs(),
strcasecmp(), strerror(), strncasecmp(), strtod(), strtol(),
```



```
strtoul(), system(), tempnam(), tmpnam(), toascii(), tolower(),
toupper(), uname(), unlink(), utime(), utimes()
```

For each application program that uses one or more of these functions, where the input/output is ASCII, add the following feature test macro:

- `#define __LIBASCII`
- Recompile that uses the `CONV(ISO8859-1)` option to cause the compiler to generate all strings that are defined in the source program in ASCII rather than EBCDIC format.

Note:

- This feature test macro is not supported in AMODE 64.
- Enhanced ASCII and `__LIBASCII` are independent and must not be used together. Using Enhanced ASCII and `__LIBASCII` together is not supported.
- The `libascii` functions are as thread-safe as the runtime library except for the `getopt()` function. The `libascii` `getopt()` function is not thread-safe. The second argument is changed for a short time from EBCDIC to ASCII and then back to EBCDIC. This feature test macro is incompatible with the `_LARGE_FILES` feature test macro.

`_LONGMAP`

Programs that are compiled with [long external names](#) and which use POSIX functions must define `_LONGMAP` when using the Prelinker outside of a z/OS UNIX shell environment.

`_MSE_PROTOS`

The `_MSE_PROTOS` feature test macro does the following:

1. Selects behavior for a multibyte extension support (MSE) function declared in `wchar.h` as specified by ISO/IEC 9899:1990/Amendment 1:1994 instead of behavior for the function as defined by CAE Specification, System Interfaces and Headers, Issue 4, July 1992 (XPG4).
2. Exposes declaration of an MSE function declared in `wchar.h`, which is specified by ISO/IEC 9899:1990/Amendment 1:1994 but not by XPG4.

Note: Defining `_ISOC99_SOURCE` or using a compiler that is designed to support C99 also exposes this namespace if `_NOISOC99_SOURCE` is not also defined.

`_NOISOC99_SOURCE`

This feature test macro prevents exposure of new interfaces that are part of the C99 standard. This feature test macro must be defined before inclusion of the first header in order to prevent new C99 interfaces from being exposed.

Note: If both `_NOISOC99_SOURCE` and `_ISOC99_SOURCE` are defined before inclusion of the first header, new C99 interfaces will not be exposed.

`_OE_SOCKETS`

This feature test macro defines a BSD-like socket interface for the function prototypes and structures involved. This can be used with `_XOPEN_SOURCE_EXTENDED 1` and the XPG4.2 socket interfaces are replaced with the BSD-like interfaces.

Restriction: This feature test macro is not supported in AMODE 64.

`_OPEN_DEFAULT`

When defined to 0, and if no other feature test macro is defined, then all symbols will be visible. If in addition to `_OPEN_DEFAULT` only POSIX and/or XPG4 feature test macros are defined, then only the

symbols so requested will be visible. Otherwise, additional symbols (for example, those visible when runtime library extensions are included), might be exposed.

When defined to 1, this provides the base level of z/OS UNIX functionality, which is POSIX.1, POSIX.1a and POSIX.2.

_OPEN_MSGQ_EXT

This feature test macro defines an interface, which enables use of `select()`, `selectex()` and `poll()` to monitor message and file descriptors.

_OPEN_SOURCE

When defined to 1, this defines all of the functionality that was available on MVS 5.1. This macro is equivalent to specifying `_OPEN_SYS`.

When defined to 2, this defines all of the functionality that is available on MVS 5.2.2, including XPG4, XPG4.2, and all of the z/OS UNIX extensions.

When defined to 3, this macro is equivalent to specifying `_ALL_SOURCE`.

If `_OPEN_THREADS` is not explicitly defined in the application, `_OPEN_SOURCE` will define `_OPEN_THREADS` 1 except when any of the following are present:

- `_ALL_SOURCE_NO_THREADS`
- `_UNIX03_THREADS`
- `_XOPEN_SOURCE` 600

_OPEN_SYS

When defined to 1, this indicates that symbols required by POSIX.1, POSIX.1a, POSIX.2 are made visible. Any symbols that are defined by the `_OPEN_THREADS` macro are allowed.

If `_OPEN_THREADS` is not explicitly defined in the application, `_OPEN_SYS` will define `_OPEN_THREADS` 1 except when any of the following are present:

- `_ALL_SOURCE_NO_THREADS`
- `_UNIX03_THREADS`
- `_XOPEN_SOURCE` 600

Additional symbols can be made visible if any of the exposed standards explicitly allows the symbol to appear in the header in question or if the symbol is defined as a z/OS UNIX System Services extension.

_OPEN_SYS_DIR_EXT

This feature test macro defines the interface and function prototypes for `__opendir2()` and `__readdir2()`.

_OPEN_SYS_FILE_EXT

When defined to any value with `#define`, `_OPEN_SYS_FILE_EXT` indicates that symbols required for file conversion, file tagging, and file attributes manipulation functions are made visible.

_OPEN_SYS_IF_EXT

When defined to 1, this feature test macro exposes BSD-like socket definitions that are found in `<net/if.h>` and `<sys/ioctl.h>` that are needed to manipulate network interfaces. This feature test macro is made available beginning with z/OS V1R9.

_OPEN_SYS_IPC_EXTENSIONS

This feature test macro defines z/OS UNIX extensions to the X/Open InterProcess Communications functions. When `_OPEN_SYS_IPC_EXTENSIONS` is defined, the POSIX.1, POSIX.1a, and the XPG4 symbols are visible. This macro should be used in `_XOPEN_SOURCE`.

`_OPEN_SYS_Mutex_EXT`

This feature test macro allows pthread condition variables and mutexes with shared memory. When this feature is defined, `pthread_mutex_t` and `pthread_cond_t` grow significantly in size.

When either `_XOPEN_SOURCE 600` or `_UNIX03_THREADS` are defined, the namespace includes all elements made visible by the `_OPEN_SYS_Mutex_EXT` macro. In this case, `_OPEN_SYS_Mutex_EXT` is redundant and does not need to be defined by the application.

`_OPEN_SYS_PTY_EXTENSIONS`

This feature test macro defines z/OS UNIX extensions to the X/Open Pseudo TTY functions. When `_OPEN_SYS_PTY_EXTENSIONS` is defined, the POSIX.1, POSIX.1a, XPG4, and XPG4.2 symbols are visible. This macro should be used in `_XOPEN_SOURCE_EXTENDED 1`.

`_OPEN_SYS_SOCK_EXT`

This feature test macro defines the interface for function prototypes and structures for the extended sockets and bulk mode support.

`_OPEN_SYS_SOCK_EXT2`

This feature test macro defines the function prototype and interfaces for `accept_and_recv()`.

`_OPEN_SYS_SOCK_EXT3`

This feature test macro defines the function prototypes and interfaces for multicast source filtering.

`_OPEN_SYS_SOCK_EXT4`

This feature test macro defines interfaces in `netinet/in.h` used for sending UDP reply packets on the same inbound interface as the request arrived.

`_OPEN_SYS_SOCK_IPV6`

When defined, indicates that symbols related to Internet Protocol Version 6 (IPv6) are made visible.

Defining `_XOPEN_SOURCE` to 600 will expose the IPv6 symbols that are required in Single Unix Specification, Version 3. However, these symbols only comprise a subset of the complete namespace that is associated with `_OPEN_SYS_SOCK_IPV6`. Although an application is allowed to define both macros, such an application may not be strictly conforming to Single UNIX Specification, Version 3.

`_OPEN_THREADS`

When defined to 1, this indicates that symbols required by POSIX.1, POSIX.1a, and POSIX.4a (draft 6) are made visible.

When defined to 2, additional pthread functions that are introduced in z/OS V1R07 from Single UNIX Specification, Version 3 are made visible, along with those made visible when this is defined to 1. The following symbols are added to the namespace when `_OPEN_THREADS` is defined to 2:

| Interfaces | Constants |
|---------------------------------------|-------------------------------------|
| <code>pthread_getconcurrency()</code> | <code>PTHREAD_CANCEL_ENABLE</code> |
| <code>pthread_setconcurrency()</code> | <code>PTHREAD_CANCEL_DISABLE</code> |

| Interfaces | Constants |
|--------------------------|-----------------------------|
| pthread_setcancelstate() | PTHREAD_CANCEL_DEFERRED |
| pthread_setcanceltype() | PTHREAD_CANCEL_ASYNCHRONOUS |
| pthread_sigmask() | |
| pthread_testcancel() | |
| pthread_key_delete() | |

When defined to 3, all pthread functions that are required for the Threads option of Single UNIX Specification, Version 3 are exposed, although behavior and function signatures are still based on the POSIX.4a draft 6 specification. In addition to the symbols exposed by `_OPEN_THREADS 2`, `_OPEN_THREADS 3` adds the following symbols to the namespace:

| Interfaces | Constants |
|------------------------------|--------------------------|
| pthread_atfork() | PTHREAD_CANCEL_CANCELED |
| pthread_attr_getguardsize() | PTHREAD_COND_INITIALIZER |
| pthread_attr_getschedparam() | PTHREAD_CREATE_DETACHED |
| pthread_attr_getstack() | PTHREAD_CREATE_JOINABLE |
| pthread_attr_getstackaddr() | PTHREAD_EXPLICIT_SCHED |
| pthread_attr_setguardsize() | |
| pthread_attr_setschedparam() | |
| pthread_attr_setstack() | |
| pthread_attr_setstackaddr() | |

Thread interfaces listed above and first exposed by `_OPEN_THREADS 2` or `3` are fully compliant with Single UNIX Specification, Version 3. However, the other threading interfaces in the library will not exhibit the new behavior or use function signatures that are changed in the new standard. Applications that define `_UNIX03_THREADS` or `_XOPEN_SOURCE 600` will obtain threads support that complies fully with Single UNIX Specification, Version 3.

If `_OPEN_THREADS` is defined with `_XOPEN_SOURCE 600`, `_OPEN_THREADS` takes precedence and overrides the default threads behavior of `_XOPEN_SOURCE 600`. However, `_OPEN_THREADS` and `_UNIX03_THREADS` are mutually exclusive.

Note: Feature test macros `_OPEN_SYS`, `_OPEN_SOURCE`, and `_ALL_SOURCE` incorporate `_OPEN_THREADS 1` by default, if `_OPEN_THREADS` has not been explicitly defined in the application, except when any of the following are present:

- `_ALL_SOURCE_NO_THREADS`
- `_UNIX03_THREADS`
- `_XOPEN_SOURCE 600`

`_POSIX1_SOURCE`

- When defined to 1, it has the same meaning as `_POSIX_SOURCE`.
- When defined to 2, both the POSIX.1a symbols and the POSIX.1 symbols are made visible. Additional symbols can be made visible if `POSIX.1a` explicitly allows the symbol to appear in the header in question.

`_POSIX_C_SOURCE`

- When defined to 1, it indicates that symbols required by POSIX . 1 are made visible. Additional symbols can be made visible if POSIX . 1 explicitly allows the symbol to appear in the header in question.
- When defined to 2, both the POSIX . 1 and POSIX . 2 symbols are made visible.
- When defined to 200112L, the Single UNIX Specification, Version 3 symbols are made visible, including POSIX.1 and POSIX.2. Since Version 3 is aligned with the ISO C standard (ISO/IEC 9899:1999), this definition of the feature test macro also exposes the C99 namespace.
- The `_POSIX_C_SOURCE` 200112L definition is available beginning with z/OS V1R9. Targeting earlier releases result in an error during compile time.
- Additional symbols can be made visible if POSIX . 2 explicitly allows the symbol to appear in the header in question.

`_POSIX_SOURCE`

When defined to any value with `#define`, it indicates that symbols required by POSIX . 1 are made visible. Additional symbols can be made visible if POSIX . 1 explicitly allows the symbol to appear in the header in question.

`_SHARE_EXT_VARS`

This feature test macro provides access to POSIX and XPG4 external variables of an application from a dynamically loaded module such as a DLL. For those external variables that have a function to access a thread-specific value, it provides access to the thread-specific value of the external variable without having to explicitly invoke the function.

Individual variables can be externalized by using the feature test macros that are prefixed with `_SHR_` and the feature test macros that are shown as follows. The entire set can be accessed by defining `_SHARE_EXT_VARS`.

Note: When an application is compiled with the XPLINK or LP64 option:

- The POSIX and XPG4 external variables are resolved through the C runtime library sidedeck in the SCEELIB data set and will be accessible from all dynamically loaded modules. See [z/OS XL C/C++ Programming Guide](#) for more details.
- The `_SHARE_EXT_VARS` feature test macro, and the following feature test macros with the `_SHR_` prefix, are only necessary for accessing the thread-specific values without having to explicitly invoke the function.

`_SHR_DAYLIGHT`

To share access to the daylight external variable from a dynamically loaded module such as a DLL, define the `_SHR_DAYLIGHT` feature test macro and include `time.h` in your program source.

`_SHR_ENVIRON`

If you have declared `char **environ` in your program and want to access the environment variable array from a dynamically loaded module such as a DLL, define the `_SHR_ENVIRON` feature test macro and include `stdlib.h` in the program source.

`_SHR_H_ERRNO`

To share access to the `h_errno` external variable from a dynamically loaded module such as a DLL, define the `_SHR_H_ERRNO` feature test macro and include `netdb.h` in your program source.

`_SHR__LOC1`

To share access to the `__loc1` external variable from a dynamically loaded module such as a DLL, define `_SHR__LOC1` feature test macro and include `libgen.h` in your program source.

`_SHR_LOC1`

To share access to the `loc1` external variable from a dynamically loaded module such as a DLL, define `_SHR_LOC1` feature test macro and include `regexp.h` in your program source.

`_SHR_LOC2`

To share access to the `loc2` external variable from a dynamically loaded module such as a DLL, define `_SHR_LOC2` feature test macro and include `regexp.h` in your program source.

`_SHR_LOCS`

To share access to the `locs` external variable from a dynamically loaded module such as a DLL, define `_SHR_LOCS` feature test macro and include `regexp.h` in your program source.

`_SHR_OPTARG`

To share access to the `optarg` external variable from a dynamically loaded module such as a DLL, define the `_SHR_OPTARG` feature test macro and include `unistd.h` or `stdio.h` in your program source.

`_SHR_OPTERR`

To share access to the `opterr` external variable from a dynamically loaded module such as a DLL, define the `_SHR_OPTERR` feature test macro and include `unistd.h` or `stdio.h` in your program source.

`_SHR_OPTIND`

To share access to the `optind` external variable from a dynamically loaded module such as a DLL, define `_SHR_OPTIND` feature test macro and include `unistd.h` or `stdio.h` in your program source.

`_SHR_OPTOPT`

To share access to the `optopt` external variable from a dynamically loaded module such as a DLL, define the `_SHR_OPTOPT` feature test macro and include `unistd.h` or `stdio.h` in your program source.

`_SHR_SIGNGAM`

To share access to the `siggam` external variable from a dynamically loaded module such as a DLL, define the `_SHR_SIGNGAM` feature test macro and include `math.h` in your program source.

`_SHR_T_ERRNO`

To share access to the `t_errno` external variable from a dynamically loaded module such as a DLL, define the `_SHR_T_ERRNO` feature test macro and include `xti.h` in your program source.

`_SHR_TIMEZONE`

To share access to the time zone external variable from a dynamically loaded module such as a DLL, define the `_SHR_TIMEZONE` feature test macro and include `time.h` in your program source. To avoid namespace pollution when `_SHR_TIMEZONE` is defined, the time zone variable must be referred to as `_timezone`.

_SHR_TZNAME

To share access to the *tzname* external variable from dynamically loaded module such as a DLL, define the `_SHR_TZNAME` feature test macro and include `time.h` in your program source.

__STDC_CONSTANT_MACROS

This feature test macro is required by C++ applications wanting to expose macros for integer constants as documented in `<stdint.h>`.

__STDC_FORMAT_MACROS

This feature test macro is required by C++ applications wanting to expose macros for format specifiers as documented in `<inttypes.h>`.

__STDC_WANT_DEC_FP__

This macro is added to the C99 DFP specification for C and C++. The user defines this macro when DFP support is wanted. It causes all DFP-oriented definitions in `<math.h>` and other headers to be exposed if `__IBM_DFP` is defined.

__STDC_LIMIT_MACROS

This feature test macro is required by C++ applications wanting to expose limits of specified-width integer types and limits of other integer types as documented in `<stdint.h>`.

__STRICT_ANSI_C__

This feature test macro exposes the macro `setjmp`.

__STRICT_POSIX__

This feature test macro exposes the macro `sigsetjmp`.

_TR1_C99

This feature test macro exposes the C++ TR1 C99 namespace as described in Chapter 8 of *ISO/IEC DTR 19768: Draft Technical Report on C++ Library Extensions*.

When both the `_TR1_C99` and `_AIX_COMPATIBILITY` Feature Test Macros are defined, the `_AIX_COMPATIBILITY` takes precedence. This affects the `copysign()`, `scalbn()`, and the floating point classification functions.

When both the `_TR1_C99` and `_FP_MODE_VARIABLE` feature test macros are defined, float overloads are not supported for the following functions:

`atan2()`, `copysign()`, `fdim()`, `fma()`, `fmax()`, `fmin()`, `fmod()`, `frexp()`, `hypot()`, `ldexp()`, `modf()`, `nextafter()`, `nexttoward()`, `pow()`, `remainder()`, `remquo()`, `scalbln()`, and `scalbn()`

Also, when both the `_TR1_C99` and `_FP_MODE_VARIABLE` feature test macros are set, the long double overloads are not supported for `frexp()` and `ldexp()`.

This feature test macro requires the use of the z/OS V1.10 z/OS XL C++ compiler or later.

_UNIX03_SOURCE

This feature test macro exposes new Single UNIX Specification, Version 3 interfaces. It does not change the behavior of existing APIs, nor expose interfaces that are controlled by feature test macros such as `_XOPEN_SOURCE_EXTENDED`. Functions and behavior that is exposed by `_UNIX03_SOURCE` are a subset and not the complete implementation of the Single UNIX Specification, Version 3. To

expose the full Single UNIX Specification, Version 3 implementation available in the C/C++ Runtime, see `_XOPEN_SOURCE` or `_POSIX_C_SOURCE`.

| Release | Interfaces Exposed with <code>_UNIX03_SOURCE</code> |
|-----------|---|
| z/OS V1R6 | <code>dlclose()</code> , <code>dlderror()</code> , <code>dlopen()</code> , <code>dlsym()</code> |
| z/OS V1R7 | <code>sched_yield()</code> , <code>strerror_r()</code> , <code>unsetenv()</code> |
| z/OS V1R8 | <code>flockfile()</code> , <code>ftrylockfile()</code> , <code>funlockfile()</code> , <code>getc_unlocked()</code> , <code>getchar_unlocked()</code> , <code>putc_unlocked()</code> , <code>putchar_unlocked()</code> |
| z/OS V1R9 | <code>posix_openpt()</code> , <code>pselect()</code> , <code>socketatmark()</code> |
| z/OS 3.1 | <code>posix_memalign()</code> |

Note: This feature test macro does not expose any new pthread interfaces. See `_OPEN_THREADS` and `_UNIX03_THREADS` to expose pthread interfaces.

`_UNIX03_THREADS`

This feature test exposes all pthread functions, function signatures, and behaviors required for the Threads option of Single UNIX Specification, Version 3. The macro is available for compilers targeting z/OS V1R9 or later.

Defining `_UNIX03_THREADS` exposes the content that is covered by feature test macro `_OPEN_SYS_MUTEX_EXT` so that the latter is redundant and need not be defined with `_UNIX03_THREADS`.

It is not necessary to define this feature test macro, if `_XOPEN_SOURCE` is defined to 600. Unless `_OPEN_THREADS` is defined, `_XOPEN_SOURCE` 600 will make available the same interfaces and behaviors as `_UNIX03_THREADS`.

`_UNIX03_THREADS` and `_OPEN_THREADS` are mutually exclusive.

`_UNIX03_WITHDRAWN`

Defining this feature test macro exposes any language elements, previously in the Legacy Feature Group or marked obsolescent, that have been removed from Single Unix Specification, Version 3. These elements would not otherwise be visible in the namespace that is exposed by compiling with `_XOPEN_SOURCE` 600 or `_POSIX_C_SOURCE` 200112L.

The following withdrawn symbols are exposed when `_UNIX03_WITHDRAWN` is defined:

| Functions | Constants |
|------------------------------|------------------------------------|
| <code>brk()</code> | <code>CLOCK_TICKS</code> |
| <code>chroot()</code> | <code>IUCLC</code> |
| <code>cuserid()</code> | <code>L_cuserid</code> |
| <code>gamma()</code> | <code>NOSTR</code> |
| <code>getdtablesize()</code> | <code>OLCUC</code> |
| <code>getpagesize()</code> | <code>PASS_MAX</code> |
| <code>getpass()</code> | <code>_SC_2_C_VERSION</code> |
| <code>getw()</code> | <code>_SC_PASS_MAX</code> |
| <code>putw()</code> | <code>_SC_XOPEN_XCU_VERSION</code> |
| <code>regcmp()</code> | <code>TMP_MAX</code> |
| <code>regex()</code> | <code>XCASE</code> |

| Functions | Constants |
|------------|--------------------------|
| sbrk() | YESSTR |
| sigstack() | |
| ttyslot() | |
| valloc() | External Variable |
| wait3() | __loc1 |

_VARARG_EXT_

This feature test macro allows users of the `va_arg`, `va_end`, and `va_start` macros to define the `va_list` type differently.

_XOPEN_SOURCE

This feature test macro defines the functionality that is defined in the XPG4 standard dated July 1992.

When defined to 500, this feature test macro makes available certain key functions that are associated with Single UNIX Specification, Version 2.

When defined to 600, this feature test macro exposes the complete implementation of the Single UNIX Specification, Version 3, including the namespace defined by `_POSIX_C_SOURCE` 200112L as well as namespaces associated with the X/Open System Interface (XSI) extension and these options and option groups:

- File synchronization
- Memory mapped files
- Memory protection
- Realtime signals extension
- Thread stack address attribute
- Thread stack size attribute
- Thread process-shared synchronization
- Thread-safe functions
- Threads
- Encryption option group
- Legacy option group
- XSI streams option group

The use of `_XOPEN_SOURCE` 600 exposes namespaces that are covered by several other feature test macros, and as such, makes those macros redundant. The following need not be defined when `_XOPEN_SOURCE` 600 is defined:

| | |
|-------------------------------------|----------------------------------|
| <code>_ISOC99_SOURCE</code> | <code>_POSIX_C_SOURCE</code> |
| <code>_UNIX03_THREADS</code> | <code>_OPEN_SYS_MUTEX_EXT</code> |
| <code>_UNIX03_SOURCE</code> | <code>_POSIX_SOURCE</code> |
| <code>_XOPEN_SOURCE_EXTENDED</code> | |

If `_OPEN_THREADS` is defined with `_XOPEN_SOURCE` 600, `_OPEN_THREADS` takes precedence and overrides Single UNIX Specification, Version 3 threads behavior. Whenever `_OPEN_THREADS` is in effect, the `_OPEN_SYS_MUTEX_EXT` extensions are also dropped, unless the application explicitly defines this macro.

The `_XOPEN_SOURCE 600` definition is available beginning with z/OS V1R9. Targeting earlier releases result in an error during compile time.

Full support of Single UNIX Specification, Version 3 requires use of a C99 compliant compiler. Most of the namespace is available to older compilers, but some elements of Version 3 (such as `<complex.h>` or `<tgmath.h>`) will not be visible.

`_XOPEN_SOURCE_EXTENDED`

When defined to 1, this defines the functions that are defined in the XPG4 standard plus the set of “Common APIs for UNIX-based Operating Systems”, April 1994, draft.

`_XPLATFORM_SOURCE`

This feature test macro exposes new typedef types, structures, and functions to provide cross-platform portability.

C/C++ header files

The C/C++ header files can be used with any of the IBM z/OS C/C++ compilers. They are shipped in the CEE.SCEEH* data sets and in the `/usr/include` directory in z/OS UNIX.

For the information about `builtins.h`, refer to the C++98 language standard (ISO/IEC 14882:1998).

`aio.h` — Asynchronous I/O operations

The `aio.h` header file contains definitions for asynchronous I/O operations. It declares these functions:

| | | |
|----------------------------|--------------------------|---------------------------|
| <code>aio_read()</code> | <code>aio_write()</code> | <code>aio_cancel()</code> |
| <code>aio_suspend()</code> | <code>aio_error()</code> | <code>aio_return()</code> |

Note: There are several sockets oriented extensions to asynchronous I/O available with the BPX1AIO callable service, such as asynchronous `accept()`, asynchronous `accept_and_recv()`, asynchronous forms of all five pairs of read and write type operations, and receiving I/O completion notifications via an ECB, exit program, or through a message queue. The `<aio.h>` header contains all the structure fields, constants, and prototypes necessary to use BPX1AIO from a C program. These extensions are exposed when the `_AIO_OS390` feature test macro is defined. The BPX1AIO stub resides in `SYS1.CSSLIB` and must be bound with your program. For a more detailed description of asynchronous I/O services, see BPX1AIO in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.

`arpa/inet.h` — Internet operations

The `arpa/inet.h` header file contains definitions for internet operations.

`arpa/nameser.h` — Construct and inspect DNS requests

The `arpa/nameser.h` header file contains the definitions used to support the construction of queries and the inspection of answers received from a Domain Name Server available in a network. It also contains the macros `GETSHORT()`, `PUTSHORT()`, `GETLONG()`, and `PUTLONG()` that are used to construct or inspect DNS requests.

`assert.h` — Insert diagnostics

The `assert.h` header file defines the `assert()` macro that allows you to insert diagnostics into your code. You must include `assert.h` when you use `assert()`.

_Ccsid.h — CCSID to codeset name conversion

The `_Ccsid.h` header file declares functions, symbols and data types used in CCSID to codeset name conversion.

ceedcct.h — C declarations of Language Environment

The `ceedcct.h` header file contains C declarations of the Language Environment® condition tokens.

cics.h — Verify CICS

The `cics.h` header file declares the `iscics()` function, which verifies whether CICS® is running.

collate.h — Current locale's collating properties

The `collate.h` header includes declarations of functions that allow retrieval of information regarding the current locale's collating properties. It declares these functions:

| | | | | |
|--------------------------|---------------------------|---------------------------|--------------------------|--------------------------|
| <code>cclass()</code> | <code>collequiv()</code> | <code>collorder()</code> | <code>collrange()</code> | <code>colltostr()</code> |
| <code>getmccoll()</code> | <code>getwmccoll()</code> | <code>ismccollet()</code> | <code>maxcoll()</code> | <code>strtcoll()</code> |

For more information about the effect of locale, see `setlocale()`, `locale.h`, or look up the individual functions in this topic. For still more information, see "Internationalization: Locales and Character Sets" in *z/OS XL C/C++ Programming Guide*.

cpio.h — CPIO archive values

The `cpio.h` header file contains CPIO archive values.

csp.h — Define __csplist macro

Restriction: This header file is not supported in AMODE 64.

The `csp.h` header file declares the `__csplist` macro, which obtains the CSP parameter list.

These macros are *not* supported under z/OS UNIX and they are not supported for C++ applications.

ctest.h — Debug and diagnostics

The `ctest.h` header file contains declarations for the functions that involve debugging and diagnostics. The diagnostic functions are:

| | | | |
|----------------------|----------------------|----------------------|-----------------------|
| <code>cdump()</code> | <code>csnap()</code> | <code>ctest()</code> | <code>ctrace()</code> |
|----------------------|----------------------|----------------------|-----------------------|

ctype.h — Character classification

The `ctype.h` header file declares functions used in character classification. The functions declared are:

| | | | | |
|----------------------------|-------------------------|-------------------------|-------------------------|------------------------|
| <code>isalnum()</code> | <code>isalpha()</code> | <code>isblank()</code> | <code>iscntrl()</code> | <code>isdigit()</code> |
| <code>isgraph()</code> | <code>islower()</code> | <code>isprint()</code> | <code>ispunct()</code> | <code>isspace()</code> |
| <code>isupper()</code> | <code>isxdigit()</code> | <code>tolower()</code> | <code>toupper()</code> | |
| <code>_XOPEN_SOURCE</code> | | | | |
| <code>isascii()</code> | <code>toascii()</code> | <code>_tolower()</code> | <code>_toupper()</code> | |

For more information about the effect of locale, see `setlocale()`, `locale.h`, or look up the individual functions in this topic. For still more information, see "Internationalization: Locales and Character Sets" in *z/OS XL C/C++ Programming Guide*.

decimal.h — Fixed-point decimal operations

The `decimal.h` header file is not supported under z/OS C++ applications.

The `decimal.h` header file contains declarations for those built-in functions that perform fixed-point decimal operations. The functions declared are:

`decabs()` `decchk()` `decfix()`

The header file also contains definitions of constants that specify the ranges of the `decimal` data types.

dirent.h — POSIX directory access

The `dirent.h` header file contains constants, prototypes, and typedef definitions for POSIX directory access functions. It declares the following functions.

`_OPEN_SYS_DIR_EXT`

`__opendir2()` `__readdir2()` `__readdir2_64()`

`_POSIX_SOURCE`

`closedir()` `opendir()` `readdir()` `rewinddir()`

`_XOPEN_SOURCE`

`seekdir()` `telldir()`

`_XOPEN_SOURCE 500`

`readdir_r()`

`_POSIX_C_SOURCE 200809L`

`dirfd()` `fdopendir()`

`_XPLATFORM_SOURCE`

`fdclosedir()`

This header file can be used by C++ POSIX(OFF) functions.

dlfcn.h — Define macros for use with dlopen()

The `dlfcn.h` header file declares the following macros for use in the construction of a `dlopen()` mode argument::

RTLD_LAZY

Relocations are performed at an implementation-defined time.

RTLD_NOW

Relocations are performed when the object is loaded.

RTLD_GLOBAL

All symbols are available for relocation processing of other modules.

RTLD_LOCAL

All symbols are not made available for relocation processing by other modules.

`dlclose()` `dLError()` `dlsym()` `dlopen()`

dll.h — DLL functions

The `dll.h` header file declares the following functions:

`dllload()` `dllqueryvar()` `dllqueryfn()` `dllfree()`

Use this header file when using these functions to import functions and variables from a DLL.

dynit.h — Dynamic allocation routines

The `dynit.h` header file contains information for dynamic allocation routines. Specifically, it contains declarations of the `dynalloc()` and `dynfree()` functions, the definition of the `dyninit()` macro, declarations of related structures, and definitions of related constants.

env.h — Set and clear environment variables

The `env.h` header file is used to declare the `setenv()` and `clearenv()` functions, which are used in POSIX programs to set and clear environment variables. The `env.h` header file requires the `_POSIX1_SOURCE 2` feature test macro.

errno.h — Symbolic constants for errno

The `errno.h` header file defines the symbolic constants that are returned in the external variable `errno`.

Table 3. Definitions in `errno.h`

| | |
|----------------------|-----------------------------------|
| EACCES | Permission denied |
| EADDRINUSE | Address in use |
| EADDRNOTAVAIL | Address not available |
| EADV | Advertise error |
| EAFNOSUPPORT | Address family not supported |
| EAGAIN | Resource temporarily unavailable |
| EALREADY | Connection already in progress |
| EBADF | Bad file descriptor |
| EBADMSG | Bad message |
| EBUSY | Resource busy |
| ECANCELED | Operation canceled |
| ECHILD | No child processes |
| ECICS | Function not supported under CICS |
| ECOMM | Communication error on send |
| ECONNABORTED | Connection aborted |
| ECONNREFUSED | Connection refused |
| ECONNRESET | Connection reset |
| EDEADLK | Resource deadlock avoided |
| EDESTADDRREQ | Destination address required |
| EDOM | Domain error |

Table 3. Definitions in *errno.h* (continued)

| | |
|---------------------------|--|
| EDOTDOT | Cross mount point (not an error) |
| EDQUOT | Reserved |
| EEXIST | File exists |
| EFAULT | Bad address |
| EFBIG | File too large |
| EHOSTDOWN | Host is down |
| EHOSTUNREACH | Destination host can not be reached |
| EIBMBADCALL | A bad socket-call constant in IUCV header |
| EIBMBADPARM | Other IUCV header error |
| EIBMCANCELLED | Request canceled |
| EIBMCONFLICT | Conflicting call outstanding on socket |
| EIBMIUCVERR | Request failed due to IUCV error |
| EIBMSOCKINUSE | Assigned socket number already in use |
| EIBMSOCKOUTOFRANGE | Assigned socket number out of range |
| EIDRM | Identifier removed |
| EILSEQ | Illegal byte sequence |
| EINPROGRESS | Connection in progress |
| EINTR | Interrupted function call |
| EINTRNODATA | Function call interrupted before any data received |
| EINVAL | Invalid argument |
| EIO | Input/output error |
| EISCONN | Socket is already connected |
| EISDIR | Is a directory |
| ELEMSGERR | Message file was not found in z/OS UNIX |
| ELEMULTITHREAD | Function not allowed in a multithreaded environment |
| ELEMULTITHREADFORK | Function not allowed in child of fork() in multithreaded environment |
| ELENOFORK | Language Environment member language cannot tolerate a fork() |
| ELOOP | A loop exists in symbolic links encountered during resolution of the path argument |
| EMFILE | Too many open files |
| EMLINK | Too many links |
| EMSGSIZE | Message too long |
| EMULTIHOP | Multihop is not allowed |
| EMVSBADCHAR | Bad character in environment variable name |
| EMVSCATLG | Catalog obtain error |
| EMVSCPLERROR | A CPL service failed |

Table 3. Definitions in *errno.h* (continued)

| | |
|-----------------------|--|
| EMVSCVAF | Catalog Volume Access Facility error |
| EMVSDYNALC | Dynamic allocation error |
| EMVSERR | An MVS internal error |
| EMVSEXPIRE | Password has expired |
| EMVSINITIAL | Process initialization err |
| EMVSNORTL | Access to the z/OS UNIX version of the C RTL is denied |
| EMVSNOTXP | z/OS UNIX are not active |
| EMVSPARM | Bad parameters were passed to the service |
| EMVSPASSWORD | Password is invalid |
| EMVSPATHOPTS | Access mode argument conflicts with PATHOPTS parameter |
| EMVSPFSFILE | PDSE/X encountered a permanent file error |
| EMVSPFSPERM | PDSE/X encountered a system error |
| EMVSSAF2ERR | SAF/RACF [®] error |
| EMVSSAFEXTRERR | SAF/RACF extract error |
| EMVSTODNOTSET | System TOD clock not set |
| ENAMETOOLONG | File name too long |
| ENETDOWN | The local interface to use or reach the destination |
| ENETRESET | Network dropped connection on reset |
| ENETUNREACH | Network unreachable |
| ENFILE | Too many open files in system |
| ENOBUFS | No buffer space available |
| ENODATA | No message available |
| ENODEV | No such device |
| ENOENT | No such file or directory |
| ENOEXEC | Exec format error |
| ENOLINK | The link has been severed |
| ENOLCK | No locks available |
| ENOMEM | Not enough space |
| ENOMSG | No message of desired type |
| ENONET | Machine is not on the network |
| ENOPROTOOPT | Protocol not available |
| ENOREUSE | The socket cannot be reused |
| ENOSPC | No space left on device |
| ENOSR | No stream resource |
| ENOSYS | Function not implemented |
| ENOSTR | Not a stream |

Table 3. Definitions in *errno.h* (continued)

| | |
|---------------------------|--|
| ENOTBLK | Block device required |
| ENOTCONN | The socket is not connected. |
| ENOTDIR | Not a directory |
| ENOTEMPTY | Directory not empty |
| ENOTSOCK | Descriptor does not refer to a socket |
| ENOTSUP | Not supported. |
| ENOTTY | Inappropriate I/O control operation |
| ENXIO | No such device or address |
| EOFFLOADboxDOWN | Offload box down |
| EOFFLOADboxERROR | Offload box error |
| EOFFLOADboxRESTART | Offload box restarted |
| EOPNOTSUPP | Operation not supported on socket |
| EOVERFLOW | Value too large to be stored in data type |
| EPERM | Operation not permitted |
| EPFNOSUPPORT | Protocol family not supported |
| EPIPE | Broken pipe |
| EPROCLIM | Too many processes |
| EPROTO | Protocol error |
| EPROTONOSUPPORT | Protocol not supported |
| EPROTOTYPE | The socket type is not supported by the protocol |
| ERANGE | Range error or pole error |
| EREMCHG | Remote address changed |
| EREMOTE | Too many levels of remote in path |
| EROFS | Read-only file system |
| ERREMOTE | Object is remote |
| ESHUTDOWN | Cannot send after socket shutdown |
| ESOCKTNOSUPPORT | Socket type not supported |
| ESPIPE | Invalid seek |
| ESRCH | No such process |
| ESRMNT | srmount error |
| ESTALE | The file handle is stale |
| ETIME | Stream ioctl() timeout |
| ETIMEDOUT | Socket not connected |
| ETOOMANYREFS | Too many references: cannot splice |
| ETXTBSY | Text file busy |
| EUSERS | Too many users |
| EWouldBLOCK | Problem on nonblocking socket |

Table 3. Definitions in `errno.h` (continued)

| | |
|--------------|---|
| EXDEV | A link to a file on another file system was attempted |
| E2BIG | Argument list too long |

The `errno.h` header file also defines `errno`, which is a modifiable lvalue having type `int`. If you intend to test the value of `errno` after library function calls, first set it to 0, because the library functions do not reset the value to 0.

`strerror()` or `perror()` functions can be used to print the description of the message associated with a particular `errno`.

To test for the explicit error, use the macro names defined in `errno.h`, rather than specific values of these macros. Doing so will ensure future compatibility and portability.

`errno.h` also declares the `__errno2()` prototype.

fcntl.h – POSIX functions for file operations

The `fcntl.h` header file declares the following POSIX functions for creating, opening, rewriting, and manipulating files.

| | | |
|--------------------------------------|------------------------|--------------------------|
| <code>_POSIX_C_SOURCE</code> 200809L | | |
| <code>faccessat()</code> | <code>openat()</code> | <code>utimensat()</code> |
| <code>_POSIX_SOURCE</code> | | |
| <code>creat()</code> | <code>fcntl()</code> | <code>open()</code> |
| <code>_XPLATFORM_SOURCE</code> | | |
| <code>futimesat()</code> | <code>openat2()</code> | |

The header also contains these constants:

| | |
|--------------------------------|-----------------------|
| <code>_XPLATFORM_SOURCE</code> | |
| <code>O_CLOEXEC</code> | <code>O_DIRECT</code> |

features.h – Feature test macros

The `features.h` header file contains definitions for feature test macros. For information on feature test macros, see [“Feature test macros” on page 3](#).

fenv.h – Floating-point environment

The `fenv.h` header contains the following data types, macros and functions. This header is supported under IEEE Binary Floating-Point only and is required to define the feature test macro `_ISOC99_SOURCE` or requires the compiler that is designed to support C99 to expose the functionality. The decimal floating-point macros, prefixed by `FE_DEC_` and `_FE_DEC_`, are used by the `fe_dec_getround` and `fe_dec_setround` functions to get and set the rounding mode of decimal floating-point operations. Decimal floating-point functionality additionally requires the `__STDC_WANT_DEC_FP__` feature test macro to be defined.

Data types

fenv_t
represents the entire floating-point environment.

fexcept_t
represents the floating-point status flags collectively.

Macros

FE_DIVBYZERO

defines the divide by zero exception

_FE_DEC_AWAYFROMZERO

rounds away from zero

FE_DEC_DOWNWARD

rounds towards minus infinity

_FE_DEC_PREPAREFORSHORTER

rounds to prepare for shorter precision

FE_DEC_TONEAREST

rounds to nearest

FE_DEC_TONEARESTFROMZERO

rounds to nearest, ties away from zero

_FE_DEC_TONEARESTTOWARDZERO

rounds to nearest, ties toward zero

FE_DEC_TOWARDZERO

rounds toward zero

FE_DEC_UPWARD

rounds toward plus infinity

FE_INEXACT

defines the inexact exception

FE_INVALID

defines the invalid exception

FE_OVERFLOW

defines the overflow exception

FE_UNDERFLOW

defines the underflow exception

FE_ALL_EXCEPT

defines the bitwise OR of all the exception macros.

FE_DOWNWARD

rounds towards minus infinity

FE_TONEAREST

rounds to nearest

FE_TOWARDZERO

rounds toward zero

FE_UPWARD

rounds towards plus infinity

FE_DFL_ENV

defines the floating-point environment as it was available at program start up

Functions

| | | | | |
|------------------------|--------------------------|--------------------------|--------------------------|-----------------------|
| feclearexcept() | fegetenv() | fegetexceptflag() | fegetround() | feholdexcept() |
| feraiseexcept() | fesetenv() | fesetexceptflag() | fesetround() | fetestexcept() |
| feupdateenv() | fe_dec_getround() | | fe_dec_setround() | |

float.h — ISO C/C++ constants for floating-point data types

The `float.h` header file contains definitions of constants listed in ISO C/C++ 5.2.4.2.2, that describe the characteristics of the internal representations of the three floating-point data types, `float`, `double`, and `long double`. The definitions are:

Constant

Description

FLT_ROUNDS

The rounding mode for floating-point addition.

FLT_RADIX

The radix for IBM z/OS C applications.

The FLT_RADIX value depends on the representation that is used for the floating-point types:

- When [IEEE floating point representation](#) is used, the FLT_RADIX value is 16.
- When [Hexadecimal floating point representation](#) is used, the FLT_RADIX value is 2

FLT_MANT_DIG**DBL_MANT_DIG****LDBL_MANT_DIG**

The number of hexadecimal digits stored to represent the significand of a fraction.

FLT_DIG**DBL_DIG****LDBL_DIG**

The number of decimal digits, q , such that any floating-point number with q decimal digits can be rounded into a floating-point number with p radix FLT_RADIX digits and back again, without any change to the q decimal digits.

FLT_MIN_EXP**DBL_MIN_EXP****LDBL_MIN_EXP**

The minimum negative integer such that FLT_RADIX raised to that power minus 1 is a normalized floating-point number.

FLT_MIN_10_EXP DBL_MIN_10_EXP**LDBL_MIN_10_EXP**

The minimum negative integer such that 10 raised to that power is in the range of normalized floating-point numbers.

FLT_MAX_EXP**DBL_MAX_EXP****LDBL_MAX_EXP**

The maximum integer such that FLT_RADIX raised to that power minus 1 is a representable finite floating-point number.

FLT_MAX_10_EXP**DBL_MAX_10_EXP****LDBL_MAX_10_EXP**

The maximum integer such that 10 raised to that power is in the range of representable finite floating-point numbers.

FLT_MAX**DBL_MAX****LDBL_MAX**

The maximum representable finite floating-point number.

FLT_EPSILON**DBL_EPSILON****LDBL_EPSILON**

The difference between 1.0 and the least value greater than 1.0 that is representable in the given floating-point type.

FLT_MIN**DBL_MIN****LDBL_MIN**

The minimum normalized positive floating-point number.

DECIMAL_DIG

The minimum number of decimal digits needed to represent all the significant digits for type long double.

FLT_EVAL_METHOD

Describes the evaluation mode for floating point operations. This value is 1, which evaluates all operations and constants of types float and double to type double and that of long double to type long double.

DEC_EVAL_METHOD

The decimal floating-point evaluation format.

FLT_MAXDIG10

DBL_MAXDIG10

LDBL_MAXDIG10

The number of base 10 digits required to ensure that values which differ by only one smallest unit in the last place (ulp) are always differentiated.

FLT_SUBNORM

DBL_SUBNORM

LDBL_SUBNORM

Characterize the presence or absence of subnormal numbers:

- -1: indeterminable
- 0: absent (type does not support subnormal numbers)
- 1: present (type does support subnormal numbers)

FLT_DECIMAL_DIG

DBL_DECIMAL_DIG

LDBL_DECIMAL_DIG

The number of decimal digits, n, such that any floating-point number with p radix b digits can be rounded to a floating-point number with n decimal digits and back again without change to the value.

FLT_TRUE_MIN

DBL_TRUE_MIN

LDBL_TRUE_MIN

The minimum positive floating-point number.

The float.h header file also contains constants that describe the characteristics of the internal representations of the three decimal floating-point data types, _Decimal32, _Decimal64, and _Decimal128. The prefixes DEC32_, DEC64_, and DEC128_ are used to denote the types _Decimal32, _Decimal64, and _Decimal128, respectively.

Constant

Description

DEC32_MANT_DIG

DEC64_MANT_DIG

DEC128_MANT_DIG

The number of digits in the coefficient.

DEC32_MIN_EXP

DEC64_MIN_EXP

DEC128_MIN_EXP

The minimum exponent.

DEC32_MAX_EXP

DEC64_MAX_EXP

DEC128_MAX_EXP

The maximum exponent.

DEC32_MAX

DEC64_MAX

DEC128_MAX

The maximum representable finite decimal floating number.

DEC32_EPSILON
DEC64_EPSILON
DEC128_EPSILON

The difference between 1 and the least value greater than 1 that is representable in the given floating point type.

DEC32_MIN
DEC64_MIN
DEC128_MIN

The minimum normalized positive decimal floating number.

DEC32_SUBNORMAL_MIN
DEC64_SUBNORMAL_MIN
DEC128_SUBNORMAL_MIN

The minimum subnormal (denormalized) positive Decimal Floating Point number.

DEC_EVAL_METHOD

The decimal floating-point evaluation format.

fmtmsg.h — Message display structures

The `fmtmsg.h` header file contains message display structures.

fnmatch.h — Filename matching types

The `fnmatch.h` header file contains filename matching types.

fpxcp.h — Floating-point exception interfaces

The `fpxcp.h` header file declares floating-point exception interfaces.

__ftp.h — FTP resolver functions

The `__ftp.h` header file contains definitions for FTP resolver functions.

ftw.h — File tree traversal constants

The `ftw.h` header file contains file tree traversal constants.

getopt.h — z/OS UNIX function for parsing command line option

The `getopt.h` header file contains definitions for command line option parsing functions.

__gfunc.h — __gtca and __gtab functions

The `__gfunc.h` header file defines the `__gtca` and `__gtab` functions.

glob.h — Pathname pattern matching types

The `glob.h` header file contains pathname pattern matching types.

grp.h — Access group databases

The `grp.h` header file declares functions used to access group databases.

`_POSIX_SOURCE`

`getgrgid()`

`__getgrgid1()`

`getgrnam()`

`__getgrnam1()`

`_OPEN_SYS`

Header files

| | | |
|--------------------------|--------------|------------|
| initgroups() | setgroups() | |
| _XOPEN_SOURCE_EXTENDED 1 | | |
| setgrent() | endgrent() | getgrent() |
| _XOPEN_SOURCE 500 | | |
| getgrgid_r() | getgrnam_r() | |

iconv.h — Code conversion

The `iconv.h` header file declares the `iconv_open()`, `iconv()`, and `iconv_close()` functions that deal with code conversion.

_Ieee754.h — IEEE 754 interfaces

The `_Ieee754.h` header file declares IEEE 754 interfaces.

ims.h — Invoke IMS facilities

Restriction: This header file is not supported in AMODE 64.

The `ims.h` header file declares the `ctdli()` function that invokes IMS facilities. The function is *not* supported from a z/OS UNIX program running POSIX(ON).

inttypes.h — I/O format of integer types

The following macros are defined in `inttypes.h`. Each expands to a character string literal containing a conversion specifier which can be modified by a length modifier that can be used in the *format* argument of a formatted input/output function when converting the corresponding integer type. These macros have the general form of PRI (character string literals for the `fprintf()` and `fwprintf()` family of functions) or SCN (character string literals for the `fscanf()` and `fwscanf()` family of functions), followed by the conversion specifier, followed by a name corresponding to a similar type name in `<inttypes.h>`. In these names, the suffix number represents the width of the type. For example, `PRIdFAST32` can be used in a format string to print the value of an integer of type `int_fast32_t`.

This header defines the type `imaxdiv_t`.

Note: Requires `long long` to be available.

`imaxdiv_t` is a structure type that is the type of the value returned by the `imaxdiv()` function. It is functionally equivalent to `lldiv_t`.

Compile requirement:

In the following list all macros with the suffix MAX or 64 require `long long` to be available.

| | | | |
|------------|-------------|-------------|-------------|
| PRId8 | PRId16 | PRId32 | PRId64 |
| PRIdLEAST8 | PRIdLEAST16 | PRIdLEAST32 | PRIdLEAST64 |
| PRIdFAST8 | PRIdFAST16 | PRIdFAST32 | PRIdFAST64 |
| PRIdMAX | | | |
| PRIdPTR | | | |
| PRId8 | PRId16 | PRId32 | PRId64 |
| PRIdLEAST8 | PRIdLEAST16 | PRIdLEAST32 | PRIdLEAST64 |
| PRIdFAST8 | PRIdFAST16 | PRIdFAST32 | PRIdFAST64 |
| PRIdMAX | | | |

PRIiPTR

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>
int main(void)
{
    int8_t i = 40;
    printf("Demonstrating the use of the following macros:\n");
    printf("Using PRId8, the printed value of 40 "
        "is %" PRId8"\n", i);
    printf("Using PRIiFAST8, the printed value of 40 "
        "is %" PRIiFAST8"\n", i);
    printf("Using PRioLEAST8, the printed value of 40 "
        "is %" PRioLEAST8 "\n", i);
    return 0;
}
```

Output:

```
Demonstrating the use of the following macros:
Using PRId8, the printed value of 40 is 40
Using PRIiFAST8, the printed value of 40 is 40
Using PRioLEAST8, the printed value of 40 is 50
```

Compile requirement:

In the following list all macros with the suffix MAX or 64 require `long long` to be available.

Macros for `fprintf` family for unsigned integers:

| | | | |
|------------|-------------|-------------|-------------|
| PRIo8 | PRIo16 | PRIo32 | PRIo64 |
| PRioLEAST8 | PRioLEAST16 | PRioLEAST32 | PRioLEAST64 |
| PRioFAST8 | PRioFAST16 | PRioFAST32 | PRioFAST64 |
| PRioMAX | | | |
| PRioPTR | | | |
| PRIu8 | PRIu16 | PRIu32 | PRIu64 |
| PRIuLEAST8 | PRIuLEAST16 | PRIuLEAST32 | PRIuLEAST64 |
| PRIuFAST8 | PRIuFAST16 | PRIuFAST32 | PRIuFAST64 |
| PRIuMAX | | | |
| PRIuPTR | | | |
| PRIx8 | PRIx16 | PRIx32 | PRIx64 |
| PRIxLEAST8 | PRIxLEAST16 | PRIxLEAST32 | PRIxLEAST64 |
| PRIxFAST8 | PRIxFAST16 | PRIxFAST32 | PRIxFAST64 |
| PRIxMAX | | | |
| PRIxPTR | | | |
| PRIX8 | PRIX16 | PRIX32 | PRIX64 |
| PRIXLEAST8 | PRIXLEAST16 | PRIXLEAST32 | PRIXLEAST64 |
| PRIXFAST8 | PRIXFAST16 | PRIXFAST32 | PRIXFAST64 |
| PRIXMAX | | | |
| PRIXPTR | | | |

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>

int main(void)
{
    uint32_t i = 24000;
    printf("Demonstrating the use of the following macros:\n");
    printf("Using PRIuPTR, the address of the variable "
           "is %" PRIuPTR "\n", i);
    printf("Using PRIXFAST32, the printed value of 24000 "
           "is %" PRIXFAST32 "\n", i);
    printf("Using PRILEAST32, the printed value of 24000 "
           "is %" PRILEAST32 "\n", i);
    return 0;
}
```

Output:

```
Demonstrating the use of the following macros:
Using PRIuPTR, the address of the variable is 538874544
Using PRIXFAST32, the printed value of 24000 is 5DC0
Using PRILEAST32, the printed value of 24000 is 5dc0
```

Compile requirement:

In the following list all macros with the suffix MAX or 64 require long long to be available.

Macros for fscanff family for signed integers:

| | | | |
|------------|-------------|-------------|-------------|
| SCNd8 | SCNd16 | SCNd32 | SCNd64 |
| SCNdLEAST8 | SCNdLEAST16 | SCNdLEAST32 | SCNdLEAST64 |
| SCNdFAST8 | SCNdFAST16 | SCNdFAST32 | SCNdFAST64 |
| SCNdMAX | | | |
| SCNdPTR | | | |
| SCNi8 | SCNi16 | SCNi32 | SCNi64 |
| SCNiLEAST8 | SCNiLEAST16 | SCNiLEAST32 | SCNiLEAST64 |
| SCNiFAST8 | SCNiFAST16 | SCNiFAST32 | SCNiFAST64 |
| SCNiMAX | | | |
| SCNiPTR | | | |

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>

int main(void)
{
    int32_t i;
    printf("Enter decimal value ");
    scanf("%i" SCNdFAST32, &i);
    printf("Print result: %" PRIuFAST32 "\n", i);
    return 0;
}
```

Output:

```
Enter decimal value 23
Print result: 23
```

Compile requirement:

In the following list all macros with the suffix MAX or 64 require `long long` to be available.

Macros for `fscanf` family for signed integers:

| | | | |
|------------|-------------|-------------|-------------|
| SCNo8 | SCNo16 | SCNo32 | SCNo64 |
| SCNoLEAST8 | SCNoLEAST16 | SCNoLEAST32 | SCNoLEAST64 |
| SCNoFAST8 | SCNoFAST16 | SCNoFAST32 | SCNoFAST64 |
| SCNoMAX | | | |
| SCNoPTR | | | |
| SCNu8 | SCNu16 | SCNu32 | SCNu64 |
| SCNuLEAST8 | SCNuLEAST16 | SCNuLEAST32 | SCNuLEAST64 |
| SCNuFAST8 | SCNuFAST16 | SCNuFAST32 | SCNuFAST64 |
| SCNuMAX | | | |
| SCNuPTR | | | |
| SCNx8 | SCNx16 | SCNx32 | SCNx64 |
| SCNxLEAST8 | SCNxLEAST16 | SCNxLEAST32 | SCNxLEAST64 |
| SCNxFAST8 | SCNxFAST16 | SCNxFAST32 | SCNxFAST64 |
| SCNxMAX | | | |
| SCNxPTR | | | |

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>

int main(void)
{
    intmax_t i;
    printf("Enter hex value ");
    scanf("%" SCNxMAX, &i);
    printf("Print result: %020" PRIxMAX "\n", i);
    return 0;
}
```

Output :

```
Enter hex value 0x32
Print result: 0000000000000000000032
```

iso646.h —Macros for operators

The header file `iso646.h` allows the user to use the following macros in place of the associated operator.

Macros

Operators

and

`&&`

and_eq

`&=`

bitand

`&`

bitor

`|`

```
compl
~
not
!
not_eq
!=
or
||
or_eq
|=
xor
^
xor_eq
^=
```

langinfo.h —Macros for date and time

The langinfo.h header file contains the declaration for the nl_langinfo() function. The header file also defines the macros that, in turn, define constants used to identify the information queried by nl_langinfo() in the current locale. The following macros are defined:

Table 4. Item Values defined in langinfo.h

| Item Name | Description |
|------------|--|
| ABDAY_1 | Abbreviated first day of the week |
| ABDAY_2 | Abbreviated second day of the week |
| ABDAY_3 | Abbreviated third day of the week |
| ABDAY_4 | Abbreviated fourth day of the week |
| ABDAY_5 | Abbreviated fifth day of the week |
| ABDAY_6 | Abbreviated sixth day of the week |
| ABDAY_7 | Abbreviated seventh day of the week |
| ABMON_1 | Abbreviated first month |
| ABMON_2 | Abbreviated second month |
| ABMON_3 | Abbreviated third month |
| ABMON_4 | Abbreviated fourth month |
| ABMON_5 | Abbreviated fifth month |
| ABMON_6 | Abbreviated sixth month |
| ABMON_7 | Abbreviated seventh month |
| ABMON_8 | Abbreviated eighth month |
| ABMON_9 | Abbreviated ninth month |
| ABMON_10 | Abbreviated tenth month |
| ABMON_11 | Abbreviated eleventh month |
| ABMON_12 | Abbreviated twelfth month |
| ALT_DIGITS | String of semicolon separated alternative symbols for digits |
| AM_STR | String for morning |

Table 4. Item Values defined in *langinfo.h* (continued)

| Item Name | Description |
|-------------|--|
| CODESET | Current encoded character set of the process |
| CRNCYSTR | Local currency symbol, preceded by '-' if the symbol should appear before the value, '+' if the symbol should appear after the value, or '.' if the symbol should replace the radix character. |
| D_FMT | String for formatting date |
| D_T_FMT | String for formatting date and time |
| DAY_1 | Name of the first day of the week |
| DAY_2 | Name of the second day of the week |
| DAY_3 | Name of the third day of the week |
| DAY_4 | Name of the fourth day of the week |
| DAY_5 | Name of the fifth day of the week |
| DAY_6 | Name of the sixth day of the week |
| DAY_7 | Name of the seventh day of the week |
| ERA | String of semicolon separated era segments |
| ERA_D_FMT | String for era date format |
| ERA_D_T_FMT | String for era date and time format |
| ERA_T_FMT | String for era time format |
| MON_1 | Name of the first month |
| MON_2 | Name of the second month |
| MON_3 | Name of the third month |
| MON_4 | Name of the fourth month |
| MON_5 | Name of the fifth month |
| MON_6 | Name of the sixth month |
| MON_7 | Name of the seventh month |
| MON_8 | Name of the eighth month |
| MON_9 | Name of the ninth month |
| MON_10 | Name of the tenth month |
| MON_11 | Name of the eleventh month |
| MON_12 | Name of the twelfth month |
| NOEXPR | Negative response expression |
| NOSTR | Negative response string |
| PM_STR | String for afternoon |
| RADIXCHAR | Radix character |
| T_FMT | String for formatting time |
| T_FMT_AMPM | String for formatting time in 12-hour clock format |
| THOUSEP | Separator for thousands |
| YESEXPR | Affirmative response expression |

Table 4. Item Values defined in *langinfo.h* (continued)

| Item Name | Description |
|-----------|-----------------------------|
| YESSTR | affirmative response string |

Note:

The YESSTR and NOSTR constants are kept for historical reasons. They were part of the Legacy Feature in Single UNIX Specification, Version 2. They have been withdrawn and are not supported as part of Single UNIX Specification, Version 3.

If it is necessary to continue using these constants in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

For more information about the effect of locale, see `setlocale()`, `locale.h`, or look up the individual functions in this topic. For still more information, see "Internationalization: Locales and Character Sets" in *z/OS XL C/C++ Programming Guide*.

lc_core.h — Locale-related data structures

The `lc_core.h` header file contains locale-related data structures.

lc_sys.h — Build references to locale methods in ASCII locales

The `lc_sys.h` header file contains definitions used by the `localedef` utility for building references to locale methods in ASCII locales.

__le_api.h — AMODE 64 C functions in Language Environment

The `__le_api.h` header file declares the following AMODE 64 C functions in Language Environment:

| | | |
|--|---|------------------------------------|
| <code>__le_ceegtjs()</code> | <code>__le_ceemict()</code> | <code>__le_ceedsgd()</code> |
| <code>__le_cib_get()</code> | <code>__le_condition_token_build()</code> | <code>__le_msg_add_insert()</code> |
| <code>__le_msg_get()</code> | <code>__le_msg_get_and_write()</code> | <code>__le_msg_write()</code> |
| <code>__le_set_debug_resume_mch()</code> | | |

Restrictions:

- This header is supported in AMODE 64 only. For AMODE 31, the `leawi.h` header file should be used.

leawi.h — Macros for Language Environment Application Writer Interfaces

Restriction: This header file is not supported in AMODE 64. For AMODE 64, the `__le_api.h` header file should be used.

The `leawi.h` header file contains internal macros. The header file is required for applications that use Language Environment Application Writer Interfaces (LE AWI).

libgen.h — Pattern matching functions

The `libgen.h` header file contains definitions for pattern matching functions.

limits.h — Standard values for limits on resources

The `limits.h` header file contains symbolic names that represent standard values for limits on resources, such as the maximum value for an object of type `char`.

Table 5. Definitions of resource limits (*limits.h*)

| | |
|----------------------------|--------------------------------------|
| ATEXIT_MAX | 2048 |
| BC_DIM_MAX | 32768 |
| BC_SCALE_MAX | 32767 |
| BC_STRING_MAX | 2048 |
| CHAR_BIT | 8 |
| CHAR_MAX | 127 (<code>_CHAR_SIGNED</code>) |
| CHAR_MAX | 255 |
| CHAR_MIN | (-128) (<code>_CHAR_SIGNED</code>) |
| CHAR_MIN | 0 |
| COLL_WEIGHTS_MAX | 2 |
| __DIR_NAME_MAX | 256 |
| EXPR_NEST_MAX | 32 |
| INT_MAX | 2147483647 |
| INT_MIN | (-2147483647 - 1) |
| LINE_MAX | 2048 |
| LLONG_MAX | (9223372036854775807LL) |
| LLONG_MIN | (-LLONG_MAX-1) |
| LONG_MAX | 2147483647 |
| LONGLONG_MAX | (9223372036854775807LL) |
| LONG_MIN | (-2147483647L - 1) |
| LONGLONG_MIN | (-LONGLONG_MAX - 1) |
| MB_LEN_MAX | 4 |
| NGROUPS_MAX | 300 |
| PASS_MAX | 255 |
| _POSIX_ARG_MAX | 4096 |
| _POSIX_CHILD_MAX | 25 |
| _POSIX_DATAKEYS_MAX | 32 |
| _POSIX_LINK_MAX | 8 |
| _POSIX_MAX_CANON | 255 |
| _POSIX_MAX_INPUT | 255 |
| _POSIX_NAME_MAX | 14 |
| _POSIX_NGROUPS_MAX | 8 |
| _POSIX_OPEN_MAX | 20 |
| _POSIX_PATH_MAX | 255 |
| _POSIX_PIPE_BUF | 512 |
| _POSIX_SSIZE_MAX | 32767 |
| _POSIX_STREAM_MAX | 8 |

Table 5. Definitions of resource limits (limits.h) (continued)

| | |
|---|---------------------------|
| POSIX_SYMLINK | 24 |
| _POSIX_TZNAME_MAX | 6 |
| _POSIX2_BC_BASE_MAX | 99 |
| _POSIX2_BC_DIM_MAX | 2048 |
| _POSIX2_BC_SCALE_MAX | 99 |
| _POSIX2_BC_STRING_MAX | 1000 |
| _POSIX2_COLL_WEIGHTS_MAX | 2 |
| _POSIX2_EXPR_NEST_MAX | 32 |
| _POSIX2_LINE_MAX | 2048 |
| _POSIX2_RE_DUP_MAX | 255 |
| RE_DUP_MAX | 255 |
| SCHAR_MAX | 127 |
| SCHAR_MIN | (-128) |
| SHRT_MAX | 32767 |
| SHRT_MIN | (-32768) |
| SSIZE_MAX | 2147483647 |
| UCHAR_MAX | 255 |
| UINT_MAX | 4294967295 |
| ULONG_MAX | 4294967295U |
| ULONGLONG_MAX | (18446744073709551615ULL) |
| ULLONG_MAX | (18446744073709551615ULL) |
| USHRT_MAX | 65535 |
| When compiled with SUSV3 thread support (_UNIX03_THREADS or _XOPEN_SOURCE 600), limits.h adds the following constants: | |
| PTHREAD_STACK_MIN | 4096 (1048576 in 64-bit) |
| _POSIX_THREAD_DESTRUCTOR_ITERATIONS | 4 |
| _POSIX_THREAD_KEYS_MAX | 128 |
| _POSIX_THREAD_THREADS_MAX | 64 |

localdef.h — Data structures for locale objects

The `localdef.h` header file defines data structures for locale objects which are loaded by `setlocale()`. The data structures in `localdef.h` are not a supported programming interface.

locale.h — Locale settings

The `locale.h` header file contains declarations for the `localdtconv()` and `localeconv()` library functions, which retrieve values from the current locale, and for the `setlocale()` function, used to query or change locale settings for internationalized applications.

The `locale.h` file declares the `lconv` structure. [Table 6 on page 37](#) below shows the elements of the `lconv` structure and the defaults for the C locale.

Table 6. Elements of `lconv` Structure

| Element | Purpose of Element | Default |
|--------------------------------------|---|------------------------|
| <code>char *decimal_point</code> | Decimal-point character used to format non-monetary quantities. | "." |
| <code>char *thousands_sep</code> | Character used to separate groups of digits to the left of the decimal-point character in formatted non-monetary quantities. | "" |
| <code>char *grouping</code> | String indicating the size of each group of digits in formatted non-monetary quantities. The value of each character in the string determines the number of digits in a group. A value of <code>CHAR_MAX</code> indicates that there are no further groupings. 0 indicates that the previous element is to be used for the remainder of the digits. | "" |
| <code>char *int_curr_symbol</code> | International currency symbol for the current locale. The first three characters contain the alphabetic international currency symbol. The fourth character (usually a space) is the character used to separate the international currency symbol from the monetary quantity. | "" |
| <code>char *currency_symbol</code> | Local currency symbol of the current locale. | "" |
| <code>char *mon_decimal_point</code> | Decimal-point character used to format monetary quantities. | "." |
| <code>char *mon_thousands_sep</code> | Separator for digits in formatted monetary quantities. | "" |
| <code>char *mon_grouping</code> | String indicating the size of each group of digits in formatted monetary quantities. The value of each character in the string determines the number of digits in a group. A value of <code>CHAR_MAX</code> indicates that there are no further groupings. 0 indicates that the previous element is to be used for the remainder of the digits. | "" |
| <code>char *positive_sign</code> | String indicating the positive sign used in monetary quantities. | "" |
| <code>char *negative_sign</code> | String indicating the negative sign used in monetary quantities. | "" |
| <code>char int_frac_digits</code> | The number of displayed digits to the right of the decimal place for internationally formatted monetary quantities. | <code>UCHAR_MAX</code> |
| <code>char frac_digits</code> | Number of digits to the right of the decimal place in monetary quantities. | <code>UCHAR_MAX</code> |
| <code>char p_cs_precedes</code> | Value indicating the placement of the currency symbol in a nonnegative, formatted monetary quantity. For a list of valid values, see Table 7 on page 39 . | <code>UCHAR_MAX</code> |

Table 6. Elements of Iconv Structure (continued)

| Element | Purpose of Element | Default |
|-------------------------|---|-----------|
| char p_sep_by_space | Value indicating the use of white space in a nonnegative, formatted monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |
| char n_cs_precedes | Value indicating the placement of the currency symbol in a negative, formatted monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |
| char n_sep_by_space | Value indicating the use of white space in a negative, formatted monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |
| char p_sign_posn | Value indicating the position of the <code>positive_sign</code> for a nonnegative formatted monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |
| char n_sign_posn | Value indicating the position of the <code>negative_sign</code> for a negative formatted monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |
| char *left_parenthesis | Negative-valued monetary symbol. Note: This element is an IBM-specific extension. | "" |
| char *right_parenthesis | Negative-valued monetary symbol. Note: This element is an IBM-specific extension. | "" |
| char *debit_sign | Debit_sign character string. Note: This element is an IBM-specific extension. | "" |
| char *credit_sign | Credit_sign character string. Note: This element is an IBM-specific extension. | "" |
| char int_p_cs_precedes | For international formatting, value indicating the placement of the currency symbol in a nonnegative, monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |
| char int_n_cs_precedes | For international formatting, value indicating the placement of the currency symbol in a negative, monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |
| char int_p_sep_by_space | For international formatting, value indicating the use of white space in a nonnegative, monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |
| char int_n_sep_by_space | For international formatting, value indicating the use of white space in a negative, monetary quantity. For a list of valid values, see Table 7 on page 39 . | UCHAR_MAX |

Table 6. Elements of `lconv` Structure (continued)

| Element | Purpose of Element | Default |
|-----------------------------------|--|------------------------|
| <code>char int_p_sign_posn</code> | For international formatting, value indicating the position of the positive sign for a nonnegative monetary quantity. For a list of valid values, see Table 7 on page 39 . | <code>UCHAR_MAX</code> |
| <code>char int_n_sign_posn</code> | For international formatting, value indicating the position of the negative sign for a negative monetary quantity. For a list of valid values, see Table 7 on page 39 . | <code>UCHAR_MAX</code> |

For a list of valid values, see [Table 7 on page 39](#).

Table 7. Monetary Formatting Values

| Element | Values |
|---------------------------|---|
| <code>cs_precedes</code> | 0 The <code>currency_symbol</code> succeeds the value for the formatted monetary quantity; |
| | 1 The <code>currency_symbol</code> precedes the value for the formatted monetary quantity |
| <code>sep_by_space</code> | 0 No space separates the <code>currency_symbol</code> from the formatted monetary quantity; |
| | 1 If <code>currency_symbol</code> and sign string are adjacent, a space separates them from the value. Otherwise, the currency symbol and value are separated by a space. |
| | 2 If <code>currency_symbol</code> and sign string are adjacent, a space separates them from each other. Otherwise, the sign string and value are separated by a space. |
| <code>sign_posn</code> | 0 Parentheses surround the quantity and <code>currency_symbol</code> ; |
| | 1 The sign string precedes the quantity and <code>currency_symbol</code> ; |
| | 2 The sign string succeeds the quantity and <code>currency_symbol</code> ; |
| | 3 The sign string immediately precedes <code>currency_symbol</code> ; |
| | 4 The sign string immediately succeeds <code>currency_symbol</code> ; |
| | 5 Substitute <code>debit_sign</code> or <code>credit_sign</code> for <code>negative_sign</code> or <code>positive_sign</code> , respectively. |

Note: This value is an IBM-specific extension.

The `locale.h` file declares the `dtconv` structure:

```
struct dtconv {
    char *abbrev_month_names[12]; /* Abbreviated month names */
    char *month_names[12];       /* full month names */
    char *abbrev_day_names[7];   /* Abbreviated day names */
    char *day_names[7];         /* full day names */
    char *date_time_format;      /* date and time format */
    char *date_format;           /* date format */
    char *time_format;           /* time format */
    char *am_string;             /* AM string */
    char *pm_string;             /* PM string */
    char *time_format_ampm;      /* long date format */
    char *iso_std8601_2000;      /* ISO 8601:2000 std date format*/
};
```

Note: This structure is an IBM-specific extension.

The `locale.h` file also contains macro definitions for use with the `setlocale()` function:

| | | | |
|-------------|------------|----------|-------------|
| LC_ALL | LC_COLLATE | LC_CTYPE | LC_MONETARY |
| LC_NUMERIC | LC_TIME | LC_TOD | NULL |
| LC_MESSAGES | LC_SYNTAX | | |

The aspects of a program related to national language or to cultural characteristics (such as time zone, currency symbols, and sorting order of characters) can be customized at run time using different locales, to suit users' requirements at those locales. See the internationalization topic in [z/OS XL C/C++ Programming Guide](#).

math.h — Floating-point math functions

The `math.h` header file contains function declarations for all the floating-point math functions:

No feature test macro required.

Notes:

1. `nan()`, `nanf()`, and `nanl()` functions are supported under IEEE only.
2. For the C99 math functions, it is required to define the feature test macro `_ISO_C99_SOURCE` or requires a compiler that is designed to support C99 to expose the functionality.

| | | | | |
|---------------------------|---------------------------|---------------------------|----------------------------|----------------------------|
| <code>absf()</code> | <code>absl()</code> | <code>acos()</code> | <code>acosf()</code> | <code>acoshf()</code> |
| <code>acoshl()</code> | <code>acosl()</code> | <code>asin()</code> | <code>asinf()</code> | <code>asinhf()</code> |
| <code>asinhf()</code> | <code>asinl()</code> | <code>atan()</code> | <code>atan2()</code> | <code>atan2f()</code> |
| <code>atan2l()</code> | <code>atanf()</code> | <code>atanl()</code> | <code>cbrtf()</code> | <code>cbrtl()</code> |
| <code>ceil()</code> | <code>ceilf()</code> | <code>ceilf()</code> | <code>copysign()</code> | <code>copysignf()</code> |
| <code>copysignl()</code> | <code>cos()</code> | <code>cosf()</code> | <code>cosh()</code> | <code>coshf()</code> |
| <code>coshl()</code> | <code>cosl()</code> | <code>exp()</code> | <code>expf()</code> | <code>expl()</code> |
| <code>expm1f()</code> | <code>expm1l()</code> | <code>exp2()</code> | <code>exp2f()</code> | <code>exp2l()</code> |
| <code>fabsf()</code> | <code>fabsl()</code> | <code>floor()</code> | <code>floorf()</code> | <code>floorl()</code> |
| <code>fma()</code> | <code>fmaf()</code> | <code>fmal()</code> | <code>fmax()</code> | <code>fmaxf()</code> |
| <code>fmaxl()</code> | <code>fmin()</code> | <code>fminf()</code> | <code>fminl()</code> | <code>fmod()</code> |
| <code>fmodf()</code> | <code>fmodl()</code> | <code>frexp()</code> | <code>frexpf()</code> | <code>frexpl()</code> |
| <code>hypotf()</code> | <code>hypotl()</code> | <code>ilogbf()</code> | <code>ilogbl()</code> | <code>ldexp()</code> |
| <code>ldexpf()</code> | <code>ldexpl()</code> | <code>lgammaf()</code> | <code>lgammal()</code> | <code>llrint()</code> |
| <code>llrintf()</code> | <code>llrintl()</code> | <code>llround()</code> | <code>llroundf()</code> | <code>llroundl()</code> |
| <code>log()</code> | <code>logbf()</code> | <code>logbl()</code> | <code>logf()</code> | <code>logl()</code> |
| <code>log1pf()</code> | <code>log1pl()</code> | <code>log10()</code> | <code>log10f()</code> | <code>log10l()</code> |
| <code>lrint()</code> | <code>lrintf()</code> | <code>lrintl()</code> | <code>lround()</code> | <code>lroundf()</code> |
| <code>lroundl()</code> | <code>modf()</code> | <code>modff()</code> | <code>modfl()</code> | <code>nan()</code> |
| <code>nanf()</code> | <code>nanl()</code> | <code>nearbyint()</code> | <code>nearbyintf()</code> | <code>nearbyintl()</code> |
| <code>nextafterf()</code> | <code>nextafterl()</code> | <code>nexttoward()</code> | <code>nexttowardf()</code> | <code>nexttowardl()</code> |
| <code>pow()</code> | <code>powf()</code> | <code>powl()</code> | <code>remainderf()</code> | <code>remainderl()</code> |

| | | | | |
|------------|-----------|-----------|-----------|------------|
| remquo() | remquof() | remquol() | rintf() | rintl() |
| round() | roundf() | roundl() | scalbln() | scalblnf() |
| scalblnl() | sin() | sinf() | sinh() | sinhf() |
| sinhl() | sinl() | sqrt() | sqrtrf() | sqrtrl() |
| tan() | tanf() | tanh() | tanhf() | tanhl() |
| tanl() | tgamma() | tgammaf() | tgammal() | |

Special Behavior for C++: For C++ applications, each of the base functions in the following list is also overloaded for float, double, and long double. For example:

- float sqrt(float)
- double sqrt(double)
- long double sqrt(long double)

_XOPEN_SOURCE

| | | | | |
|-------|--------|---------|----------|---------|
| erf() | erfc() | gamma() | hypot() | isnan() |
| j0() | j0() | j1() | lgamma() | yn() |
| y0() | y1() | | | |

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| | | | | |
|---------|---------|---------|-------------|-------------|
| acosh() | asinh() | atanh() | cbrt() | expm1() |
| ilogb() | logb() | log1p() | nextafter() | remainder() |
| rint() | scalb() | | | |

__STDC_WANT_DEC_FP__

| | | | | |
|---------------|---------------|----------------|----------------|--------------|
| acosd32() | acosd64() | acosd128() | acoshd32() | acoshd64() |
| acoshd128() | asind32() | asind64() | asind128() | asinhd32() |
| asinhd64() | asinhd128() | atand32() | atand64() | atand128() |
| atan2d32() | atan2d64() | atan2d128() | atanhd32() | atanhd64() |
| atanhd128() | __atanpid32() | __atanpid64() | __atanpid128() | cbrtd32() |
| cbrtd64() | cbrtd128() | ceil32() | ceil64() | ceil128() |
| copysignd32() | copysignd64() | copysignd128() | cosd32() | cosd64() |
| cosd128() | coshd32() | coshd64() | coshd128() | __cospid32() |
| __cospid64() | __cospid128() | erfd32() | erfd64() | erfd128() |
| erfcd32() | erfcd64() | erfcd128() | expd32() | expd64() |
| expd128() | expm1d32() | expm1d64() | expm1d128() | exp2d32() |
| exp2d64() | exp2d128() | fabsd32() | fabsd64() | fabsd128() |
| fdimd32() | fdimd64() | fdimd128() | floord32() | floord64() |
| floord128() | fmad32() | fmad64() | fmad128() | fmaxd32() |
| fmaxd64() | fmaxd128() | fmind32() | fmind64() | fmind128() |
| fmodd32() | fmodd64() | fmodd128() | frexp32() | frexp64() |
| frexp128() | hypotd32() | hypotd64() | hypotd128() | ilogbd32() |

Header files

| | | | | |
|----------------|------------------|------------------|-------------------|------------------|
| ilogbd64() | ilogbd128() | ldexpd32() | ldexpd64() | ldexpd128() |
| lgammad32() | lgammad64() | lgammad128() | llrintd32() | llrintd64() |
| llrintd128() | llroundd32() | llroundd64() | llroundd128() | logd32() |
| logd64() | logd128() | log1pd32() | log1pd64() | log1pd128() |
| log2d32() | log2d64() | log2d128() | log10d32() | log10d64() |
| log10d128() | logbd32() | logbd64() | logbd128() | lrintd32() |
| lrintd64() | lrintd128() | lroundd32() | lroundd64() | lroundd128() |
| modfd32() | modfd64() | modfd128() | nand32() | nand64() |
| nand128() | nearbyintd32() | nearbyintd64() | nearbyintd128() | nextafterd32() |
| nextafterd64() | nextafterd128() | nexttowardd32() | nexttowardd64() | nexttowardd128() |
| powd32() | powd64() | powd128() | quantexpd32() | quantexpd64() |
| quantexpd128() | quantized32() | quantized64() | quantized128() | remainderd32() |
| remainderd64() | remainderd128() | __remquod32() | __remquod64() | __remquod128() |
| rintd32() | rintd64() | rintd128() | roundd32() | roundd64() |
| roundd128() | samequantumd32() | samequantumd64() | samequantumd128() | scalblnd32() |
| scalblnd64() | scalblnd128() | scalbnd32() | scalbnd64() | scalbnd128() |
| sind32() | sind64() | sind128() | sinhd32() | sinhd64() |
| sinhd128() | __sinpid32() | __sinpid64() | __sinpid128() | sqrt32() |
| sqrt64() | sqrt128() | tand32() | tand64() | tand128() |
| tanhd32() | tanhd64() | tanhd128() | tgamma32() | tgamma64() |
| tgamma128() | truncd32() | truncd64() | truncd128() | |

For C++ applications, the following functions are overloaded for `_Decimal32`, `_Decimal64`, and `_Decimal128`:

| | | | | |
|-------------|-------------|--------------|----------|------------|
| abs() | acos() | acosh() | asin() | asinh() |
| atan() | atan2() | atanh() | cbrt() | ceil() |
| copysign() | cos() | cosh() | erf() | erfc() |
| exp() | expm1() | exp2() | fabs() | fdim() |
| floor() | fma() | fmax() | fmin() | fmod() |
| frexp() | hypot() | ilogb() | ldexp() | lgamma() |
| llrint() | llround() | log() | log1p() | log2() |
| log10() | logb() | lrint() | lround() | modf() |
| nearbyint() | nextafter() | nexttoward() | pow() | quantexp() |
| remainder() | rint() | round() | scalbn() | scalbln() |
| sin() | sinh() | sqrt() | tan() | tanh() |
| tgamma() | trunc() | | | |

For example:

- `_Decimal32 ceil(_Decimal32)`
- `_Decimal64 ceil(_Decimal64)`

- `_Decimal128 ceil(_Decimal128)`

`_TR1_C99`: The following functions provide additional overloads.

| | | | | |
|---------------------------|------------------------|--------------------------|--------------------------|--------------------------|
| <code>acos()</code> | <code>acosh()</code> | <code>asin()</code> | <code>asinh()</code> | <code>atan()</code> |
| <code>atanh()</code> | <code>atan2()</code> | <code>cbrt()</code> | <code>ceil()</code> | <code>copysign()</code> |
| <code>cos()</code> | <code>cosh()</code> | <code>erf()</code> | <code>erfc()</code> | <code>exp()</code> |
| <code>exp2()</code> | <code>expm1()</code> | <code>fabs()</code> | <code>fdim()</code> | <code>floor()</code> |
| <code>fma()</code> | <code>fmax()</code> | <code>fmin()</code> | <code>fmod()</code> | <code>frexp()</code> |
| <code>hypot()</code> | <code>ilogb()</code> | <code>ldexp()</code> | <code>lgamma()</code> | <code>llrint()</code> |
| <code>llround()</code> | <code>log()</code> | <code>log10()</code> | <code>log1p()</code> | <code>log2()</code> |
| <code>logb()</code> | <code>lrint()</code> | <code>lround()</code> | <code>nearbyint()</code> | <code>nextafter()</code> |
| <code>nexttoward()</code> | <code>pow()</code> | <code>remainder()</code> | <code>remquo()</code> | <code>rint()</code> |
| <code>round()</code> | <code>scalbln()</code> | <code>scalbn()</code> | <code>sin()</code> | <code>sinh()</code> |
| <code>sqrt()</code> | <code>tan()</code> | <code>tanh()</code> | <code>tgamma()</code> | <code>trunc()</code> |

- If any argument corresponding to a double parameter has type long double, all arguments corresponding to double parameters are effectively cast to long double. The return type will be the same return type as if the 'C' long double version of the function was called.
- Otherwise, if any argument corresponding to a double parameter has type double or an integer type, all arguments corresponding to double parameters are effectively cast to double. The return type will be the same return type as if the 'C' double version of the function was called.
- Otherwise, all arguments corresponding to double parameters are effectively cast to float. The return type will be the same return type as if the 'C' float version of the function was called.

Object-like macros: Additional object-like macros provided by the `math.h` header are described.

Note: The floating point macros and the macros `INFINITY` and `NAN` are supported under IEEE only.

DEC_INFINITY

A constant expression of type `_Decimal32` representing infinity.

DEC_NAN

A quiet decimal floating NaN for the type `_Decimal32`.

HUGE_VAL_D32

A constant expression of type `_Decimal32` representing +infinity.

HUGE_VAL_D64

A constant expression of type `_Decimal64` representing +infinity.

HUGE_VAL_D128

A constant expression of type `_Decimal128` representing +infinity.

HUGE_VALF

A very large positive number that expands to a float expression

HUGE_VALL

A very large positive number that expands to a long double expression.

INFINITY

A constant expression of type float representing positive infinity.

NAN

A constant expression of type float representing a quiet NaN.

FP_INFINITE

The value of the macro `fpclassify` for an argument that is plus or minus infinity. This expands to an integer constant expression.

FP_NAN

The value of the macro `fpclassify` for an argument that is not-a-number (NaN). This expands to an integer constant expression.

FP_NORMAL

The value of the macro `fpclassify` for an argument that is finite and normalized. This expands to an integer constant expression.

FP_SUBNORMAL

The value of the macro `fpclassify` for an argument that is finite and denormalized. This expands to an integer constant expression.

FP_ZERO

The value of the macro `fpclassify` for an argument that is positive or negative. This expands to an integer constant expression.

FP_FAST_FMA

Indicates that the `fma` function generally executes about as fast as, or faster than, a multiply and an add of double operands.

FP_FAST_FMAF

This is the float version of `FP_FAST_FMA`.

FP_FAST_FMAL

This is the long double version of `FP_FAST_FMA`.

Note: Decimal floating-point does not support `FP_FAST_FMA32`, `FP_FAST_FMA64`, and `FP_FAST_FMA128`.

FP_ILOGBO

The value returned by `ilogb()` if its argument is zero.

FP_ILOGBNAN

The value returned by `ilogb()` if its argument is a NaN.

MATH_ERRNO

This is defined as value 1 (one) and is used for testing the value of the macro `math_errhandling` to determine whether a math function reports an error by storing a nonzero value in `errno`.

MATH_ERREXCEPT

This is defined as value 2 and is used for testing the value of the macro `math_errhandling` to determine whether a math function reports an error by raising an invalid floating point exception.

math_errhandling

This macro expands to an expression that has type `int` and the value `MATH_ERRNO`, `MATH_ERREXCEPT`, or the bitwise OR of both. This implementation defines this macro as `MATH_ERRNO`.

Function-like macros or C++ function templates: Additional function-like macros or C++ function templates provided by the `<math.h>` header are listed.

| | | | | |
|----------------------------|----------------------------|------------------------------|--------------------------|-------------------------------|
| <code>fpclassify()</code> | <code>isfinite()</code> | <code>ininf()</code> | <code>isgreater()</code> | <code>isgreaterequal()</code> |
| <code>isless()</code> | <code>islessequal()</code> | <code>islessgreater()</code> | <code>isnan()</code> | <code>isnormal()</code> |
| <code>isunordered()</code> | <code>signbit()</code> | | | |

The header file includes declarations for the built-in functions `abs()` and `fabs()`. For information about built-in functions, see [“Built-in functions”](#) on page 96.

The `math.h` header file declares the macro `HUGE_VAL`, which expands to a positive double constant expression, not necessarily representable as a `float`. Similarly, the macros `HUGE_VALF` and `HUGE_VALL` are respectively `float` and `long double` analogs of `HUGE_VAL`.

For all mathematical functions, a *domain error* occurs when an input argument is outside the range of values allowed for that function. If a domain error occurs, `errno` is set to the value of `EDOM`.

A range error occurs if the result of the function cannot be represented in a float, double, long double, `_Decimal32`, `_Decimal64`, or `_Decimal128` value. If the magnitude of the result is too large (overflow), the function returns the positive or negative value of the macro `HUGE_VAL`, `HUGE_VALF`, `HUGE_VALL`, `HUGE_VAL_D32`, `HUGE_VAL_D64`, or `HUGE_VAL_D128`, as applicable, and sets `errno` to `ERANGE`. If the result is too small (underflow), the function returns 0.

A pole error occurs if the function has an exact infinite result as the finite input arguments are approached in the limit (for example, `log(0.0)`). If a pole error occurs, the function sets `errno` to `ERANGE`.

`float_t` and `double_t` are floating-point types whose type depends on the value of `FLT_EVAL_METHOD`. `FLT_EVAL_METHOD` is 1 which implies both `float_t` and `double_t` are double.

Note: Decimal floating-point does not support `FP_FAST_FMAD32`, `FP_FAST_FMAD64`, and `FP_FAST_FMAD128`.

memory.h — Memory operations

The `memory.h` header file contains declarations for memory operations.

monetary.h — strfmon() function

The `monetary.h` header file contains the declaration for the `strfmon()` function.

For more information about the effect of locale, see `setlocale()`, `locale.h`, or look up the individual functions in this topic. For still more information, see "Internationalization: Locales and Character Sets" in *z/OS XL C/C++ Programming Guide*.

msgcat.h — Message catalog structures and definitions

The `msgcat.h` header file contains message catalog structures and definitions. The data structures in `msgcat.h` are not a supported programming interface.

mtf.h — Multitasking facility functions

Restriction: This header file is not supported in AMODE 64.

The `mtf.h` header file contains declarations for the multitasking facility (MTF) functions:

`tinit()` `tsched()` `tsyncro()` `tterm()`

`tsched()` is a built-in function.

This header file also contains definitions of macros for certain return values from the above functions.

This header file is supported only under z/OS C applications. The functions are *not* supported under z/OS UNIX.

_Nascii.h — Bimodal application

The `_Nascii.h` header file contains the externals for the correspondence table and functions that support bimodal application development.

ndbm.h — ndbm database operations

The `ndbm.h` header file contains definitions for ndbm database operations.

netdb.h — Network database operations

The `netdb.h` header file contains definitions for network database operations.

net/if.h — Network interface structures and definitions

The `net/if.h` header file contains network interface structures and definitions.

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The following structures are declared:

- `ifaddr`
- `ifconf`
- `ifnet`
- `ifreq`

The following macros are declared:

- `IF_ADJ`
- `IF_DEQUEUE`
- `IF_DEQUEUEIF`
- `IF_DROP`
- `IF_ENQUEUE`
- `IF_PREPEND`
- `IF_QFULL`
- `IFF_ALLMULTI`
- `IFF_BRIDGE`
- `IFF_BROADCAST`
- `IFF_CANTCHANGE`
- `IFF_CHECKSUM`
- `IFF_DEBUG`
- `IFF_LOOPBACK`
- `IFF_MULTICAST`
- `IFF_NOARP`
- `IFF_NOTRAILERS`
- `IFF_POINTOMULTIPT`
- `IFF_POINTOPOINT`
- `IFF_PROMISC`
- `IFF_RUNNING`
- `IFF_SNAP`
- `IFF_UP`
- `IFF_VIRTUAL`
- `IFNET_SLOWHZ`
- `IFQ_MAXLEN`

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The following structure is declared:

- `if_nameindex`

The following macro is declared:

- `IF_NAMESIZE`

The following functions are declared:

- `if_freenameindex`
- `if_indextoname`
- `if_nameindex`
- `if_nametoindex`

net/rtroute.h — Network routing structures and definitions

The `net/rtroute.h` header file contains network routing structures and definitions.

netinet/icmp6.h — ICMPv6 header options

The `netinet/icmp6.h` header file defines structures and constants for ICMPv6 header options.

The following structures are exposed with this header file:

- `icmp6_hdr`
- `nd_router_solicit`
- `nd_router_advert`
- `nd_neighbor_solicit`
- `nd_neighbor_advert`
- `nd_redirect`
- `nd_opt_hdr`
- `nd_opt_prefix_info`
- `nd_opt_rd_hdr`
- `nd_opt_mtu`
- `mld_hdr`
- `icmp6_router_renum`
- `rr_pco_match`
- `rr_pco_use`
- `rr_result`

The following definitions are associated with the `icmp6_hdr` structure:

- `icmp6_data32`
- `icmp6_data16`
- `icmp6_data8`
- `icmp6_pptr`
- `icmp6_mtu`
- `icmp6_id`
- `icmp6_seq`
- `icmp6_maxdelay`

The following definitions are associated with ICMPv6 Type and Code values:

- `ICMP6_DST_UNREACH`
- `ICMP6_PACKET_TOO_BIG`
- `ICMP6_TIME_EXCEEDED`
- `ICMP6_PARAM_PROB`
- `ICMP6_INFOMSG_MASK`
- `ICMP6_ECHO_REQUEST`

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- ICMP6_ECHO_REPLY
- ICMP6_DST_UNREACH_NOROUTE
- ICMP6_DST_UNREACH_ADMIN
- ICMP6_DST_UNREACH_BEYONDScope
- ICMP6_DST_UNREACH_ADDR
- ICMP6_DST_UNREACH_NOPORT
- ICMP6_TIME_EXCEED_TRANSIT
- ICMP6_TIME_EXCEED_REASSEMBLY
- ICMP6_PARAMPROB_HEADER
- ICMP6_PARAMPROB_NEXTHDR
- ICMP6_PARAMPROB_OPTION

The following definitions are associated with the `nd_router_solicit` structure:

- ND_ROUTER_SOLICIT
- `nd_rs_type`
- `nd_rs_code`
- `nd_rs_cksum`
- `nd_rs_reserved`

The following definitions are associated with the `nd_router_advert` structure:

- ND_ROUTER_ADVERT
- `nd_ra_type`
- `nd_ra_code`
- `nd_ra_cksum`
- `nd_ra_curhoplimit`
- `nd_ra_flags_reserved`
- ND_RA_FLAG_MANAGED
- ND_RA_FLAG_OTHER
- `nd_ra_router_lifetime`

The following definitions are associated with the `nd_neighbor_solicit` structure:

- ND_NEIGHBOR_SOLICIT
- `nd_ns_type`
- `nd_ns_code`
- `nd_ns_cksum`
- `nd_ns_reserved`

The following definitions are associated with the `nd_neighbor_advert` structure:

- ND_NEIGHBOR_ADVERT
- `nd_na_type`
- `nd_na_code`
- `nd_na_cksum`
- `nd_na_flags_reserved`
- ND_NA_FLAG_ROUTER
- ND_NA_FLAG_SOLICITED
- ND_NA_FLAG_OVERRIDE

The following definitions are associated with the `nd_redirect` structure:

- `ND_REDIRECT`
- `nd_rd_type`
- `nd_rd_code`
- `nd_rd_cksum`
- `nd_rd_reserved`

The following definitions are associated with the `nd_opt_hdr` structure:

- `ND_OPT_SOURCE_LINKADDR`
- `ND_OPT_TARGET_LINKADDR`
- `ND_OPT_PREFIX_INFORMATION`
- `ND_OPT_REDIRECTED_HEADER`
- `ND_OPT_MTU`

The following definitions are associated with the `nd_opt_prefix_info` structure:

- `ND_OPT_PI_FLAG_ONLINK`
- `ND_OPT_PI_FLAG_AUTO`

The following definitions are associated with the `mld_hdr` structure:

- `MLD_LISTENER_QUERY`
- `MLD_LISTENER_REPORT`
- `MLD_LISTENER_REDUCTION`
- `mld_type`
- `mld_code`
- `mld_cksum`
- `mld_maxdelay`
- `mld_reserved`

The following definitions are associated with the `icmp6_router_renum` structure:

- `ICMP6_ROUTER_RENUMBERING`
- `rr_type`
- `rr_code`
- `rr_cksum`
- `rr_seqnum`
- `ICMP6_RR_FLAGS_TEST`
- `ICMP6_RR_FLAGS_REQRESULT`
- `ICMP6_RR_FLAGS_FORCEAPPLY`
- `ICMP6_RR_FLAGS_SPECSITE`
- `ICMP6_RR_FLAGS_PREVDONE`

The following definitions are associated with the `rr_pco_match` structure:

- `RPM_PCO_ADD`
- `RPM_PCO_CHANGE`
- `RPM_PCO_SETGLOBAL`

The following definitions are associated with the `rr_pco_use` structure:

- `ICMP6_RR_PCOUSE_RAFLAGS_ONLINK`
- `ICMP6_RR_PCOUSE_RAFLAGS_AUTO`

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- ICMP6_RR_PCOUSE_FLAGS_DECRVLTIME
- ICMP6_RR_PCOUSE_FLAGS_DECRPLTIME
- nd_ns_reserved

The following definitions are associated with the `rr_result` structure:

- ICMP6_RR_RESULT_FLAGS_OOB
- ICMP6_RR_RESULT_FLAGS_FORBIDDEN

netinet/in.h — Internet protocol family

The `netinet/in.h` header file contains definitions for the internet protocol family.

The following structure definition is supported for IPv6:

- `struct ip6_mtuinfo{}`;

The following functions are supported for IPv6:

- `bind2addrsel()`
- `inet6_is_srcaddr()`
- `inet6_rth_space()`
- `inet6_rth_init()`
- `inet6_rth_add()`
- `inet6_rth_reverse()`
- `inet6_rth_segments()`
- `inet6_rth_getaddr()`
- `inet6_opt_init()`
- `inet6_opt_append()`
- `inet6_opt_finish()`
- `inet6_opt_set_val()`
- `inet6_opt_next()`
- `inet6_opt_find()`
- `inet6_opt_get_val()`

The following macros are supported for IPv6:

```
IN6_IS_ADDR_LINKLOCAL
IN6_IS_ADDR_LOOPBACK
IN6_IS_ADDR_MC_GLOBAL
IN6_IS_ADDR_MC_LINKLOCAL
IN6_IS_ADDR_MC_NODELOCAL
IN6_IS_ADDR_MC_ORGLOCAL
IN6_IS_ADDR_MC_SITELOCAL
IN6_IS_ADDR_MULTICAST
IN6_IS_ADDR_SITELOCAL
IN6_IS_ADDR_UNSPECIFIED
IN6_IS_ADDR_V4COMPAT
IN6_IS_ADDR_V4MAPPED
```

Structures:

```
struct ip_mreq{
    struct in_addr imr_multiaddr;
    struct in_addr imr_interface;
};
```

Socket options:

- MCAST_INCLUDE
- MCAST_EXCLUDE
- IP_BLOCK_SOURCE
- IP_UNBLOCK_SOURCE
- IP_ADD_SOURCE_MEMBERSHIP
- IP_DROP_SOURCE_MEMBERSHIP
- IPV6_ADDR_PREFERENCES
- MCAST_JOIN_GROUP
- MCAST_LEAVE_GROUP
- MCAST_BLOCK_SOURCE
- MCAST_UNBLOCK_SOURCE
- MCAST_JOIN_SOURCE_GROUP
- MCAST_LEAVE_SOURCE_GROUP

Structure: Multicast filter support is accessed by defining feature test macro `_OPEN_SYS_SOCKET_EXT3`. The feature test also exposes symbols in `sys/socket.h`.

```
struct ip_mreq{}
struct ip_mreq_source {};
struct group_req {};
struct group_source_req {};
setipv4sourcefilter()
getipv4sourcefilter()
setsourcefilter()
getsourcefilter()
```

netinet/ip6.h — IPv6 header options

The `netinet/ip6.h` header file defines structures and constants for IPv6 header options.

The following structures are exposed with this header file:

- `ip6_hdr`
- `ip6_hbh`
- `ip6_dest`
- `ip6_rthdr`
- `ip6_rthdr0`
- `ip6_frag`
- `ip6_opt`
- `ip6_opt_jumbo`
- `ip6_opt_nsap`
- `ip6_opt_tunnel`
- `ip6_opt_router`

The following definitions are associated with the `ip6_hdr` structure:

- `ip6_vcf`
- `ip6_flow`
- `ip6_plen`
- `ip6_nxt`
- `ip6_hlim`

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- `ip6_hops`
- `ip6_src`
- `ip6_dst`

The following definitions are associated with the extension header structure:

- `IP6F_OFF_MASK`
- `IP6F_RESERVED_MASK`
- `IP6F_MORE_FRAG`

The following definitions are associated with the option header structure:

- `IP6OPT_TYPE`
- `IP6OPT_TYPE_SKIP`
- `IP6OPT_TYPE_DISCARD`
- `IP6OPT_TYPE_FORCEICMP`
- `IP6OPT_TYPE_ICMP`
- `IP6OPT_MUTABLE`
- `IP6OPT_PAD1`
- `IP6OPT_PADN`
- `IP6OPT_JUMBO`
- `IP6OPT_NSAP_ADDR`
- `IP6OPT_TUNNEL_LIMIT`
- `IP6OPT_ROUTER_ALERT`
- `IP6OPT_JUMBO_LEN`
- `IP6_ALERT_MLD`
- `IP6_ALERT_RSVP`
- `IP6_ALERT_AN`

netinet/tcp.h — Internet Transmission Control Protocol

The `netinet/tcp.h` header contains definitions for the Internet Transmission Control Protocol (TCP).

nlist.h — nlist() function

The `nlist.h` header file declares the `nlist()` function.

nl_types.h — National languages

The `nl_types.h` header file defines the following types:

| | |
|----------------------|---|
| <code>nl_item</code> | int used as manifest constant by <code>nl_langinfo()</code> |
| <code>nl_catd</code> | pointer to a catalog descriptor structure |

The header also contains these constants:

| | |
|----------------------|----------------------------|
| <code>NL_SETD</code> | <code>NL_CAT_LOCALE</code> |
|----------------------|----------------------------|

The following functions are prototyped:

| | | |
|-------------------------|------------------------|------------------------|
| <code>catclose()</code> | <code>catgets()</code> | <code>catopen()</code> |
|-------------------------|------------------------|------------------------|

No feature test macro is required for `nl_item`.

To expose the other definitions in this header, compile with the `_XOPEN_SOURCE` feature test macro defined.

For more information about the effect of locale, see `setlocale()`, `locale.h`, or look up the individual functions in this topic. For more information, see "Internationalization: Locales and Character Sets" in *z/OS XL C/C++ Programming Guide*.

poll.h — poll() function

The `poll.h` header file contains definitions for the `poll()` function.

pthread.h — Thread interfaces

The `pthread.h` header file contains function declarations and mappings for threading interfaces and defines a number of constants used by those functions. The header includes the `sched.h` header. When `_UNIX03_THREADS` is defined, `pthread.h` also includes the `time.h` header. For `_OPEN_THREADS` applications, `pthread.h` defines the `timespec` and `timespec64` structures.

There is a lot of overlap in the namespaces identified by the `_OPEN_THREADS` and `_UNIX03_THREADS` feature test macros. There are, however, behavioral differences between functions of the same name exposed by `_OPEN_THREADS` (POSIX.4a Draft 6) and by `_UNIX03_THREADS` (Single UNIX Specification, Version 3). See the individual function descriptions for specific details.

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| | |
|---|--|
| <code>pthread_attr_destroy()</code> | <code>pthread_attr_getdetachstate()</code> |
| <code>pthread_attr_getstacksize()</code> | <code>pthread_attr_init()</code> |
| <code>pthread_attr_setdetachstate()</code> | <code>pthread_attr_setstacksize()</code> |
| <code>pthread_cancel()</code> | <code>pthread_cleanup_pop()</code> |
| <code>pthread_cleanup_push()</code> | <code>pthread_condattr_destroy()</code> |
| <code>pthread_condattr_init()</code> | <code>pthread_cond_broadcast()</code> |
| <code>pthread_cond_destroy()</code> | <code>pthread_cond_init()</code> |
| <code>pthread_cond_signal()</code> | <code>pthread_cond_timedwait()</code> |
| <code>pthread_cond_timedwait64()</code> | <code>pthread_cond_wait()</code> |
| <code>pthread_create()</code> | <code>pthread_detach()</code> |
| <code>pthread_equal()</code> | <code>pthread_exit()</code> |
| <code>pthread_getspecific()</code> | <code>pthread_join()</code> |
| <code>pthread_key_create()</code> | <code>pthread_kill()</code> |
| <code>pthread_mutexattr_destroy()</code> | <code>pthread_mutexattr_getpshared()</code> |
| <code>pthread_mutexattr_gettype()</code> | <code>pthread_mutexattr_init()</code> |
| <code>pthread_mutexattr_setpshared()</code> | <code>pthread_mutexattr_settype()</code> |
| <code>pthread_mutex_destroy()</code> | <code>pthread_mutex_init()</code> |
| <code>pthread_mutex_lock()</code> | <code>pthread_mutex_trylock()</code> |
| <code>pthread_mutex_unlock()</code> | <code>pthread_once()</code> |
| <code>pthread_rwlockattr_destroy()</code> | <code>pthread_rwlockattr_getpshared()</code> |
| <code>pthread_rwlockattr_init()</code> | <code>pthread_rwlockattr_setpshared()</code> |
| <code>pthread_rwlock_destroy()</code> | <code>pthread_rwlock_init()</code> |
| <code>pthread_rwlock_rdlock()</code> | <code>pthread_rwlock_tryrdlock()</code> |

Header files

pthread_rwlock_trywrlock()
pthread_self()
pthread_setintrtype()
pthread_testintr()
pthread_yield()

_OPEN_THREADS 2

pthread_getconcurrency()
pthread_setcancelstate()
pthread_setconcurrency()

_OPEN_THREADS 3

pthread_atfork()
pthread_attr_getguardsize()
pthread_attr_getschedparam()
pthread_attr_getstack()
pthread_attr_getstackaddr()

_UNIX03_THREADS

pthread_atfork()
pthread_attr_destroy()
pthread_attr_getdetachstate()
pthread_attr_getguardsize()
pthread_attr_getschedparam()
pthread_attr_getstack()
pthread_attr_getstackaddr()
pthread_attr_getstacksize()
pthread_attr_init()
pthread_attr_setdetachstate()
pthread_attr_setguardsize()
pthread_attr_setschedparam()
pthread_attr_setstack()
pthread_attr_setstackaddr()
pthread_attr_setstacksize()
pthread_cancel()
pthread_cleanup_pop()
pthread_cleanup_push()
pthread_cond_broadcast()
pthread_cond_destroy()
pthread_cond_init()

pthread_rwlock_unlock()
pthread_setintr()
pthread_setspecific()
pthread_tag_np()

pthread_key_delete()
pthread_setcanceltype()
pthread_testcancel()

pthread_attr_setguardsize()
pthread_attr_setschedparam()
pthread_attr_setstack()
pthread_attr_setstackaddr()

pthread_getspecific()
pthread_join()
pthread_key_create()
pthread_key_delete()
pthread_mutex_destroy()
pthread_mutex_init()
pthread_mutex_lock()
pthread_mutex_trylock()
pthread_mutex_unlock()
pthread_mutexattr_destroy()
pthread_mutexattr_getpshared()
pthread_mutexattr_gettype()
pthread_mutexattr_init()
pthread_mutexattr_setpshared()
pthread_mutexattr_settype()
pthread_once()
pthread_rwlock_destroy()
pthread_rwlock_init()
pthread_rwlock_rdlock()
pthread_rwlock_tryrdlock()
pthread_rwlock_trywrlock()

| | |
|--|---|
| <code>pthread_cond_signal()</code> | <code>pthread_rwlock_unlock()</code> |
| <code>pthread_cond_timedwait()</code> | <code>pthread_cond_timedwait64()</code> |
| <code>pthread_rwlock_wrlock()</code> | <code>pthread_cond_wait()</code> |
| <code>pthread_rwlockattr_destroy()</code> | <code>pthread_condattr_destroy()</code> |
| <code>pthread_rwlockattr_getpshared()</code> | <code>pthread_condattr_getpshared()</code> |
| <code>pthread_rwlockattr_init()</code> | <code>pthread_condattr_init()</code> |
| <code>pthread_rwlockattr_setpshared()</code> | <code>pthread_condattr_setpshared()</code> |
| <code>pthread_self()</code> | <code>pthread_create()</code> |
| <code>pthread_setcancelstate()</code> | <code>pthread_detach()</code> |
| <code>pthread_setcanceltype()</code> | <code>pthread_equal()</code> |
| <code>pthread_setconcurrency()</code> | <code>pthread_exit()</code> |
| <code>pthread_setspecific()</code> | <code>pthread_getconcurrency()</code> |
| <code>pthread_testcancel()</code> | |
| | |
| <code>PTHREAD_CANCEL_ASYNCHRONOUS</code> | <code>PTHREAD_MUTEX_DEFAULT</code> |
| <code>PTHREAD_CANCEL_DEFERRED</code> | <code>PTHREAD_MUTEX_ERRORCHECK</code> |
| <code>PTHREAD_CANCEL_DISABLE</code> | <code>PTHREAD_MUTEX_INITIALIZER</code> |
| <code>PTHREAD_CANCEL_ENABLE</code> | <code>PTHREAD_MUTEX_NORMAL</code> |
| <code>PTHREAD_CANCELED</code> | <code>PTHREAD_MUTEX_RECURSIVE</code> |
| <code>PTHREAD_COND_INITIALIZER</code> | <code>PTHREAD_ONCE_INIT</code> |
| <code>PTHREAD_CREATE_DETACHED</code> | <code>PTHREAD_PROCESS_PRIVATE</code> |
| <code>PTHREAD_CREATE_JOINABLE</code> | <code>PTHREAD_PROCESS_SHARED</code> |
| <code>PTHREAD_EXPLICIT_SCHED</code> | <code>PTHREAD_RWLOCK_INITIALIZER_NP</code> |
| <code>PTHREAD_INHERIT_SCHED</code> | |
| | |
| <code>_OPEN_SYS</code> | |
| <code>pthread_attr_getsynctype_np()</code> | <code>pthread_attr_getweight_np()</code> |
| <code>pthread_attr_setsynctype_np()</code> | <code>pthread_attr_setweight_np()</code> |
| <code>pthread_condattr_getkind_np()</code> | <code>pthread_condattr_setkind_np()</code> |
| <code>pthread_join_d4_np()</code> | <code>pthread_mutexattr_getkind_np()</code> |
| <code>pthread_mutexattr_setkind_np()</code> | <code>pthread_security_np()</code> |
| <code>pthread_set_limit_np()</code> | <code>pthread_tag_np()</code> |
| | |
| <code>_OPEN_SYS_MUTEX_EXT</code> | |
| <code>pthread_condattr_getpshared()</code> | <code>pthread_condattr_setpshared()</code> |

The `pthread.h` header defines the following constants:

| | |
|------------------------------|-------------------------------|
| <code>__COND_DEFAULT</code> | <code>__COND_NODEBUG</code> |
| <code>__DETACHED</code> | <code>__HEAVY_WEIGHT</code> |
| <code>__MEDIUM_WEIGHT</code> | <code>__MUTEX_NODEBXXG</code> |

Header files

| | |
|--------------------------------------|--|
| <code>__MUTEX_NONRECURSIVE</code> | <code>__MUTEX_RECURSIVE</code> |
| <code>__UNDETACHED</code> | <code>NO_PRIO_INHERIT</code> |
| <code>PRIO_INHERIT</code> | <code>PTHREAD_DEFAULT_SCHED</code> |
| <code>PTHREAD_INHERIT_SCHED</code> | <code>PTHREAD_INTR_ASYNCHRONOUS</code> |
| <code>PTHREAD_INTR_CONTROLLED</code> | <code>PTHREAD_INTR_DISABLE</code> |
| <code>PTHREAD_INTR_ENABLE</code> | <code>PTHREAD_ONCE_INIT</code> |
| <code>PTHREAD_PROCESS_PRIVATE</code> | <code>PTHREAD_PROCESS_SHARED</code> |
| <code>PTHREAD_SCOPE_GLOBAL</code> | <code>PTHREAD_SCOPE_LOCAL</code> |
| <code>SCHED_FIFO</code> | <code>SCHED_OTHER</code> |
| <code>SCHED_RR</code> | <code>PRIO_PROTECT</code> |

Furthermore, `pthread.h` defines these macros:

| | |
|--------------------------------------|--|
| <code>PTHREAD_MUTEX_DEFAULT</code> | <code>PTHREAD_MUTEX_ERRORCHECK</code> |
| <code>PTHREAD_MUTEX_NORMAL</code> | <code>PTHREAD_MUTEX_INITIALIZER</code> |
| <code>PTHREAD_MUTEX_RECURSIVE</code> | <code>PTHREAD_RWLOCK_INITIALIZER</code> |
| <code>__THDQ_LENGTH</code> | |
| <code>_OPEN_THREADS 2</code> | |
| <code>PTHREAD_CANCEL_ENABLE</code> | <code>PTHREAD_CANCEL_DISABLE</code> |
| <code>PTHREAD_CANCEL_DEFERRED</code> | <code>PTHREAD_CANCEL_ASYNCHRONOUS</code> |

pwd.h — Access user database through password structure

The `pwd.h` header file declares functions that access the user database through a password structure. The header file also defines the `passwd` structure.

```
_POSIX_SOURCE

getpwnam()                getpwuid()

_XOPEN_SOURCE_EXTENDED 1

endpwent()                getpwent()                setpwent()

_XPLATFORM_SOURCE 1

getpwent_r()
```

re_comp.h — Regular expression matching functions for re_comp()

The `re_comp.h` header file contains regular expression matching functions for `re_comp()`.

Note:

This header is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use `regcomp()`, `regexexec()`, `regerror()` and `regfree()` functions and the header, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001 Regular Expressions.

Applications conforming to Single UNIX Specification, Version 3 must not include the `<re_comp.h>` header file.

regex.h — Regular expression functions

The `regex.h` header file contains definitions for the following regular expression functions.

`regcomp()` `regerror()` `regexexec()` `regfree()`

The `regex.h` header file declares the `regex_t` type, which can store a compiled regular expression.

The `regex.h` header file declares the following macros:

- Values of the *cflags* parameter of the `regcomp()` function: `REG_EXTENDED`, `REG_ICASE`, `REG_NEWLINE`, `REG_NOSUB`
- Values of the *eflags* parameter of the `regexexec()` function: `REG_NOTBOL`, `REG_NOTEOL`
- Values of the *errcode* parameter of the `regerror()` function: `REG_*`.

regexp.h — Regular expression declarations

The `regexp.h` header file contains regular expression declarations.

Note:

This header is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use `regcomp()`, `regexexec()`, `regerror()` and `regfree()` functions and the header, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001 Regular Expressions.

Applications conforming to Single UNIX Specification, Version 3 must not include the `<regexp.h>` header file.

resolv.h — IP Address Resolution

The `resolv.h` header file contains the `__res_state` structure and the definitions to support the IP Address Resolution functions commonly called the Resolver. It contains the prototypes for the following functions — `dn_comp()`, `dn_expand()`, `dn_find()`, `dn_skipname()`, `res_init()`, `res_mkquery()`, `res_query()`, `res_querydomain()`, `res_search()`, and `res_send()` — which are used to communicate with a Domain Name Server (DNS).

rexec.h — rexec() and rexec_af() functions

The `rexec.h` header file declares the `rexec()` and `rexec_af()` functions.

sched.h — Manipulate and examine process execution scheduling

The `sched.h` header file declares functions to manipulate and examine process execution scheduling.

`_UNIX03_SOURCE`

`sched_yield()`

`_XPLATFORM_SOURCE`

`clone()`

`setns()`

`unshare()`

When compiled with SUSV3 thread support (`_UNIX03_THREADS` or `_XOPEN_SOURCE 600`), `sched.h` defines the following symbols:

`SCHED_FIFO`

`SCHED_OTHER`

`SCHED_RR`

and the `sched_param` structure.

search.h — Searching tables

The `search.h` header file contains definitions for searching tables.

setjmp.h — Manipulate program state

The `setjmp.h` header file contains function declarations for `longjmp()` and `setjmp()`, which use the system stack to affect the program state. It also defines one buffer type `jmp_buf`, which the `setjmp()` and `longjmp()` functions use to save and restore the program state.

_POSIX_SOURCE: `setjmp.h` declares the functions `siglongjmp()` and `sigsetjmp()` and defines a buffer type `sigjmp_buf` that is used by `siglongjmp()` and `sigsetjmp()`.

Notes: If strict standard conformance is needed:

- `__STRICT_ANSI_C__` declares the macro `setjmp`.
- `__STRICT_POSIX__` declares the macro `sigsetjmp`.

_XOPEN_SOURCE_EXTENDED 1: `setjmp.h` declares the functions `_longjmp()` and `_setjmp()`.

signal.h — Exception handling

The `signal.h` header file defines the following values.

- Functions:

| | |
|----------------------|-----------------------|
| <code>raise()</code> | <code>signal()</code> |
|----------------------|-----------------------|

- Macros:

| | | | |
|----------------------|----------------------|----------------------|--------------------------|
| <code>SIG_DFL</code> | <code>SIG_ERR</code> | <code>SIG_IGN</code> | <code>SIG_PROMOTE</code> |
|----------------------|----------------------|----------------------|--------------------------|

- Signals:

| | | | | |
|-----------------------|----------------------|----------------------|----------------------|----------------------|
| <code>SIGABND</code> | <code>SIGABRT</code> | <code>SIGFPE</code> | <code>SIGILL</code> | <code>SIGINT</code> |
| <code>SIGIOERR</code> | <code>SIGSEGV</code> | <code>SIGTERM</code> | <code>SIGUSR1</code> | <code>SIGUSR2</code> |

- The type `sig_atomic_t`, which is the largest integer type the processor can load or store automatically in the presence of asynchronous interrupts.

The following functions are supported only in a POSIX program. You must specify the `POSIX(ON)` runtime option for these functions.

| | | | | |
|----------------------------|---------------------------|-------------------------------|---------------------------|----------------------------|
| <code>kill()</code> | <code>sigaction()</code> | <code>__sigactionset()</code> | <code>sigaddset()</code> | <code>sigdelset()</code> |
| <code>sigemptyset()</code> | <code>sigfillset()</code> | <code>sigismember()</code> | <code>siglongjmp()</code> | <code>sigpending()</code> |
| <code>sigprocmask()</code> | <code>sigsuspend()</code> | <code>sigtimedwait()</code> | <code>sigwait()</code> | <code>sigwaitinfo()</code> |

The following values are available in z/OS UNIX only:

- Signals:

| | | | | |
|----------------------|------------------------|------------------------|-----------------------|------------------------|
| <code>SIGALRM</code> | <code>SIGCHLD</code> | <code>SIGCLD</code> | <code>SIGCONT</code> | <code>SIGDSIOER</code> |
| <code>SIGHUP</code> | <code>SIGIO</code> | <code>SIGKILL</code> | <code>SIGPIPE</code> | <code>SIGQUIT</code> |
| <code>SIGSTOP</code> | <code>SIGTHCONT</code> | <code>SIGTHSTOP</code> | <code>SIGTRACE</code> | <code>SIGTRAP</code> |
| <code>SIGTSTP</code> | <code>SIGTTIN</code> | <code>SIGTTOU</code> | | |

- The structures `sigaction`, `__sigactionset_t`, `__sigactionset_s`, `sigset_t`, and `pid_t`.
- *options* arguments for `sigprocmask()`: `SIG_BLOCK`, `SIG_UNBLOCK`, and `SIG_SETMASK`.
- Flags for the `sa_flags` field, available in z/OS UNIX only: `SA_NOCLDSTOP` and `_SA_OLD_STYLE`.

`_POSIX_C_SOURCE 200809L`

- Functions :

psignal()

_XOPEN_SOURCE_EXTENDED 1:

- Signals:

| | | | | |
|---------|---------|-----------|----------|--------|
| SIGBUS | SIGPOLL | SIGPROF | SIGSYS | SIGURG |
| SIGXCPU | SIGXFSZ | SIGVTALRM | SIGWINCH | |

- Functions:

| | | | | |
|----------------|------------|---------------|-----------|-------------|
| bsd_signal() | killpg() | sigaltstack() | sighold() | sigignore() |
| siginterrupt() | sigpause() | sigrelse() | sigset() | sigstack() |

Note: `bsd_signal()` has been marked obsolescent in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `sigaction()` function is preferred for portability.

_OPEN_THREADS 2:

- Functions:

pthread_sigmask()

_UNIX03_THREADS:

- pthread_kill()

spawn.h — spawn() constants and inheritance structure

The `spawn.h` header file contains `spawn()` constants and inheritance structure.

spc.h — System library functions and storage allocation

Restriction: This header file is not supported in AMODE 64.

This header file is supported only for z/OS C applications.

The `spc.h` header file contains declarations for the functions available in the system programming environment, as described in “using the System Programming C Facility” in [z/OS XL C/C++ Programming Guide](#). The functions are:

| | | | | |
|-----------|-----------|------------|------------|-----------|
| edcxregs | edcxusr | edcxusr2 | __xhotc() | __xhotl() |
| __xhott() | __xhotu() | __xregs() | __xsacc() | __xsrvc() |
| __xusr() | __xusr2() | __24malc() | __4kmalc() | |

The `spc.h` header file also declares these functions, used for the allocation of storage and writing of strings, (which are described in [Chapter 3, “Library functions,”](#) on page 91):

| | | | | |
|----------|--------|----------|-----------|-----------|
| calloc() | free() | malloc() | realloc() | sprintf() |
|----------|--------|----------|-----------|-----------|

stdalign.h — Alignment

The `stdalign.h` header file defines macros that are associated with alignment, which is introduced in the C11 (ISO/IEC 9899:2011) standard:

| | | | |
|---------|---------|----------------------|----------------------|
| alignas | alignof | __alignas_is_defined | __alignof_is_defined |
|---------|---------|----------------------|----------------------|

stdarg.h — Access arguments in functions with variable-length argument lists

The `stdarg.h` header file defines macros used to access arguments in functions with variable-length argument lists:

`va_arg()` `va_copy()` `va_start()` `va_end()`

The `stdarg.h` header file also defines the structure `va_list`.

stdbool.h — Macros for bool type

The `<stdbool.h>` header defines the following macros:

bool

expands to `_Bool`

__bool_true_false_are_defined

expands to `1`

false

expands to `0`

true

expands to `1`

Restriction: This header is not supported for C++ applications.

stddef.h — typedef statements

The `stddef.h` header file contains definitions of the commonly used pointers, variables, and types, from the typedef statements, as listed below:

ptrdiff_t

The signed long type of the result of subtracting two pointers.

size_t

typedef for the type of the value returned by `sizeof`.

wchar_t

typedef for a wide-character constant.

max_align_t

An object type whose alignment is as great as is supported in all contexts.

`stddef.h` defines the macros `NULL` and `offsetof`. `NULL` is a pointer that never points to a data object. The `offsetof` macro expands to the number of bytes between a structure member and the start of the structure. The `offsetof` macro has the form `offsetof(structure_type, member)`

stddef.h — typedef statements

The `stddef.h` header file contains the same information as found in `<stddef.h>`.

stdint.h — Integer types

The `stdint.h` header defines integer types, limits of specified width integer types, limits of other integer types and macros for integer constant expressions.

Note: For the exact width integer types, minimum width integer types and limits of specified width integer types we support *bit sizes* *N* with the values 8, 16, 32, and 64.

The following exact width integer types are defined.

- `intN_t`

- `uintN_t`

The following minimum-width integer types are defined.

- `int_leastN_t`
- `uint_leastN_t`

The following fastest minimum-width integer types are defined. These types are the fastest to operate with among all integer types that have at least the specified width.

- `int_fastN_t`
- `uint_fastN_t`

The following greatest-width integer types are defined. These types hold the value of any signed/unsigned integer type.

Note: Requires long long to be available.

- `intmax_t`
- `uintmax_t`

The following integer types capable of holding object pointers are defined.

- `intptr_t`
- `uintptr_t`

Object-like macros for limits of integer types: Additional object-like macros provided by the `stdint.h` header are described.

Note: For the exact width integer limits, minimum width integer limits and limits of specified width integer types we support *bit sizes* N with the values 8, 16, 32, and 64.

Macros for limits of exact width integer types:

- `INTN_MAX`
- `INTN_MIN`
- `UINTN_MAX`

Macros for limits of minimum width integer types:

- `INT_LEASTN_MAX`
- `INT_LEASTN_MIN`
- `UINT_LEASTN_MAX`

Macros for limits of fastest minimum width integer types:

- `INT_FASTN_MAX`
- `INT_FASTN_MIN`
- `UINT_FASTN_MAX`

Macros for limits of greatest width integer types:

Note: Requires long long to be available.

- `INTMAX_MAX`
- `INTMAX_MIN`
- `UINTMAX_MAX`

Macros for limits of pointer integer types:

- `INTPTR_MAX`
- `INTPTR_MIN`
- `UINTPTR_MAX`

Header files

Macros for limits of ptrdiff_t:

- PTRDIFF_MAX
- PTRDIFF_MIN

Macros for limits of sig_atomic_t:

- SIG_ATOMIC_MAX
- SIG_ATOMIC_MIN

Macro for limit of size_t:

- SIZE_MAX

Macros for limits of wchar_t:

- WCHAR_MAX
- WCHAR_MIN

Macros for limits of wint_t:

- WINT_MAX
- WINT_MIN

Function-like macros for integer constants: Additional function-like macros provided by the stdint.h header are described.

Note: For the following macro for minimum width integer constants, we support *bit sizes* *N* with the values 8, 16, 32, and 64.

Macros for minimum width integer constants:

- INTN_C(value)
- UINTN_C(value)

Example:

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>

int main(void)
{
    uint32_t a = UINT32_C(1234);
    printf("%u\n", a );
}

Output
1234
```

Example of how the compiler expands the macro:

```
|    uint32_t a = UINT32_C(1234);
+    uint32_t a = 1234U;
```

Macros for greatest width integer constants:

Note: Requires long long to be available.

- INTMAX_C(value)
- UINTMAX_C(value)

Example:

```
/* long long required */
#define _ISOC99_SOURCE
#include <inttypes.h>
```



```
#include <stdio.h>

int main(void)
{
    intmax_t a = INTMAX_C(45268724);
    printf("%jd\n", a );
}

Output

45268724
```

Example of how the compiler expands the macro with the LP64 compiler option:

```
| intmax_t a = INTMAX_C(45268724);
+ intmax_t a = 45268724L;
```

Otherwise the compiler expands to:

```
| intmax_t a = INTMAX_C(45268724);
+ intmax_t a = 45268724LL;
```

stdio.h — Standard input and output

The `stdio.h` header file declares functions that deal with standard input and output. One of these functions, `fdopen()`, is supported only in a POSIX program.

The `stdio.h` header file also declares these functions:

| | | | | |
|--------------------------|--------------------------|-------------------------|------------------------|-------------------------|
| <code>asprintf()</code> | <code>clearerr()</code> | <code>clrmemf()</code> | <code>dprintf()</code> | <code>fclose()</code> |
| <code>fdelrec()</code> | <code>feof()</code> | <code>ferror()</code> | <code>fflush()</code> | <code>fgetc()</code> |
| <code>fgetpos()</code> | <code>fgets()</code> | <code>fldata()</code> | <code>flocate()</code> | <code>fopen()</code> |
| <code>fprintf()</code> | <code>fputc()</code> | <code>fputs()</code> | <code>fread()</code> | <code>freopen()</code> |
| <code>fscanf()</code> | <code>fseek()</code> | <code>fseeko()</code> | <code>fsetpos()</code> | <code>ftell()</code> |
| <code>ftello()</code> | <code>fupdate()</code> | <code>fwrite()</code> | <code>getc()</code> | <code>getchar()</code> |
| <code>getline()</code> | <code>gets()</code> | <code>perror()</code> | <code>printf()</code> | <code>putchar()</code> |
| <code>putc()</code> | <code>puts()</code> | <code>remove()</code> | <code>rename()</code> | <code>renameat()</code> |
| <code>renameat2()</code> | <code>rewind()</code> | <code>scanf()</code> | <code>setbuf()</code> | <code>setvbuf()</code> |
| <code>sprintf()</code> | <code>sscanf()</code> | <code>svc99()</code> | <code>tmpfile()</code> | <code>tmpnam()</code> |
| <code>ungetc()</code> | <code>vasprintf()</code> | <code>vfprintf()</code> | <code>vprintf()</code> | <code>vsprintf()</code> |

Defined types in stdio.h

The `FILE` type is defined in `stdio.h`. Stream functions use a pointer to the `FILE` type to get access to a given stream. The system uses the information in the `FILE` structure to maintain the stream. The C standard streams `stdin`, `stdout`, and `stderr` are also defined in `stdio.h`.

The type `fpos_t` is defined in `stdio.h` for use with `fgetpos()` and `fsetpos()`.

The types `__S99parms`, `__S99rbx_t`, and `__S99empaarms_t` are defined in `stdio.h` for use with the `svc99()` function.

The type `fldata_t` is defined in `stdio.h` for use with the `fldata()` function.

The types `__amrc_type` and `__amrc2_type` are defined in `stdio.h` for use in determining error information when I/O functions fail.

Macros defined in stdio.h

You can use these macros as constants in your programs, but you should not alter their values.

BUFSIZ

Specifies the buffer size to be used by the `setbuf()` library function when you are allocating buffers for stream I/O. This value is the expected size of the user's buffer supplied to `setbuf()`. If a larger buffer is required, for example, if *blocksize* is larger than BUFSIZ, or if special buffer attributes are required, IBM z/OS C/C++ applications will not use the user's buffer.

EOF

The value returned by an I/O function when the End Of File (EOF) (or in some cases, an error) is found.

FOPEN_MAX

The maximum number of files that can be open simultaneously.

FILENAME_MAX

The maximum number of characters in a filename. Can be used in the size specification of an array (for example, to hold the filename returned by `fldata()`).

L_tmpnam

The size of the longest temporary name that can be generated by the `tmpnam()` function.

L_ctermid

Maximum size of a character array for `ctermid()` output. This macro is supported only in a POSIX program.

NULL

A pointer which never points to a data object.

TMP_MAX

The minimum number of unique file names that can be generated by the `tmpnam()` function.

The macros `SEEK_CUR`, `SEEK_END`, and `SEEK_SET` expand to integral constant expressions and can be used as the third argument to `fseek()`.

The macros `_IOFBF`, `_IOLBF`, and `_IONBF` expand to integral constant expressions with distinct values suitable for use as the third argument to the `setvbuf()` function.

The following macros expand to integer constant expressions suitable for interpreting values returned by `fldata()`, in the `fldata_t` structure.

| | | | |
|---------------------------|-----------------------|--------------------------|-------------------------|
| <code>__APPEND</code> | <code>__BINARY</code> | <code>__BLOCKED</code> | <code>__DISK</code> |
| <code>__DUMMY</code> | <code>__ESDS</code> | <code>__ESDS_PATH</code> | <code>__HFS</code> |
| <code>__HIPERSPACE</code> | <code>__KSDS</code> | <code>__KSDS_PATH</code> | <code>__MEMORY</code> |
| <code>__MSGFILE</code> | <code>__NORLS</code> | <code>__NOTVSAM</code> | <code>__OTHER</code> |
| <code>__PRINTER</code> | <code>__READ</code> | <code>__RECORD</code> | <code>__RLS</code> |
| <code>__RSDS</code> | <code>__TAPE</code> | <code>__TDQ</code> | <code>__TERMINAL</code> |
| <code>__TEXT</code> | <code>__UPDATE</code> | <code>__WRITE</code> | |

The following macros expand to integral constant expressions suitable for use as the fourth argument to the `flocate()` function.

| | | | |
|-------------------------|---------------------------|---------------------------|-----------------------|
| <code>__KEY_EQ</code> | <code>__KEY_EQ_BWD</code> | <code>__KEY_FIRST</code> | <code>__KEY_GE</code> |
| <code>__KEY_LAST</code> | <code>__RBA_EQ</code> | <code>__RBA_EQ_BWD</code> | |

The following macros expand to integral constant expressions suitable for use as the argument to the function `clrmemf()`.

__CURRENT __CURRENT_LOWER __LOWER

The following macros expand to integral constant expressions suitable for use to determine the last operation reported in the `__amrc_type` structure. All these macros are described in [z/OS XL C/C++ Programming Guide](#).

| | | |
|-------------------|-----------------------|----------------------|
| __BSAM_BDL | __BSAM_CLOSE | __BSAM_CLOSE_T |
| __BSAM_NOTE | __BSAM_OPEN | __BSAM_POINT |
| __BSAM_READ | __BSAM_STOW | __BSAM_WRITE |
| __C_CANNOT_EXTEND | __C_DBCS_SI_TRUNCATE | __C_DBCS_SO_TRUNCATE |
| __C_DBCS_TRUNCATE | __C_DBCS_UNEVEN | __C_FCB_CHECK |
| __C_TRUNCATE | __CELMSGF_WRITE | __CICS_WRITEQ_TD |
| __HSP_CREATE | __HSP_DELETE | __HSP_EXTEND |
| __HSP_READ | __HSP_WRITE | __INTERCEPT_READ |
| __INTERCEPT_WRITE | __IO_CATALOG | __IO_DEVTYPE |
| __IO_INIT | __IO_LOCATE | __IO_OBTAIN |
| __IO_RDJFCB | __IO_RENAME | __IO_SCRATCH |
| __IO_TRKCALC | __IO_UNCATALOG | __LFS_CLOSE |
| __LFS_FSTAT | __LFS_LSEEK | __LFS_OPEN |
| __LFS_READ | __LFS_WRITE | __NOSEEK_REWIND |
| __OS_CLOSE | __OS_OPEN | __QSAM_FREEPOOL |
| __QSAM_GET | __QSAM_PUT | __QSAM_RELSE |
| __QSAM_TRUNC | __SVC99_ALLOC | __SVC99_ALLOC_NEW |
| __SVC99_UNALLOC | __TGET_READ | __TPUT_WRITE |
| __VSAM_CLOSE | __VSAM_ENDREQ | __VSAM_ERASE |
| __VSAM_GENCB | __VSAM_GET | __VSAM_MODCB |
| __VSAM_OPEN_ESDS | __VSAM_OPEN_ESDS_PATH | __VSAM_OPEN_FAIL |
| __VSAM_OPEN_KSDS | __VSAM_OPEN_KSDS_PATH | __VSAM_OPEN_RRDS |
| __VSAM_POINT | __VSAM_PUT | __VSAM_SHOWCB |
| __VSAM_TESTCB | | |

stdio_ext.h — stdio extensions

The `stdio_ext.h` header file contains prototypes and related definitions for the set of stdio extensions that allows access to the internal portions of the `FILE` structure.

stdlib.h — Standard library functions

The `stdlib.h` header file contains declarations for the following functions:

| | | | | |
|-----------------------------------|-------------------------------------|--------------------------------------|---------------------------------------|-----------------------------------|
| <code>abort()</code> | <code>abs()</code> ^[1,3] | <code>aligned_alloc()</code> | <code>alloca()</code> ^[1] | <code>atexit()</code> |
| <code>atof()</code> | <code>atoi()</code> | <code>atol()</code> | <code>bsearch()</code> | <code>calloc()</code> |
| <code>cds()</code> ^[1] | <code>clearenv()</code> | <code>cs()</code> ^[1] | <code>csid()</code> | <code>div()</code> ^[3] |
| <code>exit()</code> | <code>fetch()</code> ^[2] | <code>fetchp()</code> ^[2] | <code>free()</code> | <code>getenv()</code> |
| <code>labs()</code> | <code>ldiv()</code> | <code>llabs()</code> | <code>lldiv()</code> | <code>__librel()</code> |
| <code>malloc()</code> | <code>mblen()</code> | <code>mbstowcs()</code> | <code>mbtowc()</code> | <code>__moservices()</code> |
| <code>qsort()</code> | <code>rand()</code> | <code>realloc()</code> | <code>release()</code> ^[2] | <code>rpmatch()</code> |

Header files

| | | | | |
|--------------------|------------------|---------------------------|---------------------------|----------------------------|
| setenv() | srand() | strtod() | strtol() | strtoll() |
| strtoul() | strtoull() | system() | unatexit() | wcsid() |
| wcstombs() | wctomb() | strtod32() ^[4] | strtod64() ^[4] | strtod128() ^[4] |
| _UNIX03_SOURCE | | | | |
| unsetenv() | posix_memalign() | | | |

[1] Built-in function.

[2] Not supported under C++ applications.

[3] Special Behavior for C++: For C++ applications, the functions `abs()` and `div()` are also overloaded for the type `long`.

[4] The `__STDC_WANT_DEC_FP__` feature test macro is required to expose decimal floating-point functionality.

Two type definitions are added to `stdlib.h` for the Compare and Swap functions `cs()` and `cds()`. The structures defined are `__cs_t` and `__cds_t`.

The type `size_t` is declared in the header file. It is used for the type of the value returned by `sizeof`. The type `wchar_t` is declared and used for a wide character constant. For more information on the types `size_t` and `wchar_t`, see [“stddef.h — typedef statements”](#) on page 60.

The `stdlib.h` declares `div_t` and `ldiv_t`, which define the structure types that are returned by `div()` and `ldiv()`.

The `stdlib.h` file also contains definitions for the following macros:

NULL

The NULL pointer constant (also defined in `stddef.h`).

EXIT_SUCCESS

Used by the `atexit()` function.

EXIT_FAILURE

Used by the `atexit()` function.

RAND_MAX

Expands to an integer representing the largest number that the `RAND` function can return.

MB_CUR_MAX

Expands to an integer representing the maximum number of bytes in a multibyte character. This value is dependent on the current locale.

If `MB_CUR_MAX` is set to 1, multibyte functions will behave as if all multibyte characters are one byte long; wide-character functions are *not* supported and full DBCS support is *not* provided. If `MB_CUR_MAX` is 4, all DBCS support provided by the library is enabled.

string.h — String manipulation functions

The `string.h` header file declares the string manipulation functions and their built-in versions:

No feature test macro required.

| | | | | |
|--------------|-------------|--------------|--------------|--------------|
| memchr()[1] | memcmp()[1] | memcpy()[1] | memmove() | memset()[1] |
| strcat()[1] | strchr()[1] | strcmp()[1] | strcoll() | strcpy()[1] |
| strcspn() | strerror() | strlen()[1] | strncat()[1] | strncmp()[1] |
| strncpy()[1] | strpbrk() | strrchr()[1] | strspn() | strstr() |
| strtok() | strxfrm() | | | |

`_POSIX_C_SOURCE 200809L`

`stpcpy()` `stpncpy()` `strlen()` `strsignal()`

`_UNIX03_SOURCE`

`strerror_r`

[1] Built-in function.

`_XOPEN_SOURCE`

`memccpy()`

`_XOPEN_SOURCE_EXTENDED 1`

`strdup()`

`_XPLATFORM_SOURCE 1`

`strchrnul()`

The `string.h` header file also defines the macro `NULL` and the type `size_t`. For more information see [“stddef.h — typedef statements”](#) on page 60.

strings.h — String operations

The `strings.h` header file contains definitions for string operations.

stropts.h — Stream interface

The `stropts.h` header file declares the following functions:

| | | | |
|------------------------|--------------------------|-----------------------|------------------------|
| <code>fattach()</code> | <code>fdetach()</code> | <code>getmsg()</code> | <code>getpmsg()</code> |
| <code>ioctl()</code> | <code>isastream()</code> | <code>putmsg()</code> | <code>putpmsg()</code> |

syslog.h — System error logging

The `syslog.h` header file contains definitions for system error logging.

sys/acl.h — Manipulate ACL

The `sys/acl.h` header enables users to manipulate ACLs. It also declares the following functions:

| | | | |
|---------------------------------|---------------------------------|------------------------------|---------------------------------|
| <code>acl_create_entry()</code> | <code>acl_delete_entry()</code> | <code>acl_delete_fd()</code> | <code>acl_delete_file()</code> |
| <code>acl_first_entry()</code> | <code>acl_free()</code> | <code>acl_from_text()</code> | <code>acl_get_entry()</code> |
| <code>acl_get_fd()</code> | <code>acl_get_file()</code> | <code>acl_init()</code> | <code>acl_set_fd()</code> |
| <code>acl_set_file()</code> | <code>acl_sort()</code> | <code>acl_to_text()</code> | <code>acl_update_entry()</code> |
| <code>acl_valid()</code> | | | |

sys/__cpl.h — __cpl() function and symbolic constants

The `sys/__cpl.h` header contains definition for the `__cpl()` function. It also defines the following constants:

Table 8. Symbolic Constants defined in `sys/___cpl.h`

| Symbolic Constant | Description |
|-------------------|--|
| CPL_QUERY | Request data from available Coupling Facilities |
| CPL_CFSIZER | Request a structure size. |
| CPL_CFSIZER_W_LVL | Request a structure size with the level of the CF. |
| CPL_CFSIZER_VPL | Request a structure size and CFLevel with variable-length parameter list. |
| CPL_IXLCSP | Request a structure size and CFLevel with IXLCSP parameter list. |
| CPL_IXLMG | Request data from available coupling facilities with IXLMG parameter list. |
| CPL_IXCQUERY | Request data from the CFRM policy with IXCQUERY parameter list. |
| CPL_CFSIZER_VPL | Request a structure size and Cf Level with variable-length parameter list. |
| CPL_IXLCSP | Request a structure size and CFLevel with IXLCSP parameter list. |
| CPL_IXLMG | Request data from available coupling facilities with IXLMG parameter list. |
| CPL_IXCQUERY | Request data from the CFRM policy with IXCQUERY parameter list. |

sys/endian.h — Endian-ness of the system

The `sys/endian.h` header file defines the byte order, according to byte significance from low address to high.

sys/epoll.h — I/O event notification facility functions

The `sys/epoll.h` header file contains definitions for I/O event notification facility functions.

sys/eventfd.h — Standard library function

The `sys/epoll.h` header file contains definition for the `eventfd()` function.

sys/file.h — File manipulation constants

The `sys/file.h` header file defines file manipulation constants and the following function.

`_XPLATFORM_SOURCE`

`flock()`

sys/___getipc.h — Interprocess communication

The `sys/___getipc.h` header file contains definitions to get interprocess communication information.

sys/inotify.h — Monitor and notify file system change functions

The `sys/inotify.h` header file contains definitions for monitoring file system event functions.

sys/ioctl.h — System I/O definitions and structures

The `sys/ioctl.h` header file contains system I/O definitions and structures.

sys/ipc.h — Interprocess communication access structure

The `sys/ipc.h` header file contains definitions for the interprocess communication access structure.

sys/layout.h — Bidirectional conversion of data between Visual and Implicit formats

The `sys/layout.h` header file contains declarations for supporting bidirectional (Bidi) conversion of data between Visual (MVS) and Implicit (z/OS UNIX) formats. Initial support is for Arabic and Hebrew data.

sys/mman.h — Memory management

The `sys/mman.h` header file contains memory management declarations.

sys/__messag.h — __console() and __console2() functions

The `sys/__messag.h` header file contains definitions for the `__console()` and `__console2()` functions.

sys/mntent.h — w_getmntent() function and related structures and constants

This header file is protected by the `_OPEN_SYS` feature test macro.

The `sys/mntent.h` header file declares the `w_getmntent()` function and it defines the `mnte3`, `mnte2`, and `w_mntent` structures, along with some related constants.

sys/modes.h — Macros for stat structure

The `sys/modes.h` header file contains several macro definitions:

- Defined constant masks and bits for values of type `mode_t`, such as the `st_mode` field of the `stat` struct
- A defined constant mask for the `st_genvalue` field of the `stat` struct
- Function-like macros for testing values of the `st_mode` field of the `stat` struct.

Under IBM z/OS C support, these definitions are included in `sys/stat.h` to make `sys/stat.h` conform with POSIX.

sys/mount.h — File system mount and unmount

The `sys/inotify.h` header file contains definitions for mount and unmount file system operations functions.

sys/msg.h — Message queue structures

The `sys/msg.h` header file contains definitions for message queue structures.

sys/prctl.h — Operations on a process or thread

The `sys/prctl.h` header file contains definitions for operations on a process or thread.

sys/ps.h — w_getpsent() function and w_psproc structure

The `sys/ps.h` header file declares the `w_getpsent()` function that provides process data and defines the structure `w_psproc` along with some related constants.

It requires the `_OPEN_SOURCE 1` feature test macro.

sys/random.h — Random data operations

The `sys/random.h` header file contains definitions for random data operations, including declarations, constants, and structures that are used by the following function.

`_XPLATFORM_SOURCE`

`getrandom()`

sys/resource.h — XSI resource operations

The `sys/resource.h` header file contains definitions for XSI resource operations, including declarations, constants, and structures used by the following functions:

- `getpriority()`
- `getrlimit()`
- `getrusage()`
- `prlimit()`
- `setpriority()`
- `setrlimit()`

sys/select.h — Select types

The `sys/select.h` header file contains definitions for select types.

sys/sem.h — Semaphore facility

The `sys/sem.h` header file contains definitions for the semaphore facility.

sys/server.h — WorkLoad Manager services

The `sys/server.h` header file contains definitions for using WorkLoad Manager services.

sys/shm.h — Shared memory facility

The `sys/shm.h` header file contains definitions for the shared memory facility.

sys/socket.h — Sockets definitions

The `sys/socket.h` header file contains sockets definitions.

The structure `sockaddr_storage` is exposed by defining the feature test macro `_OPEN_SYS_SOCKET_IPV6` or `_OPEN_SYS_SOCKET_EXT3`.

Flag `O_CLOEXEC` and `O_DIRECT` are exposed by defining the feature test macro `_XPLATFORM_SOURCE`.

sys/stat.h — z/OS UNIX files and access

The `sys/stat.h` header file declares the following functions related to z/OS UNIX files and their access:

| | | | | |
|---------------------------|-----------------------------|------------------------|------------------------|------------------------|
| <code>__chattrat()</code> | <code>__chattrat64()</code> | <code>chaudit()</code> | <code>chmod()</code> | <code>creat()</code> |
| <code>fchaudit()</code> | <code>fchmod()</code> | <code>fstat()</code> | <code>fstat64()</code> | <code>fstatat()</code> |

| | | | | |
|-------------|---------------|-----------------|-----------|-----------|
| fstatat64() | lstat() | lstat64() | mkdir() | mkdirat() |
| mkfifo() | mkdirat() | mknod() | mknodat() | __mount() |
| mount() | __open_stat() | __open_stat64() | stat() | stat64() |
| umask() | umount() | | | |

sys/statfs.h – File system status

The `sys/statfs.h` header file contains functions that provide file system status.

sys/statvfs.h – File system status

The `sys/statvfs.h` header file contains definitions for file system status.

sys/time.h – Time types

The `sys/time.h` header file contains definitions for time types. It declares the following functions.

| | |
|--------------------------------|------------------------|
| <code>_XPLATFORM_SOURCE</code> | |
| <code>futimes()</code> | <code>lutimes()</code> |

sys/timex.h – Date and time

The `sys/timex.h` header file declares the `ftime()` and `ftime64()` functions that set the date and time. This header file requires the `_XOPEN_SOURCE_EXTENDED` feature test macro.

sys/times.h – Processor times

The `sys/times.h` header file declares the `times()` function that gets processor times for use by processes. It requires the `_POSIX_SOURCE` feature test macro.

sys/ttydev.h – Terminal I/O functions

The `sys/ttydev.h` header file defines constants used by the terminal I/O functions.

sys/types.h – typedef symbols and structures

The `sys/types.h` header file defines a collection of *typedef* symbols and structures.

Table 9. *sys/types.h: _OE_SOCKETS or _ALL_SOURCE*

| | |
|----------------|----------------|
| u_char | unsigned char |
| u_int | unsigned int |
| ushort | unsigned short |
| u_short | unsigned short |
| u_long | unsigned long |

Table 10. *sys/types.h: _OE_SOCKETS or _XOPEN_SOURCE_EXTENDED 1*

| | |
|------------------|-------------------------------|
| in_addr_t | Internet address |
| ip_addr_t | Internet address |
| caddr_t | Used for message data pointer |

Table 11. *sys/types.h: _OPEN_THREADS*

| | |
|----------------------------|---------------------------------------|
| pthread_t | Identify a thread |
| pthread_attr_t | Identify a thread attribute object |
| pthread_mutex_t | Mutexes |
| pthread_mutexattr_t | Identify a mutex attribute object |
| pthread_cond_t | Condition variables |
| pthread_condattr_t | Identify a condition attribute object |
| pthread_key_t | Thread-specific data keys |
| pthread_once_t | Dynamic package initialization |

Table 12. *sys/types.h: _POSIX_SOURCE*

| | |
|--------------------------|-----------------------------------|
| dev_t | Device numbers |
| gid_t | Group IDs |
| ino_t | File serial numbers |
| mode_t | Some file attributes |
| nlink_t | Link counts |
| off_t | File sizes, long |
| pid_t | Process IDs and process group ids |
| size_t | unsigned long |
| ssize_t | Signed long |
| uid_t | user IDs |
| time_t | Time values |
| clock_t | Time values, int |
| clockid_t | Clock ID type, int |
| sigset_t | Signal set |
| cc_t | cc_t |
| tty control chars | |
| speed_t | tty baud rate |
| tcflag_t | tty modes |
| mtm_t | Mount requests |
| rdev_t | Device numbers |

Table 13. *sys/types.h: _XOPEN_SOURCE*

| | |
|--------------|-----------------------------------|
| key_t | Interprocess communications, long |
|--------------|-----------------------------------|

Table 14. *sys/types.h: _XOPEN_SOURCE 500*

| | |
|-------------------|-------------------------|
| blksize_t | Block sizes |
| blkcnt_t | File block counts |
| fsblkcnt_t | Filesystem block counts |

Table 14. *sys/types.h: _XOPEN_SOURCE 500 (continued)*

| | |
|--------------------|-------------------------------------|
| fsfilcnt_t | File serial numbers |
| suseconds_t | Time values in range [-1,1,000,000] |

Table 15. *sys/types.h: _XOPEN_SOURCE_EXTENDED 1*

| | |
|--------------------|--|
| id_t | General identifier, can contain a pid_t or a gid_t |
| useconds_t | Microseconds |
| sa_family_t | Address family |
| in_port_t | AF_INET port |

sys/uio.h — Vector I/O operations

The `sys/uio.h` header file contains definitions for vector I/O operations.

sys/un.h — UNIX-domain sockets

The `sys/un.h` header file contains definitions for UNIX-domain sockets.

sys/__ussos.h — Security facility authorization

The `sys/__ussos.h` header file contains the `_SET_THLIIPADDR()` macro, which sets a client's IP address for security facility authorization (SAF).

sys/utsname.h — Operating system name

The `sys/utsname.h` header file declares the `utsname` structure and the `uname()` function, which returns the name of the current operating system. It requires the `_POSIX_SOURCE` feature test macro.

sys/wait.h — Hold processes

The `sys/wait.h` header file declares the following functions, used for holding processes.

`_POSIX_SOURCE:`

`wait()` `waitpid()`

`_XOPEN_SOURCE_EXTENDED 1:`

`waitid()` `wait3()`

Note: `wait3()` has been withdrawn in Single UNIX Specification, Version 3.

`_XPLATFORM_SOURCE`

`wait4()`

sys/__wlm.h — WorkLoad Manager functions

The `sys/__wlm.h` header file contains definitions for WorkLoad Manager functions.

sys/xattr.h — Extended attributes handling

The `sys/xattr.h` header file contains definitions for extended attributes handling functions.

tar.h — tar utility

The `tar.h` header file contains definitions for the tar utility.

termios.h — POSIX terminal I/O functions

The `termios.h` header file contains constants, prototypes, and typedef definitions of POSIX terminal I/O functions. It includes the `__termcp` structure, and declares the following functions:

| | | | | |
|----------------------------|----------------------------|----------------------------|------------------------------|-------------------------|
| <code>cfgetispeed()</code> | <code>cfgetospeed()</code> | <code>cfsetispeed()</code> | <code>cfsetospeed()</code> | <code>tcdrain()</code> |
| <code>tcflow()</code> | <code>tcflush()</code> | <code>tcgetattr()</code> | <code>__tcgetcp()</code> | <code>tcgetsid()</code> |
| <code>tcsendbreak()</code> | <code>tcsetattr()</code> | <code>__tcsetcp()</code> | <code>__tcsettables()</code> | |

These functions are supported only in a POSIX program.

The `termios.h` header file also contains constants, prototypes and typedef definitions for the `w_ioctrl()` function.

tgmath.h — Mathematics and complex data type

The header `tgmath.h` includes the headers `math.h` and `complex.h` and defines a number of type-generic macros. This requires the compiler that is designed to support C99.

Use of the macro invokes a function whose corresponding real type and type domain are determined by the arguments for the generic parameters. If there is more than one real floating type argument, usual arithmetic conversions are applied to the real floating type arguments so that they have compatible types. Then,

- If any argument has type `_Decimal128`, the type determined is `_Decimal128`.
- Otherwise, if any argument has type `_Decimal64`, the type determined is `_Decimal64`.
- Otherwise, if any argument has type `_Decimal32`, the type determined is `_Decimal32`.
- Otherwise, if any argument has type `long double`, the type determined is `long double`.
- Otherwise, if any argument has type `double` or is of integer type, the type determined is `double`.
- Otherwise, if none of the above the type determined is `float`.

All the functions in `math.h` and `complex.h` have their corresponding type generic macros in this header where if for a function in `math.h`, there is a corresponding `c` prefixed function in `complex.h`, then the corresponding type generic macro has the same name as the one in `math.h`. The macros are:

| | | | | | |
|-------------------|----------------------------|------------------------|-------------------------|---------------------|------------------------|
| acos | <code>acosh</code> | <code>asin</code> | <code>asinh</code> | <code>atan</code> | <code>atan2</code> |
| atanh | <code>carg</code> | <code>cbrt</code> | <code>ceil</code> | <code>cimag</code> | <code>conj</code> |
| copysign | <code>cos</code> | <code>cosh</code> | <code>cproj</code> | <code>creal</code> | <code>erf</code> |
| erfc | <code>exp</code> | <code>exp2</code> | <code>expm1</code> | <code>fabs</code> | <code>fdim</code> |
| floor | <code>fma</code> | <code>fmax</code> | <code>fmin</code> | <code>fmod</code> | <code>frexp</code> |
| hypot | <code>ilogb</code> | <code>ldexp</code> | <code>lgamma</code> | <code>llrint</code> | <code>llround</code> |
| log | <code>log10</code> | <code>log1p</code> | <code>log2</code> | <code>logb</code> | <code>lrint</code> |
| lround | <code>nearbyint</code> | <code>nextafter</code> | <code>nexttoward</code> | <code>pow</code> | <code>remainder</code> |
| remquo | <code>rint</code> | <code>round</code> | <code>scalbln</code> | <code>scalbn</code> | <code>sin</code> |
| sinh | <code>sqrt</code> | <code>tan</code> | <code>tanh</code> | <code>tgamma</code> | <code>trunc</code> |
| quantize() | <code>samequantum()</code> | | | | |

[1] The following type-generic macros are not supported for decimal-floating point types: `carg()`, `cimag()`, `conj()`, `cproj()`, `creal()`.

Restrictions:

- This header does not support the `_FP_MODE_VARIABLE` feature test macro.
- This header is not supported for C++ applications.

For example:

The macro `exp(int n)` invokes the function `exp(int n)`

The macro `acosh(float f)` invokes the function `acoshf(float f)`

The macro `log(float complex fc)` invokes the complex function `clogf(float complex fc)`

The macro `pow(double complex dc, float f)` invokes `cpow(double complex dc, float f)`

)

time.h — Time and date

The `time.h` header file declares the time and date functions:

| | | | | |
|-------------------------|--------------------------|-----------------------------------|--------------------------|-------------------------|
| <code>asctime()</code> | <code>clock()</code> | <code>clock_gettime()</code> | <code>ctime()</code> | <code>difftime()</code> |
| <code>gmtime()</code> | <code>localtime()</code> | <code>mktime()</code> | <code>nanosleep()</code> | <code>strftime()</code> |
| <code>strptime()</code> | <code>time()</code> | <code>tzset()</code> ¹ | | |

Note:

1. This function is supported only in a POSIX program.

The `time.h` header file also provides:

- A structure `timespec` that contains the following members:

| | | |
|---------------------|-----------------------|-------------|
| <code>time_t</code> | <code>tv_sec;</code> | seconds |
| <code>long</code> | <code>tv_nsec;</code> | nanoseconds |

- A structure `timespec64` that contains the following members:

| | | |
|-----------------------|-----------------------|-------------|
| <code>time64_t</code> | <code>tv_sec;</code> | seconds |
| <code>long</code> | <code>tv_nsec;</code> | nanoseconds |

Note: In addition to the requirements for accessing structure `timespec`, feature test macro `_LARGE_TIME_API` is needed to expose `timespec64`.

- A structure `tm` that contains the components of a calendar time. See Table 16 on page 76 for a list of the members of the `tm` structure. This structure is used by the functions `asctime()`, `gmtime()`, `localtime()`, `mktime()`, `strftime()`, and `strptime()`.
- A macro `CLOCKS_PER_SEC` equal to the number per second of the value returned by the `clock()` function.
- Types `clock_t`, `clockid_t`, `time_t`, and `size_t`.
- The NULL pointer constant. For more information on NULL and the type `size_t`, see “[stddef.h — typedef statements](#)” on page 60.
- The macro `CLK_TCK`, which is the number of clock ticks per second, is kept for historical reasons. It was used in connection with the return value of the `clock()` function. `CLK_TCK` has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use `sysconf(_SC_CLK_TCK)` instead of the `CLK_TCK` macro.

However, if it is necessary to continue using this symbol in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols that are removed in Single UNIX Specification, Version 3.

| Table 16. Fields of tm Structure | |
|----------------------------------|--|
| Field | Description |
| tm_sec | Seconds (0-60) |
| tm_min | Minutes (0-59) |
| tm_hour | Hours (0-23) |
| tm_mday | Day of month (1-31) |
| tm_mon | Month (0-11; January = 0) |
| tm_year | Year (current year minus 1900) |
| tm_wday | Day of week (0-6; Sunday = 0) |
| tm_yday | Day of year (0-365; January 1 = 0) |
| tm_isdst | Zero if Daylight Saving Time is not in effect; positive if Daylight Saving Time is in effect; negative if the information is not available. |
| tm_gmtoff ¹ | Time zone that is used to compute this broken-down time value, including any adjustment for daylight saving. It represents the number of seconds that must be added to Coordinated Universal Time to get local time. |
| tm_zone ¹ | Name for the time zone that is used to compute this broken-down time value. |

Note:

1. Only when `_XPLATFORM_SOURCE` is defined, this field is included in the `tm` structure. The value of this field is available only after the `localtime_r()` function is called with `_XPLATFORM_SOURCE` defined. In other cases, using this field might result in unknown behavior.

The time functions are affected by the current locale selected. The `LC_CTYPE` category affects the behavior of the `strftime()`, `strptime()`, and `wcsftime()` functions. The `LC_TOD` category affects the behavior of the `gmtime()`, `mktime()`, and `localtime()` functions.

uchar.h — Extended character data types

This header defines typedefs and macros associated with extended character data types.

The following typedefs are defined:

char16_t char32_t mbstate_t size_t

The following object-like macros are defined:

__STDC_UTF_16__ __STDC_UTF_32__

The `uchar.h` header file also declares functions that deal with conversions between multibyte characters and `char16_t`/`char32_t`. The following functions are declared:

mbrtoc16() mbrtoc32() c16rtomb() c32rtomb()

ucontext.h — Context related functions

The `ucontext.h` header file contains the prototypes and definitions needed by the following functions:

getcontext() setcontext() makecontext() swapcontext()

uheap.h — Heap storage

The `uheap.h` header file contains the prototypes and definitions needed by the following functions:

| | | | |
|--------------------------|--------------------------|------------------------|------------------------------|
| <code>__ucreate()</code> | <code>__umalloc()</code> | <code>__ufree()</code> | <code>__uheapreport()</code> |
|--------------------------|--------------------------|------------------------|------------------------------|

ulimit.h — ulimit commands

The `ulimit.h` header file contains definitions for **ulimit** commands.

unistd.h — Implementation-specific functions

The `unistd.h` header file declares a number of implementation-specific functions:

| | | | |
|--------------------------------|-------------------------|-------------------------------|--|
| <code>__atoe()</code> | <code>__atoe_l()</code> | <code>__authenticate()</code> | <code>__check_resource_auth_n p()</code> |
| <code>__convert_id_np()</code> | <code>__etoea()</code> | <code>__etoea_l()</code> | <code>__isPosixOn()</code> |
| <code>__smf_record()</code> | <code>__wsinit()</code> | | |

XPLINK

| | | | |
|------------------------|------------------------|------------------------|------------------------|
| <code>__a2e_l()</code> | <code>__a2e_s()</code> | <code>__e2a_l()</code> | <code>__e2a_s()</code> |
|------------------------|------------------------|------------------------|------------------------|

There are also a large number of POSIX and UNIX functions declared, shown below with the minimum feature test macro needed to expose them:

| | | | |
|------------------------------|----------------------------|--------------------------|-------------------------------|
| <code>access()</code> | <code>alarm()</code> | <code>chdir()</code> | <code>chown()</code> |
| <code>close()</code> | <code>ctermid()</code> | <code>dup()</code> | <code>dup2()</code> |
| <code>execl()</code> | <code>execle()</code> | <code>execlp()</code> | <code>execv()</code> |
| <code>execve()</code> | <code>execvp()</code> | <code>_exit()</code> | <code>fork()</code> |
| <code>fpathconf()</code> | <code>getcwd()</code> | <code>getegid()</code> | <code>geteuid()</code> |
| <code>getgid()</code> | <code>getgroups()</code> | <code>getlogin()</code> | <code>getpgrp()</code> |
| <code>getpid()</code> | <code>getppid()</code> | <code>getuid()</code> | <code>isatty()</code> |
| <code>link()</code> | <code>lseek()</code> | <code>pathconf()</code> | <code>pause()</code> |
| <code>pipe()</code> | <code>read()</code> | <code>rmdir()</code> | <code>setgid()</code> |
| <code>setpgid()</code> | <code>setsid()</code> | <code>setuid()</code> | <code>sleep()</code> |
| <code>sysconf()</code> | <code>tcgetpgrp()</code> | <code>tcsetpgrp()</code> | <code>ttyname()</code> |
| <code>unlink()</code> | <code>write()</code> | | |
| <code>__certificate()</code> | <code>__getlogin1()</code> | <code>__login()</code> | <code>__pid_affinity()</code> |

POSIX1_SOURCE = 2

| | | | |
|------------------------|-------------------------|--------------------------|-------------------------|
| <code>fchown()</code> | <code>fsync()</code> | <code>ftruncate()</code> | <code>readlink()</code> |
| <code>setegid()</code> | <code>setgeuid()</code> | <code>symlink()</code> | |

POSIX_C_SOURCE = 2

| | | | |
|---------------------|---------------------|---------------------|---------------------|
| <code>optarg</code> | <code>opterr</code> | <code>optind</code> | <code>optopt</code> |
|---------------------|---------------------|---------------------|---------------------|

External Variables

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Header files

faccessat() fchownat() linkat() readlinkat() symlinkat() unlinkat()

_XOPEN_SOURCE

chroot() confstr() crypt() cuserid()
encrypt() getopt() getpass() nice()
swab()

_XOPEN_SOURCE = 500

brk() fchdir() fdatsync() getdtablesize()
gethostid() gethostname() getlogin_r() getpagesize()
getpgid() getsid() getwd() lchown()
lockf() pread() pwrite() sbrk()
setpgrp() setregid() setreuid() sync()
truncate() ttyname_r() ualarm() usleep()
vfork()

_XPLATFORM_SOURCE

dup3() getentropy() pipe2() pivot_root()
syncfs() syscall()

The `unistd.h` header file also defines many symbols to represent configuration variables and implementation features provided. Some of these are used at compile time, while others are used to interrogate the system at run time, using `sysconf()`, `confstr()`, `pathconf()`, or `fpathconf()`.

utime.h — File access and time modification

The `utime.h` header file declares the `utimbuf` and `utimbuf64` structures and the `utime()` and `utime64()` functions, which are used to set file access and modification times.

The `utime()` and `utime64()` function are supported only in a POSIX program.

Note: Feature test macro `_LARGE_TIME_API` is needed to expose the `utimbuf64` structure.

utmpx.h — User accounting database

The `utmpx.h` header file contains user accounting database definitions.

varargs.h — Handle variable argument lists

The `varargs.h` header file contains definitions for handling variable argument lists.

Note:

This header is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use the `<stdarg.h>` header to support variable argument list functionality compatible with IEEE Std 1003.1-2001.

Applications conforming to Single UNIX Specification, Version 3 must not include the header file.

variant.h — LC_SYNTAX characters

The `variant.h` header file declares the `getsyntax()` function, which returns LC_SYNTAX characters. It also contains the declaration of the `variant` structure:

```
struct variant {
    char    *codeset;           /* code set of the current locale */
    char    backslash;         /* encoding of \ */
    char    right_bracket;     /* encoding of ] */
    char    left_bracket;      /* encoding of [ */
    char    right_brace;       /* encoding of } */
    char    left_brace;        /* encoding of { */
    char    circumflex;        /* encoding of ^ */
    char    tilde;             /* encoding of ~ */
    char    exclamation_mark;  /* encoding of ! */
    char    number_sign;       /* encoding of # */
    char    vertical_line;     /* encoding of | */
    char    dollar_sign;       /* encoding of $ */
    char    commercial_at;     /* encoding of @ */
    char    grave_accent;      /* encoding of ` */
};

struct variant *getsyntax(void);
```

For more information about the effect of locale, see `setlocale()`, `locale.h`, or look up the individual functions in this topic. For still more information, see "Internationalization: Locales and Character Sets" in *z/OS XL C/C++ Programming Guide*.

wchar.h — ISO/C Multibyte Support extensions

The `wchar.h` header file contains the declaration for the supported subset of the ISO/C Multibyte Support extensions introduced in ISO/IEC 9899:1990/Amendment 1:1993(E) extensions. You don't need to include `stdio.h` and `stdarg.h` to use the header file. The following functions are declared in `wchar.h`. `wmemchr()`, `wmemcpy()`, `wmemcmp()`, and `wmemset()` are also available as their built-in versions.

| | | | | |
|--|---|-------------------------|--------------------------|--|
| <code>btowc()</code> | <code>fgetwc()</code> | <code>fgetws()</code> | <code>fputwc()</code> | <code>fputws()</code> |
| <code>fwide()</code> | <code>fwprintf()</code> | <code>fwscanf()</code> | <code>getwc()</code> | <code>getwchar()</code> |
| <code>mbrlen()</code> | <code>mbrtowc()</code> | <code>mbsinit()</code> | <code>mbsrtowcs()</code> | <code>putwc()</code> |
| <code>putwchar()</code> | <code>swprintf()</code> | <code>swscanf()</code> | <code>ungetwc()</code> | <code>vfwprintf()</code> |
| <code>vfwscanf()</code> | <code>vswprintf()</code> | <code>vswscanf()</code> | <code>vwprintf()</code> | <code>vwscanf()</code> |
| <code>wcrtomb()</code> | <code>wcscat()</code> | <code>wcschr()</code> | <code>wcscmp()</code> | <code>wscoll()</code> |
| <code>wcscpy()</code> | <code>wcscspn()</code> | <code>wcsftime()</code> | <code>wcslen()</code> | <code>wcsncat()</code> |
| <code>wcsncmp()</code> | <code>wcsncpy()</code> | <code>wcspbrk()</code> | <code>wcsrchr()</code> | <code>wcsrtombs()</code> |
| <code>wcsspn()</code> | <code>wcsstr()</code> | <code>wcstod()</code> | <code>wcstok()</code> | <code>wcstol()</code> |
| <code>wcstoll()</code> | <code>wcstoul()</code> | <code>wcstoull()</code> | <code>wcswidth()</code> | <code>wcsxfrm()</code> |
| <code>wctob()</code> | <code>wcwidth()</code> | <code>wmemchr()</code> | <code>wmemcpy()</code> | <code>wmemcmp()</code> |
| <code>wmemmove()</code> | <code>wmemset()</code> | <code>wprintf()</code> | <code>wscanf()</code> | <code>wcstod32()</code> ^[1] |
| <code>wcstod64()</code> ^[1] | <code>wcstod128()</code> ^[1] | | | |

1. The `__STDC_WANT_DEC_FP__` feature test macro is required to expose decimal floating-point functionality.

`_POSIX_C_SOURCE 200809L`

`wcpncpy()` `wcpcnpy()` `wcsnlen()`

The header file `wchar.h` contains definitions of the following types:

mbstate_t

Conversion-state information needed when converting between sequences of multibyte characters and wide characters.

size_t

typedef for the type of the value returned by *sizeof*.

wchar_t

typedef for a wide-character constant.

wint_t

An integral type unchanged by integral promotions that can hold any value corresponding to members of the extended character set, as well as WEOF (see below).

FILE

The FILE structure type is defined in both `stdio.h` and `wchar.h`. Stream functions use a pointer to the FILE type to get access to a given stream. The system uses the information in the FILE structure to maintain the stream. The C standard streams `stdin`, `stdout`, and `stderr` are also defined in `stdio.h`.

va_list

This type is defined in both `stdarg.h` and `wchar.h`.

The header file `wchar.h` also contains definitions of the following constants:

NULL

A pointer that never points to a data object.

WEOF

Expands to a constant expression of type `wint_t`, whose value does not correspond to any member of the extended character set. It indicates End Of File (EOF).

WCHAR_MIN

Defines the lower limit of the `wchar_t` type.

WCHAR_MAX

Defines the upper limit of the `wchar_t` type.

You can perform wide-character input/output on the streams described in the ISO/IEC 9899:1990 standard, sub-clause 7.9.2. This standard expands the definition of a stream to include an *orientation* for both text and binary streams. For more information about DBCS orientation, see the section on Double-Byte Characters Sets in [z/OS XL C/C++ Programming Guide](#).

The wide-character string functions are also declared in `wcstr.h` for compatibility with previous releases of C/370, although `wcstr.h` may be withdrawn in the future.

For more information about the effect of locale, see `setlocale()`, `locale.h`, or look up the individual functions in this topic. For still more information, see the "Internationalization: Locales and Character Sets" in [z/OS XL C/C++ Programming Guide](#).

wcstr.h — Multibyte functions

The `wcstr.h` header file declares the following multibyte functions:

| | | | | |
|------------------------|------------------------|------------------------|------------------------|------------------------|
| <code>wcscat()</code> | <code>wcschr()</code> | <code>wcscmp()</code> | <code>wscpy()</code> | <code>wcscspn()</code> |
| <code>wcslen()</code> | <code>wcsncat()</code> | <code>wcsncmp()</code> | <code>wcsncpy()</code> | <code>wcspbrk()</code> |
| <code>wcsrchr()</code> | <code>wcsspn()</code> | <code>wcswcs()</code> | | |

`wcstr.h` also defines the types `size_t`, `NULL`, `wchar_t`, and `wint_t`.

The wide-character string functions are also declared in `wchar.h` for compatibility with previous releases of C/370. `wcstr.h` may be withdrawn in future releases of the IBM z/OS C/C++ product.

`wcstr.h` is a non-standard header that is provided for compatibility with previous releases of C/370. Functions in `wcstr.h` are exposed by enabling the [runtime library extensions](#). The `wcstr.h` header might be withdrawn in future releases of the IBM z/OS C/C++ product. The wide character functions in `wcstr.h` are also declared in the `wchar.h` header, which is the standard interface.

wctype.h — Wide character properties

The `wctype.h` header declares functions that deal with wide character properties. The following are declared as functions and are also defined as macros:

| | | | | |
|-------------------------|-------------------------|--------------------------|-------------------------|-------------------------|
| <code>iswalnum()</code> | <code>iswalpha()</code> | <code>iswblank()</code> | <code>iswcntrl()</code> | <code>iswctype()</code> |
| <code>iswdigit()</code> | <code>iswgraph()</code> | <code>iswlower()</code> | <code>iswprint()</code> | <code>iswpunct()</code> |
| <code>iswspace()</code> | <code>iswupper()</code> | <code>iswxdigit()</code> | <code>towlower()</code> | <code>towupper()</code> |
| <code>wctype()</code> | | | | |

The following are declared as prototypes only:

| | | |
|--------------------------|------------------------|-----------------------|
| <code>towctrans()</code> | <code>wctrans()</code> | <code>wctype()</code> |
|--------------------------|------------------------|-----------------------|

The `wctype.h` header defines the types `wctrans_t`, `wctype_t` and `wint_t`. The `wctype.h` defines the macro `WEOF`, which expands to a constant expression of type `wint_t`, whose value does not correspond to any member of the extended character set. The macro `WEOF` indicates End Of File (EOF).

wordexp.h — Word expansion types

The `wordexp.h` header file contains definitions for word expansion types.

xti.h — _XOPEN_SOURCE_EXTENDED feature test macro

The `xti.h` header file declares the following symbolic constants under the `_XOPEN_SOURCE_EXTENDED` feature test macro:

Table 17. Symbolic Constants defined in xti.h

| Symbolic Constant | Description |
|-------------------|-------------------------------|
| TBADADDR | Incorrect addr format |
| TBADOPT | Incorrect option format |
| TACCES | Incorrect permissions |
| TBADF | Illegal transport fd |
| TNOADDR | Could not allocate addr |
| TOUTSTATE | Out of state |
| TBADSEQ | Bad call sequence number |
| TSYSERR | System error |
| TLOOK | Event requires attention |
| TBADDATA | Illegal amount of data |
| TBUFOVFLW | Buffer not large enough |
| TFLOW | Flow control |
| TNODATA | No data |
| TNODIS | Discon_ind not found on queue |
| TNOUDERR | unitdata error not found |

Table 17. Symbolic Constants defined in xti.h (continued)

| Symbolic Constant | Description |
|-------------------|------------------------------------|
| TBADFLAG | Bad flags |
| TNOREL | No ord rel found on queue |
| TNOTSUPPORT | Primitive not supported |
| TSTATECHNG | State currently changing |
| TNOSTRUCTYPE | unknown struct-type requested |
| TBADNAME | Invalid transport name |
| TBADQLEN | Qlen is zero |
| TADDRBUSY | Address in use |
| TINDOUT | Outstanding connect indications |
| TPROVMISMATCH | Transport provider mismatch |
| TRESQLEN | Resfd specified to accept w/qlen>0 |
| TRESADDR | Resfd not bound to same addr as fd |
| TQFULL | Incoming connection queue full |
| TPROTO | XTI protocol error |
| T_LISTEN | Connection indication received |
| T_CONNECT | Connect confirmation received |
| T_DATA | Normal data received |
| T_EXDATA | Expedited data received |
| T_DISCONNECT | Disconnect received |
| T_UDERR | Datagram error indication |
| T_ORDREL | Orderly release indication |
| T_GODATA | Sending normal data is possible |
| T_GOEXDATA | Sending expedited data is possible |
| T_EVENTS | Event mask |
| T_MORE | More data |
| T_EXPEDITED | Expedited data |
| T_NEGOTIATE | Set opts |
| T_CHECK | Check opts |
| T_DEFAULT | Get default opts |
| T_SUCCESS | Successful |
| T_FAILURE | Failure |
| T_CURRENT | Current opts |
| T_PARTSUCCESS | Partial success |
| T_READONLY | Read-only |
| T_NOTSUPPORT | Not supported |
| T_BIND | S |

XL C++ header files

The XL C++ header files can be used with the z/OS XL C++ compiler only.

For the information about the following XL C/C++ header files, refer to the C++98 language standard (ISO/IEC 14882:1998).

- algorithm
- bitset
- complex
- deque
- fstream
- functional
- iomanip
- ios
- iosfwd
- istream
- iterator
- limits
- list
- locale
- map
- memory
- numeric
- ostream
- queue
- set
- sstream
- stack
- stdexcept
- stl.h
- streambuf
- string
- stringstream
- ustream.h
- utility
- valarray
- vector

cassert — Enforce assertions

The `cassert` header file contains definitions for C++ for enforcing assertions when functions execute. Include the standard header into a C++ program to effectively include the standard header `<assert.h>` within the `std` namespace.

```
namespace std {  
  #include <assert.h>  
};
```

cctype — Classify characters

The `cctype` header file contains definitions for C++ for classifying characters. Include the standard header into a C++ program to effectively include the standard header `<cctype.h>` within the `std` namespace.

```
namespace std {  
#include <cctype.h>  
};
```

cerrno — Test error codes

The `cerrno` header file contains definitions for C++ for testing error codes reported by library functions. Include the standard header into a C++ program to effectively include the standard header `<errno.h>` within the `std` namespace.

```
namespace std {  
#include <errno.h>  
};
```

cfloat — Test floating-point type properties

The `cfloat` header file contains definitions for C++ for testing floating-point type properties. Include the standard header into a C++ program to effectively include the standard header `<float.h>` within the `std` namespace.

```
namespace std {  
#include <float.h>  
};
```

ciso646 — ISO646 variant character sets

The `ciso646` header file contains definitions for C++ for programming in ISO646 variant character sets. Include the standard header into a C++ program to effectively include the standard header `<iso646.h>` within the `std` namespace.

```
namespace std {  
#include <iso646.h>  
};
```

climits — Test integer type properties

The `climits` header file contains definitions for C++ for testing integer type properties. Include the standard header into a C++ program to effectively include the standard header `<limits.h>` within the `std` namespace.

```
namespace std {  
#include <limits.h>  
};
```

locale — Adapt to different cultural conventions

The `locale` header file contains definitions for C++ for adapting to different cultural conventions. Include the standard header into a C++ program to effectively include the standard header `<locale.h>` within the `std` namespace.

```
namespace std {  
#include <locale.h>  
};
```

cmath — Common mathematical functions

The `cmath` header file contains definitions for C++ for computing common mathematical functions. Include the standard header into a C++ program to effectively include the standard header `<math.h>` within the `std` namespace.

```
namespace std {
#include <math.h>
};
```

complex.h — Complex math functions

The `complex.h` header file contains function declarations for all the complex math functions listed below.

| | | | | |
|------------------------|------------------------|------------------------|-----------------------|-----------------------|
| <code>cabs()</code> | <code>cabsf()</code> | <code>cabsl()</code> | <code>cacos()</code> | <code>cacosf()</code> |
| <code>cacosh()</code> | <code>cacoshf()</code> | <code>cacoshl()</code> | <code>cacosl()</code> | <code>carg()</code> |
| <code>cargf()</code> | <code>cargl()</code> | <code>casin()</code> | <code>casinf()</code> | <code>casinh()</code> |
| <code>casinhf()</code> | <code>casinhl()</code> | <code>casinl()</code> | <code>catan()</code> | <code>catanf()</code> |
| <code>catanh()</code> | <code>catanhf()</code> | <code>catanhl()</code> | <code>catanl()</code> | <code>ccos()</code> |
| <code>ccosf()</code> | <code>ccosh()</code> | <code>ccoshf()</code> | <code>ccoshl()</code> | <code>ccosl()</code> |
| <code>cexp()</code> | <code>cexpf()</code> | <code>cexpl()</code> | <code>cimag()</code> | <code>cimagf()</code> |
| <code>cimagl()</code> | <code>clog()</code> | <code>clogf()</code> | <code>clogl()</code> | <code>conj()</code> |
| <code>conjf()</code> | <code>conjl()</code> | <code>cpow()</code> | <code>cpowf()</code> | <code>cpowl()</code> |
| <code>cproj()</code> | <code>cprojf()</code> | <code>cprojl()</code> | <code>creal()</code> | <code>crealf()</code> |
| <code>creall()</code> | <code>csin()</code> | <code>csinf()</code> | <code>csinh()</code> | <code>csinhf()</code> |
| <code>csinhl()</code> | <code>csinl()</code> | <code>csqrt()</code> | <code>csqrtf()</code> | <code>csqrtl()</code> |
| <code>ctan()</code> | <code>ctanf()</code> | <code>ctanh()</code> | <code>ctanhf()</code> | <code>ctanhl()</code> |
| <code>ctanl()</code> | | | | |

The `complex.h` header file defines the following macros:

complex

expands to `_Complex`, where `_Complex` is a type specifier.

_Complex_I

expands to `const float _Complex` with the value of the imaginary unit

I

expands to `_Complex_I`

Compile requirement: Use of this header requires a compiler that is designed to support C99.

csetjmp — Execute non-local goto statements

The `csetjmp` header file contains definitions for C++ for executing non-local `goto` statements. Include the standard header into a C++ program to effectively include the standard header `<setjmp.h>` within the `std` namespace.

```
namespace std {
#include <setjmp.h>
};
```

csignal — Exception control

The `csignal` header file contains definitions for C++ for controlling various exceptional conditions. Include the standard header into a C++ program to effectively include the standard header `<signal.h>` within the `std` namespace.

```
namespace std {  
#include <signal.h>  
};
```

cstdarg — Access arguments

The `cstdarg` header file contains definitions for C++ for accessing a varying number of arguments. Include the standard header into a C++ program to effectively include the standard header `<stdarg.h>` within the `std` namespace.

```
namespace std {  
#include <stdarg.h>  
};
```

cstddef — Define data types and macros

The `cstddef` header file contains definitions for C++ for defining several useful types and macros. Include the standard header into a C++ program to effectively include the standard header `<stddef.h>` within the `std` namespace.

```
namespace std {  
#include <stddef.h>  
};
```

cstdio — Perform input and output

The `cstdio` header file contains definitions for C++ for performing input and output. Include the standard header into a C++ program to effectively include the standard header `<stdio.h>` within the `std` namespace.

```
namespace std {  
#include <stdio.h>  
};
```

cstdlib — Standard library

The `cstdlib` header file contains definitions for C++ for performing a variety of operations. Include the standard header into a C++ program to effectively include the standard header `<stdlib.h>` within the `std` namespace.

```
namespace std {  
#include <stdlib.h>  
};
```

cstring — Manipulate strings

The `cstring` header file contains definitions for C++ for manipulating several kinds of strings. Include the standard header into a C++ program to effectively include the standard header `<string.h>` within the `std` namespace.

```
namespace std {  
#include <string.h>  
};
```


ctime — Convert time and date formats

The `ctime` header file contains definitions for C++ for converting between various time and date formats. Include the standard header into a C++ program to effectively include the standard header `<time.h>` within the `std` namespace.

```
namespace std {
#include <time.h>
};
```

cwchar — Manipulating wide streams and strings

The `cwchar` header file contains definitions for C++ for manipulating wide streams and several kinds of strings. Include the standard header into a C++ program to effectively include the standard header `<wchar.h>` within the `std` namespace.

```
namespace std {
#include <wchar.h>
};
```

cwctype — Wide character classification

The `cwctype` header file contains definitions for C++ for classifying wide characters. Include the standard header into a C++ program to effectively include the standard header `<cwctype.h>` within the `std` namespace.

```
namespace std {
#include <cwctype.h>
};
```

exception — Exception handling

The `exception` header file defines several types and functions related to the handling of exceptions.

```
namespace std {
class exception;
class bad_exception;
typedef void (*terminate_handler)();
typedef void (*unexpected_handler)();
terminate_handler
    set_terminate(terminate_handler ph) throw();
unexpected_handler
    set_unexpected(unexpected_handler ph) throw();
void terminate();
void unexpected();
bool uncaught_exception();
};
```

bad_exception

```
class bad_exception : public exception {
};
```

The class describes an exception that can be thrown from an `unexpected` handler. The value returned by `what()` is an implementation-defined C string. None of the member functions throw any exceptions.

exception

```
class exception {
public:
    exception() throw();
    exception(const exception& rhs) throw();
    exception& operator=(const exception& rhs) throw();
    virtual ~exception() throw();
    virtual const char* what() const throw();
};
```

The class serves as the base class for all exceptions thrown by certain expressions and by the Standard C++ library. The C string value returned by `what()` is left unspecified by the default constructor, but may be defined by the constructors for certain derived classes as an implementation-defined C string. None of the member functions throw any exceptions.

`terminate_handler`

```
typedef void (*terminate_handler)();
```

The type describes a pointer to a function suitable for use as a terminate handler.

`unexpected_handler`

```
typedef void (*unexpected_handler)();
```

The type describes a pointer to a function suitable for use as an unexpected handler.

new — Storage allocation and free

The `<new>` header file defines several types and functions that control allocation and freeing of storage under program control.

Some of the functions declared in this header are replaceable. The implementation supplies a default version. A program can, however, define a function with the same signature to replace the default version at link time. The replacement version must satisfy the requirements of the function.

```
namespace std {
    typedef void (*new_handler)();
    class bad_alloc;
    class nothrow_t;
    extern const nothrow_t nothrow;
    // FUNCTIONS
    new_handler set_new_handler(new_handler ph) throw();
};
// OPERATORS
void operator delete(void *p) throw();
void operator delete(void *, void *) throw();
void operator delete(void *p, const std::nothrow_t&) throw();
void operator delete[](void *p) throw();
void operator delete[](void *, void *) throw();
void operator delete[](void *p, const std::nothrow_t&) throw();
void *operator new(std::size_t n) throw(std::bad_alloc);
void *operator new(std::size_t n, const std::nothrow_t&) throw();
void *operator new(std::size_t n, void *p) throw();
void *operator new[](std::size_t n) throw(std::bad_alloc);
void *operator new[](std::size_t n, const std::nothrow_t&) throw();
void *operator new[](std::size_t n, void *p) throw();
```

The `<new>` header file supercedes the `new.h` header, which remains for compatibility as a wrapper to `<new>`.

`bad_alloc`

```
class bad_alloc : public exception {
};
```

The class describes an exception thrown to indicate that an allocation request did not succeed. The value returned by `what()` is an implementation-defined C string. None of the member functions throw any exceptions.

`new_handler`

```
typedef void (*new_handler)();
```

The type points to a function suitable for use as a new handler.

`nothrow`

```
extern const nothrow_t nothrow;
```

The object is used as a function argument to match the parameter type `nothrow_t`.

`nothrow_t`

```
class nothrow_t {};
```

The class is used as a function parameter to operator `new` to indicate that the function should return a null pointer to report an allocation failure, rather than throw an exception.

new.h — Storage allocation and free

The ISO/ANSI C++ Standard (ISO/IEC 14882:1998(E)) supersedes this header with the new header `<new>`. However, `new.h` remains for compatibility as a wrapper for a [target operating system release](#) of z/OS V1R2 and later.

For compilations with a [target operating system release](#) before z/OS V1R2, the `new.h` header file declares the `set_new_handler()` function, which is used for z/OS C++ exception handling (`try`, `throw`, and `catch`). This header file also declares array and non-array version of the allocation operator `new` and the deallocation operator `delete`.

terminat.h — Exception handling

The ISO/ANSI C++ Standard (ISO/IEC 14882:1998(E)) supersedes this header with the new header `<exception>`. However, `terminat.h` remains for compatibility as a wrapper for a [target operating system release](#) of z/OS V1R2 and later.

For compilations with a [target operating system release](#) before z/OS V1R2, the `terminat.h` header file, which is used for C++ exception handling, declares the `terminate()` and `set_terminate()` functions.

typeinfo — Type identification operator

The `typeinfo` header file defines several types associated with the type identification operator `typeid`, which yields information about both static and dynamic types.

```
namespace std {
    class type_info;
    class bad_cast;
    class bad_typeid;
};
```

`type_info`

The class describes type information generated within the program by the implementation. Objects of this class effectively store a pointer to a name for the type, and an encoded value suitable for comparing two types for equality or collating order. The names, encoded values, and collating order for types are all unspecified and may differ between program executions.

An expression of the form `typeid x` is the only way to construct a (temporary) `type_info` object. The class has only a private copy constructor. Since the assignment operator is also private, you cannot copy or assign objects of class `type_info` either.

```
class type_info {
public:
    virtual ~type_info();
    bool operator==(const type_info& rhs) const;
    bool operator!=(const type_info& rhs) const;
    bool before(const type_info& rhs) const;
    const char *name() const;
private:
    type_info(const type_info& rhs);
    type_info& operator=(const type_info& rhs);
};

type_info::operator!=
```

```
bool operator!=(const type_info& rhs) const;
The function returns !(*this == rhs).

type_info::operator==
bool operator==(const type_info& rhs) const;
The function returns a nonzero value if *this and rhs represent the
same type.

type_info::before
bool before(const type_info& rhs) const;
The function returns a nonzero value if *this precedes rhs in the
collating order for types.

type_info::name
const char *name() const;
The function returns a C string which specifies the name of the type.
```

bad_cast

```
class bad_cast : public exception {
};
```

The class describes an exception thrown to indicate that a dynamic cast expression, of the form:

```
dynamic_cast<type>(expression)
```

generated a null pointer to initialize a reference. The value returned by `what()` is an implementation-defined C string. None of the member functions throw any exceptions.

bad_typeid

```
class bad_typeid : public exception {
};
```

The class describes an exception thrown to indicate that a typeid operator encountered a null pointer. The value returned by `what()` is an implementation-defined C string. None of the member functions throw any exceptions.

typeinfo.h — Type identification operator

The ISO/ANSI C++ Standard (ISO/IEC 14882:1998(E)) supersedes this header with the new header `<typeinfo>`. While this header represents function that did not previously exist on the z/OS and OS/390® operating systems, it is being provided now for compatibility as a wrapper to `<typeinfo>`.

The `typeinfo.h` header file contains definitions for types associated with the type identification operator `typeid`, which yields information about both static and dynamic types.

unexpected.h — Exception handling

The ISO/ANSI C++ Standard (ISO/IEC 14882:1998(E)) supersedes this header with the new header `<exception>`. However, `unexpected.h` remains for compatibility as a wrapper for a [target operating system release of z/OS V1R2 and later](#).

For compilations with a [target operating system release before z/OS V1R2](#), the `unexpected.h` header file, which is used for C++ exception handling, declares the `unexpected()` and `set_unexpected()` functions.

Chapter 3. Library functions

This topic describes the z/OS C/C++ runtime library functions, including the built-in library functions used by the IBM z/OS C/C++ compilers.

Names

Identifiers (function names, macros, types) defined by the various standards in the headers are reserved. Also reserved are:

- Identifiers that begin with an underscore and either an uppercase letter or another underscore.
- Identifiers that end with “_t”.

Do not use these reserved identifiers for any purpose other than those defined in the documentation.

All identifiers other than the ISO C identifiers comprise the *user's name space*. You are free to use any of these names. However, a number of names in the z/OS C/C++ runtime library encroach on the user's name space. This is a result of our desire to provide names that are meaningful and easy to remember, or to support industry-defined names, for example: `fetchep()` or `pthread_cancel()`. The header files cause these names to be renamed into reserved names and these in turn are mapped onto the external entry point names that usually are operating-system specific.

If you want to use names in the z/OS C/C++ runtime library that are in the user's name space as defined, just include the appropriate header. If you cannot include the appropriate header because it would bring in other names that collide with your own private names, but you still want to use some of the functions defined there, you can refer to these functions by their reserved internal names. These reserved names are unique, not longer than 8 characters, and usually start with a double underscore.

When long external names are not supported, the compiler automatically maps all underscores and lowercase letters in external identifiers in source code to ‘@’ characters and uppercase characters in the object deck. Thus, to refer to the `fetchep()` function without including the `stdlib.h` header, you can use its reserved internal name `__fetchep()`, which is then automatically mapped to the external entry point `@@FTCHEP`. For C++ functions, you must ensure C linkage by declaring the functions as `extern “C”`.

Functions that are mapped this way have the external entry point listed in the function description in this part under the heading, “External Entry Point”.

Related information

- See [#pragma csect and #pragma map](#) in *z/OS XL C/C++ Language Reference* for more information about external names.
- See [Prelinking and linking z/OS XL C/C++ programs](#) in *z/OS XL C/C++ User's Guide*.
- See [Naming conventions](#) in *z/OS XL C/C++ Programming Guide* for details about external names.

Unsupported functions and external variables in AMODE 64

All examples have been tested to work in 31-bit mode. Some examples might not work in 64-bit mode (AMODE 64). As examples are updated for AMODE 64, a statement of AMODE 64 support is added to the description of the example.

The following functions are not supported in AMODE 64:

- `advance()`
- `brk()`
- `compile()`

- `__console()`
- `__csplist`
- `ctdli()`
- `fortrc().__openMvsRel()`
- `__pcblist`
- `pthread_quiesce_and_get_np()`
- `re_comp()`
- `re_exec()`
- `regcmp()`
- `regex()`
- `sbrk()`
- `sock_debug_bulk_perf0()`
- `sock_do_bulkmode()`
- `step()`
- `tinit()`
- `tsched()`
- `tsetsubt()`
- `tsyncro()`
- `tterm()`
- `valloc()`

The following external variables are not supported in AMODE 64:

- `__loc1`
- `loc1`
- `loc2`
- `locs`

Standards

Each function description begins with a table to indicate the standards/extensions, language support, and dependencies.

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | | |

See the tables below for more details.

Standards and extensions

The "Standards / Extensions" column describes the supported standards and extensions.

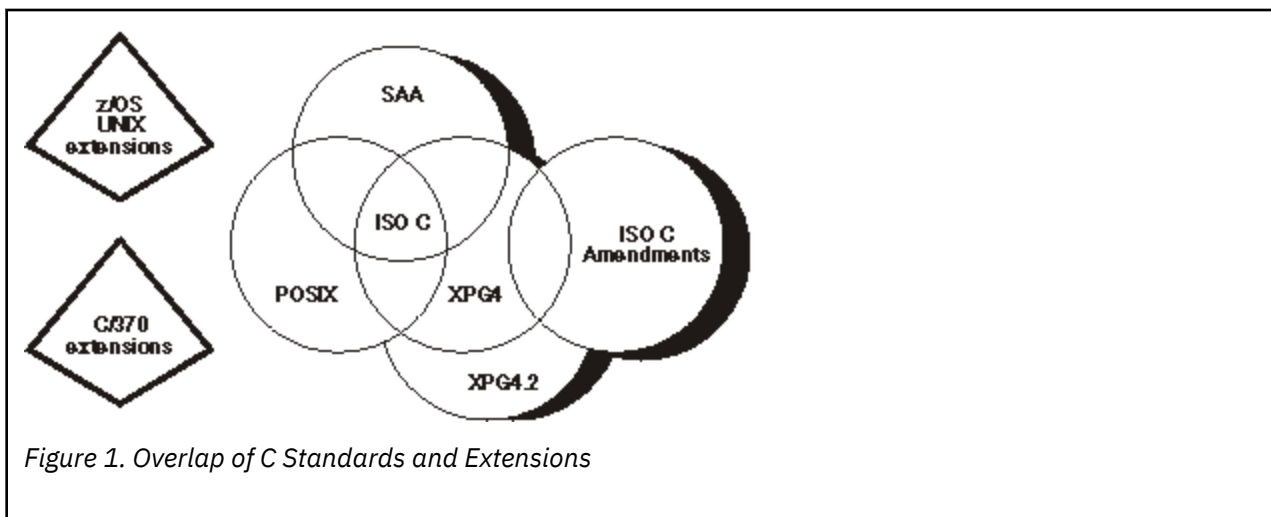
Note: By indicating a standard, we refer to the origin of the function, not necessarily the compliance. For example, functions that are enriched by features from XPG4 have XPG4 listed.

| Standards / Extensions | Refer to |
|------------------------|---|
| ISO C | ISO/IEC 9899:1990(E) |
| ISO C Amendment | A subset of the ISO/IEC 9899:1990/Amendment 1:1993(E) |
| POSIX.1 | ISO/IEC 9945-1:1990/IEEE POSIX 1003.1-1990 |

| Standards / Extensions | Refer to |
|--------------------------------------|--|
| POSIX.1a | A subset of IEEE POSIX 1003.1a, Draft 7, May 1992 |
| POSIX.2 | IEEE Portable Operating System Interface (POSIX) Part 2, P1003.2 draft 12 |
| POSIX.4a | A subset of IEEE POSIX 1003.4a, Draft 6, Feb. 26,1992 |
| POSIX.4b | A subset of IEEE 1003.4b |
| BSD 4.3 | Berkeley Software Distribution (BSD) 4.3 standard (also known as Berkeley sockets) |
| XPG4 | X/Open Common Applications Environment Specification, System Interfaces and Headers, Issue 4 |
| XPG4.2 | X/Open Common Applications Environment Specification, System Interfaces and Headers, Issue 4, Version 2 |
| SAA | IBM Systems Application Architecture® Common Programming Interface (SAA CPI) Level 2 definition of the C language |
| C Library | Functions that are extensions to the runtime library, before the Language Environment product |
| Language Environment | Functions that are extensions to the conventional standards |
| z/OS UNIX | Functions that provide z/OS UNIX support beyond the defined standards |
| Single UNIX Specification, Version 2 | IEEE Std 1003.1-1997 |
| Single UNIX Specification, Version 3 | IEEE Std 1003.1-2001 |
| ISO/ANSI C++ | ISO/ANSI C++ Standard (ISO/IEC 14882:1998(E)) |
| RFC2292 | Advanced Sockets API for IPv6 (draft-ietf-ipngwg-rfc2292bis-06.txt, dated February 25, 2002) Note: Not all of the support described in this draft is available on z/OS. |
| RFC2553 | Basic socket interface extensions for IPv6 (draft-ietf-ipngwg-rfc2253bis-05.txt, dated February 2002) Note: Not all of the support described in this draft is available on z/OS. |
| RFC3678 | Socket interface extensions for multicast source filters |
| ANSI/IEEE Standard P754 | IEEE standard for binary floating-point arithmetic |
| C99 | ISO/IEC 9899:1999(E) |

| Standards / Extensions | Refer to |
|----------------------------|--|
| C/C++ DFP | <ol style="list-style-type: none"> 1. ISO/IEC TR24732 -- Extensions for the programming language C to support decimal floating point arithmetic 2. ISO/IEC TR24733 -- Extensions for the programming language C++ to support decimal floating point arithmetic |
| C++ TR1 C99 | ISO/IEC DTR 19768 - Draft Technical Report on C++ library Extensions, chapter 8, C compatibility |
| C11 | ISO/IEC 9899:2011(E) |
| Runtime library extensions | Additional functions to the runtime library |

These standards do have some overlap, as illustrated in [Figure 1 on page 94](#).



The C library contains several functions that are extensions to the SAA CPI Level 2 definition. These library functions are available only with the runtime library extensions. As indicated, some of the *stub* routines for the extensions are available if they are ISO C/C++ compliant. They are made available for compatibility with Version 1; they may not be available in the future. (Within runtime libraries, a *stub routine* is a routine that contains the minimum lines of code required to locate a given routine at run time.)

Many of the symbols that are defined in headers are “protected” by a feature test macro. For information on the relationships between feature test macros and the standards, see [“Feature test macros” on page 3](#).

Language support

The "C or C++" column indicates the language support for each function.

| C or C++ | Description |
|----------|--|
| C only | The function is supported by the IBM z/OS C compiler only |
| C++ only | The function is supported by the IBM z/OS C++ compiler only. |
| both | The function is supported by both the IBM z/OS C and the IBM z/OS C++ compilers. |

Dependencies

The "Dependencies" column indicates the dependencies that are identified for each function. If the dependencies are not met, then the function fails, and returns an `errno` of `EMVSNORTL`. Functions defined by the standards that cannot fail, will cause abnormal termination and return Language Environment condition CEE5001.

| Dependencies | Description |
|--------------|--|
| POSIX(ON) | <ul style="list-style-type: none"> POSIX(ON) <i>required</i> refers to whether the enclave can run with the POSIX semantics. <p>POSIX is an application characteristic that is maintained at the enclave level. After you have established the characteristic during enclave initialization, you cannot change it.</p> <p>When you set POSIX to ON, you can use functions that are unique to POSIX, such as <code>pthread_create()</code>.</p> <p>One of the effects of POSIX(ON) is the enablement of POSIX signal handling semantics, which interact closely with the z/OS Language Environment condition handling semantics. Where ambiguities exist between ISO C/C++ and POSIX semantics, the POSIX runtime setting indicates that the POSIX semantics will be followed.</p> |
| OS/390 V2R6 | |
| OS/390 V2R7 | |
| OS/390 V2R8 | |
| OS/390 V2R9 | |
| OS/390 V2R10 | |
| z/OS V1R1 | |
| z/OS V1R2 | |
| z/OS V1R3 | |
| z/OS V1R4 | |
| z/OS V1R5 | |
| z/OS V1R6 | |
| z/OS V1R7 | |
| z/OS V1R8 | |
| z/OS V1R9 | |
| AMODE 64 | |

Using C include files from C++

If you need to use an old C header file in a C++ program, use `extern`, like this:

```
extern "C" {
    #include "myhdr.include"
}
```

Built-in functions

Built-in functions are ones for which the compiler generates inline code at compile time. Every call to a built-in function eliminates a runtime call to the function having the same name in the dynamic library.

Built-in functions are used by application code, while it is running, without reference to the dynamic library. Although built-in functions increase the size of a generated application slightly, this should be offset by the improved performance resulting from reducing the overhead of the dynamic calls. Built-in functions can be used with the System Programming C (SPC) Facilities to generate free-standing C applications.

Restriction: The SPC facility is not supported in AMODE 64.

Table 18 on page 96 shows all of the built-in functions. In the listing of library functions, each built-in function is labeled as such.

Table 18. Built-in library functions

| Built-in library functions | | | | |
|----------------------------|-----------|----------|-----------|-----------|
| abs() | alloca() | cabs() | cs() | decabs() |
| decchk() | decfix() | fabs() | fortrc() | memchr() |
| memcmp() | memcpy() | memset() | strcat() | strchr() |
| strcmp() | strcpy() | strlen() | strncat() | strncmp() |
| strncpy() | strrchr() | tsched() | wmemchr() | wmemcmp() |
| wmemcpy() | wmemset() | | | |

The built-in versions of these functions are accessed by preprocessor macros defined in the standard header files. They are not used unless the appropriate header file (such as `decimal.h`, `math.h`, `stdlib.h`, `string.h` or `wchar.h`) is included in the source file.

The built-in versions of functions `wmemchr()`, `wmemcmp()`, `wmemcpy()`, and `wmemset()` are only available under **ARCH(7)** when LP64 is not used.

Your program will use the built-in version of a standard function only if you include the associated standard header file. However, `decfix()`, `decabs()`, and `decchk()` are implemented only as built-in functions. They are not available without including the header file.

Note: When **NOOPT** or **COMPACT** is specified, the compiler might not expand all built-in functions.

If you are using the standard header file, but want to use the function in the dynamic library instead of the built-in function, you can force a call to the dynamic library by putting parentheses around the function name in your source code: `(memcpy)(buf1, buf2, len)`

The built-in functions are documented in [Using hardware built-in functions in z/OS XL C/C++ Programming Guide](#).

If you will never use the built-in version, you can also use `#undef` with the function name. For example, `#undef memcpy` causes all calls to `memcpy` in the compilation unit to make a dynamic call to the function rather than using the built-in version.

IEEE binary floating-point

Starting with OS/390 V2R6 (including the Language Environment and C/C++ components), support has been added for IEEE binary floating-point (IEEE floating-point) as defined by the ANSI/IEEE Standard 754-1985, IEEE Standard for Binary Floating-Point Arithmetic.

Notes:

1. You must have OS/390 Release 6 or higher to use the IEEE Binary Floating-Point instructions. In Release 6, the base control program (BCP) is enhanced to support the new IEEE Binary Floating-Point hardware in the IBM S/390® Generation 5 Server. This enables programs running on OS/390 Release 6 to use the IEEE Binary Floating-Point instructions and 16 floating-point registers. In addition, the BCP provides simulation support for all the new floating-point hardware instructions. This enables applications that make light use of IEEE Binary Floating-Point, and can tolerate the overhead of software simulation, to execute on OS/390 V2R6 without requiring an IBM S/390 Generation 5 Server.
2. The terms *binary floating point* and *IEEE binary floating point* are used interchangeably. The abbreviations BFP and HFP, which are used in some function names, refer to binary floating point and hexadecimal floating point respectively.
3. Under Hexadecimal Floating-Point format, the rounding mode is set to round toward 0. Under IEEE Binary Floating-Point format, the rounding mode is to round toward the nearest integer.

You can select the format of floating-point numbers that are produced in a compile unit to be either [IEEE floating point representation](#) or [hexadecimal floating point representation](#).

The C/C++ runtime library interfaces, which formerly supported only hexadecimal floating-point format, have been changed in OS/390 V2R6 to support both IEEE Binary Floating-Point and hexadecimal floating-point formats. These interfaces are documented in the *z/OS C/C++ Runtime Library Reference*.

The primary documentation for the IEEE Binary Floating-Point support is contained in *z/Architecture® Principles of Operation* and *z/OS XL C/C++ User's Guide*.

IEEE binary floating point support provides interoperability and portability between platforms. It is anticipated that the support will be most commonly used for new and ported applications and in emerging environments, such as Java. Customers should not migrate existing applications that use hexadecimal floating point to binary floating point, unless there is a specific reason.

IBM does not recommend mixing floating-point formats in an application. However, for applications which must handle both formats, the z/OS C/C++ runtime library does offer some support. Reference information for IEEE Binary Floating-Point can also be found in *z/OS XL C/C++ Language Reference*.

IEEE decimal floating-point

Starting with z/OS V1R9 (including the Language Environment and C/C++ components), support has been added for IEEE decimal floating-point as defined by the ANSI/IEEE Standard P754/D0.15.3, IEEE Standard for Floating-Point Arithmetic.

Note:

1. You must have z/OS V1R9 or higher to use IEEE decimal floating-point, the hardware must have the Decimal Floating Point Facility installed and the `__STDC_WANT_DEC_FP__` feature test macro must be defined.
2. The abbreviation DFP refers to IEEE decimal floating-point.
3. IEEE decimal floating-point is not supported in a CICS environment.

The compiler supports [IEEE decimal floating-point types](#). z/OS C/C++ runtime library interfaces, which support IEEE decimal floating-point numbers have been added for z/OS V1R9 and other existing interfaces have been updated to support DFP.

4. When one or more input values for a Decimal Floating Point (DFP) library function are not in the preferred Densely Packed Decimal (DPD) encoding, it is not defined whether or not the output values

are converted to the preferred DPD coding. Applications should not rely on the current behavior of library functions regarding the DPD recoding of output values.

Related information

- Reference information for IEEE floating-point can also be found in *z/OS XL C/C++ Language Reference*.
- The primary documentation for the IEEE decimal floating-point support is contained in *z/Architecture Principles of Operation* and *z/OS XL C/C++ User's Guide*.

External variables

The POSIX 1003.1 and X/Open CAE Specification 4.2 (XPG4.2) require that the C system header files define certain external variables. Additional variables are defined for use with POSIX or XPG4.2 functions. If you define one of the POSIX or XPG4 feature test macros and include one of these headers, the external variables will be defined in your program. These external variables are treated differently compared with other global variables in a multithreaded environment (values are thread-specific) and across a call to a fetched module (values are propagated).

To access the global variable values, the following must be specified during C/C++ compiles and z/OS bind:

Non-XPLINK (non-thread-safe)

To compile C code, the compiler must generate reentrant code for the code that is not naturally reentrant or generate object code for DLLs or DLL applications. The SCEEOBJ autocall library must be specified during the bind.

Non-XPLINK (thread-safe)

No additional options are required for either C or C++. The `_SHARE_EXT_VARS` feature test macro, or the necessary `_SHR_` prefixed feature test macros must be used.

Equivalently, the necessary thread-specific functions can be called directly (as documented below under each external variable).

XPLINK (non-thread-safe)

When you compile with XPLINK linkage, the C runtime library side-deck, member CELHS003 of the SCEELIB data set, must be included during the bind.

XPLINK (thread-safe)

When you compile with XPLINK linkage, the C runtime library side-deck, member CELHS003 of the SCEELIB dataset, must be included during the bind.

The `_SHARE_EXT_VARS` feature test macro, or the necessary `_SHR_` prefixed feature test macros must be used. Equivalently, the necessary thread-specific functions can be called directly (as documented in the later sections under each external variable).

LP64 (non-thread-safe)

When you compile in 64-bit addressing mode, the C runtime library side-deck, member CELQS003 of the SCEELIB dataset, must be included during the bind.

The `_SHARE_EXT_VARS` feature test macro, or the necessary `_SHR_` prefixed feature test macros must be used.

Equivalently, the necessary thread-specific functions can be called directly (as documented in the later sections under each external variable).

LP64 (thread-safe)

When you compile in 64-bit addressing mode, the C runtime library side-deck, member CELQS003 of the SCEELIB dataset, must be included during the bind.

The `_SHARE_EXT_VARS` feature test macro, or the necessary `_SHR_` prefixed feature test macros must be used.

Equivalently, the necessary thread-specific functions can be called directly (as documented in the later sections under each external variable).

Note: When you compile with XPLINK linkage or in 64-bit mode, z/OS UNIX invocation commands automatically include the side-deck.

errno

When a runtime library function fails, the function may do any of the following to identify the error:

- Set `errno` to a documented value.
- Set `errno` to a value that is not documented. You can use `strerror()` or `perror()` to get the message associated with the `errno`.
- Not set `errno`.
- Clear `errno`.

See also **errno.h**.

daylight

Daylight savings time flag set by `tzset()`. Note that other time zone sensitive functions such as `ctime()`, `localtime()`, `mktime()`, and `strftime()` implicitly call `tzset()`.

Note: Use the `__dlight()` function to access the thread-specific value of `daylight`.

See also `time.h`.

getdate_err

The variable is set to the value below when an error occurs in the `getdate()` function.

1. The `DATMSK` environment variable is `NULL` or undefined.
2. The template file cannot be opened for reading.
3. Failed to get file status information.
4. The template file is not a regular file.
5. An error was encountered while reading the template file.
6. Memory allocation failed (not enough memory available).
7. No line in the template file matches the input specification.
8. Non-valid input specification. For example, February 31; or a time that can not be represented in a `time_t` (representing the time is seconds since Epoch - midnight, January 1, 1970 (UTC)).
9. Unable to determine current time.

Any changes to `errno` are unspecified.

Note: This value is unique for z/OS UNIX.

The `getdate64()` interface affects the same pointer to the thread-specific value of `getdate_err` and uses the same `getdate_err` values as the `getdate()` interface.

Note: Use the `__gderr()` function to access the thread-specific value of `getdate_err`. The `getdate64()` function affects the same pointer to the thread-specific value of `getdate_err` as the `getdate()` function does.

See also `time.h`.

h_errno

An integer which holds the specific error code when the network name server encounters an error. The network name server is used by the `gethostbyname()` and `gethostbyaddr()` functions.

Notes:

- Use the `_h_errno()` function to access the thread-specific value of `h_errno`. See also `netdb.h`.
- This variable is kept for historical reasons. However, it is used only in connection with the functions `gethostbyaddr()` and `gethostbyname()`, which are obsolescent in Single UNIX Specification, Version 3, so that the `h_errno` variable may also be withdrawn in the future.

__loc1

Restriction: This external variable is not supported in AMODE 64

A global character pointer which is set by the `regex()` function to point to the first matched character in the input string. Use the `___loc1()` function to access the thread-specific value of `__loc1`.

Note: This variable is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use the interfaces supported by the `<regex.h>` header, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001 Regular Expressions. See also `regex.h`.

If it is necessary to continue using this symbol in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3. See also `libgen.h`.

loc1

Restriction: This external variable is not supported in AMODE 64.

A pointer to characters matched by regular expressions used by `step()`. The value is not propagated across a call to a fetched module.

Note: This variable is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use the interfaces supported by the `<regex.h>` header, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001 Regular Expressions. See also `regex.h`.

loc2

Restriction: This external variable is not supported in AMODE 64

A pointer to characters matched by regular expressions used by `step()`. The value is not propagated across a call to a fetched module.

Note: This variable is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use the interfaces supported by the `<regex.h>` header, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001 Regular Expressions. See also `regex.h`.

locs

Restriction: This external variable is not supported in AMODE 64

Used by `advance()` to stop regular expression matching in a string. The value is not propagated across a call to a fetched module. See also `regex.h`.

Note: This variable is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use the interfaces supported by the `<regex.h>` header, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001 Regular Expressions. See also `regex.h`.

optarg

Character pointer used by `getopt()` and `getopt_long()` for options parsing variables.

Notes:

- Use the `__opargf()` function to access the thread-specific value of `optarg`.
- This variable has been removed from `stdio.h` by Single UNIX Specification, Version 3 and is exposed for Version 3 only in `unistd.h`. See also `stdio.h` and `unistd.h`.

opterr

Error value used by `getopt()` and `getopt_long()`.

Notes:

- Use the `__operrf()` function to access the thread-specific value of `opterr`.
- This variable has been removed from `stdio.h` by Single UNIX Specification, Version 3 and is exposed for Version 3 only in `unistd.h`. See also `stdio.h` and `unistd.h`.

optind

Integer pointer used by `getopt()` and `getopt_long()` for options parsing variables.

Notes:

- Use the `__opindf()` function to access the thread-specific value of `optind`.
- This variable has been removed from `stdio.h` by Single UNIX Specification, Version 3 and is exposed for Version 3 only in `unistd.h`. See also `stdio.h` and `unistd.h`.

optopt

Integer pointer used by `getopt()` and `getopt_long()` for options parsing variables.

Notes:

- Use the `__opoptf()` function to access the thread-specific value of `optopt`.
- This variable has been removed from `stdio.h` by Single UNIX Specification, Version 3 and is exposed for Version 3 only in `unistd.h`. See also `stdio.h` and `unistd.h`.

signgam

Storage for sign of `lgamma()`. This function defaults to thread-specific. See also `math.h`.

stderr

Standard Error stream. The external variable will be initialized to point to the enclave-level stream pointer for the standard error file. There is no multithreaded function. See also `stdio.h`.

stdin

Standard Input stream. The external variable will be initialized to point to the enclave-level stream pointer for the standard input file. There is no multithreaded function. See also `stdio.h`.

stdout

Standard Output stream. The external variable will be initialized to point to the enclave-level stream pointer for the standard output file. There is no multithreaded function. See also `stdio.h`.

t_errno

An integer which holds the specific error code when a failure occurs in one of the X/Open Transport Interface (XTI) functions. Use the `__t_errno()` function to access the thread-specific value of `t_errno`.

Note: Use the `__t_errno()` function to access the thread-specific value of `t_errno`.

See also `xti.h`.

timezone

Long integer difference from UTC and standard time as set by `tzset()`. Note that other time zone sensitive functions such as `ctime()`, `localtime()`, `mktime()`, and `strftime()` implicitly call `tzset()`.

Note: Use the `__tzone()` function to access the thread-specific value of `timezone`.

See also `time.h`.

tzname

Character pointer to unsized array of timezone strings used by `tzset()` and `ctime()`. The `*tzname` variable contains the Standard and Daylight Savings time zone names. If the TZ environment variable is present and correct, `tzname` will be set from TZ. Otherwise `tzname` will be set from the LC_TOD locale category. See the `tzset()` function for a description. There is no multithreaded function. See also `time.h`.

The `__restrict__` macro

The `restrict` keyword is being made available in the form of a macro named `__restrict__` that can be used for coding before the availability of a compiler that is designed to support C99. Once the compiler support is available, only a recompile is necessary. Applications need to include `<features.h>` before using the `__restrict__` macro.

The `__NORETURN` macro

The `_Noreturn` keyword is being made available in the form of a macro named `__NORETURN`. Applications need to include `<features.h>` before using the `__NORETURN` macro.

The `__noreturn__` macro

The `_Noreturn` keyword is being made available in the form of a macro named `__noreturn__`, which can be used for coding before the availability of a compiler that is designed to support C11. Once the compiler support is available, only a recompile is necessary. Applications need to include `<features.h>` before using the `__noreturn__` macro.

Note: Open XL C/C++ for z/OS reserves `__noreturn__` as a keyword. To avoid name conflict, `__noreturn__` is not defined as a macro in `features.h` for Open XL C/C++ for z/OS.

abort() — Stop a program

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 C11 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

__noreturn__ void abort(void);
```

General description

Causes an abnormal program termination and returns control to the host environment. The `abort()` function flushes all buffers and closes all open files. Be aware that abnormal termination will *not* run the `atexit()` list functions.

If the `abort()` function is called and the user has a handler for `SIGABRT`, then `SIGABRT` is raised; however, `SIGABRT` is raised again when the handler associated with the default action is returned. The code path only passes through the user's handler once, even if the handler is reset. The same thing occurs if `SIGABRT` is ignored; abnormal termination occurs.

The `abort()` function will not result in program termination if `SIGABRT` is caught by a signal handler, and the signal handler does not return. You can avoid returning by “jumping” out of the handler with `setjmp()` and `longjmp()`. In IBM z/OS C programs, you can jump out of the handler with `sigsetjmp()` and `siglongjmp()`.

For more information see the process termination sections in the chapter “Using Runtime User Exits” in [z/OS XL C/C++ Programming Guide](#).

Special behavior for POSIX C: To obtain access to the special POSIX behavior for `abort()`, the POSIX runtime option must be set ON.

Calls to `abort()` raise the `SIGABRT` signal, using `pthread_kill()`, so that the signal is directed to the same thread. A `SIGABRT` signal generated by `abort()` cannot be blocked.

Under POSIX, the handler can use `siglongjmp()` to restore the environment at a place in the code where a `sigsetjmp()` was previously issued. In this way, an application can avoid the process for termination.

Special behavior for C++: If `abort()` is called from a IBM z/OS C++ program, the program will be terminated immediately, without leaving the current block. Functions passed to `atexit()`, and destructors for static and local (automatic) objects, will not be called.

By default, the IBM z/OS C++ function `terminate()` calls `abort()`.

Returned value

The abnormal termination return code for z/OS is 2000.

Example

CELEBA01

```
/* CELEBA01

This example tests for successful opening of the file myfile.
If an error occurs, an error message is printed and the program
ends with a call to the abort() function.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    FILE *stream;
    unlink("myfile.dat");
    if ((stream = fopen("myfile.dat", "r")) == NULL)
    {
        printf("Could not open data file\n");
        abort();
    }
    printf("Should not see this message\n");
}
}
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“assert\(\) — Verify condition” on page 189](#)
- [“atexit\(\) — Register program termination function” on page 197](#)
- [“exit\(\) — End program” on page 449](#)
- [“pthread_kill\(\) — Send a signal to a thread” on page 1293](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)

abs(), absf(), absl() – Calculate integer absolute value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | |

Format

```
#include <stdlib.h>

int abs(int n);
long abs(long n);           /* C++ only */

#include <math.h>

double abs(double n);       /* C++ only */
float abs(float n);         /* C++ only */
long double abs(long double n); /* C++ only */
float absf(float n);
long double absl(long double n);
```

DFP:

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 abs(_Decimal32 x); /* C++ only */
_Decimal64 abs(_Decimal64 x); /* C++ only */
_Decimal128 abs(_Decimal128 x); /* C++ only */
```

C++ TR1 C99:

```
#define _TR1_C99
#include <inttypes.h>
intmax_t abs(intmax_t n);

#define _TR1_C99
#include <stdlib.h>
long long abs(long long n);
```

General description

The functions `abs()`, `absf()`, and `absl()` return the absolute value of an argument *n*.

For the integer version of `abs()`, the minimum allowable integer is `INT_MIN+1`. (`INT_MIN` is a macro that is defined in the `limits.h` header file.) For example, with the IBM z/OS C/C++ compiler, `INT_MIN+1` is `-2147483648`.

For the double, float, and long double versions of `abs()`, the minimum allowable values are `DBL_MIN+1`, `FLT_MIN+1`, and `LDBL_MIN+1`, respectively. (The floating-point macro constants are defined in the `float.h` header file.)

If the value entered cannot be represented as an integer, the `abs()`, `absf()`, and `absl()` functions return the same value.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Special behavior for C++: For C++ applications, `abs()` is also overloaded for the types `long`, `float`, and `long double`.

Returned value

The returned value is the absolute value, if the absolute value is possible to represent.

Otherwise the input value is returned.

There are no `errno` values defined.

Example

CELEBA02

```
/* CELEBA02

   This example calculates the absolute value of an integer
   x and assigns it to y.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    int x = -4, y;

    y = abs(x);
    printf("The absolute value of %d is %d.\n", x, y);
}
```

Output

The absolute value of -4 is 4.

Related information

- [“float.h — ISO C/C++ constants for floating-point data types” on page 24](#)
- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“math.h — Floating-point math functions” on page 40](#)
- [“stdlib.h — Standard library functions” on page 65](#)
- [“fabs\(\), fabsf\(\), fabsl\(\) — Calculate floating-point absolute value” on page 465](#)
- [“labs\(\) — Calculate long absolute value” on page 934](#)

accept() — Accept a new connection on a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int accept(int socket, struct sockaddr *__restrict__ address,
           socklen_t *__restrict__ address_len);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>

int accept(int socket, struct sockaddr *address, int *address_len);
```

General description

The `accept()` call is used by a server to accept a connection request from a client. When a connection is available, the socket created is ready for use to read data from the process that requested the connection. The call accepts the first connection on its queue of pending connections for the given socket *socket*. The `accept()` call creates a new socket descriptor with the same properties as *socket* and returns it to the caller. If the queue has no pending connection requests, `accept()` blocks the caller unless *socket* is in nonblocking mode. If no connection requests are queued and *socket* is in nonblocking mode, `accept()` returns -1 and sets the error code to EWOULDBLOCK. The new socket descriptor cannot be used to accept new connections. The original socket, *socket*, remains available to accept more connection requests.

Parameter

Description

socket

The socket descriptor.

address

The socket address of the connecting client that is filled in by `accept()` before it returns. The format of *address* is determined by the domain that the client resides in. This parameter can be NULL if the caller is not interested in the client address.

address_len

Must initially point to an integer that contains the size in bytes of the storage pointed to by *address*. On return, that integer contains the size required to represent the address of the connecting socket. If this value is larger than the size supplied on input, then the information contained in `sockaddr` is truncated to the length supplied on input. If *address* is NULL, *address_len* is ignored.

The *socket* parameter is a stream socket descriptor created with the `socket()` call. It is usually bound to an address with the `bind()` call. The `listen()` call marks the socket as one that accepts connections and allocates a queue to hold pending connection requests. The `listen()` call places an upper boundary on the size of the queue.

The *address* parameter is a pointer to a buffer into which the connection requester's address is placed. The *address* parameter is optional and can be set to be the NULL pointer. If set to NULL, the requester's address is not copied into the buffer. The exact format of *address* depends on the addressing domain from which the communication request originated. For example, if the connection request originated in the AF_INET domain, *address* points to a **sockaddr_in** structure, or if the connection request originated in the AF_INET6 domain, *address* points to a **sockaddr_in6** structure. The **sockaddr_in** and **sockaddr_in6** structures are defined in `netinet/in.h`. The *address_len* parameter is used only if the address is not NULL. Before calling `accept()`, you must set the integer pointed to by *address_len* to the size of the buffer, in bytes, pointed to by *address*. On successful return, the integer pointed to by *address_len* contains the actual number of bytes copied into the buffer. If the buffer is not large enough to hold the address, up to *address_len* bytes of the requester's address are copied. If the actual length of the address is greater than

the length of the supplied **sockaddr**, the stored address is truncated. The **sa_len** member of the store structure contains the length of the untruncated address.

Notes:

1. This call is used only with SOCK_STREAM sockets. There is no way to screen requesters without calling `accept()`. The application cannot tell the system the requesters from which it will accept connections. However, the caller can choose to close a connection immediately after discovering the identity of the requester.
2. The `accept()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

A socket can be checked for incoming connection requests using the `select()` call.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, `accept()` returns a nonnegative socket descriptor.

If unsuccessful, `accept()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAGAIN

If during an `accept` call that changes identity, the UID of the new identity is already at MAXPROCUID, the `accept` call fails.

EBADF

The *socket* parameter is not within the acceptable range for a socket descriptor.

EFAULT

Using *address* and *address_len* would result in an attempt to copy the address into a portion of the caller's address space into which information cannot be written.

EINTR

A signal interrupted the `accept()` call before any connections were available.

EINVAL

`listen()` was not called for socket descriptor *socket*.

EIO

There has been a network or transport failure.

EMFILE

An attempt was made to open more than the maximum number of file descriptors allowed for this process.

EMVSEERR

Two consecutive `accept` calls that cause an identity change are not allowed. The original identity must be restored (`close()` the socket that caused the identity change) before any further accepts are allowed to change the identity

ENFILE

The maximum number of file descriptors in the system are already open.

ENOBUFS

Insufficient buffer space is available to create the new socket.

ENOTSOK

The *socket* parameter does not refer to a valid socket descriptor.

EOPNOTSUPP

The socket type of the specified socket does not support accepting connections.

EWOULDBLOCK

The socket descriptor *socket* is in nonblocking mode, and no connections are in the queue.

Example

The following are two examples of the `accept()` call. In the first, the caller wishes to have the requester's address returned. In the second, the caller does not wish to have the requester's address returned.

```
int clientsocket;
int s;
struct sockaddr clientaddress;
int address_len;
int accept(int s, struct sockaddr *addr, int *address_len);
/* socket(), bind(), and listen()
have been called */
/* EXAMPLE 1: I want the address now */
address_len = sizeof(clientaddress);
clientsocket = accept(s, &clientaddress, &address_len);
/* EXAMPLE 2: I can get the address later using getpeername() */
clientsocket = accept(s, (struct sockaddr *) 0,
(int *) 0);
```

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“getpeername\(\) — Get the name of the peer connected to a socket” on page 750](#)
- [“listen\(\) — Prepare the server for incoming client requests” on page 977](#)
- [“socket\(\) — Create a socket” on page 1677](#)

accept4() — Accept a new connection on a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int accept4(int sockfd, struct sockaddr *addr, socklen_t *addrlen, int flags);
```

General description

`accept4()` is used by a server to accept a connection request from a client. When a connection is available, the created socket is ready for use to read data from the process that requests the connection. The call accepts the first connection on its queue of pending connections for the given *socket*. `accept4()` creates a new socket descriptor with the same properties as *socket* and returns it to the caller. If the queue has no pending connection requests, `accept4()` blocks the caller unless *socket* is in nonblocking mode. If no connection requests are queued and *socket* is in nonblocking mode, `accept4()` returns -1 and sets the error code to `EWOULDBLOCK`. The new socket descriptor cannot be used to accept new connections. The original *socket* remains available to accept more connection requests. `accept4()` extends the `accept()` function by accepting the `SOCK_CLOEXEC` and `SOCK_NONBLOCK` flags.

Parameter

Description

socket

The socket descriptor

address

The socket address of the connecting client that is filled in by `accept4()` before it returns. The format of *address* is determined by the domain that the client resides in. This parameter can be NULL if the caller is not interested in the client address.

address_len

Must initially point to an integer that contains the size in bytes of the storage pointed to by *address*. On return, that integer contains the size that is required to represent the address of the connecting socket. If this value is larger than the size that is supplied on input, then the information that is contained in *sockaddr* is truncated to the length that is supplied on input. If *address* is NULL, *address_len* is ignored.

flags

If *flags* is 0, then `accept4()` is the same as `accept()`. The following values can be bitwise ORed in *flags* to obtain different behavior:

SOCK_NONBLOCK

Set the `O_NONBLOCK` file status flag on the new open file description. Using this flag saves extra calls to `fcntl()` to achieve the same result.

SOCK_CLOEXEC

Set the `close-on-exec` (`FD_CLOEXEC`) flag on the new file descriptor. See the description of the `O_CLOEXEC` flag in [open\(\)](#) for more information.

The *socket* parameter is a stream socket descriptor that is created with the `socket()` call. It is bound to an address with the `bind()` call. The `listen()` call marks the socket as one that accepts connections and allocates a queue to hold pending connection requests. The `listen()` call places an upper boundary on the size of the queue.

The *address* parameter is a pointer to a buffer into which the connection requester's address is placed. The *address* parameter is optional and can be set to be the NULL pointer. If set to NULL, the requester's address is not copied into the buffer. The exact format of *address* depends on the addressing domain from which the communication request originated. For example, if the connection request originated in the `AF_INET` domain, *address* points to a `sockaddr_in` structure, or if the connection request originated in the `AF_INET6` domain, *address* points to a `sockaddr_in6` structure. The `sockaddr_in` and `sockaddr_in6` structures are defined in `netinet/in.h`. The *address_len* parameter is used only if *address* is not NULL. Before calling `accept4()`, you must set the integer pointed to by *address_len* to the size of the buffer, in bytes, pointed to by *address*. On successful return, the integer pointed to by *address_len* contains the actual number of bytes that are copied into the buffer. If the buffer is not large enough to hold the address, up to *address_len* bytes of the requester's address are copied. If the actual length of the address is greater than the length of the supplied `sockaddr`, the stored address is truncated. The `sa_len` member of the store structure contains the length of the untruncated address.

Note: `accept4()` is used only with `SOCK_STREAM` sockets. There is no way to screen requesters without calling `accept4()`. The application cannot tell the system the requesters from which it accepts connections. However, the caller can choose to close a connection after discovering the identity of the requester.

A socket can be checked for incoming connection requests by using `select()`.

Returned value

If successful, `accept4()` returns a nonnegative socket descriptor.

If unsuccessful, `accept4()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EAGAIN**

If during an `accept` call that changes identity, the UID of the new identity is already at `MAXPROCUID`, the `accept` call fails.

EBADF

The *socket* parameter is not within the acceptable range for a socket descriptor.

EFAULT

Using *address* and *address_len* can result in an attempt to copy the address into a portion of the caller's address space into which information cannot be written.

EINTR

A signal interrupts the `accept4()` call before any connections are available.

EINVAL

`listen()` is not called for socket descriptor *socket*.

EIO

There is a network or transport failure.

EMFILE

An attempt is made to open more than the maximum number of file descriptors that are allowed for this process.

EMVSERR

Two consecutive `accept` calls that cause an identity change are not allowed. The original identity must be restored by closing the socket that caused the identity change before any further accepts are allowed to change the identity.

ENFILE

The maximum number of file descriptors in the system are already open.

ENOBUFS

Insufficient buffer space is available to create the new socket.

ENOTSOCK

The *socket* parameter does not refer to a valid socket descriptor.

EOPNOTSUPP

The socket type of the specified socket does not support accepting connections.

EWouldBlock

The socket descriptor *socket* is in nonblocking mode, and no connections are in the queue.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“getpeername\(\) — Get the name of the peer connected to a socket” on page 750](#)
- [“listen\(\) — Prepare the server for incoming client requests” on page 977](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)

accept_and_recv() — Accept connection and receive first message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

X/Open:

```
#define _OPEN_SYS_SOCKET_EXT2
#include <sys/socket.h>

int accept_and_recv(int socket, int *accept_socket,
                   struct sockaddr *remote_address,
                   socklen_t *remote_address_len,
                   struct sockaddr *local_address,
                   socklen_t *local_address_len,
                   void *buffer, size_t buffer_len);
```

General description

The `accept_and_recv()` function extracts the first connection on the queue of pending connections. It either reuses the specified socket (if **accept_socket* is not -1) or creates a new socket with the same socket type, protocol, and address family as the listening socket (if **accept_socket* is -1). It then returns the first block of data sent by the peer and returns the local and remote socket addresses associated with the connection.

The function takes the following arguments:

Parameter Description

socket

Specifies a socket that was created with `socket()`, has been bound to an address with `bind()`, and has issued a successful call to `listen()`.

accept_socket

Pointer to an `int` which specifies the socket on which to accept the incoming connection. The socket must not be bound or connected. Use of this parameter lets the application reuse the accepting socket. It is possible that the system may choose to reuse a different socket than the one the application specified by this argument. In this case, the system will set **accept_socket* to the socket actually reused.

A value of -1 for **accept_socket* indicates that the accepting socket should be assigned by the system and returned to the application in this parameter. It is recommended that a value of -1 be used on the first call to `accept_and_recv()`. For more details, see [“Usage notes” on page 113](#).

remote_address

Either a NULL pointer or a pointer to a `sockaddr` structure where the address of the connecting socket will be returned.

remote_address_len

Points to a `socklen_t`. On input, this specifies the length of the supplied `sockaddr` structure. On output, this contains the length of the stored address.

local_address

Either a NULL pointer or a pointer to a `sockaddr` structure where the address of the local socket will be returned.

local_address_len

Points to a `socklen_t`. On input, this specifies the length of the supplied `sockaddr` structure. On output, this contains the length of the stored address.

buffer

Either a NULL pointer, or a pointer to a buffer where the message should be stored. If this is a NULL pointer, no receive is performed, and `accept_and_recv()` completes when the incoming connection is received.

buffer_len

Specifies the length in bytes of the buffer pointed to by the *buffer* argument.

If **accept_socket* is not -1, the incoming connection will be accepted on the socket specified by **accept_socket*. The system may choose to reuse a different socket. If it does, the system will change **accept_socket* to reflect the socket actually used.

If *remote_address* is not a NULL pointer, the address of the peer for the accepted connection is stored in the *sockaddr* structure pointed to by *remote_address*, and the length of this address is stored in the object pointed to by *remote_address_len*. If the actual length of the address is greater than the length of the supplied socket address structure, the stored address will be truncated.

If *local_address* is not a NULL pointer, the address of the local socket associated with this connection is stored in the *sockaddr* structure pointed to by *local_address*, and the length of this address is stored in the object pointed to by *local_address_len*. If the actual length of the address is greater than the length of the supplied socket address structure, the stored address will be truncated.

Nonblocking mode is not supported for this function. If *O_NONBLOCK* is set on the socket file descriptor, the function will return with -1 and *errno* will be set to *EOPNOTSUPP*.

If the listen queue is empty of connection requests, *accept_and_recv()* will not return until an incoming connection is received.

If *buffer* is not NULL, *accept_and_recv* will not return until the first block of data on the connection has been received, otherwise *accept_and_recv()* returns 0 after the connection is established.

Note: The *accept_and_recv()* function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Usage notes

1. On the first call to *accept_and_recv()*, it is recommended that the application set the socket pointed to by *accept_socket* to -1. This will cause the system to assign the accepting socket. The application then passes the assigned value into the next call to *accept_and_recv()* (by setting *accept_socket = socket_ptr*).

To take full advantage of the performance improvements offered by the *accept_and_recv()* function, a process/thread model different from the one where a parent accepts in a loop and spins off child process threads is needed. The parent/process thread is eliminated. Multiple worker processes/threads are created, and each worker process/thread then executes the *accept_and_recv()* function in a loop. The performance benefits of *accept_and_recv()* include fewer buffer copies, recycled sockets, and optimal scheduling.

Returned value

If successful, *accept_and_recv()* returns the number of bytes (zero or more) stored in the buffer pointed to by the *buffer* argument. Zero can be returned when *buffer* is NULL or when the client closes the socket without sending any data.

A partial success is achieved with **accept_socket* being assigned, a return value of -1 and *errno* set to one of the following values:

| | |
|-------------------|--------------------|
| Error Code | Description |
|-------------------|--------------------|

EINTRNODATA

The *accept_and_recv()* function was interrupted by a signal that was caught after a valid connection was established, but before the first block of data arrived.

EWOULDBLOCK

A new connection was established, but the *SO_RCVTIMEO* timeout value was reached before data was available.

If unsuccessful, *accept_and_recv()* sets **accepted_socket* to -1, returns -1 and sets *errno* to one of the following values:

**Error Code
Description****EBADF**

One of two errors occurred:

1. *socket* is not a valid descriptor.
2. *accept_socket* does not point to a valid descriptor.

ECONNABORTED

A connection has been aborted.

ECONNRESET

A connection was forcibly closed by a peer.

EFAULT

The data buffer pointed to by *accept_socket*, *remote_address*, *remote_address_len*, *local_address*, *local_address_len*, or *buffer* was not valid.

EINTR

The `accept_and_recv()` function was interrupted by a signal that was caught before a valid connection was established.

EINVAL

The *socket* is not accepting connections.

EIO

An I/O error occurred.

EISCONN

The *accept_socket* is either bound or connected already.

EMFILE

OPEN_MAX descriptors are already open in the calling process.

ENOBUFS

No buffer space is available.

ENOMEM

There was insufficient memory available to complete the operation.

ENOREUSE

Socket reuse is not supported.

ENOSR

There were insufficient STREAMS resources available for the operation to complete.

ENOTSOCK

The *socket* argument does not refer to a socket, or *accept_socket* does not point to a socket.

EOPNOTSUPP

One of errors occurred:

1. The type of the socket does not support accepting connections.
2. O_NONBLOCK is set for the socket and nonblocking is not supported for this function.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“getpeername\(\) — Get the name of the peer connected to a socket” on page 750](#)
- [“getsockname\(\) — Get the name of a socket” on page 777](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)

access() — Determine whether a file can be accessed

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int access(const char *pathname, int how);
```

General description

Determines how a z/OS UNIX file can be accessed. When checking to see if a process has appropriate permissions, `access()` looks at the *real* user ID (UID) and group ID (GID), not the effective IDs.

pathname is the name of the file whose accessibility you want to test. The *how* argument indicates the access modes you want to test. The following symbols are defined in the `unistd.h` header file for use in the *how* argument:

F_OK

Tests whether the file exists.

R_OK

Tests whether the file can be accessed for reading.

W_OK

Tests whether the file can be accessed for writing.

X_OK

Tests whether the file can be accessed for execution.

You can take the bitwise inclusive-OR of any or all of the last three symbols to test several access modes at once. If you are using `F_OK` to test for the file's existence, you cannot use OR with any of the other symbols.

Returned value

If the specified access is permitted, `access()` returns 0.

If the given file cannot be accessed in the specified way, `access()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have appropriate permissions to access the file in the specified way, or does not have search permission on some component of the *pathname* prefix.

EINVAL

The value of *how* is incorrect.

ELOOP

A loop exists in the symbolic links.

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters. The **PATH_MAX** value is determined using `pathconf()`.

ENOENT

There is no file named *pathname*, or the *pathname* argument is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EROFS

The argument *how* has specified write access for a file on a read-only file system.

Returned value for POSIX C

The following `errno` values behave differently when a program is running with `POSIX(ON)`:

Error Code**Description****ELOOP**

A loop exists in the symbolic links. This error is issued if the number of symbolic links detected in the resolution is greater than `POSIX_SYMLINK` (a value defined in the `limits.h` header file).

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters, or some component of *pathname* is longer than **NAME_MAX**, when `_POSIX_NO_TRUNC` (defined in the `unistd.h` header file) is in effect. The **PATH_MAX** and **NAME_MAX** values are determined using `pathconf()`.

Example**CELEBA03**

```
/* CELEBA03
   The following example determines how a file is accessed.
*/

#define _POSIX_SOURCE
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    char path[]="/";

    if (access(path, F_OK) != 0)
        printf("%s' does not exist!\n", path);
    else {
        if (access(path, R_OK) == 0)
            printf("You have read access to '%s'\n", path);
        if (access(path, W_OK) == 0)
            printf("You have write access to '%s'\n", path);
        if (access(path, X_OK) == 0)
            printf("You have search access to '%s'\n", path);
    }
}
```

Output: From a non-superuser:

```
You have read access to '/'
You have search access to '/'
```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)

- “stat(), stat64() — Get file information” on page 1706

acl_create_entry() — Add a new extended ACL entry to the ACL

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int acl_create_entry(lacl_t *acl_p, acl_entry_t entry_p, int version);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_create_entry()` function creates a new extended ACL entry in the ACL pointed to by the contents of the pointer argument `acl_p`. The contents of the `acl_entry` are specified by `entry_p`. ACL working storage is allocated as needed. The first call to `acl_get_entry()` following the call to `acl_create_entry()` will obtain the first extended ACL entry in the ACL, as ordered by the system.

The version tells the function the version of ACL entry. See “[sys/acl.h — Manipulate ACL](#)” on page 67 for ACL entry mapping.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_create_entry()` function returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EINVAL

Argument `acl_p` does not point to a pointer to an ACL structure. Argument `entry_d` does not point to a valid extended ACL entry.

ENOMEM

The ACL working storage requires more memory than is available.

Related information

- “[sys/acl.h — Manipulate ACL](#)” on page 67

acl_delete_entry() – Delete an extended ACL entry from the ACL

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS 1
#include <sys/acl.h>

int acl_delete_entry(lacl_t acl_d, acl_entry_t entry_d);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_delete_entry()` function removes the extended ACL entry indicated by `entry_d` in the ACL pointed to by argument `acl_d`. The first call to `acl_get_entry()` following the call to `acl_delete_entry()` will obtain the first extended ACL entry in the ACL, as ordered by the system.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_delete_entry()` function returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EINVAL

Argument `acl_d` does not point to a pointer to an ACL structure. Argument `entry_d` does not point to a valid extended ACL entry or not within the given ACL structure.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)

acl_delete_fd() – Delete an ACL by file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS 1
#include <sys/acl.h>
```



```
int    acl_delete_fd (int fd, int type_d);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_delete_fd()` function deletes the `type_d` ACL. That means that all extended ACL entries are deleted for `type_d` ACL. A file/dir subject must match the owner of the directory/file or the subject must have appropriate privileges.

The effective UID of the process must match the owner of the directory/file or the process must have appropriate privileges. If the `type_d` is the directory/file default and the object referred to by `fd` is not a directory, then the function will fail. An attempt to delete an ACL from a file that does not have that ACL is not considered an error.

Upon successful completion, the `acl_delete_fd()` will delete the type ACL associated with the file referred by argument `fd`. If unsuccessful, the type ACL associated with the file object referred by argument `fd` will not be changed.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_delete_fd()` function returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EBADF

The `fd` argument is not a valid file descriptor.

EINVAL

Argument `type_d` is not a valid ACL type.

ENOTDIR

The type specifies directory/file default ACL and the argument `fd` does not refer to a directory object.

EACCES

The process does not have appropriate privilege to delete the type ACL.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_delete_file\(\) — Delete an ACL by file name” on page 119](#)

[acl_delete_file\(\) — Delete an ACL by file name](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int    acl_delete_file (const char *path_p, int type_d);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_delete_file()` function deletes the *type_d* ACL. That means that all extended ACL entries are deleted for *type_d* ACL. A file/directory always has base ACL entries so they cannot be deleted. The effective UID of the process must match the owner of the directory/file or the process must have appropriate privileges.

If the *type_d* is the directory/file default and the object referred to by *fd* is not a directory, then the function will fail. An attempt to delete an ACL from a file that does not have that ACL is not considered an error.

Upon successful completion, the `acl_delete_file()` will delete the type ACL associated with the file referred by argument *path_p*. If unsuccessful, the type ACL associated with the file object referred by argument *path_p* will not be changed.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_delete_file()` function returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EACCES

Search permission is denied for a component of the path prefix or the object exists and the subject does not have appropriate access rights.

EINVAL

Argument *type_d* is not a valid ACL type.

ENAMETOOLONG

The length of the path name argument exceeds `PATH_MAX`, or a path name component is longer than `NAME_MAX` and `{_POSIX_NO_TRUNC}` is in effect for that file. For symbolic links, the length of the path name string substituted for a symbolic link exceeds `PATH_MAX`. `PATH_MAX` and `NAME_MAX` values can be determined by using `pathconf()`.

ENOENT

The named object does not exist or the *path_p* argument points to an empty string.

ENOTDIR

The type specified was directory/file default but the argument *path_p* is not a directory or a component of the path prefix is not a directory.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_delete_fd\(\) — Delete an ACL by file descriptor” on page 118](#)

acl_first_entry() – Return to beginning of ACL working storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int    acl_first_entry (lacl_t acl_d);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

A call to `acl_first_entry()` sets the internal ACL entry offset descriptor for the `acl_d` argument such that a subsequent call to `acl_get_entry()` using the same `acl_d` argument obtains the first extended ACL entry in the ACL.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_init()` function returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EINVAL

Argument `acl_d` does not point to an ACL structure.

Related information

- [“sys/acl.h – Manipulate ACL” on page 67](#)
- [“acl_get_entry\(\) – Get an ACL entry” on page 124](#)

acl_free() – Release memory allocated to an ACL data object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>
```

```
int      acl_free (lacl_t acl_d);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX,TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_free()` function frees any releasable memory currently allocated to the ACL data object identified by `acl_d`. Use of the object reference pointed to by `acl_d` after the memory has been released is undefined.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_free()` function returns -1 and sets `errno` to the corresponding value:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EINVAL
The value of the `acl_d` argument is not valid.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_init\(\) — Initialize ACL working storage” on page 128](#)

acl_from_text() — Create an ACL from text

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS      1
#include <sys/acl.h>

int      acl_from_text (const char *buf_p, short OpType, acl_all_t ptr, char **ret);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_from_text()` function converts the text form of an ACL referred to by `buf_p` into the `acl_t` form of an ACL. It parses both the extended and base ACL entries.

If successful, the structure that `ptr` points to will be updated with ACL entries for the 3 types of ACLs. The structure members that `ptr` points to must either be NULL or point to a valid `acl_t` structure. If the

structure member is not NULL, ACL entries contained in *buf_p* will be merged in. New storage for those structure members may be allocated as needed and in that case passed-in storage will be freed, so structure members may point to a different storage than the one originally supplied.

If *ptr* is NULL, the *acl_from_text* will fail. If the *buf_p* has no ACL entries (such as empty string, only empty lines, etc), *acl_from_text()* will fail with *errno* set to *EINVAL* and *ret* will point to the null terminator in *buf_p*.

Working storage is allocated for the individual ACLs structures as needed and need to be freed using *acl_free()*.

If the function is unsuccessful due to error encountered in parsing, *ret* will contain the address of beginning of extended/base ACL entry where the error was found in *buf_p* and *errno* will be set to *EINVAL*. Otherwise *ret* will be NULL.

The text form of the ACL referred to by *buf_p* may be incomplete or may be a non-valid ACL as defined by *acl_valid()*. The *buf_p* must be null terminated. The first call to *acl_get_entry()* following the call to *acl_from_text()* obtains the first entry in the ACL as ordered by the system.

For *OpType* = *ACL_DELETE*, the extended ACL entries will be updated with the flag bit to be removed from the ACL when *acl_set_fd()* or *acl_set_file()* is called. The base ACL entries are parsed but not put into the structure that *ptr* points to since you cannot delete base ACL entries.

The *buf_p* cannot have a mixture of ACL entry delimiters (newline and comma). All ACL entries in the *buf* must use the same delimiter, either a newline or comma. For a mixture of delimiters, *acl_from_text()* will fail with *errno* set to *EINVAL* and *ret* parameter will point to the delimiter in error.

acl_all_t :

index 0

access acl

index 1

file default acl

index 2

directory default acl

Valid text input format based on *OpType*:

tag

fdefault, default (access if nothing is specified)

type

user, group, other

id

uid, gid, username, groupname

perm

rxw (or '-' for no permission), octal (0-7) , +/^ (where + is turn on and ^ is turn off)

Pound sign (#) is used to designate a comment. When the input is separated by commas, everything past # is treated as a comment. When the input is separated by a newline, everything after # till the newline is considered a comment. Comments are ignored and are not stored in the buffer.

```
ACL_ADD      tag:type:id:perm    // extended ACL entry
ACL_MODIFY   type::perm          // base ACL entry
ACL_DELETE   tag:type:id         // extended ACL entry
```

Note: The extended ACL entries must have the type (group or user) and the id (uid/gid). The base ACL entries do not have a value for the id field. The id field or the lack of one is what distinguishes the base ACL entry from the extended ACL entry. The base ACL entries do not have the tag fields since they only apply to access ACL.

The `acl_from_text()` allows for trailing ACL entry separator (newline or comma). For relative permission settings, only one of '+' or '^' is allowed per ACL entry. When using relative permissions you must have at least one of r, w, or x. For example: +rw or ^rwx.

Returned value

Upon successful completion, the function returns a zero.

If any of the following conditions occur, the `acl_from_text()` function returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EINVAL

Argument `buf_p` cannot be translated into an ACL.

ENOMEM

The ACL working storage requires more memory than is available.

E2BIG

The number of base ACL entries exceeded allowable 3.

The `ret` will contain the address in `buf_p` where the error was found.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_free\(\) — Release memory allocated to an ACL data object” on page 121](#)
- [“acl_to_text\(\) — Convert an ACL to text” on page 133](#)

acl_get_entry() — Get an ACL entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int    acl_get_entry (lacl_t acl_d, acl_entry_t *entry_p);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_get_entry()` function obtains a descriptor to the next extended ACL entry of the ACL indicated by argument `acl_d`. Upon successful execution, the `acl_get_entry()` function returns a descriptor for the extended ACL entry via `entry_p`. Argument `acl_d` must refer to a valid `acl_t` structure.

The first call to `acl_get_entry()` following a call to `acl_first_entry()`, `acl_from_text()`, `acl_get_fd()`, `acl_get_file()`, `acl_set_fd()`, `acl_set_file()`, or `acl_valid()` obtains the first extended ACL entry in the ACL, as ordered by the system. Subsequent calls to `acl_get_entry()` obtain successive extended ACL entries, until

the last entry is obtained. After the last extended ACL entry has been obtained from the *acl_d* the value NULL is returned via *entry_p*.

To determine if ACL has any base ACL entries, check *acl_d->lacl_base*, which gives the number of base ACL entries present. Then the process can access the base ACL entries directly in the *acl_d*. (For example: *acl_d->lacl_base_entries[0].acl_type* is the type field of the first base ACL entry.)

Returned value

If the function successfully obtains a pointer to the extended ACL entry, the function returns a value of one. If the last extended ACL entry in the ACL has already been returned by a previous call to *acl_get_entry()* or if ACL has no extended ACL entries, the function returns a value of zero.

If any of the following conditions occur, the *acl_get_entry()* function returns -1 and sets *errno* to the corresponding value:

Error Code Description

EINVAL

Argument *acl_d* does not point to an ACL structure.

Related information

- “[sys/acl.h — Manipulate ACL](#)” on page 67
- “[acl_init\(\) — Initialize ACL working storage](#)” on page 128
- “[acl_get_file\(\) — Get ACL by file name](#)” on page 126
- “[acl_first_entry\(\) — Return to beginning of ACL working storage](#)” on page 121

acl_get_fd() — Get ACL by file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS 1
#include <sys/acl.h>

int  acl_get_fd (int fd, acl_type_t type_d, lacl_t acl_d, int *num);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The *acl_get_fd()* function retrieves an ACL based on *type_d* argument for an object associated with the file descriptor *fd*. The ACL is retrieved into the supplied working storage pointed to by *acl_d*. For the *type_d* = *ACL_ACCESS*, *acl_get_fd()* will get both the base ACL entries and extended ACL entries. (The base ACL entries only apply to the *ACL_ACCESS* ACL.)

The working storage should be allocated using the *acl_init()* function. If the buffer is not big enough, the *acl_get_fd()* will fail with *errno*=*E2BIG* and *num* will be filled with the number of ACLs in the ACL pointed to by *fd*. The user can get a bigger *acl_t* structure buffer using the *num* value and reissue the *acl_get_fd()*.

If the object associated with the file descriptor does not have the specified ACL, then an ACL containing zero ACL entries will be returned. If the argument *fd* refers to an object other than a directory and the value of *type_d* is a directory/file default, then the function will fail.

The first call to `acl_get_entry()` following the call to `acl_get_fd()` obtains the first extended ACL entry in the ACL as ordered by the system.

The result of `acl_get_fd()` can be used to set that same ACL using `acl_set_fd()` or `acl_set_file()` using `OpType = ACL_ADD`.

Returned value

Upon successful completion, the function returns 0.

If any of the following conditions occur, the `acl_get_fd()` function returns a value of NULL and sets `errno` to the corresponding value:

Error Code
Description

EACCES
The required access to the file referred to by *fd* is denied.

EBADF
The *fd* argument is not a valid file descriptor.

EINVAL
Argument *type_d* is not a valid ACL type. Argument *acl_d* does not point to an ACL structure.

ENOTDIR
The type specified was directory/file default but the argument *fd* does not refer to a directory.

E2BIG
The supplied buffer is too small for all extended ACL entries. *num* value has the number of ACL entries that need to fit in the buffer.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_free\(\) — Release memory allocated to an ACL data object” on page 121](#)
- [“acl_get_entry\(\) — Get an ACL entry” on page 124](#)
- [“acl_set_fd\(\) — Set an ACL by file descriptor” on page 129](#)

acl_get_file() — Get ACL by file name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int  acl_get_file (const char *path_p, acl_type_t type_d, lacl_t acl_d, int *num);
```


General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_get_file()` function retrieves an ACL based on *type_d* argument for an object associated with the object via file name. The ACL is retrieved into the specified working storage pointed to by *acl_d*. For the *type_d* = `ACL_ACCESS`, `acl_get_file()` will get both the base ACL entries and extended ACL entries. The base ACL entries only apply to the `ACL_ACCESS` ACL.

The working storage should be allocated using the `acl_init()` function. If the buffer is not big enough, the `acl_get_fd()` will fail with `errno=E2BIG` and *num* will be filled with the number of ACLs in the ACL pointed to by *fd*. The user can get a bigger `acl_t` structure buffer using the *num* value and reissue the `acl_get_fd()`.

If the object associated with the file descriptor does not have the specified ACL, then an ACL containing zero ACL entries will be returned. If the argument *fd* refers to an object other than a directory and the value of *type_d* is a directory/file default, then the function will fail.

The first call to `acl_get_entry()` following the call to `acl_get_fd()` obtains the first extended ACL entry in the ACL as ordered by the system. The result of `acl_get_fd()` can be used to set that same ACL using `acl_set_fd()` or `acl_set_file()` using `OpType = ACL_ADD`.

Returned value

Upon successful completion, the function returns 0.

If any of the following conditions occur, the `acl_get_file()` function returns a value of NULL and sets `errno` to the corresponding value:

Error Code

Description

EACCES

Search permission is denied for a component of the path prefix or the object exists and the subject does not have appropriate access rights.

EINVAL

Argument *type_d* is not a valid ACL type. Argument *acl_d* does not point to an ACL structure.

ENAMETOOLONG

The length of the path name argument exceeds `PATH_MAX`, or a path name component is longer than `NAME_MAX` and `{_POSIX_NO_TRUNC}` is in effect for that file. For symbolic links, the length of the path name string substituted for a symbolic link exceeds `PATH_MAX`. `PATH_MAX` and `NAME_MAX` values can be determined by using `pathconf()`.

ENOENT

The named object does not exist or the *path_p* argument points to an empty string.

ENOTDIR

The type specified was directory/file default but the argument *path_p* is not a directory or a component of the path prefix is not a directory.

E2BIG

The supplied buffer is too small for all extended ACL entries. *Num* value has the number of ACL entries that need to fit in the buffer.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_free\(\) — Release memory allocated to an ACL data object” on page 121](#)
- [“acl_set_file\(\) — Set an ACL by file name” on page 131](#)
- [“acl_get_entry\(\) — Get an ACL entry” on page 124](#)

acl_init() — Initialize ACL working storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

lacl_t  acl_init (int count);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_init()` function allocates and initializes working storage for an ACL of at least *count* extended ACL entries. A pointer to the working storage is returned. The working storage allocated to contain the ACL must be freed by a call to `acl_free()`. The working storage contains an ACL with no ACL entries. The count must be greater than 0.

The `acl_init()` function initializes fields in the *lacl_t* it returns. When those fields are destroyed (for example, using `memset` or overwriting storage), the results are unpredictable. To re-use the buffer, `acl_entry_delete()` all extended ACL entries and set `lacl_base = 0` or `acl_free()` the existing buffer and `acl_init()` for a new one.

Returned value

Upon successful completion, the function returns a pointer to the working storage.

If any of the following conditions occur, the `acl_init()` function returns NULL and sets `errno` to the corresponding value:

Error Code

Description

ENOMEM

The *lacl_t* to be returned requires more memory than is available.

EINVAL

The count is less than or equal to zero.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_free\(\) — Release memory allocated to an ACL data object” on page 121](#)

acl_set_fd() – Set an ACL by file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int    acl_set_fd (int fd, acl_type_t type_d, lacl_t acl_d, short OpType,
                  acl_entry_t *entry_p);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_set_fd()` function associates the `type_d` ACL with the object referred to by `fd`. The effective UID of the subject must match the owner of the object or the subject must have appropriate privileges.

If the `type_d` is the directory/file default and the object referred to by `fd` is not a directory, then the function will fail.

The `acl_set_fd()` function will succeed only if the ACL is valid as defined by the `acl_valid()` function.

Upon successful completion, `acl_set_fd()` will set the ACL of the object. For `type_d = ACL_ACCESS`, `acl_set_fd()` will also set the base ACL entries. The base ACL entries only apply to `ACL_ACCESS` ACL type, so for any other type the base ACL entries are ignored.

The `OpType` determines whether the ACL is updated or replaced.

OpType

Action

ACL_ADD

replace the whole ACL with the given extended and base ACL entries

ACL_MODIFY

update the ACL with the given extended and/or base ACL entries (if individual extended ACL entries are marked for deletion, then `ACL_MODIFY` removes them)

ACL_DELETE

delete from the ACL the specified extended ACL entries; marks the individual extended ACL entries for deletion (cannot delete base ACL entries)

If `OpType` is `ACL_MODIFY`, the setting will modify the existing extended ACL entries and add new ones if they do not exist. Both ACL entry's mask and value are used to determine ACL entry's permission to set.

If `OpType` is `ACL_ADD`, the existing ACL is replaced by the new one. Only extended ACL entry's value is used to determine permissions to set. The object's previous ACL will no longer be in effect. If the object had no ACL, a new one is added for both `ACL_MODIFY` and `ACL_ADD`.

Similarly, for `OpType = ACL_ADD`, base ACL entries are replaced with the new values specified (mask field is ignored). All three base ACL entries (`ACL_USER`, `ACL_GROUP`, and `ACL_OTHER`) must be specified. For `OpType = ACL_MODIFY`, the base ACL entries are modified with the specified values (both mask and value fields are used).

For Optype = ACL_MODIFY only the base ACL entries to be changed need to be specified. The Optype = ACL_DELETE does not apply to base ACL entries since they cannot be removed. Every file always has base ACL entries.

If the `acl_set_fd()` is unsuccessful, the ACL of the object referred to by argument *fd* is not changed.

The ordering of entries within ACL referred to by *acl_d* may be changed. The first call to `acl_get_entry()` following the call to `acl_set_fd()` obtains the first extended ACL entry in the ACL as ordered by the system.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_set_file()` function returns a value of -1 and sets `errno` to the corresponding value:

Error Code

Description

EACCES

Search permission is denied for a component of the path prefix or the object exists and the subject does not have appropriate access rights.

E2BIG

The ACL has more extended ACL entries than is allowed.

ENOENT

The named object does not exist or the *path_p* argument points to an empty string.

EINVAL

Argument *acl_d* does not point to a valid ACL structure.

ENOSPC

The directory or file system that would contain the new ACL cannot be extended or the file system is out of space.

ENOTDIR

The *type_d* specified was directory/file default but the argument *path_p* does not refer to a directory.

ENAMETOOLONG

The length of the path name argument exceeds PATH_MAX, or a path name component is longer than NAME_MAX and {_POSIX_NO_TRUNC} is in effect for that file. For symbolic links, the length of the path name string substituted for a symbolic link exceeds PATH_MAX. PATH_MAX and NAME_MAX values can be determined by using `pathconf()`.

EMVSERR

Other internal RACF error (more information in `errno2`)

The function will return -2 and set `errno` to EINVAL if the base ACL entry is not unique or is not a valid type or for ACL_ADD, there are less than 3 base ACL entries. The *entry_p* will be NULL.

The function will return -3 and set `errno` to EINVAL if the extended ACL entry is not unique or is not a valid type. The *entry_p*, if not NULL, will point to the extended ACL entry in error.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_get_fd\(\) — Get ACL by file descriptor” on page 125](#)

acl_set_file() – Set an ACL by file name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int    acl_set_file (char *path_p, acl_type_t type_d, lacl_t acl_d, short OpType,
                    acl_entry_t *entry_p);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_set_file()` function associates the `type_d` ACL with the object referred to by file name `path_p`. The effective UID of the subject must match the owner of the object or the subject must have appropriate privileges.

If the `type_d` is the directory/file default and the object referred to by file name `path_p` is not a directory, then the function will fail.

The `acl_set_file()` function will succeed only if the ACL is valid as defined by the `acl_valid()` function.

Upon successful completion, `acl_set_file()` will set the ACL of the object. For `type_d = ACL_ACCESS`, `acl_set_file()` will also set the base ACL entries. The base ACL entries only apply to `ACL_ACCESS` ACL type, so for any other type the base ACL entries are ignored.

The `OpType` determines whether the ACL is updated or replaced.

OpType

Action

ACL_ADD

replace the whole ACL with the given extended and base ACL entries

ACL_MODIFY

update the ACL with the given extended and/or base ACL entries (if individual extended ACL entries are marked for deletion, then `ACL_MODIFY` removes them)

ACL_DELETE

delete from the ACL the specified extended ACL entries; marks the individual extended ACL entries for deletion (cannot delete base ACL entries)

If `OpType` is `ACL_MODIFY`, the setting will modify the existing extended ACL entries and add new ones if they do not exist. Both ACL entry's mask and value are used to determine ACL entry's permission to set.

If `OpType` is `ACL_ADD`, the existing ACL is replaced by the new one. Only extended ACL entry's value is used to determine permissions to set. The object's previous ACL will no longer be in effect. If the object had no ACL, a new one is added for both `ACL_MODIFY` and `ACL_ADD`.

Similarly, for `OpType = ACL_ADD`, base ACL entries are replaced with the new values specified (mask field is ignored). All three base ACL entries (`ACL_USER`, `ACL_GROUP`, and `ACL_OTHER`) must be specified. For `OpType = ACL_MODIFY`, the base ACL entries are modified with the specified values (both mask and value fields are used).

For Optype = ACL_MODIFY only the base ACL entries to be changed need to be specified. The Optype = ACL_DELETE does not apply to base ACL entries since they cannot be removed. Every file always has base ACL entries.

If the acl_set_file() is unsuccessful, the ACL of the object referred to by argument *path_p* is not changed.

The ordering of entries within ACL referred to by *acl_d* may be changed. The first call to acl_get_entry() following the call to acl_set_file() obtains the first extended ACL entry as ordered by the system.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the acl_set_file() function will return a value of -1 and set errno to the corresponding value:

Error Code

Description

EACCES

Search permission is denied for a component of the path prefix or the object exists and the subject does not have appropriate access rights.

E2BIG

The ACL has more extended ACL entries than are allowed.

ENOENT

The named object does not exist or the *path_p* argument points to an empty string.

EBADF

The *fd* argument is not a valid file descriptor.

EINVAL

Argument *acl_d* does not point to a valid ACL structure.

ENOSPC

The directory or file system that would contain the new ACL cannot be extended or the file system is out of space.

ENOTDIR

The *type_d* specified was directory/file default but the argument *path_p* does not refer to a directory.

ENAMETOOLONG

The length of the path name argument exceeds PATH_MAX, or a path name component is longer than NAME_MAX and {_POSIX_NO_TRUNC} is in effect for that file. For symbolic links, the length of the path name string substituted for a symbolic link exceeds PATH_MAX. PATH_MAX and NAME_MAX values can be determined by using pathconf().

EMVSERR

Other internal RACF error (more information in errno2)

The function will return -2 and set errno to EINVAL if the base ACL entry is not unique or is not a valid type or for ACL_ADD, there are less than 3 base ACL entries. The *entry_p* will be NULL.

The function will return -3 and set errno to EINVAL if the extended ACL entry is not unique or is not a valid type. The *entry_p*, if not NULL, will point to the extended ACL entry in error.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_get_fd\(\) — Get ACL by file descriptor” on page 125](#)
- [“acl_valid\(\) — Validate an ACL” on page 136](#)

acl_sort() – Sort the extended ACL entries

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS 1
#include <sys/acl.h>

int acl_sort(lacl_t acl_d);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_sort()` function sorts the extended ACL entries in the following orders:

- ACL_USER lowest to highest uid
- ACL_GROUP lowest to highest gid

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_sort()` returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EINVAL

Argument `acl_d` does not point to a valid ACL structure.

Related information

- [“sys/acl.h – Manipulate ACL” on page 67](#)

acl_to_text() – Convert an ACL to text

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS 1
#include <sys/acl.h>
```

```
char *    acl_to_text (const lacl_t acl_d, ssize_t *len_p, acl_type_t type_d,
                     char delim);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See [z/OS UNIX System Services Planning](#) for details.

The `acl_to_text()` function translates the extended ACL entries in an ACL pointed to by argument `acl_d` into a NULL terminated character string. This function allocates any memory necessary to contain the string and returns a pointer to the string. The memory allocated to contain the string must be freed. If the pointer `len_p` is not NULL, then the function returns the full length of the string (not including the NULL terminator) in the location pointed to by `len_p`. The `delim` parameter determines the delimiter used to separate the ACL entries (usually newline or comma).

The mask field in the base and extended ACL entry is ignored and only the ACL entry value field is used to display the ACL entry permissions.

For `acl_d` with no extended ACL entries, `acl_to_text()` returns NULL. When `acl_to_text()` cannot convert uid/gid to username/groupname, it leaves the uid/gid in the string.

The format of the text string:

```
<acl_entry>delim<acl_entry> ... <acl_entry>
```

where `acl_entry` may be:

```
base_acl_tag::permissions
user:user_name:permissions
group:group_name:permissions
default:user_name:permissions
```

base_acl_entry:
user, group, or other

permissions:
rwx (with '-' for no permission)

default:
fdefault - file default
default - directory default

Returned value

Upon successful completion, the function returns a pointer to the text form of an ACL.

If any of the following conditions occur, the `acl_to_text()` returns NULL and sets `errno` to the corresponding value:

| | |
|-------------------|--------------------|
| Error Code | Description |
|-------------------|--------------------|

| | |
|---------------|--|
| EINVAL | Argument <code>acl_d</code> does not point to a valid ACL structure. The ACL referenced by <code>acl_d</code> contains one or more improperly formed ACL entries, or for some other reason cannot be translated into the string form of ACL. |
|---------------|--|

| | |
|---------------|---|
| ENOMEM | The character string to be returned requires more memory than is available. |
|---------------|---|

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_free\(\) — Release memory allocated to an ACL data object” on page 121](#)
- [“acl_from_text\(\) — Create an ACL from text” on page 122](#)

acl_update_entry() — Update the extended ACL entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int acl_update_entry(lacl_t acl_d, acl_entry_t entry_s, acl_entry_t entry_d
                    int version);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. Currently, ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See *z/OS UNIX System Services Planning* for details.

The `acl_update_entry()` function updates the extended ACL entry `entry_s` with the values from `entry_d`. The `version` tells the function the version of ACL entry. See [“sys/acl.h — Manipulate ACL” on page 67](#) for ACL entry mapping.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the `acl_create_entry()` function returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EINVAL

Argument `entry_s` or `entry_d` do not point to a valid extended ACL entry. Argument `acl_d` does not point to a valid ACL structure.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)

acl_valid() – Validate an ACL

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS    1
#include <sys/acl.h>

int    acl_valid (lacl_t acl_d, acl_entry_t *entry_p);
```

General description

Use access control lists (ACLs) in conjunction with permission bits to control access to files and directories. Currently, ACLs are supported by the z/OS UNIX, TFS, and zFS file systems. You must know whether your security product supports ACLs and what rules are used when determining file access. See *z/OS UNIX System Services Planning* for details.

The `acl_valid()` function checks the access ACL, file default ACL, or directory default ACL referred to by the argument `acl_d` for validity.

The ACL_USER, ACL_GROUP, and ACL_OTHER can only exist once in base ACL entries. The ACL_OTHER only applies to base ACL entries.

The tag type (user, group) must contain valid values for the extended ACL entries. The qualifier field (uid, gid) must be unique among all extended ACL entries of the same ACL except for the extended ACL entries that are mapped for deletion (see ACL entry mapping in “[sys/acl.h – Manipulate ACL](#)” on page 67 for more information). The ordering of base and/or extended ACL entries within ACL referred by the `acl_d` may be changed.

The first call to `acl_get_entry()` following the call to `acl_valid()` obtains the first extended ACL entry in the ACL as ordered by the system.

Returned value

Upon successful completion, the function returns a value of zero.

If any of the following conditions occur, the location referred to by `entry_p` will be undefined and the `acl_valid()` function returns -1 and sets `errno` to the corresponding value:

Error Code

Description

EINVAL

Argument `acl_d` does not point to an ACL structure.

If any of the following conditions occur, the `acl_valid()` function will set the location referred to by `entry_p` to one of the ACL entries in error, return -2 and set `errno` to the appropriate value.

Error Code

Description

EINVAL

The ACL contains extended ACL entries that are not unique or is not a valid ACL entry type.

If any of the following conditions occur, the `acl_valid()` function will return -3 and set `errno` to the appropriate value.

Error Code

Description

EINVAL

The ACL contains base ACL entries that are not unique or is not a valid ACL entry type. Only one base ACL entry of the same tag type (ACL_USER, ACL_GROUP, ACL_OTHER) may exist.

Related information

- [“sys/acl.h — Manipulate ACL” on page 67](#)
- [“acl_init\(\) — Initialize ACL working storage” on page 128](#)
- [“acl_get_fd\(\) — Get ACL by file descriptor” on page 125](#)
- [“acl_get_file\(\) — Get ACL by file name” on page 126](#)
- [“acl_set_fd\(\) — Set an ACL by file descriptor” on page 129](#)
- [“acl_set_file\(\) — Set an ACL by file name” on page 131](#)

acos(), acosf(), acosl() — Calculate arccosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double acos(double x);
float  acos(float x);           /* C++ only */
long double acos(long double x); /* C++ only */
float  acosf(float x);
long double acosl(long double x);
```

General description

Calculates the arccosine of x , expressed in radians, in the range 0 to π .

The value of x must be between -1 and 1 inclusive.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

Special behavior for C/370: If x is less than -1 or greater than 1, the function sets `errno` to `EDOM` and returns 0. If the correct value would cause underflow, zero is returned and the value `ERANGE` is stored in `errno`.

Special behavior for XPG4.2: If successful, the function returns the arccosine of x , in the range $[0, \pi]$ radians.

If the value of x is not in the range $[-1,1]$, the function returns 0.0 and sets `errno` to the following value. No other errors will occur.

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|-------------|--|
| EDOM | The value x is not in the range $[-1,1]$. |
|-------------|--|

Special behavior for IEEE: If successful, the function returns the arccosine of the argument x .

If x is less than -1 or greater than 1, the function sets `errno` to `EDOM` and returns `NaNQ` (Not a Number Quiet). No other errors will occur.

Example

CELEBA04

```

/* CELEBA04

   This example prompts for a value for x.
   It prints an error message if x is greater than 1 or
   less than -1; otherwise, it assigns the arccosine of
   x to y.

   */
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#define MAX 1.0
#define MIN -1.0

int main(void)
{
    double x, y;

    printf( "Enter x\n" );
    scanf( "%lf", &x );

    /* Output error if not in range */
    if ( x > MAX )
        printf( "Error: %f too large for acos\n", x );
    else if ( x < MIN )
        printf( "Error: %f too small for acos\n", x );
    else {
        y = acos( x );
        printf( "acos( %f ) = %f\n", x, y );
    }
}

```

Output

Expected result if 0.4 is entered:

```

Enter x
acos( 0.400000 ) = 1.159279

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“atanh\(\), atanhf\(\), atanhhl\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)

- “[sin\(\), sinf\(\), sinl\(\) — Calculate sine](#)” on page 1662
- “[sinh\(\), sinhf\(\), sinhl\(\) — Calculate hyperbolic sine](#)” on page 1664
- “[tan\(\), tanf\(\), tanl\(\) — Calculate tangent](#)” on page 1809
- “[tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent](#)” on page 1812

acosd32(), acosd64(), acosd128() - Calculate arccosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 acosd32(_Decimal32 x);
_Decimal64 acosd64(_Decimal64 x);
_Decimal128 acosd128(_Decimal128 x);
_Decimal32 acos(_Decimal32 x);      /* C++ only */
_Decimal64 acos(_Decimal64 x);      /* C++ only */
_Decimal128 acos(_Decimal128 x);    /* C++ only */
```

General description

Calculates the arccosine of x , expressed in radians, in the range 0 to π .

The value of x must be between -1 and 1 inclusive.

These functions work in IEEE decimal floating-point format. See “[IEEE decimal floating-point](#)” on page 97 for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, the function returns the arccosine of the argument x .

If x is less than -1 or greater than 1, the function sets `errno` to `EDOM` and returns `NaNQ`. No other errors will occur.

Example

CELEBA11

```
/* CELEBA11

   The example illustrates the acosd32() function.

   This example prompts for a value for x.
   It prints an error message if x is greater than 1 or
   less than -1; otherwise, it assigns the arccosine of
   x to y.

*/

#define __STDC_WANT_DEC_FP__
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#define MAX 1.0DF
```

```
#define MIN -1.0DF

int main(void)
{
    _Decimal32 x, y;

    printf( "Enter x\n" );
    scanf( "%Hf", &x );

    /* Output error if not in range */
    if ( x > MAX )
        printf( "Error: %f too large for acosd32\n", x );
    else if ( x < MIN )
        printf( "Error: %f too small for acosd32\n", x );
    else {
        y = acosd32( x );
        printf( "acosd32( %Hf ) = %Hf\n", x, y );
    }
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acoshd32\(\), acoshd64\(\), acoshd128\(\) - Calculate hyperbolic arccosine” on page 142](#)
- [“asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine” on page 184](#)
- [“asinhd32\(\), asinhd64\(\), asinhd128\(\) - Calculate hyperbolic arcsine” on page 187](#)
- [“atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent” on page 192](#)
- [“atanhd32\(\), atanhd64\(\), atanhd128\(\) - Calculate hyperbolic arctangent” on page 195](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“coshd32\(\), coshd64\(\), coshd128\(\) - Calculate hyperbolic cosine” on page 334](#)
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine” on page 1663](#)
- [“sinhd32\(\), sinhd64\(\), sinhd128\(\) - Calculate hyperbolic sine” on page 1666](#)
- [“tand32\(\), tand64\(\), tand128\(\) - Calculate tangent” on page 1810](#)
- [“tanhd32\(\), tanhd64\(\), tanhd128\(\) - Calculate hyperbolic tangent” on page 1813](#)

acosh(), acoshf(), acoshl() — Calculate hyperbolic arccosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double acosh(double x);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>
```

```
float acoshf(float x);
long double acoshl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>
float acosh(float x);
long double acosh(long double x);
```

General description

The acosh functions compute the (nonnegative) arc hyperbolic cosine of x . A domain error occurs for arguments less than 1.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| acosh | X | X |
| acoshf | X | X |
| acoshl | X | X |

Returned value

If successful, `acosh()` returns the hyperbolic arccosine of its argument x .

If the value of x is less than 1.0, then the function returns 0.0 and sets `errno` to `EDOM`.

Special behavior for IEEE: If successful, the function returns the hyperbolic arccosine of its argument x .

If x is less than 1.0, the function sets `errno` to `EDOM` and returns `NaNQ`.

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine”](#) on page 137
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine”](#) on page 183
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine”](#) on page 186
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent”](#) on page 191
- [“atanh\(\), atanhf\(\), atanhhl\(\) — Calculate hyperbolic arctangent”](#) on page 194
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine”](#) on page 330
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine”](#) on page 333
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine”](#) on page 1662
- [“sinh\(\), sinhf\(\), sinhl\(\) — Calculate hyperbolic sine”](#) on page 1664
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent”](#) on page 1809
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent”](#) on page 1812

acoshd32(), acoshd64(), acoshd128() - Calculate hyperbolic arccosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 acoshd32(_Decimal32 x);
_Decimal64 acoshd64(_Decimal64 x);
_Decimal128 acoshd128(_Decimal128 x);
_Decimal32 acosh(_Decimal32 x);      /* C++ only */
_Decimal64 acosh(_Decimal64 x);      /* C++ only */
_Decimal128 acosh(_Decimal128 x);    /* C++ only */
```

General description

The acosh functions compute the (nonnegative) arc hyperbolic cosine of x . A domain error occurs for arguments less than 1.

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, the function returns the hyperbolic arccosine of its argument x .

If x is less than 1.0, the function sets `errno` to `EDOM` and returns `NaNQ`.

Example

CELEBA12

```
/* CELEBA12
   This example illustrates the acoshd64() function.
*/
#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 x, y;

    x = 100.0DD;
    y = acoshd64(x);

    printf("acoshd64(%Df) = %Df\n", x, y);
}
```


Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acosd32\(\), acosd64\(\), acosd128\(\) - Calculate arccosine” on page 139](#)
- [“asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine” on page 184](#)
- [“asinh32\(\), asinh64\(\), asinh128\(\) - Calculate hyperbolic arcsine” on page 187](#)
- [“atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent” on page 192](#)
- [“atanh32\(\), atanh64\(\), atanh128\(\) - Calculate hyperbolic arctangent” on page 195](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“cosh32\(\), cosh64\(\), cosh128\(\) - Calculate hyperbolic cosine” on page 334](#)
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine” on page 1663](#)
- [“sinh32\(\), sinh64\(\), sinh128\(\) - Calculate hyperbolic sine” on page 1666](#)
- [“tand32\(\), tand64\(\), tand128\(\) - Calculate tangent” on page 1810](#)
- [“tanh32\(\), tanh64\(\), tanh128\(\) - Calculate hyperbolic tangent” on page 1813](#)

advance() — Pattern match given a compiled regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE
#include <regex.h>

int advance(const char *string, const char *expbuf);

extern char *loc2, *locs;
```

General description

Restriction: This function is not supported in AMODE 64.

The `advance()` function attempts to match an input string of characters with the compiled regular expression which was obtained by an earlier call to `compile()`.

The first parameter *string* is a pointer to a string of characters to be checked for a match.

expbuf is the pointer to the regular expression which was previously obtained by a call to `compile()`.

The external variable *loc2* will point to the next character in *string* after the last character that matched the regular expression.

The external variable *locs* can be optionally set to point to some point in the input regular expression string to cause the `advance()` function to exit its back up loop.

Note: The external variables *cirf*, *sed*, and *nbra* are reserved.

During the pattern matching operation, when `advance()` encounters a `*` or `{\}` sequence in the regular expression, it will advance its pointer to the string to be matched as far as possible and will recursively call itself trying to match the rest of the string to the rest of the regular expression. As long as there is no match, `advance()` will back up along the string until it finds a match or reaches the point in the string that

initially matched the * or `{\}`. It is sometime desirable to stop this backing up before the initial point in the string is reached. If the external character pointer *locs* is equal to the point in the string at some time during the back up process, `advance()` will break out of the loop that backs up and will return 0 (a failure indication).

Notes:

1. The application must provide the proper serialization for the `compile()`, `step()`, and `advance()` functions if they are run under a multithreaded environment.
2. The `compile()`, `step()`, and `advance()` functions are provided for historical reasons. These functions were part of the Legacy Feature in Single UNIX Specification, Version 2. They have been withdrawn and are not supported as part of Single UNIX Specification, Version 3. New applications should use the newer functions `fnmatch()`, `glob()`, `regcomp()` and `regexexec()`, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001.

Returned value

If the initial substring of *string* matches the regular expression in *expbuf*, `advance()` returns nonzero.

If there is no match, `advance()` returns 0.

If there is a match, `advance()` sets an external character pointer, *loc2*, as a side effect. The variable *loc2* points to the next character in *string* after the last character that matched the regular expression.

Related information

- [“regex.h — Regular expression declarations” on page 57](#)
- [“compile\(\) — Compile regular expression” on page 305](#)
- [“fnmatch\(\) — Match file name or path name” on page 569](#)
- [“glob\(\) — Generate path names matching a pattern” on page 808](#)
- [“regcomp\(\) — Compile regular expression” on page 1416](#)
- [“regexexec\(\) — Execute compiled regular expression” on page 1421](#)
- [“step\(\) — Pattern match with regular expression” on page 1715](#)

`__ae_correstbl_query()` — Return coded character set ID type (ASCII and EBCDIC)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R2 |

Format

```
#include <_Nascii.h>

__argument_t __ae_correstbl_query(void *search_argument, int src_arg_type,
                                   _AE_correstbl_t **ebcdic_entry_ptr,
                                   _AE_correstbl_t **ascii_entry_ptr);
```

General description

The `__ae_correstbl_query()` function is a method by which the user can obtain coded character set id (CCSID), type, and correspondence information from the EBCDIC/ASCII Correspondence and CCSID/Codeset Name Lookup Table, CEL4CTBL.

The user must provide the following:

Argument

Description

*search_argument

A Codeset Name or CCSID search argument.

src_arg_type

Specifies whether *search_argument* is a Codeset Name or a CCSID, using one of the defined values from `<_Nascii.h>`:

- `_AE_CODESET_SRCH_ARG`
- `_AE_CCSID_SRCH_ARG`

**ebcdic_entry_ptr

The address of an `_AE_correstbl_t` pointer for storing the EBCDIC table entry.

**ascii_entry_ptr

The address of an `_AE_correstbl_t` pointer for storing the ASCII table entry.

The function will then populate the supplied pointers with the address of `_AE_correstbl_t` structures containing the requested codeset's table entry as well as the address of the corresponding codeset's entry. However, not every EBCDIC codeset in the table has a corresponding ASCII encoding and vice versa. When a corresponding codeset does not exist, the pointer value returned in that argument is zero.

For consistency, the first `_AE_correstbl_t` pointer address argument will be populated with the EBCDIC entry address, and the second `_AE_correstbl_t` pointer will be populated with the ASCII entry address, regardless of which was the requested codeset and which was the corresponding codeset.

The `__argument_t` return value for `__ae_correstbl_query()` indicates the EBCDIC or ASCII type of the provided codeset.

Returned value

If successful, `__ae_correstbl_query()` returns either:

- `_AE_EBCDIC_TYPE`, when the requested entry is EBCDIC.
- `_AE_ASCII_TYPE`, when the requested entry is ASCII.

If unsuccessful, because the correspondence table cannot be loaded or the provided Codeset Name or CCSID is not valid, `__ae_correstbl_query()` returns `_AE_UNKNOWN_TYPE`.

Related information

- [“_Ccsid.h — CCSID to codeset name conversion” on page 17](#)
- [“_Nascii.h — Bimodal application” on page 45](#)
- [“__CcsidType\(\) — Return coded character set ID type” on page 247](#)
- [“__CSNameType\(\) — Return codeset name type” on page 351](#)
- [“__toCcsid\(\) — Convert codeset name to coded character set ID” on page 1881](#)
- [“__toCSName\(\) — Convert coded character set ID to codeset name ” on page 1882](#)

aio_cancel() – Cancel an asynchronous I/O request

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R7 |

Format

```
#define _XOPEN_SOURCE 500
#include <aio.h>

int aio_cancel(int fildev, struct aiocb *aiocbp);
```

General description

The `aio_cancel()` function attempts to cancel one or more asynchronous I/O requests currently outstanding against file descriptor *fildev*. The *aiocbp* argument points to an *aiocb* structure for a particular request to be canceled or is NULL to cancel all outstanding cancelable requests against *fildev*.

Normal asynchronous notification occurs for asynchronous I/O operations that are successfully canceled. The associated error status is set to ECANCELED and the return status is set to -1 for the canceled requests.

For requests that cannot be canceled, the normal asynchronous completion process takes place when their I/O completes. In this case the *aiocb* is not modified by `aio_cancel()`.

An asynchronous operation is cancelable if it is currently blocked or becomes blocked. Once an outstanding request can be completed it is allowed to complete. For example, an `aio_read()` will be cancelable if there is no data available at the time that `aio_cancel()` is called.

fildev must be a valid file descriptor, but when *aiocbp* is not NULL *fildev* does not have to match the file descriptor with which the asynchronous operation was initiated. For maximum portability, though, it should match.

The `aio_cancel()` function always waits for the request being canceled to either complete or be canceled. When control returns from `aio_cancel()`, the program may safely free the original request's *aiocb* and buffer. If a signal was specified on the original request, the signal handler for that request's I/O complete notification may run before, during, or after control returns from `aio_cancel()`, so coordination may be necessary between the signal handler and the caller of `aio_cancel()`. This is particularly unpredictable when `aio_cancel()` is called from a different thread than the original request, unless the original thread no longer exists.

Canceling all requests on a given descriptor does not stop new requests from being made or otherwise affect the descriptor. The program may start again or close the descriptor depending on why it issued the cancel.

An individual request can only be canceled once. Subsequent attempts to explicitly cancel the same request will fail with EALREADY.

Returned value

`aio_cancel()` returns one of the following values:

- AIO_CANCELED if the requested operations were canceled.
- AIO_NOTCANCELED if at least one of the requested operations cannot be canceled because it is in progress.

In this case, the state of the other operations, if any, referenced in the call to `aio_cancel()` is not indicated by the return value of `aio_cancel()`. The application can determine the status of these operations by using `aio_error()`.

- `AIO_ALLDONE` if all of the operations have already completed. This is returned when there are no outstanding requests found that match the criteria specified. This is also the result returned when a file associated with *fildev* does not support the asynchronous I/O function because there are no outstanding requests to be found that match the criteria specified.
- `-1` if there was an error. `aio_cancel()` sets `errno` to one of the following values:

Error Code

Description

EALREADY

The operation to be canceled is already being canceled.

EBADF

The *fildev* argument is not a valid file descriptor.

Related information

- [“aio.h — Asynchronous I/O operations” on page 16](#)
- [“aio_error\(\) — Retrieve error status for an asynchronous I/O operation” on page 147](#)
- [“aio_read\(\) — Asynchronous read from a socket” on page 148](#)
- [“aio_return\(\) — Retrieve status for an asynchronous I/O operation” on page 151](#)
- [“aio_write\(\) — Asynchronous write to a socket” on page 153](#)

aio_error() — Retrieve error status for an asynchronous I/O operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R7 |

Format

```
#define _XOPEN_SOURCE 500
#include <aio.h>

int aio_error(const struct aiocb *aiocbp);
```

General description

The `aio_error()` function returns the error status associated with the *aiocb* structure referenced by the *aiocbp* argument. The error status for an asynchronous I/O operation is the `errno` value that would be set by the corresponding `read()`, or `write()` operation. If the operation has not yet completed, then the error status will be equal to `EINPROGRESS`.

Returned value

If the asynchronous I/O operation has completed successfully, `aio_error()` returns 0.

If the asynchronous I/O operation has completed unsuccessfully, `aio_error()` returns the error status as described for `read()`, or `write()`.

If the asynchronous I/O operation has not yet completed, then `EINPROGRESS` is returned.

`aio_error()` does not set `errno`.

When the `errno` is returned is not `EINPROGRESS` and not zero, the `errno2` set by either `read()` or `write()` can be retrieved by using the `__errno2()` function.

Related information

- [“aio.h — Asynchronous I/O operations” on page 16](#)
- [“aio_read\(\) — Asynchronous read from a socket” on page 148](#)
- [“aio_return\(\) — Retrieve status for an asynchronous I/O operation” on page 151](#)
- [“aio_suspend\(\) — Wait for an asynchronous I/O request” on page 151](#)

aio_read() — Asynchronous read from a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R7 |

Format

```
#define _XOPEN_SOURCE 500
#include <aio.h>

int aio_read(struct aiocb *aiocbp);
```

General description

The `aio_read()` function initiates an asynchronous read operation as described by the `aiocb` structure (the asynchronous I/O control block).

The `aiocbp` argument points to the `aiocb` structure. This structure contains the following members:

- aio_fildes**
file descriptor
- aio_offset**
file offset
- aio_buf**
location of buffer
- aio_nbytes**
length of transfer
- aio_reqprio**
request priority offset
- aio_sigevent**
signal number and value
- aio_lio_opcode**
operation to be performed

The operation reads up to *aio_nbytes* from the socket or file associated with *aio_fildes* into the buffer pointed to by *aio_buf*. The call to *aio_read()* returns when the request has been initiated or queued to the file or device (even when the data cannot be delivered immediately).

Asynchronous I/O is currently only supported for sockets. The *aio_offset* field may be set but it will be ignored.

With a stream socket an asynchronous read may be completed when the first packet of data arrives and the application may have to issue additional reads, either asynchronously or synchronously, to get all the data it wants. A datagram socket has message boundaries and the operation will not complete until an entire message has arrived.

The *aiocbp* value may be used as an argument to *aio_error()* and *aio_return()* functions in order to determine the error status and return status, respectively, of the asynchronous operation. While the operation is proceeding, the error status retrieved by *aio_error()* is *EINPROGRESS*; the return status retrieved by *aio_return()* however is unpredictable.

If an error condition is encountered during the queueing, the function call returns without having initiated or queued the request.

When the operation completes asynchronously the program can be notified by a signal as specified in the *aio_sigevent* structure. It is significantly more efficient to receive these notifications with *sigwaitinfo()* or *sigtimedwait()* than to let them drive a signal handler. At this time the return and error status will have been updated to reflect the outcome of the operation. The *sigevent* structure's notification function fields are not supported. If a signal is not desired the program can occasionally poll the *aiocb* with *aio_error()* until the result is no longer *EINPROGRESS*.

Be aware that the operation may complete, and the signal handler may be delivered, before control returns from the call to *aio_read()*. Even when the operation does complete this quickly the return value from the call to *aio_read()* will be zero, reflecting the queueing of the I/O request not the results of the I/O itself.

An asynchronous operation may be canceled with *aio_cancel()* before its completion. Canceled operations complete with an error status of *ECANCELED* and any specified signal will be delivered. Due to timing, the operation may still complete naturally, either successfully or unsuccessfully, before it can be canceled by *aio_cancel()*.

If the file descriptor of this operation is closed, the operation will be deleted if it has not completed or is not just about to complete. Signals specified for deleted operations will not be delivered. *Close()* will wait for asynchronous operations in progress for the descriptor to be deleted or completed.

You may use *aio_suspend()* to wait for the completion of asynchronous operations.

Sockets must be in blocking state or the operation may fail with *EWOULDBLOCK*.

If the control block pointed by *aiocbp* or the buffer pointed to by *aio_buf* becomes an illegal address before the asynchronous I/O completion, then the behavior of *aio_read()* is unpredictable.

If the thread that makes the *aio_read()* request terminates before the I/O completes the *aiocb* structure will still be updated with the return and error status, and any specified signal will be delivered to the process in which the thread was running. If thread related storage was used on the request the results are quite unpredictable.

Simultaneous asynchronous operations using the same *aiocbp*, asynchronous operations using a non-valid *aiocbp*, or any system action, that changes the process memory space while asynchronous I/O is outstanding to that address range, will produce unpredictable results

Simultaneous *aio_read()* operations on the same socket should not be done in general. With stream sockets, the I/O complete notifications may not be delivered in the same order as the bytes to which they refer, and so the byte stream may appear out of order. With UDP sockets, each datagram will complete one *aio_read()* operation, but you should not use multiple *aio_reads* for UDP sockets because this can cause significantly more system overhead as data arrives than a single outstanding request would.

There are several sockets oriented extensions to asynchronous I/O available with the BPX1AIO callable service, such as asynchronous *accept()*, asynchronous *accept_and_recv()*, asynchronous forms of all

five pairs of read and write type operations, and receiving I/O completion notifications via an ECB, exit program, or through a message queue. The `<aio.h>` header contains all the structure fields, constants, and prototypes necessary to use BPX1AIO from a C program. These extensions are exposed when the `_AIO_OS390` feature test macro is defined. The BPX1AIO stub resides in SYS1.CSSLIB and must be bound with your program. For a more detailed description of asynchronous I/O services, see BPX1AIO in [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

The `aio_lio_opcode` field is set to `LIO_READ` by the function `aio_read()`.

`_POSIX-PRIORITIZED_IO` is not supported. The `aio_reqprio` field may be set but it will be ignored.

`_POSIX-SYNCHRONIZED_IO` is not supported.

Returned value

If successful, `aio_read()` returns 0 to the calling process.

If unsuccessful, `aio_read()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EAGAIN

The requested asynchronous I/O operation was not queued due to system resource limitations.

ENOSYS

The file associated with `aio_fildes` does not support the `aio_read()` function.

Each of the following conditions may be detected synchronously at the time of the call to `aio_read()`, or asynchronously. If any of the conditions below are detected synchronously, `aio_read()` returns -1 and sets the `errno` to the corresponding value. If any of the conditions below are detected asynchronously, the return status of the asynchronous operation is set to -1, and the error status of the asynchronous operation will be set to the corresponding value.

Error Code Description

EBADF

The `aio_fildes` argument is not a valid file descriptor open for reading.

EINVAL

`aio_sigevent` contains a non-valid value.

EWOULDBLOCK

The file associated with `aio_fildes` is in nonblocking state and there is no data available.

In the case where the `aio_read()` function successfully queues the I/O operation but the operation is subsequently canceled or encounters an error, the return status of the asynchronous operations is set to -1, and the error status of the asynchronous operation will be set to the error status normally set by the `read()` function call, or to the following value:

Error Code Description

ECANCELED

The requested I/O was canceled before the I/O completed due to an explicit call to `aio_cancel()`.

Related information

- [“aio.h — Asynchronous I/O operations” on page 16](#)
- [“aio_cancel\(\) — Cancel an asynchronous I/O request” on page 146](#)
- [“aio_error\(\) — Retrieve error status for an asynchronous I/O operation” on page 147](#)
- [“aio_return\(\) — Retrieve status for an asynchronous I/O operation” on page 151](#)
- [“aio_suspend\(\) — Wait for an asynchronous I/O request” on page 151](#)
- [“aio_write\(\) — Asynchronous write to a socket” on page 153](#)

aio_return() — Retrieve status for an asynchronous I/O operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R7 |

Format

```
#define _XOPEN_SOURCE 500
#include <aio.h>

int aio_return(const struct aiocb *aiocbp);
```

General description

The `aio_return()` function returns the return status associated with the *aiocb* structure referenced by the *aiocbp* argument. The return status for an asynchronous I/O operation is the value that would be set by the corresponding `read()` or `write()` operation. While the operation is proceeding, the error status retrieved by `aio_error()` is `EINPROGRESS`; the return status retrieved by `aio_return()` however is unpredictable. The `aio_return()` function may be called to retrieve the return status of a given asynchronous operation; once `aio_error()` has returned with 0.

Returned value

If the asynchronous I/O operation has completed successfully, `aio_return()` returns the status as described for `read()` or `write()`.

If the asynchronous I/O operation has not yet completed, then the return status is unpredictable. `aio_return()` does not set `errno`.

Related information

- [“aio.h — Asynchronous I/O operations” on page 16](#)
- [“aio_error\(\) — Retrieve error status for an asynchronous I/O operation” on page 147](#)
- [“aio_read\(\) — Asynchronous read from a socket” on page 148](#)
- [“aio_suspend\(\) — Wait for an asynchronous I/O request” on page 151](#)

aio_suspend() — Wait for an asynchronous I/O request

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R7 |

Format

```
#define _XOPEN_SOURCE 500
#include <aio.h>

int aio_suspend(const struct aiocb *const list[],
               int nent, const struct timespec *timeout);
```

General description

The `aio_suspend()` function suspends the calling thread when the *timeout* is a NULL pointer until at least one of the asynchronous I/O operations referenced by the *list* argument has completed, or until a signal interrupts the function. Or, if *timeout* is not NULL, it is suspended until the time interval specified by *timeout* has passed. If the time interval indicated in the *timespec* structure pointed to by *timeout* passes before any of the I/O operations referenced by *list*, then `aio_suspend()` returns with an error. If any of the *aiocb* structures in the list correspond to completed asynchronous I/O operations (that is, the error status for the operation is not equal to EINPROGRESS) at the time of the call, the function returns without suspending the calling thread.

The *list* argument is an array of pointers to asynchronous I/O control blocks (AIOCBs). The *nent* argument indicates the number of elements in the array. Each *aiocb* structure pointed to will have been used in initiating an asynchronous I/O request. This array may contain NULL pointers, which are ignored. If this array contains pointers that refer to *aiocb* structures that have not been used in submitting asynchronous I/O or *aiocb* structures that are not valid, the results are unpredictable.

Returned value

If successful, `aio_suspend()` returns 0.

If unsuccessful, `aio_suspend()` returns -1. The application may determine which asynchronous I/O completed by scanning the associated error and return status using `aio_error()` or `aio_return()`, respectively. `aio_suspend()` sets `errno` to one of the following values:

Error Code

Description

EAGAIN

No asynchronous I/O indicated in the list referenced by *list* completed in the time interval indicated by *timeout*.

EINTR

A signal interrupted the `aio_suspend()` function. Note that, since each asynchronous I/O operation may possibly provoke a signal when it completes, this error return may be caused by the completion of one (or more) of the very I/O operations being awaited.

ENOSYS

z/OS UNIX System Services does not support the `aio_suspend()` function.

Usage notes

1. The AIOCBs represented by the list of AIOCB pointers must reside in the same storage key as the key of the invoker of `aio_suspend`. If the AIOCB Pointer List or any of the AIOCBs represented in the list are not accessible by the invoker an EFAULT may occur.
2. AIOCB pointers in the list with a value of zero will be ignored.
3. A timeout value of zero (seconds+nanoseconds) means that the `aio_suspend()` call will not wait at all. It will check for any completed asynchronous I/O requests. If none are found it will return with a EAGAIN. If at least one is found `aio_suspend()` will return with success.
4. A timeout value of a *timespec* with the `tv_sec` field set with INT_MAX, as defined in <limits.h>, will cause the `aio_suspend` service to wait until a asynchronous I/O request completes or a signal is received.

If the Macro `_AIO_OS390` is defined then the following may also apply.

5. The number of pointers to AIOCBs that use application supplied event control block (ECB) pointers for invocations of asynchronous I/O is limited to 253. There is no limit when not using the `_AIO_OS390` Feature Test Macro. See *z/OS UNIX System Services Programming: Assembler Callable Services Reference* under the BPX1AIO for information on supplying user-defined ECBs in the AIOCB data area.
6. The AIOCBs passed to `aio_suspend()` must not be freed or reused by other threads in the process while this service is still in progress. This service may use the AIOCBs even after the asynchronous I/O completes. This restriction excludes multiple threads from doing `aio_suspend()` on the same AIOCB at the same time. Modifying the AIOCB during an `aio_suspend()` will produce unpredictable results.
7. The use of these extensions will require macros from SYS1.CSSLIB. Make sure that it is included in the SYSLIB concatenation during the compile.

Related information

- [“aio.h — Asynchronous I/O operations” on page 16](#)
- [“aio_error\(\) — Retrieve error status for an asynchronous I/O operation” on page 147](#)
- [“aio_read\(\) — Asynchronous read from a socket” on page 148](#)
- [“aio_return\(\) — Retrieve status for an asynchronous I/O operation” on page 151](#)

aio_write() — Asynchronous write to a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R7 |

Format

```
#define _XOPEN_SOURCE 500
#include <aio.h>

int aio_write(struct aiocb *aiocbp);
```

General description

The `aio_write()` function initiates an asynchronous write as described by the `aiocb` structure (the asynchronous I/O control block).

The `aiocbp` argument points to the `aiocb` structure. This structure contains the following members:

aio_fildes

file descriptor

aio_offset

file offset

aio_buf

location of buffer

aio_nbytes

length of transfer

aio_reqprio

request priority offset

aio_sigevent

signal number and value

aiowrite_opcode

operation to be performed

The operation will write *aio_nbytes* from the buffer pointed to by *aio_buf* to the socket or file associated with *aio_fildes*. The call to *aio_write()* returns when the request has been initiated or queued to the file or device (even when the data cannot be delivered immediately).

Asynchronous I/O is currently only supported for sockets. The *aio_offset* field may be set but it will be ignored.

The *aio_cbp* value may be used as an argument to *aio_error()* and *aio_return()* functions in order to determine the error status and return status, respectively, of the asynchronous operation. While the operation is proceeding, the error status retrieved by *aio_error()* is *EINPROGRESS*; the return status retrieved by *aio_return()* however is unpredictable.

If an error condition is encountered during the queueing, the function call returns without having initiated or queued the request.

When the operation completes asynchronously the program can be notified by a signal as specified in the *aio_sigevent* structure. It is significantly more efficient to receive these notifications with *sigwaitinfo()* or *sigtimedwait()* than to let them drive a signal handler. At this time the return and error status will have been updated to reflect the outcome of the operation. The *sigevent* structure's notification function fields are not supported. If a signal is not desired the program can occasionally poll the *aio_cbp* with *aio_error()* until the result is no longer *EINPROGRESS*.

Be aware that the operation may complete, and the signal handler may be delivered, before control returns from the call to *aio_read()*. Even when the operation does complete this quickly the return value from the call to *aio_read()* will be zero, reflecting the queueing of the I/O request not the results of the I/O itself.

An asynchronous operation may be canceled with *aio_cancel()* before its completion. Canceled operations complete with an error status of *ECANCELED* and any specified signal will be delivered. Due to timing, the operation may still complete naturally, either successfully or unsuccessfully, before it can be canceled by *aio_cancel()*.

If the file descriptor of this operation is closed, the operation will be deleted if it has not completed or is not just about to complete. Signals specified for deleted operations will not be delivered. *Close()* will wait for asynchronous operations in progress for the descriptor to be deleted or completed.

You may use *aio_suspend()* to wait for the completion of asynchronous operations.

Sockets must be in blocking state or the operation may fail with *EWouldBlock*.

If the control block pointed by *aio_cbp* or the buffer pointed to by *aio_buf* becomes an illegal address before the asynchronous I/O completion, then the behavior of *aio_read()* is unpredictable.

If the thread that makes the *aio_read()* request terminates before the I/O completes, the *aio_cbp* structure will still be updated with the return and error status, and any specified signal will be delivered to the process in which the thread was running. If thread related storage was used on the request the results are quite unpredictable.

Simultaneous asynchronous operations using the same *aio_cbp*, attempting asynchronous operations using a non-valid *aio_cbp*, or any system action, that changes the process memory space while asynchronous I/O is outstanding to that address range, will produce unpredictable results.

Simultaneous *aio_write()* operations on the same stream socket should not be done because the data may be transmitted on the network out of order. With UDP sockets each *aio_write* defines a single datagram and there is no implied order of arrival in UDP. Beware, though, of sending too many datagrams. If there is network congestion or the receiver is slow you can tie up a large amount of system storage with uncontrolled *aio_writes*, and eventually they may start to fail with *ENOBUFS*.

There are several sockets oriented extensions to asynchronous I/O available with the *BPX1AIO* callable service, such as asynchronous *accept()*, asynchronous *accept_and_recv()*, asynchronous forms of all five pairs of read and write type operations, and receiving I/O completion notifications via an ECB, exit program, or through a message queue. The *<aio.h>* header contains all the structure fields, constants,

and prototypes necessary to use BPX1AIO from a C program. These extensions are exposed when the `_AIO_OS390` feature test macro is defined. The BPX1AIO stub resides in SYS1.CSSLIB and must be bound with your program. For a more detailed description of asynchronous I/O services, see BPX1AIO in [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

The `aio_lio_opcode` field is set to `LIO_WRITE` by the function `aio_write()`.

`_POSIX_PRIORITIZED_IO` is not supported. The `aio_reqprio` field may be set but it will be ignored.

`_POSIX_SYNCHRONIZED_IO` is not supported.

Returned value

If the I/O operation is successfully queued, `aio_write()` returns 0 to the calling process.

If the I/O operation is not queued, `aio_write()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EAGAIN

The requested asynchronous I/O operation was not queued due to system resource limitations.

ENOSYS

The file associated with `aio_fildes` does not support the `aio_write()` function.

Each of the following conditions may be detected synchronously at the time of the call to `aio_write()`, or asynchronously. If any of the conditions below are detected synchronously, `aio_write()` returns -1 and sets the `errno` to the corresponding value. If any of the conditions below are detected asynchronously, the return status of the asynchronous operation is set to -1, and the error status of the asynchronous operation will be set to the corresponding value.

Error Code Description

EBADF

The `aio_fildes` argument is not a valid file descriptor open for writing.

EINVAL

The `aio_nbytes` is not a valid value or `aio_sigevent` contains a value that is not valid.

EWOULDBLOCK

The file associated with `aio_fildes` is in nonblocking state and there is no data available.

In the case where `aio_write()` successfully queues the I/O operation but the operation is subsequently canceled or encounters an error, the return status of the asynchronous operation is set to -1, and the error status of the asynchronous operation is set to the error status normally set by the `write()` function call, or to the following value:

Error Code Description

ECANCELED

The requested I/O was canceled before the I/O completed due to an explicit call to `aio_cancel()`.

Related information

- [“aio.h — Asynchronous I/O operations” on page 16](#)
- [“aio_cancel\(\) — Cancel an asynchronous I/O request” on page 146](#)
- [“aio_error\(\) — Retrieve error status for an asynchronous I/O operation” on page 147](#)
- [“aio_read\(\) — Asynchronous read from a socket” on page 148](#)
- [“aio_return\(\) — Retrieve status for an asynchronous I/O operation” on page 151](#)
- [“aio_suspend\(\) — Wait for an asynchronous I/O request” on page 151](#)

alarm() — Set an alarm

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

unsigned int alarm(unsigned int seconds);
```

General description

Generates a SIGALRM signal after the number of seconds specified by the *seconds* parameter has elapsed. The SIGALRM signal delivery is directed at the calling thread.

seconds is the number of real seconds to wait before the SIGALRM signal is generated. Because of processor delays, the SIGALRM signal may be generated slightly later than this specified time. If *seconds* is zero, any previously set alarm request is canceled.

Only one such alarm can be active at a time. If you set a new alarm time, any previous alarm is canceled.

This function is supported only in a POSIX program.

Special behavior for XPG4: The `fork()` function clears pending alarms in the child thread. However, a new thread image created by one of the `exec` functions inherits the time left to an alarm in the old thread's image.

Special behavior for XPG4.2: `alarm()` will interact with the `setitimer()` function when the `setitimer()` function is used to set the 'real' interval timer (ITIMER_REAL).

`alarm()` does not interact with the `usleep()` function.

Returned value

If a prior alarm request has not yet completed, `alarm()` returns the number of seconds remaining until that request would have generated a SIGALRM signal.

If there are no prior alarm requests with time remaining, `alarm()` returns 0. Because `alarm()` is always successful, there is no failure return. If any failures are encountered that prevent `alarm()` from completing successfully, an abend is generated.

Example

CELEBA05

```
/* CELEBA05
   The following example generates a SIGALRM signal.
*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <signal.h>
#include <time.h>
#include <unistd.h>
```

```

volatile int footprint=0;

void catcher(int signum) {
    puts("inside signal catcher!");
    footprint = 1;
}

main() {
    struct sigaction sact;
    volatile double count;
    time_t t;

    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = catcher;
    sigaction(SIGALRM, &sact, NULL);

    alarm(5); /* timer will pop in five seconds */

    time(&t);
    printf("before loop, time is %s", ctime(&t));
    for (count=0; (count<1e10) && (footprint == 0); count++);
    time(&t);
    printf("after loop, time is %s", ctime(&t));

    printf("the sum so far is %.0f\n", count);

    if (footprint == 0)
        puts("the signal catcher never gained control");
    else
        puts("the signal catcher gained control");
}

```

Output

```

before loop, time is Fri Jun 16 08:37:03 2006
inside signal catcher!
after loop, time is Fri Jun 16 08:37:08 2006
the sum so far is 17417558

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“setitimer\(\) — Set value of an interval timer” on page 1540](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sleep\(\) — Suspend execution of a thread” on page 1668](#)
- [“usleep\(\) — Suspend execution for an interval” on page 1951](#)

aligned_alloc() — Allocating aligned memory blocks

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C11 | both | |

Format

```
#include <stdlib.h>
void *aligned_alloc( size_t alignment, size_t size );
```

General description

The `aligned_alloc` function allocates space for an object whose alignment is specified by `alignment`, whose size is specified by `size`, and whose value is indeterminate.

Special behavior for C++: The C++ keywords `new` and `delete` are not interoperable with `aligned_alloc()`, `calloc()`, `free()`, `malloc()`, `posix_memalign()`, or `realloc()`.

Note: To use the `aligned_alloc()` function, compile the source code with C11 standard based compilation.

Parameters

alignment

Specifies the alignment. The value of *alignment* is a power of two.

size

Number of bytes to allocate. The value of *size* is an integral multiple of alignment.

Returned Value

On success, returns the pointer to the beginning of newly allocated memory. To avoid a memory leak, the returned pointer must be deallocated with `free()` or `realloc()`.

If `size` was specified as 0, `aligned_alloc()` returns a null pointer.

On failure, returns a null pointer, it sets `errno` to one of the following values:

Error Code

EINVAL

The value of *alignment* or *size* is not supported.

ENOMEM

Insufficient memory is available

Example

CELEBM26

```
/* CELEBM26
This example prompts you allocate size (which is an integral multiple of alignment) bytes of
uninitialized storage.
If &aligned_alloc was successful, the example prints the address returned; otherwise, it prints
errno.
*/
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

int main(void)
{
    int *p1 = aligned_alloc(8, 8*sizeof *p1);
    if(!p1)
    {
        printf("aligned_alloc failed with errno = %d\n", errno);
        return -1;
    }
    else
    {
        printf("8-byte aligned addr: %p\n", (void*)p1);
        free(p1);
    }
}
```



```
return 0;
}
```

Output

One possible output is:

```
8-byte aligned addr: 22575D20
```

Related information

- “Using the system programming C facilities” in *z/OS XL C/C++ Programming Guide*
- “[stdlib.h — Standard library functions](#)” on page 65
- “[calloc\(\) — Reserve and initialize storage](#)” on page 232
- “[free\(\) — Free a block of storage](#)” on page 620
- “[malloc\(\) — Reserve storage block](#)” on page 1035
- “[__malloc24\(\) — Allocate 24-bit storage](#)” on page 1037
- “[__malloc31\(\) — Allocate 31-bit storage](#)” on page 1038
- “[posix_memalign\(\) — Reserve aligned storage block](#)” on page 1201
- “[realloc\(\) — Change reserved storage block size](#)” on page 1395

alloca() — Allocate storage from the stack

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | OS/390 V2R6 |

Format

```
#include <stdlib.h>

void *alloca(unsigned int size);
```

General description

The built-in `alloca()` function obtains memory from the stack. This eliminates the need for an explicit `free()` as the memory is freed when the stack is collapsed.

If the `alloca()` function is unable to obtain the requested storage, control will not return to the caller. Instead the application will terminate due to an out of memory condition (if the reserve stack is available and the caller is not XPLINK), or it will terminate with an abend indicating that storage could not be obtained.

To avoid infringing on the user's name space, this nonstandard function is exposed only when you enable the [runtime library extensions](#) or [extended language level](#).

Note: Storage from an `alloca()` is done after a `setjmp()` (or any variation thereof) is freed on a `longjmp()` (or any variation thereof) to an XPLINK-compiled function, and not freed on a `longjmp()` to a NOXPLINK-compiled function. See the `longjmp()` family of functions for more details.

Returned value

If successful, `alloca()` returns the address of the requested storage.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“Built-in functions” on page 96](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“setjmp\(\) — Preserve stack environment” on page 1542](#)
- [“_setjmp\(\) — Set jump point for a nonlocal goto” on page 1544](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

arm_bind_thread() — Bind the current thread to a given transaction

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_bind_thread(
/* [in]      */ arm_start_handle_t      start_handle,
/* [in]      */ arm_int32_t             flags,
/* [in]      */ arm_buffer4_t          *buffer4,
);
```

General description

Use arm_bind_thread() to indicate the current thread is performing processing on behalf of a given transaction, and no other transaction. This enables eWLM to collect resource usage and delay information for threads serving each class of work, and to adjust the resources given to threads to help them meet the goals assigned to those classes.

Any number of threads can bind to the same transaction at the same time. However a single thread cannot bind to more than one transaction at the same time. If a thread calls arm_bind_thread() when it is already bound to a transaction, the call is not honored and it returns a negative value to indicate an error.

A thread that calls arm_bind_thread() must call arm_unbind_thread() when it completes its processing on behalf of the transaction. (If arm_unbind_thread() is not called, then arm_stop_transaction() unbinds any threads that remain bound to the transaction. This exists for recovery purposes. Applications are expected to use arm_unbind_thread() as part of normal processing.)

start_handle

The handle returned by arm_start_transaction() for the transaction.

flags

Reserved for future use. The argument must be set to 0.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. Currently no sub-buffers are defined for this function so a null pointer should be passed. If a buffer is passed eWLM ignores it.

Returned value

On success, arm_bind_thread returns ARM_RC_SUCCESS. On failure, the errno and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes.

| |
|--------------------|
| Error Code |
| Description |

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSAARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to ARM_RC_AUTH_ERROR.

EMVSSAF2ERR

An error occurred in the security product.

Return code

The following list contains all possible return codes for the ARM function calls.

| |
|--------------------|
| Return Code |
| Description |

ARM_RC_APP_INPUT

User provided application id is invalid.

ARM_RC_APPL_INST_MAX

Maximum number of application instances per process is exceeded.

ARM_RC_APPL_INST_NAME

Application instance name is too long.

ARM_RC_APPL_MAX

Maximum number of registered applications is exceeded.

ARM_RC_APPL_NAME

Application name is missing or too long.

ARM_RC_AUTH_ERROR

User is not authorized to perform ARM calls.

ARM_RC_BLOCKED_MAX

Maximum number of blocked threads per transaction is exceeded.

ARM_RC_CORR_BAD_SIZE

Correlator size is not valid.

ARM_RC_CORR_EFAULT

Correlator return address is not valid.

ARM_RC_ENOMEM

Process or system is out of memory.

ARM_RC_FLAGS_EINVAL

Flags value is not valid.

ARM_RC_GRP_MAX

Maximum number of registered application groups is exceeded.

ARM_RC_GRP_NAME

Application group name is too long.

ARM_RC_HANDLE_EFAULT

Handle return address is not valid.

ARM_RC_MAXMEM

Maximum ARM services memory limit is exceeded.

ARM_RC_PARENT_CORR_INVAL

Parent correlator is not valid.

ARM_RC_PARENT_CORR_SZ

Parent correlator is too small.

ARM_RC_PARENT_CORR_VERSION

Parent correlator version is not correct.

ARM_RC_PROC_VAL_MSMTCH

Property values do not match property names.

ARM_RC_PROP_NAME

Transaction property name is too long.

ARM_RC_PROP_NAME_MAX

Too many property names are passed to ARM call.

ARM_RC_PROP_NAME_SUBBUF_MAX

Too many property name sub-buffers are passed to ARM call.

ARM_RC_PROP_VAL

Transaction property value is too long.

ARM_RC_PROP_VAL_MAX

Too many property values are passed to ARM call.

ARM_RC_PROP_VAL_SUBBUF_MAX

Too many property value sub-buffers are passed to ARM call.

ARM_RC_TIME_SUBBUF_MAX

Too many arrival time sub-buffers are passed to ARM call.

ARM_RC_TRAN_INPUT

User provided transaction type id is not valid.

ARM_RC_TRAN_MAX

Maximum number of transactions is exceeded.

ARM_RC_TRAN_STATUS_EINVAL

Invalid transaction status.

ARM_RC_TRAN_TYPE_INST_MAX

Maximum number of registered transaction type instances per process is exceeded.

ARM_RC_TRAN_TYPE_MAX

Maximum number of registered transaction types is exceeded.

ARM_RC_TRAN_TYPE_NAME

Transaction type name is missing or too long.

ARM_RC_UNKN_APPL_INST

Application instance is not found.

ARM_RC_UNKN_BLOCKED

Blocked thread is not valid for the specified transaction.

ARM_RC_UNKN_PARENT

Parent transaction is not a valid transaction.

ARM_RC_UNKN_PROC

The calling processing did not register an application instance.

ARM_RC_UNKN_TRAN

Transaction was not found for the calling process.

ARM_RC_UNKN_TRANCLASS_INST

Transaction class instance is not found.

ARM_RC_URI_NAME

URI value is too long.

ARM_RC_URI_SUBBUF_MAX

Too many URI value sub-buffers are passed to ARM call.

ARM_RC_VERSION_NAME

Application version name is too long.

Related information

- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)
- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_blocked() — Indicate the processing of a transaction is blocked

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_blocked(
/* [in] */ arm_start_handle_t start_handle,
/* [in] */ arm_int32_t flags,
/* [in] */ arm_buffer4_t *buffer4,
/* [out] */ arm_block_handle_t *block_handle
);
```

General description

Use `arm_blocked()` to indicate that processing of a transaction is blocked waiting for a transaction in another application to complete. This helps to identify what portion of a transaction's response time is spent in its own application and what portion is spent in downstream applications.

start_handle

The handle returned by `arm_start_transaction()` for the transaction.

flags

Reserved for future use. The argument must be set to 0.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. Currently no sub-buffers are defined for this function so a null pointer should be passed. If a buffer is passed eWLM ignores it.

block_handle

A pointer to a 64-bit area where a handle that identifies the arm_blocked() call is returned. The handle must be passed to arm_unblocked(). The handle is valid only within the caller's process.

Returned value

On success, arm_blocked returns ARM_RC_SUCCESS. On failure, the errno and return code are set to indicate the error. See “Return code” on page 161 for the list of all possible return codes. On failure, the block_handle is set to a dummy value which can be used for later calls to other interfaces. Those interfaces will recognize that the block_handle contains a dummy value and return without performing any action.

Error Code**Description****EFAULT**

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to ARM_RC_AUTH_ERROR.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)
- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_correlator_get_length() – Get the actual size of the transaction correlator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_correlator_get_length(
/* [in] */ arm_correlator_t *corr_ptr,
/* [out] */ arm_correlator_length_t **result_ptr
);
```

General description

Returns the actual size of a given correlator.

corr_ptr

Address of correlator.

result_ptr

Set to the address of the length of the correlator.

Returned value

On success, arm_correlator_get_length returns ARM_RC_SUCCESS. On failure, the errno and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes.

Error Code

Description

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to ARM_RC_AUTH_ERROR.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) – Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) – Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_end_application\(\) – Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) – Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) – Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) – Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) – Defines and initializes an ARM transaction type” on page 171](#)

- “[arm_start_transaction\(\)](#) — Mark the start of an ARM transaction” on page 173
- “[arm_stop_transaction\(\)](#) — Mark the end of an ARM transaction” on page 174
- “[arm_unbind_thread\(\)](#) — Unbind the current thread to a given transaction” on page 176
- “[arm_unblocked\(\)](#) — Indicate the processing of a transaction is no longer blocked” on page 177
- “[arm_update_transaction\(\)](#) — Update a given transaction” on page 178

arm_end_application() — Undefines an ARM application

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_end_application(
/* [in/out] */ arm_appl_id_t  *application_id
/* [in]      */ arm_int32_t    flags,
/* [in]      */ arm_buffer4_t  *buffer4,
);
```

General description

Use `arm_end_application()` to close ARM API activity for a particular application. `arm_end_application()` invalidates the application handle returned by `arm_init_application()`, all transaction type handles associated with the application handle, and all transaction handles associated with those transaction types. Any further API calls using these handles will be rejected with a negative status return value. Information about transactions that were started and not yet stopped is discarded.

application_id

The handle passed to or returned by `arm_init_application()` for the application.

flags

Reserved for future use. The argument must be set to 0.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. Currently no sub-buffers are defined for this function so a null pointer should be passed. If a buffer is passed eWLM ignores it.

Returned value

On success, `arm_stop_transaction` returns `ARM_RC_SUCCESS`. On failure, the `errno` and return code are set to indicate the error. See “[Return code](#)” on page 161 for the list of all possible return codes.

Error Code

Description

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to `ARM_RC_AUTH_ERROR`.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)
- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_get_correlator_max_length() — Get the max length of the transaction correlator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_int32_t arm_get_correlator_max_length();
```

General description

Returns the size of the buffer required for the correlator returned by arm_start_transaction().

Note: The size applies only to correlators returned by arm_start_transaction(). It does not necessarily apply to parent correlators received from other applications, which may have been created by another ARM implementation and may have a different maximum size. The ARM 2.0 and ARM 3.0 standards defined the maximum size of the correlator for any implementation as 168 bytes. However the proposed ARM 4.0 standard most likely will drop this restriction and implementations will be allowed to create a correlator of any length.

Returned value

On success, arm_iget_correlator_max_length returns a positive number representing the maximum correlator length. On failure, the errno and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes.

Error Code**Description**

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to ARM_RC_AUTH_ERROR.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)
- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_get_timestamp() — Get the current timestamp

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_get_timestamp(
/* [out] */ arm_timestamp_t *timestamp
);
```

General description

Use `arm_get_timestamp()` to obtain the current time. If the application wants to pass the arrival time sub-buffer to `arm_start_transaction()`, it must call `arm_get_timestamp()` to capture the arrival time in a format that is compatible with the arrival time sub-buffer.

timestamp

Area where the current time is returned. The format of the timestamp is implementation-dependent.

Returned value

On success, `arm_get_timestamp` returns `ARM_RC_SUCCESS`. On failure, the `errno` and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes.

Error Code

Description

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to `ARM_RC_AUTH_ERROR`.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)
- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_init_application() — Defines an ARM application

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_init_application(
/* [in] */ arm_string_t application_name,
/* [in] */ arm_string_t application_group_name,
/* [in] */ arm_string_t application_instance_name,
/* [in] */ arm_int32_t flags,
/* [in] */ arm_buffer4_t *buffer4,
/* [in/out] */ arm_appl_id_t *application_id
);
```

General description

Use `arm_init_application()` to define an application. This function must be called before any other ARM API calls. Typically it should be called during the application's initialization.

If an application exists as multiple processes, it must call `arm_init_application()` in each process. This is necessary for eWLM to understand how each process contributes to the application. Multiple applications can register from within one process. This is useful if external functions are packaged in the same process.

`arm_init_application()` is the ARM 4.0 equivalent of ARM 2.0's `arm_init` function.

application_name

The name used generically to identify the application. The maximum length is 128 characters including the null string terminator.

application_group_name

The name of a group of application instances to which this instance belongs. The maximum length is 256 characters including the null string terminator. If no value is desired, a null pointer should be passed.

application_instance_name

The name of this instance of the application. The maximum length is 256 characters including the null string terminator. If no value is desired, a null pointer should be passed.

flags

One flag is defined. `ARM_INIT_FLAG_ID_INPUT` indicates whether the application id is an input (flag is one) or an output (flag is zero). See the application id parameter below. All other flag bits are reserved and must be zero.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. Currently no sub-buffers are defined for this function so a null pointer should be passed. If a buffer is passed, eWLM ignores it.

application_id

A pointer to a 64-bit area handle that identifies the application. The application can define its own handle and pass it as input or it can have eWLM generate a handle and return it. The choice is indicated by the flag `ARM_INIT_FLAG_ID_INPUT`. The handle must be passed to `arm_init_transaction_type()` and `arm_end_application()`. The handle is defined only within the caller's process.

Returned value

On success, `arm_init_application` returns `ARM_RC_SUCCESS`. On failure, the `errno` and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes. On failure, the `application_id` is set to a dummy value which can be used for later calls to other interfaces. Those interfaces will recognize that the `application_id` contains a dummy value and return without performing any action.

Error Code

Description

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to `ARM_RC_AUTH_ERROR`.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)
- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_init_transaction_type() — Defines and initializes an ARM transaction type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_init_transaction_type(
/* [in]      */ arm_appl_id_t   *application_id,
/* [in]      */ arm_string_t    transaction_name,
/* [in]      */ arm_int32_t     flags,
/* [in]      */ arm_buffer4_t   *buffer4,
/* [in/out] */ arm_appl_id_t    *transaction_type_id
);
```

General description

Use `arm_init_transaction_type()` to define a transaction classtype. A transaction type represents a type of transaction that is executed by an application. A transaction type must be defined before transactions of that type can be measured using `arm_start_transaction()` and `arm_stop_transaction()`.

A transaction type consists of a transaction type name and a list of up to 20 transaction property names. Multiple transaction types with the same transaction type name and different transaction property names are allowed. It is the complete set of names that determines the uniqueness of a transaction type.

It is recommended that transaction types be defined during the application's initialization. eWLM expects transaction types to represent broad categories of work so that ordinarily there will be few of them. Detailed transaction identification should be done using the transaction-level properties.

Transaction types also can be defined as needed, during the application's processing of transactions. The ARM implementation must check whether there is an existing definition of the same type to prevent duplicates. Since this adds further overhead into mainline processing, this approach is not recommended.

Transaction classtype definitions remain valid for the life of the application (i.e. until it calls `arm_end_application()` or its process terminates).

arm_init_application_type() is the ARM 4.0 equivalent of ARM 2.0's arm_getid function.

application_id

The handle passed to or returned by arm_init_application() for the application associated with this transaction type.

transaction_name

The name used to identify the transaction type. The maximum length is 128 characters including the null string terminator. Classification rules in the eWLM policy can use the transaction type name to categorize transactions into eWLM service classes and report classes.

flags

One flag is defined. ARM_INIT_FLAG_ID_INPUT indicates whether the transaction type id is an input (flag is one) or an output (flag is zero). See the transaction type id parameter below. All other flag bits are reserved and must be zero.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. A null value can be specified if no additional data is required.

transaction_type_id

A pointer to a 64-bit handle that identifies the transaction type. The application can define its own handle and pass it as input or it can have eWLM generate a handle and return it. The choice is indicated by the flag ARM_INIT_FLAG_ID_INPUT. The handle must be passed to arm_start_transaction(). The handle is defined only within the caller's process. If eWLM is asked to generate a handle and the transaction type name and the transaction property names (in the user data buffer) match the names passed on a previous arm_init_transaction_type() call, the handle value that is returned will be the same as the previous call.

Returned value

On success, arm_init_application returns ARM_RC_SUCCESS. On failure, the errno and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes. On failure, the application_id is set to a dummy value which can be used for later calls to other interfaces. Those interfaces will recognize that the application_id contains a dummy value and return without performing any action.

Error Code**Description****EFAULT**

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to ARM_RC_AUTH_ERROR.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)

- “[arm_init_application\(\)](#) — Defines an ARM application” on page 169
- “[arm_start_transaction\(\)](#) — Mark the start of an ARM transaction” on page 173
- “[arm_stop_transaction\(\)](#) — Mark the end of an ARM transaction” on page 174
- “[arm_unbind_thread\(\)](#) — Unbind the current thread to a given transaction” on page 176
- “[arm_unblocked\(\)](#) — Indicate the processing of a transaction is no longer blocked” on page 177
- “[arm_update_transaction\(\)](#) — Update a given transaction” on page 178

arm_start_transaction() — Mark the start of an ARM transaction

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_start_transaction(
/* [in] */ arm_appl_id_t *transaction_id,
/* [in] */ arm_correlator_t *parent_correlator_ptr,
/* [in] */ arm_int32_t flags,
/* [in] */ arm_buffer4_t *buffer4,
/* [out] */ arm_start_handle_t *start_handle,
/* [out] */ arm_correlator_t *current_correlator_ptr
);
```

General description

Use `arm_start_transaction()` to mark the beginning of execution of a transaction. The transaction must be identified as a member of a transaction type that was previously defined by `arm_init_transaction_type()`. There can be any number of transactions executing simultaneously.

transaction_id

The handle passed to or returned by `arm_init_transaction_type()` for the transaction type.

parent_correlator_ptr

A pointer to the parent correlator for this transaction. If there is no parent correlator, a null value should be passed.

flags

One flag bit is defined: `ARM_START_FLAG_TRACE_REQUEST` requests tracing of the transaction. Currently eWLM has no support to trace transactions and ignores the flag. All other flag bits are reserved and must be zero.

buffer4

A pointer to a buffer that identifies one or more sub-buffers with additional data. A null value can be specified if no additional data is required.

start_handle

A pointer to a 64-bit area where a handle that identifies the transaction is returned. The handle must be passed to other transaction-level interfaces such as `arm_stop_transaction()`. The handle is valid only within the caller's process.

current_correlator_ptr

A pointer to a buffer into which eWLM will store a correlator for the transaction. The length of the buffer must be at least the length returned from the `arm_get_correlator_max_length()` function.

Returned value

On success, `arm_init_application` returns `ARM_RC_SUCCESS`. On failure, the `errno` and return code are set to indicate the error. See “Return code” on page 161 for the list of all possible return codes. On failure, the `application_id` is set to a dummy value which can be used for later calls to other interfaces. Those interfaces will recognize that the `application_id` contains a dummy value and return without performing any action.

Error Code

Description

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to `ARM_RC_AUTH_ERROR`.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- “`arm_bind_thread()` — Bind the current thread to a given transaction” on page 160
- “`arm_blocked()` — Indicate the processing of a transaction is blocked” on page 163
- “`arm_correlator_get_length()` — Get the actual size of the transaction correlator” on page 165
- “`arm_end_application()` — Undefines an ARM application” on page 166
- “`arm_get_correlator_max_length()` — Get the max length of the transaction correlator” on page 167
- “`arm_get_timestamp()` — Get the current timestamp” on page 168
- “`arm_init_application()` — Defines an ARM application” on page 169
- “`arm_init_transaction_type()` — Defines and initializes an ARM transaction type” on page 171
- “`arm_stop_transaction()` — Mark the end of an ARM transaction” on page 174
- “`arm_unbind_thread()` — Unbind the current thread to a given transaction” on page 176
- “`arm_unblocked()` — Indicate the processing of a transaction is no longer blocked” on page 177
- “`arm_update_transaction()` — Update a given transaction” on page 178

arm_stop_transaction() — Mark the end of an ARM transaction

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_stop_transaction(
/* [in] */ arm_start_handle_t start_handle,
/* [in] */ arm_int32_t transaction_status,
/* [in] */ arm_int32_t flags,
/* [in] */ arm_buffer4_t *buffer4,
);
```


General description

Use `arm_stop_transaction()` to mark the end of execution of a transaction.

If any threads are bound to the transaction, `arm_stop_transaction()` unbinds them. If the transaction is in a blocked state due to outstanding `arm_blocked()` calls, then `arm_stop_transaction()` considers the transaction to be unblocked at the time it is stopped. This cleanup processing exists for recovery purposes. Applications are expected to use `arm_unbind_thread()` and `arm_unblocked()` as part of normal processing.

start_handle

The handle returned by `arm_start_transaction()` for the transaction.

transaction_status

The completion code of the transaction.

ARM_STATUS_GOOD

Transaction successful.

ARM_STATUS_ABORT

Transaction aborted This value indicates there was a fundamental failure in the system; for example, a communications timeout or a database operation error.

ARM_STATUS_FAILED

Transaction failed. This value indicates the system worked properly but the transaction was not successful; for example, when making an airline reservation, no seats are available on the requested flight.

ARM_STATUS_UNKNOWN

Transaction status is unknown.

flags

Reserved for future use. The argument must be set to 0.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. A null pointer can be passed if no additional data is required. The proposed ARM4 standard defines a metric values sub-buffer for this function but eWLM does not process metrics. If a buffer is passed eWLM ignores it.

Returned value

On success, `arm_end_application` returns `ARM_RC_SUCCESS`. On failure, the `errno` and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes.

Error Code

Description

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to `ARM_RC_AUTH_ERROR`.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)

- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefined an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_unbind_thread() — Unbind the current thread to a given transaction

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_unbind_thread(
/* [in] */ arm_start_handle_t start_handle,
/* [in] */ arm_int32_t flags,
/* [in] */ arm_buffer4_t *buffer4,
);
```

General description

Use `arm_unbind_thread()` to indicate the current thread is no longer performing processing on behalf of a given transaction.

If `arm_unbind_thread()` is not called, then `arm_stop_transaction()` unbinds any threads that remain bound to the transaction. This exists for recovery purposes. Applications are expected to use `arm_unbind_thread()` as part of normal processing.

start_handle

The handle returned by `arm_start_transaction()` for the transaction.

flags

Reserved for future use. The argument must be set to 0.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. Currently no sub-buffers are defined for this function so a null pointer should be passed. If a buffer is passed eWLM ignores it.

Returned value

On success, `arm_unbind_thread` returns `ARM_RC_SUCCESS`. On failure, the `errno` and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes.

Error Code

Description

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to ARM_RC_AUTH_ERROR.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_unblocked() — Indicate the processing of a transaction is no longer blocked

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_unblocked(
/* [in]      */ arm_start_handle_t   start_handle,
/* [in]      */ arm_block_handle_t   block_handle,
/* [in]      */ arm_int32_t          flags,
/* [in]      */ arm_buffer4_t        *buffer4,
);
```

General description

Use arm_unblocked() to indicate that processing of a transaction is no longer blocked.

If arm_unblocked() is not called, then arm_stop_transaction() considers the transaction to be unblocked at the time it is stopped. This exists for recovery purposes. Applications are expected to use arm_unblocked() as part of normal processing.

start_handle

The handle returned by `arm_startarm_start_transaction()` for the transaction.

block_handle

The handle returned by `arm_blocked()`.

flags

Reserved for future use. The argument must be set to 0.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. Currently no sub-buffers are defined for this function so a null pointer should be passed. If a buffer is passed eWLM ignores it.

Returned value

On success, `arm_unblocked` returns `ARM_RC_SUCCESS`. On failure, the `errno` and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes.

Error Code**Description****EFAULT**

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSAARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to `ARM_RC_AUTH_ERROR`.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)
- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_update_transaction\(\) — Update a given transaction” on page 178](#)

arm_update_transaction() — Update a given transaction

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <sys/_Elmarm4.h>

arm_error_t arm_update_transaction(
/* [in] */ arm_start_handle_t start_handle,
/* [in] */ arm_int32_t flags,
/* [in] */ arm_buffer4_t *buffer4,
);
```

General description

arm_update_transaction() does not perform any function in the eWLM developer's edition. A future edition of eWLM may support a version of arm_update_transaction() that can be used to log problem determination data associated with the transaction.

start_handle

The handle returned by arm_start_transaction() for the transaction.

flags

Reserved for future use. The argument must be set to 0.

buffer4

A pointer to a buffer that identifies one or more sub-buffers containing additional data. A null pointer can be passed if no additional data is required. The proposed ARM4 standard defines a metric values sub-buffer for this function but eWLM does not process metrics. If a buffer is passed eWLM ignores it.

Returned value

On success, arm_update_transaction returns ARM_RC_SUCCESS. On failure, the errno and return code are set to indicate the error. See [“Return code” on page 161](#) for the list of all possible return codes.

Error Code

Description

EFAULT

A parameter of this service contained an address that was not accessible to the caller.

EINVAL

A parameter of this service contained a value that was not valid.

EMVSARMERROR

An ARM error occurred. Refer to the return code for the specific error.

EPERM

The caller does not have the appropriate privileges. The return code is set to ARM_RC_AUTH_ERROR.

EMVSSAF2ERR

An error occurred in the security product.

Related information

- [“arm_bind_thread\(\) — Bind the current thread to a given transaction” on page 160](#)
- [“arm_blocked\(\) — Indicate the processing of a transaction is blocked” on page 163](#)
- [“arm_correlator_get_length\(\) — Get the actual size of the transaction correlator” on page 165](#)
- [“arm_end_application\(\) — Undefines an ARM application” on page 166](#)
- [“arm_get_correlator_max_length\(\) — Get the max length of the transaction correlator” on page 167](#)
- [“arm_get_timestamp\(\) — Get the current timestamp” on page 168](#)
- [“arm_init_application\(\) — Defines an ARM application” on page 169](#)
- [“arm_init_transaction_type\(\) — Defines and initializes an ARM transaction type” on page 171](#)
- [“arm_start_transaction\(\) — Mark the start of an ARM transaction” on page 173](#)
- [“arm_stop_transaction\(\) — Mark the end of an ARM transaction” on page 174](#)

- [“arm_unbind_thread\(\) — Unbind the current thread to a given transaction” on page 176](#)
- [“arm_unblocked\(\) — Indicate the processing of a transaction is no longer blocked” on page 177](#)

asctime(), asctime64() — Convert time to character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <time.h>

char *asctime(const struct tm *timeptr);

#define _LARGE_TIME_API
#include <time.h>

char asctime64(const struct tm *timeptr);
```

General description

Converts time stored as a structure, pointed to by *timeptr*, to a character string. The *timeptr* value can be obtained from a call to `gmtime()` or `localtime()`. Both functions return a pointer to a `tm` structure defined in “time.h — Time and date” on page 75.

The string result that `asctime()` produces contains exactly 26 characters and has the format:

```
"%.3s %.3s%3d %.2d:%.2d:%.2d %d\n"
```

The following is an example of the string returned:

```
Fri Jun 16 02:03:55 2006\n\0
```

Notes:

1. The calendar time returned by a call to the `time()` function begins at epoch, which was at 00:00:00 Coordinated Universal Time (UTC), January 1, 1970.
2. The `asctime()` function uses a 24-hour clock format.
3. The days are abbreviated to: Sun, Mon, Tue, Wed, Thu, Fri, and Sat.
4. The months are abbreviated to: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, and Dec.
5. All fields have a constant width.
6. Dates with only one digit are preceded either with a zero or a blank space.
7. The newline character (`\n`) and the NULL character (`\0`) occupy the last two positions of the string.
8. The `asctime()`, `ctime()`, and other time functions can use a common, statically allocated buffer for holding the return string. Each call to one of these functions may possibly destroy the result of the previous call.

The function `asctime64()` will behave exactly like `asctime()` except it will support a structured date beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Returned value

If successful, `asctime()` returns a pointer to the resulting character string.

If the function is unsuccessful, it returns `NULL`.

Example

CELEBA06

```
/* CELEBA06

   This example polls the system clock and prints a message
   giving the current time.

*/
#include <time.h>
#include <stdio.h>

int main(void)
{
    struct tm *newtime;
    time_t ltime;

    /* Get the time in seconds */
    time(&ltime);
    /* Break it down & store it in the structure tm */
    newtime = localtime(&ltime);

    /* Print the local time as a string */
    printf("The current date and time are %s",
           asctime(newtime));
}
```

Output

```
The current date and time are Fri Jun 16 13:29:51 2006
```

Related information

- [“time.h — Time and date” on page 75](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) — Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)
- [“time\(\), time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

asctime_r(), asctime64_r() – Convert date and time to a character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 Language Environment | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <time.h>
```

```
char *asctime_r(const struct tm *__restrict__ tm, char *__restrict__ buf);
```

```
#define _LARGE_TIME_API
#include <time.h>
```

```
char *asctime64_r(const struct tm *__restrict__ tm, char *__restrict__ buf);
```

General description

The `asctime_r()` function converts the broken-down time in the structure pointed to by *tm* into a character string that is placed in the user-supplied buffer pointed to by *buf* (which contains at least 26 bytes) and then returns *buf*.

The function `asctime64_r()` will behave exactly like `asctime_r()` except it will support a structured date beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Returned value

If successful, `asctime_r()` returns a pointer to a character string containing the date and time. This string is pointed to by the argument *buf*.

If unsuccessful, `asctime_r()` returns NULL.

There are no documented errno values.

Related information

- [“time.h – Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) – Convert time to character string” on page 180](#)
- [“ctime\(\), ctime64\(\) – Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) – Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) – Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) – Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) – Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) – Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) – Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) – Convert local time” on page 1084](#)
- [“strftime\(\) – Convert to formatted time” on page 1735](#)

- [“time\(\),time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

asin(), asinf(), asinl() — Calculate arcsine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double asin(double x);
float asin(float x);           /* C++ only */
long double asin(long double x); /* C++ only */
float asinf(float x);
long double asinl(long double x);
```

General description

Calculates the arcsine of x , in the range $-\pi/2$ to $\pi/2$ radians.

The value of x must be between -1 and 1 .

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

If x is less than -1 or greater than 1 , the function sets `errno` to `EDOM`, and returns `0`. Otherwise, it returns a nonzero value.

If the correct value would cause an underflow, `0` is returned and the value `ERANGE` is stored in `errno`.

Special behavior for IEEE: If successful, the function returns the arcsine of its argument x .

If x is less than -1 or greater than 1 , the function sets `errno` to `EDOM` and returns `NaNQ`. No other errors will occur.

Example

CELEBA07

```
/* CELEBA07

This example prompts for a value for x.
It prints an error message if x is greater than 1 or
less than -1; otherwise, it assigns the arcsine of
x to y.

*/
#include <stdio.h>
#include <stdlib.h>
```

```

#include <math.h>
#define MAX 1.0
#define MIN -1.0

int main(void)
{
    double x, y;

    printf( "Enter x\n" );
    scanf( "%lf", &x );

    /* Output error if not in range */
    if ( x > MAX )
        printf( "Error: %f too large for asin\n", x );
    else if ( x < MIN )
        printf( "Error: %f too small for asin\n", x );
    else {
        y = asin( x );
        printf( "asin( %f ) = %f\n", x, y );
    }
}

```

Output

```

Enter x
0.2 is entered
asin( 0.200000 ) = 0.201358

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“atanh\(\), atanhf\(\), atanhhl\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)
- [“sinh\(\), sinhlf\(\), sinhl\(\) — Calculate hyperbolic sine” on page 1664](#)
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent” on page 1809](#)
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent” on page 1812](#)

asind32(), asind64(), asind128() - Calculate arcsine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 asind32(_Decimal32 x);
_Decimal64 asind64(_Decimal64 x);
_Decimal128 asind128(_Decimal128 x);
_Decimal32 asin(_Decimal32 x);      /* C++ only */

```

```
_Decimal64 asin(_Decimal64 x);    /* C++ only */
_Decimal128 asin(_Decimal128 x);  /* C++ only */
```

General description

Calculates the arcsine of x , in the range $-\pi/2$ to $\pi/2$ radians.

The value of x must be between -1 and 1 .

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point”](#) on page 97 for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, the function returns the arcsine of its argument x .

If x is less than -1 or greater than 1 , the function sets `errno` to `EDOM` and returns NaNQ. No other errors will occur.

Example

CELEBA13

```
/* CELEBA13

   This example illustrates the asind128() function.

   This example prompts for a value for x.
   It prints an error message if x is greater than 1 or
   less than -1; otherwise, it assigns the arcsine of
   x to y.

*/

#define __STDC_WANT_DEC_FP__
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
#define MAX 1.0DL
#define MIN -1.0DL

int main(void)
{
    _Decimal128 x, y;

    printf( "Enter x\n" );
    scanf( "%DDf", &x );

    /* Output error if not in range */
    if ( x > MAX )
        printf( "Error: %f too large for asind128\n", x );
    else if ( x < MIN )
        printf( "Error: %f too small for asind128\n", x );
    else {
        y = asind128( x );
        printf( "asind128( %DDf ) = %DDf\n", x, y );
    }
}
```

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“acosd32\(\), acosd64\(\), acosd128\(\) - Calculate arccosine”](#) on page 139
- [“acoshd32\(\), acoshd64\(\), acoshd128\(\) - Calculate hyperbolic arccosine”](#) on page 142
- [“asinh32\(\), asinh64\(\), asinh128\(\) - Calculate hyperbolic arcsine”](#) on page 187

- [“atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent” on page 192](#)
- [“atanhd32\(\), atanh64\(\), atanh128\(\) - Calculate hyperbolic arctangent” on page 195](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“coshd32\(\), coshd64\(\), coshd128\(\) - Calculate hyperbolic cosine” on page 334](#)
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine” on page 1663](#)
- [“sinhd32\(\), sinhd64\(\), sinhd128\(\) - Calculate hyperbolic sine” on page 1666](#)
- [“tand32\(\), tand64\(\), tand128\(\) - Calculate tangent” on page 1810](#)
- [“tanh32\(\), tanhd64\(\), tanhd128\(\) - Calculate hyperbolic tangent” on page 1813](#)

asinh(), asinhf(), asinhl() — Calculate hyperbolic arcsine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double asinh(double x);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

float asinhf(float x);
long double asinhl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float asinh(float x);
long double asinh(long double x);
```

General description

The asinh() functions return the hyperbolic arcsine of its argument x.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| asinh | X | X |
| asinhf | X | X |
| asinhl | X | X |

Returned value

`asinh()` returns the hyperbolic arcsine of its argument x . The function is always successful.

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“`acos\(\)`, `acosf\(\)`, `acosl\(\)` — Calculate arccosine” on page 137](#)
- [“`acosh\(\)`, `acoshf\(\)`, `acoshl\(\)` — Calculate hyperbolic arccosine” on page 140](#)
- [“`asin\(\)`, `asinf\(\)`, `asinl\(\)` — Calculate arcsine” on page 183](#)
- [“`atan\(\)`, `atanf\(\)`, `atanl\(\)`, `atan2\(\)`, `atan2f\(\)`, `atan2l\(\)` — Calculate arctangent” on page 191](#)
- [“`atanh\(\)`, `atanhf\(\)`, `atanhl\(\)` — Calculate hyperbolic arctangent” on page 194](#)
- [“`cos\(\)`, `cosf\(\)`, `cosl\(\)` — Calculate cosine” on page 330](#)
- [“`cosh\(\)`, `coshf\(\)`, `coshl\(\)` — Calculate hyperbolic cosine” on page 333](#)
- [“`sin\(\)`, `sinf\(\)`, `sinl\(\)` — Calculate sine” on page 1662](#)
- [“`sinh\(\)`, `sinhf\(\)`, `sinhl\(\)` — Calculate hyperbolic sine” on page 1664](#)
- [“`tan\(\)`, `tanf\(\)`, `tanl\(\)` — Calculate tangent” on page 1809](#)
- [“`tanh\(\)`, `tanhf\(\)`, `tanh\(\)` — Calculate hyperbolic tangent” on page 1812](#)

asinhd32(), asinhd64(), asinhd128() - Calculate hyperbolic arcsine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 asinhd32(_Decimal32 x);
_Decimal64 asinhd64(_Decimal64 x);
_Decimal128 asinhd128(_Decimal128 x);
_Decimal32 asinh(_Decimal32 x);      /* C++ only */
_Decimal64 asinh(_Decimal64 x);      /* C++ only */
_Decimal128 asinh(_Decimal128 x);    /* C++ only */
```

General description

The `asinhd()` functions return the hyperbolic arcsine of its argument x .

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

`asinhd()` returns the hyperbolic arcsine of its argument x . The function is always successful.

Example

CELEBA14

```
/* CELEBA14

   This example illustrates the asinhd32() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal32 x, y;

    x = 1.0DF;
    y = asinhd32(x);

    printf("asinhd32(%Hf) = %Hf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acosd32\(\), acosd64\(\), acosd128\(\) - Calculate arccosine” on page 139](#)
- [“acoshd32\(\), acoshd64\(\), acoshd128\(\) - Calculate hyperbolic arccosine” on page 142](#)
- [“asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine” on page 184](#)
- [“atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent” on page 192](#)
- [“atanhd32\(\), atanh64\(\), atanh128\(\) - Calculate hyperbolic arctangent” on page 195](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“coshd32\(\), coshd64\(\), coshd128\(\) - Calculate hyperbolic cosine” on page 334](#)
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine” on page 1663](#)
- [“sinhd32\(\), sinhd64\(\), sinhd128\(\) - Calculate hyperbolic sine” on page 1666](#)
- [“tand32\(\), tand64\(\), tand128\(\) - Calculate tangent” on page 1810](#)
- [“tanh32\(\), tanhd64\(\), tanhd128\(\) - Calculate hyperbolic tangent” on page 1813](#)

asprintf(), vasprintf() – Print to allocated string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <stdio.h>

int asprintf(char **strp, const char *fmt, ...);
int vasprintf(char **strp, const char *fmt, va_list ap);
```

General description

`asprintf()` and `vasprintf()` are analogs of `sprintf()` and `vsprintf()`, except that they allocate a string that is large enough to hold the output including the terminating NULL byte, and return a pointer to it via the first argument. This pointer must be passed to `free()` to release the allocated storage when it is no longer needed.

Returned value

If successful, `asprintf()` and `vasprintf()` return the number of bytes that are printed, same as `sprintf()`.

If memory allocation is not possible, or some other error occurs, `asprintf()` and `vasprintf()` return -1 and the content of `strp` is undefined.

Related information

- [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data” on page 593](#)
- [“vprintf\(\) — Format and print data to stdout” on page 1974](#)

assert() — Verify condition

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <assert.h>

void assert(int expression);
```

General description

The `assert()` macro inserts diagnostics into a program. If the expression (which will have a scalar type) is false (that is, compares equal to 0), a diagnostic message of the form shown below is printed to `stderr`, and `abort()` is called to abnormally end the program. The `assert()` macro takes no action if the expression is true (nonzero).

Without a compiler that is designed to support C99, or when compiling C++ code, the diagnostic message has the following format:

```
Assertion failed: expression, file filename, line line-number.
```

With a compiler that is designed to support C99, or when compiling C++ code, the diagnostic message has the following format:

```
Assertion failed: expression, file filename, line line-number, function function-name.
```

If you define `NDEBUG` to any value with a `#define` directive or the compiler option to define macros, the C/C++ preprocessor expands all `assert()` invocations to void expressions.

Note: The `assert()` function is a macro. Using the `#undef` directive with the `assert()` macro results in undefined behavior. The `assert()` macro uses `__FILE__`, `__LINE__` and, with a compiler that is designed to support C99, `__func__`...

Returned value

`assert()` returns no values.

Example

CELEBA08

```
/* CELEBA08

   In this example, the assert() macro tests the string argument for a
   null string and an empty string, and verifies that the length argument
   is positive before proceeding.

*/
#include <stdio.h>
#include <assert.h>

void analyze(char *, int);
int main(void)
{
    char *string1 = "ABC";
    char *string2 = "";
    int length = 3;

    analyze(string1, length);
    printf("string1 %s is not null or empty, "
           "and has length %d \n", string1, length);
    analyze(string2, length);
    printf("string2 %s is not null or empty, "
           "and has length %d\n", string2, length);
}

void analyze(char *string, int length)
{
    assert(string != NULL);      /* cannot be NULL */
    assert(*string != '\0');     /* cannot be empty */
    assert(length > 0);         /* must be positive */
}
```

Output without a compiler that is designed to support C99

```
String1 ABC is not NULL or empty, and has length 3
Assertion failed: *string != '\0', file: CELEBA08 C      A1, line: 26
```

Output with a compiler that is designed to support C99

```
String1 ABC is not NULL or empty, and has length 3
Assertion failed: *string != '\0', file: CELEBA08 C      A1, line: 26 in function analyze
```

Related information

- [“assert.h — Insert diagnostics” on page 16](#)
- [“abort\(\) — Stop a program” on page 103](#)

atan(), atanf(), atanl(), atan2(), atan2f(), atan2l() – Calculate arctangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double atan(double x);
float atan(float x);           /* C++ only */
long double atan(long double x); /* C++ only */
float atanf(float x);
long double atanl(long double x);

double atan2(double y, double x);
float atan2(float y, float x);   /* C++ only */
long double atan2(long double y, long double x); /* C++ only */
float atan2f(float y, float x);
long double atan2l(long double y, long double x);
```

General description

The `atan()` and `atan2()` functions calculate the arctangent of x and y/x , respectively.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Restriction: The `atan2f()` function does not support the `_FP_MODE_VARIABLE` feature test macro.

Returned value

Returns a value in the range $-\pi/2$ to $\pi/2$ radians.

The `atan2()` functions return a value in the range $-\pi$ to π radians. If both arguments of `atan2()` are zero, the function sets `errno` to `EDOM`, and returns 0. If the correct value would cause underflow, zero is returned and the value `ERANGE` is stored in `errno`.

Special behavior for IEEE: If successful, `atan2()` returns the arctangent of y/x .

If both arguments of `atan2()` are zero, the function sets `errno` to `EDOM` and returns 0. No other errors will occur.

Example

CELEBA09

```
/* CELEBA09 */
#include <math.h>
#include <stdio.h>

int main(void)
```

```
{
    double a,b,c,d;

    c = 0.45;
    d = 0.23;

    a = atan(c);
    b = atan2(c,d);

    printf("atan( %f ) = %f\n", c, a);
    printf("atan2( %f, %f ) = %f\n", c, d, b);
}
```

Output

```
atan( 0.450000 ) = 0.422854
atan2( 0.450000, 0.230000 ) = 1.098299
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atanh\(\), atanhf\(\), atanhhl\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)
- [“sinh\(\), sinh\(\), sinhl\(\) — Calculate hyperbolic sine” on page 1664](#)
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent” on page 1809](#)
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent” on page 1812](#)

atand32(), atand64(), atand128(), atan2d32(), atan2d64(), atan2d128() - Calculate arctangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 atand32(_Decimal32 x);
_Decimal64 atand64(_Decimal64 x);
_Decimal128 atand128(_Decimal128 x);
_Decimal32 atan(_Decimal32 x); /* C++ only */
_Decimal64 atan(_Decimal64 x); /* C++ only */
_Decimal128 atan(_Decimal128 x); /* C++ only */

_Decimal32 atan2d32(_Decimal32 y, _Decimal32 x);
_Decimal64 atan2d64(_Decimal64 y, _Decimal64 x);
_Decimal128 atan2d128(_Decimal128 y, _Decimal128 x);
_Decimal32 atan2(_Decimal32 y, _Decimal32 x); /* C++ only */
```

```
_Decimal64 atan2(_Decimal64 y, _Decimal64 x); /* C++ only */
_Decimal128 atan2(_Decimal128 y, _Decimal128 x); /* C++ only */
```

General description

The `atan()` and `atan2()` functions calculate the arctangent of x and y/x , respectively.

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point”](#) on page 97 for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

Returns a value in the range $-\pi/2$ to $\pi/2$ radians.

If both arguments of `atan2()` are zero, the function sets `errno` to `EDOM` and returns 0. No other errors will occur.

Example

CELEBA15

```
/* CELEBA15
   This example illustrates the atand64() and atan2d64() functions.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 a,b,c,d;

    c = 0.45DD;
    d = 0.23DD;

    a = atand64(c);
    b = atan2d64(c,d);

    printf("atand64( %Df ) = %Df\n", c, a);
    printf("atan2d64( %Df, %Df ) = %Df\n", c, d, b);
}
```

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“acosd32\(\), acosd64\(\), acosd128\(\) - Calculate arccosine”](#) on page 139
- [“acoshd32\(\), acoshd64\(\), acoshd128\(\) - Calculate hyperbolic arccosine”](#) on page 142
- [“asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine”](#) on page 184
- [“asinh32\(\), asinh64\(\), asinh128\(\) - Calculate hyperbolic arcsine”](#) on page 187
- [“atanhd32\(\), atanh64\(\), atanh128\(\) - Calculate hyperbolic arctangent”](#) on page 195
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine”](#) on page 332
- [“coshd32\(\), coshd64\(\), coshd128\(\) - Calculate hyperbolic cosine”](#) on page 334
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine”](#) on page 1663
- [“sinhd32\(\), sinhd64\(\), sinhd128\(\) - Calculate hyperbolic sine”](#) on page 1666
- [“tand32\(\), tand64\(\), tand128\(\) - Calculate tangent”](#) on page 1810
- [“tanh32\(\), tanhd64\(\), tanhd128\(\) - Calculate hyperbolic tangent”](#) on page 1813

atanh(), atanhf(), atanh() – Calculate hyperbolic arctangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double atanh(double x);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

float atanhf(float x);
long double atanh1(long double x);
```

C++ TR1 C99

```
#define _TR1_C99
#include <math.h>
float atanh(float x);
long double atanh(long double x);
```

General description

The `atanh()` function returns the hyperbolic arctangent of its argument x .

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>atanh</code> | X | X |
| <code>atanhf</code> | X | X |
| <code>atanhl</code> | X | X |

Returned value

If successful, `atanh()` returns the hyperbolic arctangent of its argument x .

`atanh()` fails, returns 0.0 and sets `errno` to one of the following values:

Error Code

Description

EDOM

The x argument has a value greater than 1.0.

ERANGE

The x argument has a value equal to 1.0.

Special behavior for IEEE: If successful, the function returns the hyperbolic arctangent of its argument x .

If the absolute value of x is greater than 1.0, `atanh()` sets `errno` to `EDOM` and returns `NaNQ`. If the value of x is equal to 1.0, the function sets `errno` to `ERANGE` and returns `+HUGE_VAL`.

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)
- [“sinh\(\), sinh\(\), sinhl\(\) — Calculate hyperbolic sine” on page 1664](#)
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent” on page 1809](#)
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent” on page 1812](#)

atanhd32(), atanh64(), atanh128() - Calculate hyperbolic arctangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 atanh32(_Decimal32 x);
_Decimal64 atanh64(_Decimal64 x);
_Decimal128 atanh128(_Decimal128 x);
_Decimal32 atanh(_Decimal32 x); /* C++ only */
_Decimal64 atanh(_Decimal64 x); /* C++ only */
_Decimal128 atanh(_Decimal128 x); /* C++ only */
```

General description

The `atanh()` function returns the hyperbolic arctangent of its argument x .

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, the function returns the hyperbolic arctangent of its argument x .

If the absolute value of x is greater than 1.0, atanh() sets errno to EDOM and returns NaNQ. If the value of x is equal to 1.0, the function sets errno to ERANGE and returns +HUGE_VAL_D32, +HUGE_VAL_D64 or +HUGE_VAL_D128.

Example

CELEBA16

```
/* CELEBA16

   This example illustrates the atanh32() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal32 x, y;

    x = 0.5DF;
    y = atanh32(x);

    printf("atanh32(%Hf) = %Hf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos32\(\), acos64\(\), acos128\(\) - Calculate arccosine” on page 139](#)
- [“acosh32\(\), acosh64\(\), acosh128\(\) - Calculate hyperbolic arccosine” on page 142](#)
- [“asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine” on page 184](#)
- [“asinh32\(\), asinh64\(\), asinh128\(\) - Calculate hyperbolic arcsine” on page 187](#)
- [“atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent” on page 192](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“cosh32\(\), cosh64\(\), cosh128\(\) - Calculate hyperbolic cosine” on page 334](#)
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine” on page 1663](#)
- [“sinh32\(\), sinh64\(\), sinh128\(\) - Calculate hyperbolic sine” on page 1666](#)
- [“tand32\(\), tand64\(\), tand128\(\) - Calculate tangent” on page 1810](#)
- [“tanh32\(\), tanh64\(\), tanh128\(\) - Calculate hyperbolic tangent” on page 1813](#)

__atanpid32(), __atanpid64(), __atanpid128() - Calculate arctangent(x)/pi

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>
```

```
_Decimal32 __atanpid32(_Decimal32 x);
_Decimal64 __atanpid64(_Decimal64 x);
_Decimal128 __atanpid128(_Decimal128 x);
```

General description

Calculates the value of $\arctangent(x)/\pi$.

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

Returns the calculated value expressed in radians.

Example

CELEBA17

```
/* CELEBA17
   This example illustrates the __atanpid64() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 x, y;

    x = 5.0DD;
    y = __atanpid64(x);

    printf("__atanpid64(%Df) = %Df\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“__cospid32\(\), __cospid64\(\), __cospid128\(\) — Calculate cosine of pi * x” on page 335](#)
- [“__sinpid32\(\), __sinpid64\(\), __sinpid128\(\) — Calculate sine of pi * x” on page 1667](#)

atexit() — Register program termination function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

int atexit(void (*func)(void));
```

General description

Records a function, pointed to by *func*, that the system calls at normal program termination. Termination is a result of `exit()` or returning from `main()`, regardless of the language of the `main()` routine. Process termination started by `_exit()` or by a terminating signal under Language Environment is not included.

The functions are executed in the reverse order that they were registered. The registered function must return to ensure that all registered functions are called. The functions registered with `atexit()` are started before streams and files are closed. You may specify a number of functions to the limit set by the `ATEXIT_MAX` constant, which is defined in `<limits.h>`.

Under z/OS UNIX services only, when a process ends, the address space is ended; otherwise, the address space persists.

Special behavior for IBM z/OS C

The C Library `atexit()` function has the following restrictions:

- Any function registered by a fetched module that has been released is removed from the list at the time of `release()`. See `fetch()`, `fetchep()`, and `release()` for details about fetching and releasing modules.
- Any function registered in an explicitly loaded DLL (using `dllload()`) that has been freed (using `dllfree()`) is removed from the list. But, if the DLL in question has also been implicitly loaded, then the function is NOT removed from the `atexit` list.
- All C Library library functions can be used in a registered routine except `exit()`.
- When a program is running under CICS control, if an `EXEC CICS RETURN` command or an `EXEC CICS XCTL` command is issued, the `atexit()` list that has been previously registered is not run.
- Use of the `system()` library function within `atexit()` may result in undefined behavior.
- Use of non-C subroutines or functions in the `atexit()` list will result in undefined behavior.
- The `atexit()` list will not be run when `abort()` is called.

Special behavior for IBM z/OS C++

- All of the behaviors listed under "Special Behavior for IBM z/OS C".
- Because C and C++ linkage conventions are incompatible, `atexit()` cannot receive C++ function pointers. If you attempt to pass a C++ function pointer to `atexit()`, the compiler will flag it as an error. To use the C++ `atexit()` function, you must ensure that all functions registered for `atexit()` have C linkage by declaring them as `extern "C"`.
- You can use `try`, `throw`, and `catch` in a function registered for `atexit()`. However, by the time an `atexit()` function is driven, all stack frames will have collapsed. As a result, the only `catch` clauses available for `throw` will be the ones coded in the `atexit()` function. If those `catch` clauses cannot handle the thrown object, `terminate()` will be called.

Special behavior for XPG4.2: The maximum number of functions that can be registered is specified by the symbol `ATEXIT_MAX` which is defined in the `limits.h` header.

Returned value

If successful, `atexit()` returns 0.

If unsuccessful, `atexit()` returns nonzero.

Example

CELEBA10

```

/* CELEBA10

   This example uses the atexit() function to call the function goodbye()
   at program termination.

   */
#include <stdlib.h>
#include <stdio.h>

#ifdef __cplusplus      /* the __cplusplus macro is      */
extern "C" void goodbye(void); /* automatically defined by the */
#else                  /* C++/MVS compiler      */
void goodbye(void);
#endif

int main(void)
{
    int rc;

    rc = atexit(goodbye);
    if (rc != 0)
        printf("Error in atexit");
    exit(0);
}

void goodbye(void)
/* This function is called at normal program termination */
{
    printf("The function goodbye was called \
at program termination\n");
}

```

Output

```
The function goodbye was called at program termination
```

Related information

- “Condition Handling” in [z/OS Language Environment Programming Guide](#)
- “stdlib.h — Standard library functions” on [page 65](#)
- “abort() — Stop a program” on [page 103](#)
- “exit() — End program” on [page 449](#)
- “fetch() — Get a load module” on [page 516](#)
- “fetchep() — Share writable static” on [page 526](#)
- “release() — Delete a load module” on [page 1424](#)
- “signal() — Handle interrupts” on [page 1635](#)

__atoe() — ISO8859-1 to EBCDIC string conversion

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#include <unistd.h>

int __atoe(char *string);

```

General description

The __atoe() function converts an ISO8859-1 character string *string* to its EBCDIC equivalent. The conversion is performed using the codeset page associated with the current locale. The input character string up to, but not including, the NULL is changed from an ISO8859-1 representation to that of the current locale.

The argument *string* points to the ISO8859-1 character string to be converted to its EBCDIC equivalent.

Returned value

If successful, __atoe() converts the input ISO8859-1 character string to its equivalent EBCDIC value, and returns the length of the converted string.

If unsuccessful, __atoe() returns -1 and sets errno to one of the following values:

Error Code
Description

EINVAL
The current locale does not describe a single-byte character set.

ENOMEM
There is insufficient storage to complete the conversion process.

Note: This function may internally call iconv_open() and iconv(). The errnos returned by these functions are propagated without modification.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“iconv\(\) — Code conversion” on page 824](#)
- [“iconv_open\(\) — Allocate code conversion descriptor” on page 828](#)

__atoe_l() — ISO8859-1 to EBCDIC conversion operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <unistd.h>

int __atoe_l(char *bufferptr, int leng);
```

General description

The __atoe_l() function converts *leng* ISO8859-1 bytes in the buffer pointed to by *bufferptr* to their EBCDIC equivalent. The conversion is performed using the codeset page associated with the current locale.

The argument *bufferptr* points to a buffer containing the ISO8859-1 bytes to be converted to their EBCDIC equivalent. The input buffer is treated as sequence of bytes, and all bytes in the input buffer are converted, including any imbedded NULLs.

Returned value

If successful, `__atoe_l()` converts the input IOS8859-1 bytes to their equivalent EBCDIC value, and returns the number of bytes that were converted.

If unsuccessful, `__atoe_l()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The current locale does not describe a single-byte character set.

ENOMEM

There is insufficient storage to complete the conversion process.

Note: This function may internally call `iconv_open()` and `iconv()`. The `errno`s returned by these functions are propagated without modification.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“iconv\(\) — Code conversion” on page 824](#)
- [“iconv_open\(\) — Allocate code conversion descriptor” on page 828](#)

atof() — Convert character string to double

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

double atof(const char *nptr);
```

General description

The `atof()` function converts the initial portion of the string pointed to by `nptr` to a 'double'. This is equivalent to

```
strtod(nptr, (char**)NULL)
```

The double value is either hexadecimal floating point or binary floating point, depending on the floating point mode of the thread invoking the `atof()` function. This function uses `_isBF()` to determine the floating point mode of the invoking thread.

See the [“fscanf Family of Formatted Input Functions” on fscanf\(\), scanf\(\), sscanf\(\) — Read and format data](#) for a description of special infinity and NaN sequences recognized by z/OS formatted input functions, including `atof()` and `strtod()` in IEEE Binary Floating-Point mode.

Returned value

The `atof()` function returns the converted value if the value can be represented, otherwise the return value is undefined.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“atoi\(\) — Convert character string to integer” on page 202](#)
- [“atol\(\) — Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“strtod\(\) — Convert character string to double” on page 1759](#)
- [“strtol\(\) — Convert character string to long” on page 1768](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)

atoi() — Convert character string to integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

int atoi(const char *nptr);
```

General description

The `atoi()` function converts the initial portion of the string pointed to by `nptr` to a 'int'. This is equivalent to

```
(int)strtol(nptr, NULL, 10)
```

Returned value

There are no documented `errno` values.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“atof\(\) — Convert character string to double” on page 201](#)
- [“atol\(\) — Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“strtod\(\) — Convert character string to double” on page 1759](#)

- [“strtol\(\) — Convert character string to long” on page 1768](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)

atol() — Convert character string to long

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

long int atol(const char *nptr);
```

General description

The `atol()` function converts the initial portion of the string pointed to by *nptr* to a 'long int'. This is equivalent to

```
strtol(nptr, (char**)NULL, 10)
```

Returned value

The `atol()` function returns the converted value if the value can be represented, otherwise the return value is undefined.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“atof\(\) — Convert character string to double” on page 201](#)
- [“atoi\(\) — Convert character string to integer” on page 202](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“strtod\(\) — Convert character string to double” on page 1759](#)
- [“strtol\(\) — Convert character string to long” on page 1768](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)

atoll() – Convert character string to signed long long

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <stdlib.h>
long long atoll(const char *nptr);
```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

atoll() converts the initial portion of the string pointed to by *nptr* to a 'long long int'. This is equivalent to strtoll(*nptr*, (char **)NULL, 10).

Returned value

If successful, atoll() returns the converted signed long long value, represented in the string. If unsuccessful, it returns an undefined value.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“atof\(\) – Convert character string to double” on page 201](#)
- [“atoi\(\) – Convert character string to integer” on page 202](#)
- [“atol\(\) – Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) – Read and format data” on page 626](#)
- [“strtod\(\) – Convert character string to double” on page 1759](#)
- [“strtoul\(\) – Convert string to unsigned integer” on page 1773](#)
- [“strtol\(\) – Convert character string to long” on page 1768](#)

__authenticate() – Authenticate the specified user’s credentials

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <unistd.h>

int __authenticate(unsigned int Auth_cred_type, int *User_name_length,
                  char *User_name, int Pass_length, char *Pass, int New_pass_length,
```

```
char *New_pass, int *Idt_buffer_length, char *Idt_buffer_ptr,
int *Idt_length, char **Msg_buffer_ptr, int Appl_id_length,
char *Appl_id, unsigned int *Option_flags);
```

General description

The `__authenticate()` function authenticates a user by using passwords, password phrases, PassTickets, or Identity Tokens (IDTs). It also optionally generates an IDT, which is used for follow-on authentications. The `__authenticate()` function authenticates the user's credentials only. `__authenticate()` does not create a security context (ACEE) or modify the caller's process or thread identity.

Auth_cred_type

Identifies the type of credentials to be used for authentication. It can be specified to the following values:

AUTH_USER_ID

The *User_name* parameter that is specified by the caller is passed to RACF for the authentication.

AUTH_ID_TOKEN

The IDT from the location that is specified by the *Idt_buffer_ptr* parameter is passed to RACF for authentication.

Note: When both AUTH_USER_ID and AUTH_ID_TOKEN are specified, both the *userid* and IDT are passed to RACF. If the *userid* that is associated with the IDT does not match the *User_name* parameter, the authentication fails.

User_name_length

When AUTH_USER_ID is specified for the *Auth_cred_type* parameter, it specifies the length of the *User_name* parameter string.

Returned length of the *User_name* parameter string that is returned when authenticating with only an IDT. The name is obtained from a temporary ACEE that is created by RACF. The caller must specify the maximum *userid* length of 8 characters to accommodate all possible *userid* sizes. `authenticate()` does not modify the *User_name_length* parameter that is specified by the caller to indicate the length of the returned *User_name* parameter string.

User_name

Supplied *userid* when *Auth_cred_type* specifies AUTH_USER_ID.

Returned *userid* when *Auth_cred_type* specifies AUTH_ID_TOKEN and AUTH_USER_ID is not specified.

This parameter is an input/output parameter, the storage must be writable.

Pass_length

Contains the length of the *Pass* parameter. This length must be between 1 and 8 characters for a password or PassTicket or between 9 and 100 characters for a password phrase. A length of zero indicates that *Pass* is to be ignored.

Pass

Contains left-justified, the password, PassTicket, or password phrase that is to be verified.

New_pass_length

Contains the length of *New_pass*. This length must be between 1 and 8 characters for a password or between 9 and 100 characters for a password phrase. A length of zero indicates that *New_pass* is to be ignored.

New_pass

Contains left-justified, the new password or password phrase.

Idt_buffer_length

Contains supplied length of the buffer that is pointed to by *Idt_buffer_ptr*. If the supplied buffer is smaller than the IDT that is built by RACF, `__authenticate()` fails with -1 and EINVAL, and JrBuffTooSmall and the required length is returned in the *Idt_length* parameter. In this situation, the caller must allocate a larger buffer and recall `__authenticate()`.

__authenticate()

Idt_buffer_ptr

Contains supplied address of the buffer that can be used for input or output of an IDT.

When AUTH_ID_TOKEN is specified for the *Auth_cred_type* parameter, the buffer contains an IDT that `__authenticate()` passes to RACF to be authenticated.

When only AUTH_USER_ID is specified for the *Auth_cred_type* parameter and AUTH_BUILD_IDT is specified for the *Option_flags* parameter, if an IDT is generated, `__authenticate()` copies the generated IDT into the buffer.

In both cases, if an IDT is copied into the buffer, the AUTH_RETURNED_IDT flag in the *Option_flags* parameter is set by `__authenticate()` and returned to the caller.

Idt_length

Contains the address of IDT length.

When AUTH_ID_TOKEN is specified for the *Auth_cred_type* parameter, this parameter supplies the length of the IDT whose location is specified by the *Idt_buffer_ptr* parameter. In this case, when AUTH_USER_ID is specified for the *Auth_cred_type* parameter and AUTH_BUILD_IDT is specified for the *Option_flags* parameter, the length must be zero.

When AUTH_ID_TOKEN is specified for the *Auth_cred_type* parameter and RACF refreshes the IDT while authenticating the IDT that is supplied by the caller, this parameter returns the length of the IDT that is copied into the location that is specified by the *Idt_buffer_ptr* parameter. In this case, when AUTH_USER_ID is specified for the *Auth_cred_type* parameter and AUTH_BUILD_IDT is specified for the *Option_flags* parameter, the size of the created IDT that is generated by RACF is returned.

Note: The *Idt_length* parameter can be both supplied and returned for the same `__authenticate()` call depending on the previous conditions being met or not.

Msg_buffer_ptr

Contains the address of a pointer of a message buffer if any messages are returned by RACF. All message buffers for one `__authenticate()` call are located in a contiguous piece of storage and the caller is responsible for freeing the buffer storage by using `free()`. The AUTH_MSGRTRN option in the *Option_flags* parameter must be specified to have messages returned.

Appl_id_length

Contains the length of the *Appl_id* parameter. This length must be between 1 and 8 characters. A length of zero indicates the *Appl_id* parameter is to be ignored.

Appl_id

Contains left-justified, the APPLID that identifies the name of the application that requests authentication. If *Appl_id* is not specific (*Appl_id_length* of zero), the application ID defaults to OMVSAPPL.

Option_flags

Contains the `__authenticate()` options. If no options are required, specify 0 for this parameter.

The following values are valid for this parameter:

AUTH_BUILD_IDT

Requests that an ID Token is built by RACF and returned to the caller. This option is valid when only AUTH_USER_ID is specified (AUTH_ID_TOKEN is not specified) for the *Auth_cred_type* parameter. The ID Token is returned to the caller in the buffer that is pointed to by the *Idt_buffer_ptr* parameter and its length is returned in the *Idt_length* parameter.

AUTH_RETURN_USERNAME

Requests that the userid that is associated with the ID Token that is used for authentication be returned in the field that is specified by the *User_name* parameter. This option is valid when only AUTH_ID_TOKEN is specified (AUTH_USER_ID is not specified) for the *Auth_cred_type* parameter and the *User_name_length* parameter contains a value of 8. If those conditions are not met, the request fails. The length of the returned *User_name* is returned in the *User_name_length* parameter.

AUTH_MSGRTRN

Controls the *MSGRTRN* parameter that is specified on the RACROUTE REQUEST=VERIFY call that is made by `__authenticate()`.

When *AUTH_MSGRTRN* is not specified, *MSGRTRN*=NO is specified for the resulting RACROUTE REQUEST=VERIFY by default. Messages are not returned in a buffer but are issued by RACF using TPUT.

When *AUTH_MSGRTRN* is specified, *MSGRTRN*=YES is specified for RACROUTE REQUEST=VERIFY. The address of the message buffer that is obtained by RACF is returned in the *Msg_buffer_ptr* parameter.

AUTH_RETURNED_IDT

Returned by `__authenticate()` to indicate that an IDT is copied into the location that is specified by the *Idt_buffer_ptr* parameter. The length of that IDT is returned in the *Idt_length* parameter. This occurs when the caller requests to build a new IDT or authenticates with an IDT and RACF refreshes the IDT in response to changes of system or user settings. *AUTH_RETURNED_IDT* must not be specified by the caller. Otherwise, `__authenticate()` fails with -1, EINVAL, and JrBadOptnFlags.

Returned value

If successful, `__authenticate()` returns a value of 0.

If unsuccessful, `__authenticate()` returns a value of -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Permission is denied.

EINVAL

The parameter is incorrect.

ESRCH

No such process or thread exists.

EMVSSAFEXTRERR

SAF/RACF extract error.

EMVSSAF2ERR

SAF/RACF error.

EMVSEXPIRE

The password for the specified resource is expired.

EMVSPASSWORD

The new password or password phrase that is specified is not valid.

Usage notes

- If a profile is defined in the FACILITY class protecting the BPX.DAEMON resource, all programs that are loaded into the caller's address space must be controlled programs by the installed security product (such as RACF). If `__authenticate` detects that a load of a nonprogram control program is done, it fails with an `errno` of EMVSERR and an `errnojr` of JRENVDIRTY. For more information, see [Establishing the correct level of security for daemons in z/OS UNIX System Services Planning](#).
- To request RACF to return messages in a buffer, the *AUTH_MSGRTRN* option in the *Option_flags* parameter must be specified with the *Msg_buffer_ptr* parameter. If the *AUTH_MSGRTRN* option is not specified, the *Msg_buffer_ptr* parameter is ignored and `__authenticate()` does not request RACF to return messages resulting from the request. When not returning messages, RACF issues the messages by using TPUT. For more information about messages returned by RACF, see the MSGSP and MSGRTRN parameters in [RACROUTE \(standard form\)](#) in *z/OS Security Server RACROUTE Macro Reference*.

- When a message buffer address is returned to the caller in the *Msg_buff_ptr* parameter, the caller is responsible to free the storage it points to. The format of the buffer is defined by RACF. The area consists of two fullwords followed by the message itself in write-to-operator (WTO) parameter list format. The first word is the length of the area including the two-fullword header; the second word points to the next message area, if there is one, or contains zero if no more message areas exist. See MSGRTRN and MSGSP parameters in *RACROUTE (standard form)* in *z/OS Security Server RACROUTE Macro Reference* for more information about messages that are returned by RACF.
- The minimum size of an IDT is 1024 bytes. See *Activating and using the IDTA parameter in RACROUTE REQUEST=VERIFY and initACEE* in *z/OS Security Server RACROUTE Macro Reference* for more information about IDTs.
- `__authenticate` accepts and returns signed IDTs only. See *Activating and using the IDTA parameter in RACROUTE REQUEST=VERIFY and initACEE* in *z/OS Security Server RACROUTE Macro Reference* for more information about signed and unsigned IDTs.
- The *Idt_buffer_length* and *Idt_buffer_ptr* parameters detail the length and location of the buffer that is supplied by the caller for storing IDTs. The *Idt_length* parameter details the length of an IDT that is located in the IDT buffer. The caller specifies the *Idt_length* when supplying an IDT for authentication. The system returns the *Idt_length* when either building a new IDT or for an IDT that is refreshed by RACF when authenticating with an IDT. When the system returns a new or refreshed IDT, the AUTH_RETURNED_IDT flag in the *Option_flags* parameter is set and returned to the caller to indicate a created or refreshed IDT is returned.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

`__a2e_l()` — Convert characters from ASCII to EBCDIC

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | z/OS V1R2 |

Format

```
#include <unistd.h>

size_t __a2e_l(char *bufptr, size_t szLen)
```

General description

The `__a2e_l()` function converts *szLen* characters in *bufptr* from ASCII to EBCDIC, returning the number of characters converted if successful or -1 if not. Conversion occurs in place in the buffer. `__a2e_l()` is not sensitive to the locale, and only converts between ISO8859-1 and IBM-1047.

Note: This function is valid for applications compiled XPLINK only.

Returned value

If successful, `__a2e_l()` returns the number of characters converted.

If unsuccessful, `__a2e_l()` returns -1 and sets `errno` to the following value:

Error Code

Description

EINVAL

The pointer to *bufptr* is NULL or *szLen* is a negative value.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“__a2e_s\(\) — Convert string from ASCII to EBCDIC” on page 209](#)
- [“__e2a_l\(\) — Convert characters from EBCDIC to ASCII” on page 464](#)
- [“__e2a_s\(\) — Convert string from EBCDIC to ASCII” on page 464](#)

__a2e_s() — Convert string from ASCII to EBCDIC

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | z/OS V1R2 |

Format

```
#include <unistd.h>

size_t __a2e_s(char *string)
```

General description

The `__a2e_s()` function converts a string from ASCII to EBCDIC, returning the string length if successful or -1 if not. Conversion occurs in place in the string. `__a2e_s()` is not sensitive to the locale, and only converts between ISO8859-1 and IBM-1047.

Note: This function is valid for applications compiled XPLINK only.

Returned value

If successful, `__a2e_s()` returns the string length.

If unsuccessful, `__a2e_s()` returns -1 and sets `errno` to the following value:

Error Code

Description

EINVAL

The pointer to string is NULL.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“__a2e_l\(\) — Convert characters from ASCII to EBCDIC” on page 208](#)
- [“__e2a_l\(\) — Convert characters from EBCDIC to ASCII” on page 464](#)
- [“__e2a_s\(\) — Convert string from EBCDIC to ASCII” on page 464](#)

a64l() — Convert base 64 string representation to long integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

long a64l(const char *string);
```

General description

The a64l() function converts a string representation of a base 64 number into its corresponding long value. It scans the string from left to right with the least significant character on the left, decoding each character as a 6-bit base 64 number. If the string pointed to by *string* contains more than six characters, a64l() uses only the first six. If the first six characters of the string contain a NULL character, a64l() uses only the characters preceding the first NULL. The following characters are used to represent digits:

| Character | Digit Represented |
|-----------|-------------------|
| . | 0 |
| / | 1 |
| 0-9 | 2-11 |
| A-Z | 12-37 |
| a-z | 38-63 |

Returned value

If successful, a64l() returns the long value resulting from conversion of the input string.
If the string pointed to by *string* is NULL, a64l() returns 0.
There are no errno values defined.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“l64a\(\) – Convert long to base 64 string representation” on page 1029](#)
- [“strtoul\(\) – Convert string to unsigned integer” on page 1773](#)

basename() – Return the last component of a path name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <libgen.h>
```

```
char *basename(char *path);
```

General description

The `basename()` function takes the pathname pointed to by *path* and returns a pointer to the final component of the pathname, deleting any trailing '/' characters.

If the string consists entirely of the '/' character, `basename()` returns a pointer to the string "/".

If *path* is a NULL pointer or points to an empty string, `basename()` returns a pointer to the string ".". The `basename()` function may modify the string pointed to by *path*.

Examples:

| Input String | Output String |
|--------------|---------------|
| "/usr/lib" | "lib" |
| "/usr/" | "usr" |
| "/" | "/" |

Returned value

If successful, `basename()` returns a pointer to the final component of *path*.

There are no `errno` values defined.

Related information

- [“libgen.h — Pattern matching functions” on page 34](#)
- [“dirname\(\) — Report the parent directory of a path name” on page 382](#)

bcmp() — Compare bytes in memory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <strings.h>

int bcmp(const void *s1, const void *s2, size_t n);
```

General description

The `bcmp()` function compares the first *n* bytes of the area pointed to by *s1* with the area pointed to by *s2*.

Note: The `bcmp()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `memcmp()` function is preferred for portability.

Returned value

If *s1* and *s2* are identical, `bcmp()` returns 0. Otherwise, `bcmp()` returns nonzero. Both areas are assumed to be at least *n* bytes long.

If the value of *n* is zero, `bcmp()` returns 0.

There are no errno values defined.

Related information

- [“strings.h — String operations” on page 67](#)
- [“bcopy\(\) — Copy bytes in memory” on page 212](#)
- [“bzero\(\) — Zero bytes in memory” on page 224](#)
- [“memcmp\(\) — Compare bytes” on page 1065](#)

bcopy() — Copy bytes in memory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <strings.h>

void bcopy(const void *s1, void *s2, size_t n);
```

General description

The `bcopy()` function copies *n* bytes from the area pointed to by *s1* to the area pointed to by *s2* using the `memcpy()` function.

Note: The `bcopy()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `memmove()` function is preferred for portability.

Returned value

`bcopy()` returns no values.

There are no errno values defined.

Related information

- [“strings.h — String operations” on page 67](#)
- [“bcmp\(\) — Compare bytes in memory” on page 211](#)
- [“bzero\(\) — Zero bytes in memory” on page 224](#)
- [“memcpy\(\) — Copy bytes in memory” on page 1063](#)
- [“memcpy\(\) — Copy buffer” on page 1066](#)
- [“memmove\(\) — Move buffer” on page 1067](#)

bind() — Bind a name to a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int bind(int socket, const struct sockaddr *address, socklen_t address_len);
```

Berkeley Sockets

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>

int bind(int socket, struct sockaddr *address, int address_len);
```

General description

The `bind()` function binds a unique local name to the socket with descriptor *socket*. After calling `socket()`, a descriptor does not have a name associated with it. However, it does belong to a particular address family as specified when `socket()` is called. The exact format of a name depends on the address family.

Parameter

Description

socket

The socket descriptor returned by a previous `socket()` call.

address

The pointer to a **sockaddr** structure containing the name that is to be bound to *socket*.

address_len

The size of *address* in bytes.

The *socket* parameter is a socket descriptor of any type created by calling `socket()`.

The *address* parameter is a pointer to a buffer containing the name to be bound to *socket*. The *address_len* parameter is the size, in bytes, of the buffer pointed to by *address*. For `AF_UNIX`, this function creates a file that you later need to unlink besides closing the socket.

Socket Descriptor Created in the `AF_INET` Domain

If the socket descriptor *socket* was created in the `AF_INET` domain, the format of the name buffer is expected to be **sockaddr_in**, as defined in the include file `netinet/in.h`:

```
struct in_addr
{
    ip_addr_t s_addr;
};

struct sockaddr_in {
    unsigned char sin_len;
    unsigned char sin_family;
    unsigned short sin_port;
    struct in_addr sin_addr;
    unsigned char sin_zero[8];
};
```

```
};
```

The *sin_family* field must be set to AF_INET.

The *sin_port* field is set to the port to which the application must bind. It must be specified in network byte order. If *sin_port* is set to 0, the caller leaves it to the system to assign an available port. The application can call `getsockname()` to discover the port number assigned.

The *sin_addr.s_addr* field is set to the Internet address and must be specified in network byte order. On hosts with more than one network interface (called multihomed hosts), a caller can select the interface to which it is to bind. Subsequently, only UDP packets and TCP connection requests from this interface (which match the bound name) are routed to the application. If this field is set to the constant INADDR_ANY, as defined in `netinet/in.h`, the caller is requesting that the socket be bound to all network interfaces on the host. Subsequently, UDP packets and TCP connections from all interfaces (which match the bound name) are routed to the application. This becomes important when a server offers a service to multiple networks. By leaving the address unspecified, the server can accept all UDP packets and TCP connection requests made for its port, regardless of the network interface on which the requests arrived.

The *sin_zero* field is not used and must be set to all zeros.

Socket Descriptor Created in the AF_INET6 Domain If the socket descriptor *socket* was created in the AF_INET6 domain, the format of the name buffer is expected to be **sockaddr_in6**, as defined in the include file `netinet/in.h`. The structure is defined as follows:

```
struct sockaddr_in6 {
    uint8_t      sin6_len;
    sa_family_t  sin6_family;
    in_port_t    sin6_port;
    uint32_t     sin6_flowinfo;
    struct in6_addr sin6_addr;
    uint32_t     sin6_scope_id;
};
```

The *sin6_len* field is set to the size of this structure. The SIN6_LEN macro is defined to indicate the version of the `sockaddr_in6` structure being used.

The *sin6_family* field identifies this as a `sockaddr_in6` structure. This field overlays the *sa_family* field when the buffer is cast to a `sockaddr` structure. The value of this field must be AF_INET6.

The *sin6_port* field contains the 16-bit UDP or TCP port number. This field is used in the same way as the *sin_port* field of the `sockaddr_in` structure. The port number is stored in network byte order.

The *sin6_flowinfo* field is a 32-bit field that contains the traffic class and the flow label.

The *sin6_addr* field is a single `in6_addr` structure. This field holds one 128-bit IPv6 address. The address is stored in network byte order.

The *sin6_scope_id* field is a 32-bit integer that identifies a set of interfaces as appropriate for the scope of the address carried in the *sin6_addr* field. For a link scope *sin6_addr*, *sin6_scope_id*, this would be an interface index. For a site scope *sin6_addr*, *sin6_scope_id*, this would be a site identifier.

Socket Descriptor Created in the AF_UNIX Domain

If the socket descriptor *socket* is created in the AF_UNIX domain, the format of the name buffer is expected to be `sockaddr_un`, as defined in the include file **un.h**.

```
struct sockaddr_un {
    unsigned char sun_len;
    unsigned char sun_family;
    char          sun_path[108];    /* pathname */
};
```

The *sun_family* field is set to AF_UNIX.

The *sun_path* field contains the NULL-terminated pathname, and *sun_len* contains the length of the pathname.

Notes:

1. For AF_UNIX, when a bind is issued, a file is created with a mode of 660. In order to allow other users to access this file, a `chmod()` should be issued to modify this mode if desired.
2. For AF_UNIX, when closing sockets that were bound, you should also use `unlink()` to delete the file created at `bind()` time.
3. The pathname the client uses on the `bind()` must be unique.
4. The `sendto()` call must specify the pathname associated with the server.
5. For AF_INET or AF_INET6, the user must have appropriate privileges to bind to a port in the range from 1 to 1023.

Special Behavior for C++

To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Note: The `bind()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `bind()` returns 0.

If unsuccessful, `bind()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCES**

Permission denied.

EADDRINUSE

The address is already in use. See the `SO_REUSEADDR` option described under [“getsockopt\(\) — Get the options associated with a socket”](#) on page 778 and the `SO_REUSEADDR` described under the [“setsockopt\(\) — Set options associated with a socket”](#) on page 1573 for more information.

EADDRNOTAVAIL

The address specified is not valid on this host. For example, the Internet address does not specify a valid network interface.

EAFNOSUPPORT

The address family is not supported (it is not AF_UNIX, AF_INET, or AF_INET6).

EBADF

The *socket* parameter is not a valid socket descriptor.

EINVAL

One of three conditions may apply:

- The socket is already bound to an address—for example, trying to bind a name to a socket that is already connected.
- The socket was shut down.
- An incorrect parameter was passed on the `bind()` invocation.

Check the parameter values passed and ensure they are specified as described above.

EIO

There has been a network or transport failure.

ENOBUFS

`bind()` is unable to obtain a buffer due to insufficient storage.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The socket type of the specified socket does not support binding to an address.

EPERM

The user is not authorized to bind to the port specified.

The following are for AF_UNIX only:

Error Code**Description****EACCES**

A component of the path prefix denies search permission, or the requested name requires writing in a directory with a mode that denies write permission.

EDESTADDRREQ

The *address* argument is a NULL pointer.

EIO

An I/O error occurred.

ELOOP

Too many symbolic links were encountered in translating the pathname in *address*.

ENAMETOOLONG

A component of a pathname exceeded **NAME_MAX** characters, or an entire pathname exceeded **PATH_MAX** characters.

ENOENT

A component of the pathname does not name an existing file or the pathname is an empty string.

ENOTDIR

A component of the path prefix of the pathname in *address* is not a directory.

EROFS

The name would reside on a read-only file system.

Example

The following are examples of the `bind()` call. It is a good idea to zero the structure before using it to ensure that the name requested does not set any reserved fields.

AF_INET Domain Example

The following example illustrates the `bind()` call binding to interfaces in the AF_INET domain. The Internet address and port must be in network byte order. To put the port into network byte order, the `htons()` utility routine is called to convert a short integer from host byte order to network byte order. The *address* field is set using another utility routine, `inet_addr()`, which takes a character string representing the dotted-decimal address of an interface and returns the binary Internet address representation in network byte order.

```
int rc;
int s;
struct sockaddr_in myname;
/* Bind to a specific interface in the Internet domain */
/* make sure the sin_zero field is cleared */
memset(&myname, 0, sizeof(myname));
myname.sin_family = AF_INET;
myname.sin_addr.s_addr = inet_addr("129.5.24.1");
/* specific interface */
myname.sin_port = htons(1024);
:
rc = bind(s, (struct sockaddr *) &myname,
sizeof(myname));
/* Bind to all network interfaces in the Internet domain */
/* make sure the sin_zero field is cleared */
memset(&myname, 0, sizeof(myname));
myname.sin_family = AF_INET;
myname.sin_addr.s_addr = INADDR_ANY; /* specific interface */
myname.sin_port = htons(1024);
:
rc = bind(s, (struct sockaddr *) &myname,
sizeof(myname));
/* Bind to a specific interface in the Internet domain.
   Let the system choose a port */
*/
```

```
/* make sure the sin_zero field is cleared */
memset(&myname, 0, sizeof(myname));
myname.sin_family = AF_INET;
myname.sin_addr.s_addr = inet_addr("129.5.24.1");
/* specific interface */
myname.sin_port = 0;
:
rc = bind(s, (struct sockaddr *) &myname,
sizeof(myname));
```

AF_UNIX Domain Example

The following example illustrates the `bind()` call binding to interfaces in the AF_UNIX domain.

```
/* Bind to a name in the UNIX domain */
struct sockaddr_un myname;
char socket_name[]="/tmp/socket.for._";
:
memset(&myname, 0, sizeof(myname));
myname.sun_family = AF_UNIX;
strcpy(myname.sun_path,socket_name);
myname.sun_len = sizeof(myname.sun_path);
:
rc = bind(s, (struct sockaddr *) &myname, SUN_LEN(&myname));
```

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“getnetbyname\(\) — Get a network entry by name” on page 743](#)
- [“getsockname\(\) — Get the name of a socket” on page 777](#)
- [“htons\(\) — Translate an unsigned short integer into network byte order” on page 820](#)
- [“inet_addr\(\) — Translate an Internet address into network byte order” on page 854](#)
- [“listen\(\) — Prepare the server for incoming client requests” on page 977](#)
- [“socket\(\) — Create a socket” on page 1677](#)

bind2addrsel() - Bind with source address selection

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC 5014 | both | |

Format

```
#define _OPEN_SYS SOCK_IPV6
#include <netinet/in.h>

int bind2addrsel(int sd, const struct sockaddr *dstaddr, socklen_t dstaddrlen);
```

General description

The `bind2addrsel()` function binds a socket to a source address and port that is appropriate to communicate with a given destination address. The source address is selected by the TCP stack according to either the default preference flags or the flags previously expressed by the application by use of the `setsockopt() IPV6_ADDR_PREFERENCES` call on this socket. If the bind is successful, the application can call `getsockname()` to determine the address and port selected. The application can then call `inet6_is_srcaddr()` to determine if the bound local address meets its preferences. For more information on source address selection, see *z/OS Communications Server: IPv6 Network and Appl Design Guide*.

Argument**Description****sd**

The socket to bind to a stack-selected source address and port.

dstaddr

A non-NULL pointer to a `sockaddr_in6` structure initialized as follows:

- Clear the entire structure for `sizeof(struct sockaddr_in6)`.
- `sin6_family` must be set to `AF_INET6`.
- Set `sin6_len` to the correct length for `AF_INET6`.
- Set `sin6_addr` to a 128-bit IPv6 destination address with which the local node wants to communicate.
- The `sin6_scope_id` must be set if the address is link-local.

dstaddrlen

The size of the `sockaddr` structure passed as argument.

Returned value

If successful, `bind2addrsel()` returns 0.

If unsuccessful, `bind2addrsel()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EADDRNOTAVAIL**

The destination address is a multicast address but the socket type is `SOCK_STREAM` or there are no ephemeral ports available to satisfy the bind request.

EAFNOSUPPORT

The address family specified in the address structure is not supported.

EBADF

The socket descriptor is incorrect.

EHOSTUNREACH

The destination address is not reachable because there is no route.

EINVAL

One of the input parameters was not valid.

EIO

There has been a network or transport failure.

ENOBUFS

A buffer could not be obtained.

ENOTSOCK

The `sd` parameter does not refer to a valid socket descriptor.

EOPNOTSUPP

The socket domain type is not supported.

EPROTOTYPE

The socket protocol is not TCP or UDP.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“inet6_is_srcaddr\(\) - Socket address verification” on page 840](#)
- [“getaddrinfo\(\) — Get address information” on page 685](#)

- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)

brk() — Change space allocation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int brk(void *addr);
```

General description

Restriction: This function is not supported in AMODE 64.

The `brk()` function is used to change the space allocated for the calling process. The change is made by setting the process's break value to `addr` and allocating the appropriate amount of space. The amount of allocated space increases as the break value increases. The newly-allocated space is set to 0. However, if the application first decrements and then increments the break value, the contents of the reallocated space are not zeroed.

The storage space from which the `brk()` and `sbrk()` functions allocate storage is separate from the storage space that is used by the other memory allocation functions (`malloc()`, `calloc()`, etc.). Because this storage space must be a contiguous segment of storage, it is allocated from the initial heap segment only and thus is limited to the initial heap size specified for the calling program or the largest contiguous segment of storage available in the initial heap at the time of the first `brk()` or `sbrk()` call. Since this is a separate segment of storage, the `brk()` and `sbrk()` functions can be used by an application that is using the other memory allocation functions. However, it is possible that the user's region may not be large enough to support extensive usage of both types of memory allocation.

Prior usage of the `brk()` function has been limited to specialized cases where no other memory allocation function performed the same function. Because the `brk()` function may be unable to sufficiently increase the space allocation of the process when the calling application is using other memory functions, the use of other memory allocation functions, such as `mmap()`, is now preferred because it can be used portably with all other memory allocation functions and with any function that uses other allocation functions. Applications that require the use of `brk()` and/or `sbrk()` should refrain from using the other memory allocation functions and should be run with an initial heap size that will satisfy the maximum storage requirements of the program. The `brk()` function is not supported from a multithreaded environment, it will return in error if it is invoked in this environment.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use `malloc()` instead of `brk()` or `sbrk()`.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `brk()` returns 0.

If unsuccessful, brk() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|--------|--|
| ENOMEM | The requested change would allocate more space than allowed for the calling process. |
|--------|--|

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“sbrk\(\) — Change space allocation” on page 1464](#)

bsd_signal() — BSD version of signal()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

void (*bsd_signal(int sig, void (*func)(int)))(int);
```

General description

The bsd_signal() function provides a partially compatible interface for programs written to use the BSD form of the signal() function.

BSD signal() differs from ISO C/C++ signal() in that the **SA_RESTART** flag is set and the **SA_RESETHAND** is cleared when bsd_signal() is used. Whereas for signal() both of these flags are cleared and **_SA_OLD_STYLE** is set.

There are three functions available for establishing a signal's action, signal(), bsd_signal(), and sigaction(). The sigaction() function is the strategic way to establish a signal's action. The bsd_signal() and signal() functions are provided for compatibility with BSD and ISO C/C++, respectively.

The argument sig is the signal type. See Table 57 on page 1606 for a list of the supported signal types or refer to the <signal.h> header. The argument func is the signal action. It may be set to **SIG_DFL**, **SIG_IGN**, or the address of a signal catching function that takes one input argument.

Special Behavior for C++

Because C and C++ linkage conventions are incompatible, bsd_signal() cannot receive a C++ function pointer as the start routine function pointer. If you attempt to pass a C++ function pointer to bsd_signal(), the compiler will flag it as an error. You can pass a C or C++ function to bsd_signal() by declaring it as extern "C".

Usage notes

1. The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.
2. The bsd_signal() function has been marked obsolescent in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The sigaction() function is preferred for portability.

Returned value

If successful, `bsd_signal()` returns the previous action established for this signal type.
If unsuccessful, `bsd_signal()` returns **SIG_ERR** and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|---------------|--|
| EINVAL | The value of the argument <i>sig</i> was not a valid signal type, or an attempt was made to catch a signal that cannot be caught, or ignore a signal that cannot be ignored. |
|---------------|--|

Related information

- [“signal.h – Exception handling” on page 58](#)
- [“sigaction\(\) – Examine or change a signal action” on page 1605](#)
- [“signal\(\) – Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) – Examine or change a thread” on page 1643](#)

bsearch() – Search arrays

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

void *bsearch(const void *key, const void *base, size_t num, size_t size,
              int (*compare)(const void *element1, const void *element2));
```

General description

Performs a binary search of an array of *num* elements, each of *size* bytes.
The pointer *base* points to the initial element of the array to be searched. *key* points to the object containing the value being sought. The array must be sorted in ascending key sequence, according to the comparison function. Otherwise, undefined behavior occurs.
The *compare* parameter is a pointer to a function you must supply. It compares two array elements and returns a value specifying their relationship. The `bsearch()` function calls this function one or more times during the search, passing the key and the pointer to one array element on each call. The function compares the elements and then returns one of the following values:

| Value | Meaning |
|-------|--|
| < 0 | Object pointed to by key is less than the array element. |

= 0

Object pointed to by key is equal to the array element.

> 0

Object pointed to by key is greater than the array element.

Special Behavior for C++

Because C++ and C linkage conventions are incompatible, `bsearch()` cannot receive C++ function pointers. If you attempt to pass a C++ function pointer to `bsearch()`, the compiler will flag it as an error. To use the C++ `bsearch()` function, you must ensure that the *compare* function has C linkage by declaring it as `extern "C"`.

Returned value

If successful, `bsearch()` returns a pointer to a matching element of the array. If two or more elements are equal, the element pointed to is not specified.

If unsuccessful finding the key, `bsearch()` returns NULL.

Example**CELEBB01**

```

/* CELEBB01

This example performs a binary search on the argv array of pointers o
to the program arguments and finds the position of the argument PATH.
It first removes the program name from argv, and then sorts the array
alphabetically before calling bsearch().

The functions compare1 and compare2 compare the values pointed to by
arg1 and arg2, and they return the result to bsearch().

*/
#include <stdlib.h>
#include <stdio.h>
#include <string.h>

#ifdef __cplusplus /* the __cplusplus macro is */
extern "C" {      /* automatically defined by the */
#endif           /* C++/MVS compiler */
    int compare1(const void *arg1, const void *arg2);
    int compare2(const void *arg1, const void *arg2);
#ifdef __cplusplus
}
#endif

int main(int argc, char *argv[])
{
    char **result;
    char *key = "PATH";
    int i;
    argv++;
    argc--;

    /* sort to ensure that the input is ordered */
    qsort((char *)argv, argc, sizeof(char *), compare1);

    result = (char**)bsearch(key, (void *)argv, argc, sizeof(char *),
                           compare2);
    if (result != NULL) {
        printf("The key <%s> was found.\n", *result);
    }
    else printf("Match not found\n");
}

int compare1(const void *arg1, const void *arg2)
{
    return (strcmp(*(char **)arg1, *(char **)arg2));
}

int compare2(const void *arg1, const void *arg2) {

```



```
    return (strcmp((char *)arg1, *(char **)arg2));
}
```

Input

```
progname Is there PATH in this sentence?
```

Output

```
The key <PATH> was found.
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“qsort\(\) — Sort array” on page 1367](#)

btowc() — Convert single-byte character to wide-character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C C99 Single UNIX Specification, Version 3 | both | z/OS V1R2 |

Format

```
#include <wchar.h>

wint_t btowc(int c);
```

General description

The `btowc()` function determines whether `c` constitutes a valid (one-byte) character in the initial shift state.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

If successful, `btowc()` returns the wide-character representation of the character `c`.

If `c` has the value `EOF` or if `(unsigned char)c` does not constitute a valid (one-byte) character in the initial shift state, `btowc()` returns `WEOF`.

There are no documented `errno` values.

Related information

- [“Internationalization: Locales and Character Sets” in *z/OS XL C/C++ Programming Guide*](#)
- [“locale.h — Locale settings” on page 36](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“mbtowc\(\) — Convert multibyte character to wide character” on page 1059](#)
- [“setlocale\(\) — Set locale” on page 1547](#)
- [“wctob\(\) — Convert wide character to byte” on page 2039](#)

bzero() – Zero bytes in memory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <strings.h>

void bzero(void *s, size_t n);
```

General description

The `bzero()` function places *n* zero-valued bytes in the area pointed to by *s*.

Note: The `bzero()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `memset()` function is preferred for portability.

Returned value

`bzero()` returns no values.

There are no `errno` values defined for `bzero()`.

Related information

- [“strings.h – String operations” on page 67](#)
- [“bcmp\(\) – Compare bytes in memory” on page 211](#)
- [“bcopy\(\) – Copy bytes in memory” on page 212](#)
- [“memset\(\) – Set buffer to value” on page 1069](#)

c16rtomb() – Convert a char16_t character to a multibyte character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C Amendment C11 | both | z/OS V2R1 |

Format

```
#include <uchar.h>

size_t c16rtomb(char * restrict s, char16_t c16, mbstate_t * restrict ps);
```

General description

The `c16rtomb()` function converts a wide character of type `char16_t` to a multibyte character, and returns the number of bytes stored in `s` (including any shift sequences).

If `s` is not a null pointer, the `c16rtomb()` function determines the number of bytes needed to represent the multibyte character that corresponds to the wide character given by `c16` (including any shift sequences), and stores the multibyte character representation in the array whose first element is pointed to by `s`. At most `MB_CUR_MAX` bytes are stored. If the `c16` is a null wide character, a null byte is stored, preceded by any shift sequence needed to restore the initial shift state; the resulting state described is the initial conversion state.

If `s` is a null pointer, the `c16rtomb()` function is equivalent to the call `c16rtomb(buf, L'\0', ps)`, where `buf` is an internal buffer.

If `ps` is a null pointer, `c16rtomb()` uses its own internal object to track the shift state. Otherwise `*ps` must be a valid `mbstate_t` object. An `mbstate_t` object `*ps` can be initialized to the initial state by assigning 0 to it, or by calling `c16rtomb(NULL, L'\0', ps)`.

Usage notes

1. To use the `c16rtomb()` function, compile the source code with [C11 standard based compilation](#).
2. The result `s` for stateful multibyte encodings, such as EBCDIC MBCS, might leave out shift bytes according to the conversion state. The first DBCS character in the output sequence has only shift-out character, and the following characters have neither shift-out nor shift-in. The ending shift-in will not be produced until an SBCS character or a null wide character is encountered.
3. The `c16rtomb()` function only supports the CCSIDs that are provided by Unicode Services.
4. The Unicode combining characters are not supported, and will be converted to substitute character of target CCSID.
5. The result of converting multiple string alternately in one thread by using multiple `mbstate_t` objects (including the internal one) is undefined.

Returned value

The `c16rtomb()` function returns the number of bytes stored in the array object (including any shift sequences). When `c16` is not a valid wide character, an encoding error occurs. The function stores the value of the macro `EILSEQ` in `errno` and returns `(size_t)-1`; the conversion state is unspecified.

Example

```
#include <stdio.h>
#include <stdlib.h>
#include <uchar.h>

int main(void)
{
    char16_t in = u'a';
    mbstate_t st = 0;
    char out[MB_CUR_MAX];
    int rc, i;
    rc = c16rtomb(out, in, &st);
    if (rc < 0) {
        perror("c16rtomb() fails to convert");
        exit(-1);
    }
    printf(" c16: 0x%04x \n", in);
    printf(" return code: %d \n", rc);
    printf(" mb character: ");
    for (i=0; i<rc; i++)
        printf(" 0x%02x", out[i]);
    printf("\n");
    return 0;
}
```

Output:

```
c16: 0x0061
return code: 1
mb character: 0x81
```

Related information

- “Internationalization: Locales and Character Sets” in *z/OS XL C/C++ Programming Guide*
- “Appendix A. Description of CCSIDs” in *z/OS Unicode Services User's Guide and Reference*
- “uchar.h — Extended character data types” on page 76
- “setlocale() — Set locale” on page 1547
- “c32rtomb() — Convert a char32_t character to a multibyte character” on page 226
- “mbrtoc16() — Convert a multibyte character to a char16_t character” on page 1048

c32rtomb() — Convert a char32_t character to a multibyte character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C Amendment C11 | both | z/OS V2R1 |

Format

```
#include <uchar.h>

size_t c32rtomb(char * restrict s, char32_t c32, mbstate_t * restrict ps);
```

General description

The `c32rtomb()` function converts a wide character of type `char32_t` to a multibyte character, and returns the number of bytes stored in the `s` (including any shift sequences).

If `s` is not a null pointer, the `c32rtomb()` function determines the number of bytes needed to represent the multibyte character that corresponds to the wide character given by `c32` (including any shift sequences), and stores the multibyte character representation in the array whose first element is pointed to by `s`. At most `MB_CUR_MAX` bytes are stored. If the `c32` is a null wide character, a null byte is stored, preceded by any shift sequence needed to restore the initial shift state; the resulting state described is the initial conversion state.

If `s` is a null pointer, the `c32rtomb()` function is equivalent to the call `c32rtomb(buf, L'\0', ps)`, where `buf` is an internal buffer.

If `ps` is a null pointer, `c32rtomb()` uses its own internal object to track the shift state. Otherwise `*ps` must be a valid `mbstate_t` object. An `mbstate_t` object `*ps` can be initialized to the initial state by assigning 0 to it, or by calling `c32rtomb(NULL, L'\0', ps)`.

Usage notes

1. To use the `c32rtomb()` function, compile the source code with [C11 standard based compilation](#).
2. The result `s` for stateful multibyte encodings, such as EBCDIC MBCS, might leave out shift bytes according to the conversion state. The first DBCS character in the output sequence has only shift-out

character, and the following characters have neither shift-out nor shift-in. The ending shift-in will not be produced until an SBCS character or a null wide character is encountered.

3. The `c32rtomb()` function only supports the CCSIDs that are provided by Unicode Services.
4. The Unicode combining characters are not supported, and will be converted to substitute character of target CCSID.
5. The result of converting multiple string alternately in one thread by using multiple `mbstate_t` objects (including the internal one) is undefined.

Returned value

The `c32rtomb()` function returns the number of bytes stored in the array object (including any shift sequences). When `c32` is not a valid wide character, an encoding error occurs. The function stores the value of the macro `EILSEQ` in `errno` and returns `(size_t)-1`; the conversion state is unspecified.

Example

```
#include <stdio.h>
#include <stdlib.h>
#include <uchar.h>

int main(void)
{
    char32_t in = U'a';
    mbstate_t st = 0;
    char out[MB_CUR_MAX];
    int rc, i;
    rc = c32rtomb(out, in, &st);
    if (rc < 0) {
        perror("c32rtomb() fails to convert");
        exit(-1);
    }
    printf(" c32: 0x%04x \n", in);
    printf(" return code: %d \n", rc);
    printf(" mb character: ");
    for (i=0; i<rc; i++)
        printf(" 0x%02x", out[i]);
    printf("\n");
    return 0;
}
```

Output:

```
c32: 0x00000061
return code: 1
mb character:  0x81
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “Appendix A. Description of CCSIDs” in [z/OS Unicode Services User's Guide and Reference](#)
- “uchar.h — Extended character data types” on page 76
- “setlocale() — Set locale” on page 1547
- “c16rtomb() — Convert a char16_t character to a multibyte character” on page 224
- “mbrtoc32() — Convert a multibyte character to a char32_t character” on page 1050

__cabend() – Terminate the process with an abend

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <ctest.h>

void __cabend(int abendcode, int reasoncode, int clean_up);
```

General description

Causes an abnormal process termination and returns an abend code.

Note: When TRAP(OFF) is specified, __cabend() behaves as if clean_up was set to 0.

Parameter

Description

abendcode

Numeric value for the user abend code.

reasoncode

Numeric value of the reason code.

clean_up

Specifies whether normal process cleanup should be performed with the type of dump the user requires.

0 - Issue the abend without cleanup

1 - Issue the abend with cleanup honoring the TERMTHDACT runtime option that the user has specified

2 - Issue the abend with cleanup honoring the TERMTHDACT runtime option for system dump of the user address space but always suppressing the CEEDUMP

3 - Issue the abend with cleanup honoring the TERMTHDACT runtime option but always suppressing both the system dump and the CEEDUMP

4 - Issue the abend with cleanup honoring the TERMTHDACT runtime option for CEEDUMP but always suppressing the system dump

5 - Issue the abend with cleanup forcing a system dump of the user address space but not specifying the TERMTHDACT runtime option

cabs(), cabsf(), cabsl() – Calculate the complex absolute value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double cabs(double complex z);
float cabsf(float complex z);
long double cabsl(long double complex z);
```

General description

The `cabs()` family of functions compute the complex absolute value (also called norm, modules, or magnitude) of `z`.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|--------------------|-----|------|
| <code>cabs</code> | X | X |
| <code>cabsf</code> | X | X |
| <code>cabsl</code> | X | X |

Returned value

The `cabs` functions return the complex absolute value.

Example

```
/*
 * This example calculates the complex absolute
 * value of complex number 'z'
 */
#include <complex.h>
#include <stdio.h>

void main()
{
    double complex z=3.5 + I*2.21;
    double res;

    res = cabs(z);
    printf("cabs(%f + I*%f) = %f\n",creal(z), cimag(z),res);
}

/*
 * Output:
 * cabs(3.5 + I*2.21) = 4.139336
 */
```

Related information

- [“complex.h — Complex math functions”](#) on page 85
- [“cimag\(\), cimagf\(\), cimagl\(\) — Calculate the complex imaginary part”](#) on page 282
- [“creal\(\), crealf\(\), creall\(\) — Calculate the complex real part”](#) on page 341

cacos(), cacosf(), cacosl() – Calculate the complex arc cosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex cacos(double complex z);
float complex cacosf(float complex z);
long double complex cacosl(long double complex z);
```

General description

The cacos() family of functions compute the complex arc cosine of z, with branch cuts outside the interval [-1, +1] along the real axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| cacos | X | X |
| cacosf | X | X |
| cacosl | X | X |

Returned value

The cacos() family of functions return the complex arc cosine value, in the range of a strip, mathematically unbounded along the imaginary axis and in the interval [0, π] along the real axis.

Example

```
/*
 * This example calculates the complex arc-cosine of
 * complex number 'z'
 */
#include <complex.h>
#include <stdio.h>

void main()
{
    long double complex z1=3.5 + I*2.21;
    double complex zd=(double complex)z1;
    float complex zf=(float complex)z1;
    long double resl;
    double resd;
    float resf;
    char *func = "cacos";

    printf("Example of the %s complex function\n",func);
    resd = cacos(zd);
    resf = cacosf(zf);
    resl = cacosl(z1);
    printf("\t%s(%f + I*%f) = %f\n",func, creal(zd), cimag(zd),resd);
    printf("\t%sf(%f + I*%f) = %f\n",func, crealf(zf), cimagf(zf),resf);
    printf("\t%s1(%Lf + I*%Lf) = %Lf\n",func, creall(z1), cimagl(z1),resl);
}
```


Output:

```
Example of the cacos complex function
cacos(3.500000 + I*2.210000) = 0.576628
cacoshf(3.500000 + I*2.209999) = 0.576627
cacoshl(3.500000 + I*2.210000) = 0.576628
```

Related information

- “[complex.h — Complex math functions](#)” on page 85
- “[cacosh\(\), cacoshf\(\), cacoshl\(\) — Calculate the complex arc hyperbolic cosine](#)” on page 231
- “[catan\(\), catanf\(\), catanl\(\) — Calculate the complex arc tangent](#)” on page 236
- “[ccos\(\), ccosf\(\), ccosl\(\) — Calculate the complex cosine](#)” on page 245
- “[ccosh\(\), ccoshf\(\), ccoshl\(\) — Calculate the complex hyperbolic cosine](#)” on page 246

cacosh(), cacoshf(), cacoshl() — Calculate the complex arc hyperbolic cosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex cacosh(double complex z);
float complex cacoshf(float complex z);
long double complex cacoshl(long double complex z);
```

General description

The `cacosh()` family of functions compute the complex arc hyperbolic cosine of z , with a branch cut at values less than 1 along the real axis.

Note: The following table shows the viable formats for these functions. See “[IEEE binary floating-point](#)” on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------------------|-----|------|
| <code>cacosh</code> | X | X |
| <code>cacoshf</code> | X | X |
| <code>cacoshl</code> | X | X |

Returned value

The `cacosh()` family of functions return the complex arc hyperbolic cosine value, in the range of a half-strip, non-negative value along the real axis and in the interval $[-i\pi, +i\pi]$ along the imaginary axis.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h – Complex math functions” on page 85](#)
- [“cacos\(\), cacosh\(\), cacosl\(\) – Calculate the complex arc cosine” on page 230](#)
- [“ccosh\(\), ccoshf\(\), ccoshl\(\) – Calculate the complex hyperbolic cosine” on page 246](#)
- [“ccos\(\), ccosf\(\), ccosl\(\) – Calculate the complex cosine” on page 245](#)
- [“csin\(\), csinf\(\), csinl\(\) – Calculate the complex sine” on page 349](#)
- [“csinh\(\), csinhf\(\), csinhl\(\) – Calculate the complex hyperbolic sine” on page 350](#)

calloc() – Reserve and initialize storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

void *calloc(size_t num, size_t size);
```

General description

Reserves storage space for an array of *num* elements, each of length *size* bytes. The `calloc()` function then gives all the bits of each element an initial value of 0.

`calloc()` returns a pointer to the reserved space. The storage space to which the returned value points is aligned for storage of any type of object.

This function is also available to C applications in free-standing System Programming C (SPC) Facilities applications.

Special behavior for C++: The C++ keywords `new` and `delete` are not interoperable with `aligned_alloc()`, `calloc()`, `free()`, `malloc()`, `posix_memalign()`, or `realloc()`.

Note: To use the `aligned_alloc()` function, compile the source code with [C11 standard based compilation](#).

Returned value

If successful, `calloc()` returns the pointer to the area of memory reserved.

If there is not enough space to satisfy the request or if *num* or *size* is 0, `calloc()` returns NULL. If `calloc()` returns NULL because there is not enough storage, it sets `errno` to one of the following values:

Error Code Description

ENOMEM

Insufficient memory is available

Example

CELEBC01

```
/* CELEBC01

This example prompts for the number of array entries required
and then reserves enough space in storage for the entries.

If &calloc. is successful, the example prints out each entry;
otherwise, it prints out an error message.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    long * array;      /* start of the array */
    long * index;      /* index variable */
    int    i;          /* index variable */
    int    num;         /* number of entries in the array */

    printf( "Enter the number of elements in the array\n" );
    scanf( "%i", &num );

    /* allocate num entries */
    if ( (index = array = (long *)calloc( num, sizeof( long ))) != NULL )
    {
        for ( i = 0; i < num; ++i )          /* put values in array */
            *index++ = i;                    /* using pointer notation */

        for ( i = 0; i < num; ++i )          /* print the array out */
            printf( "array[ %i ] = %i\n", i, array[i] );
    }
    else
    { /* out of storage */
        printf( "Out of storage\n" );
        abort();
    }
}
```

Output

```
Enter the size of the array
array[ 0 ] = 0
array[ 1 ] = 1
array[ 2 ] = 2
```

Related information

- See the topic about using the system programming C facilities in [z/OS XL C/C++ Programming Guide](#).
- [“stdlib.h — Standard library functions” on page 65](#)
- [“free\(\) — Free a block of storage” on page 620](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“realloc\(\) — Change reserved storage block size” on page 1395](#)

carg(), cargf(), cargl() – Calculate the argument

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double carg(double complex z);
float cargf(float complex z);
long double cargl(long double complex z);
```

General description

The `carg()` family of functions compute the argument (phase angle) of z , with a branch cut along the negative real axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|--------------------|-----|------|
| <code>carg</code> | X | X |
| <code>cargf</code> | X | X |
| <code>cargl</code> | X | X |

Returned value

The `carg()` family of functions return the value of the argument in the interval $[-\pi, +\pi]$.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h – Complex math functions” on page 85](#)
- [“creal\(\), crealf\(\), creall\(\) – Calculate the complex real part” on page 341](#)
- [“cimag\(\), cimagf\(\), cimagl\(\) – Calculate the complex imaginary part” on page 282](#)
- [“conj\(\), conjf\(\), conjl\(\) – Calculate the complex conjugate” on page 311](#)
- [“cproj\(\), cprojf\(\), cprojl\(\) – Calculate the projection” on page 340](#)

casin(), casinf(), casinl() – Calculate the complex arc sine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex casin(double complex z);
float complex casinf(float complex z);
long double complex casinl(long double complex z);
```

General description

The `casin()` family of functions compute the complex arc sine of z , with branch cuts outside the interval $[-1, +1]$ along the real axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>casin</code> | X | X |
| <code>casinf</code> | X | X |
| <code>casinl</code> | X | X |

Returned value

The `casin()` family of functions return the complex arc sine value, in the range of a strip, mathematically unbounded along the imaginary axis and in the interval $[-\pi/2, +\pi/2]$ along the real axis.

Related information

- [“complex.h – Complex math functions”](#) on page 85
- [“casinh\(\), casinhf\(\), casinhl\(\) – Calculate the complex arc hyperbolic sine”](#) on page 235
- [“catan\(\), catanf\(\), catanl\(\) – Calculate the complex arc tangent”](#) on page 236
- [“csin\(\), csinf\(\), csinl\(\) – Calculate the complex sine”](#) on page 349
- [“csinh\(\), csinhf\(\), csinhl\(\) – Calculate the complex hyperbolic sine”](#) on page 350

casinh(), casinhf(), casinhl() – Calculate the complex arc hyperbolic sine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#define _ISOC99_SOURCE
#include <complex.h>

double complex casinh(double complex z);
float complex casinhf(float complex z);
long double complex casinhl(long double complex z);
```

General description

The `casinh()` family of functions compute the complex arc hyperbolic sine of z , with branch cuts outside the interval $[-i, +i]$ along the imaginary axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------------------|-----|------|
| <code>casinh</code> | X | X |
| <code>casinhf</code> | X | X |
| <code>casinhl</code> | X | X |

Returned value

The `casinh()` family of functions return the complex arc hyperbolic sine value, in the range of a strip, mathematically unbounded along the real axis and in the interval $[-i\pi/2, +i\pi/2]$ along the imaginary axis.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h – Complex math functions” on page 85](#)
- [“casin\(\), casinf\(\), casinl\(\) – Calculate the complex arc sine” on page 235](#)
- [“cacosh\(\), cacoshf\(\), cacoshl\(\) – Calculate the complex arc hyperbolic cosine” on page 231](#)
- [“cacos\(\), cacosf\(\), cacosl\(\) – Calculate the complex arc cosine” on page 230](#)
- [“csin\(\), csinf\(\), csinl\(\) – Calculate the complex sine” on page 349](#)
- [“csinh\(\), csinhf\(\), csinhl\(\) – Calculate the complex hyperbolic sine” on page 350](#)

catan(), catanf(), catanl() – Calculate the complex arc tangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex catan(double complex z);
```

```
float complex catanf(float complex z);
long double complex catanl(long double complex z);
```

General description

The `catan()` family of functions compute the complex arc tangent of z , with branch cuts outside the interval $[-i, +i]$ along the imaginary axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>catan</code> | X | X |
| <code>catanf</code> | X | X |
| <code>catanl</code> | X | X |

Returned value

The `catan()` family of functions return the complex arc tangent value, in the range of a strip, mathematically unbounded along the imaginary axis and in the interval $[-\pi/2, +\pi/2]$ along the real axis.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h — Complex math functions” on page 85](#)
- [“casin\(\), casinf\(\), casinl\(\) — Calculate the complex arc sine” on page 235](#)
- [“casinh\(\), casinhf\(\), casinhl\(\) — Calculate the complex arc hyperbolic sine” on page 235](#)
- [“catanh\(\), catanhf\(\), catanhl\(\) — Calculate the complex arc hyperbolic tangent” on page 237](#)
- [“csin\(\), csinf\(\), csinl\(\) — Calculate the complex sine” on page 349](#)
- [“csinh\(\), csinhf\(\), csinhl\(\) — Calculate the complex hyperbolic sine” on page 350](#)

catanh(), catanhf(), catanhl() — Calculate the complex arc hyperbolic tangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex catanh(double complex z);
float complex catanhf(float complex z);
long double complex catanhl(long double complex z);
```

General description

The `catanh()` family of functions compute the complex arc hyperbolic tangent of z , with branch cuts outside the interval $[-1, +1]$ along the real axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------------------|-----|------|
| <code>catanh</code> | X | X |
| <code>catanhf</code> | X | X |
| <code>catanhl</code> | X | X |

Returned value

The `catanh()` family of functions return the complex arc hyperbolic tangent value, in the range of a strip, mathematically unbounded along the real axis and in the interval $[-i\pi/2, +i\pi/2]$ along the imaginary axis.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h — Complex math functions”](#) on page 85
- [“catan\(\), catanf\(\), catanl\(\) — Calculate the complex arc tangent”](#) on page 236
- [“catanh\(\), catanhf\(\), catanhl\(\) — Calculate the complex arc hyperbolic tangent”](#) on page 237
- [“ctan\(\), ctanf\(\), ctanl\(\) — Calculate the complex tangent”](#) on page 354
- [“csin\(\), csinf\(\), csinl\(\) — Calculate the complex sine”](#) on page 349
- [“csinh\(\), csinhf\(\), csinhl\(\) — Calculate the complex hyperbolic sine”](#) on page 350

catclose() — Close a message catalog descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <nl_types.h>

int catclose(nl_catd catd);
```

General description

The `catclose()` function closes the message catalog identified by `catd`. If a catalog is opened more than once in the same process, a use count is incremented. `catclose()` decrements this use count. When the use count reaches zero then the file descriptor for that catalog is closed.

Returned value

If successful, `catclose()` returns 0.

If unsuccessful, `catclose()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

The catalog descriptor is not valid.

EINTR

`catclose()` was interrupted by a signal.

Related information

- [“nl_types.h — National languages” on page 52](#)
- [“catgets\(\) — Read a program message” on page 239](#)
- [“catopen\(\) — Open a message catalog” on page 240](#)

catgets() — Read a program message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <nl_types.h>

char *catgets(nl_catd catd, int set_id, int msg_id, const char *s);
```

General description

The `catgets()` function attempts to read message `msg_id`, in set `set_id`, from the message catalog identified by `catd`. The `catd` argument is a message catalog descriptor returned from an earlier call to `catopen()`. The `s` argument points to a default message string which will be returned by `catgets()` if it cannot retrieve the identified message.

When message source files are processed by the `gencat` command, the CODESET used to create them is saved in the resulting message catalog. The `catgets()` function interrogates this CODESET value to see if it differs from the CODESET value of the current locale. If it does differ then `catgets()` uses the `iconv()` function to convert the message text coming from the message catalog into the codeset of the current locale. The default message string (`s`) is not affected by this conversion. If `iconv()` does not support the conversion specified by the two CODESETs then the default message string is returned.

Returned value

If the identified message is retrieved successfully, `catgets()` returns a pointer to an internal buffer area containing the NULL-terminated message string.

If unsuccessful, `catgets()` returns `s` and sets `errno` to one of the following values:

Error Code Description

EBADF

The *catd* argument is not a valid message catalog descriptor open for reading.

EINTR

The read operation was terminated due to the receipt of a signal, and no data was transferred.

Special behavior for z/OS UNIX Services:

Error Code Description

EINVAL

May be returned for several reasons:

- The message catalog identified by *catd* is not a valid message catalog, or has been corrupted. Ensure that the message catalog was created using the z/OS UNIX *gencat* command.
- *iconv()* does not support the conversion between the codeset of the message catalog and that of the current locale. To check the codeset that the message catalog was created in, look for the codeset name at offset 28 into the message catalog.

ENOMSG

The message identified by *set_id* and *msg_id* is not in the message catalog.

Related information

- [“nl_types.h — National languages” on page 52](#)
- [“catclose\(\) — Close a message catalog descriptor” on page 238](#)
- [“catopen\(\) — Open a message catalog” on page 240](#)

catopen() — Open a message catalog

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <nl_types.h>

nl_catd catopen(const char *name, int oflag);
```

General description

The *catopen()* function opens a message catalog and returns a message catalog descriptor. The *name* argument specifies the name of the message catalog to be opened. If *name* contains a */*, then *name* specifies a complete name for the message catalog. Otherwise, the environment variable *NLSPATH* is used with *name* substituted for *%N* (see the XBD specification, Chapter 6, Environment Variables). If *NLSPATH* does not exist in the environment, or if a message catalog cannot be found in any of the components specified by *NLSPATH*, then the default path of */usr/lib/nls/msg/%L/%N* is used. The *%L* component of this default path is replaced by the setting of *LC_MESSAGES* if the value of *oflag* is

NL_CAT_LOCALE, or the LANG environment variable if oflag is 0. A change in the setting of the LANG or LC_MESSAGES will have no effect on existing open catalogs.

A message catalog descriptor remains valid in a process until that process closes it, or a successful call to one of the exec functions. When a message catalog is opened the FD_CLOEXEC flag will be set. See [“fcntl\(\) — Control open file descriptors” on page 483](#). Portable applications must assume that message catalog descriptors are not valid after a call to one of the exec functions.

If a catalog is opened more than once in the same process, a use count is incremented. When the use count reaches zero, by using catclose() to close the catalog, then the file descriptor for that catalog is closed.

Returned value

If successful, catopen() returns a message catalog descriptor for use on subsequent calls to catgets() and catclose().

If unsuccessful, catopen() returns (nl_catd)-1 and sets errno to one of the following values:

Error Code
Description

- EACCES**
Search permission is denied for the component of the path prefix of the message catalog or read permission is denied for the message catalog.
- EMFILE**
OPEN_MAX file descriptors are currently open in the calling process.
- ENAMETOOLONG**
The length of the path name of the message catalog exceeds **PATH_MAX**, or a path name component is longer than **NAME_MAX**.
- ENFILE**
Too many files are currently open in the system.
- ENOENT**
The message catalog does not exist or the name argument points to an empty string.
- ENOMEM**
Insufficient storage space is available.
- ENOTDIR**
A component of the path prefix of the message catalog is not a directory.

Related information

- [“nl_types.h — National languages” on page 52](#)
- [“catclose\(\) — Close a message catalog descriptor” on page 238](#)
- [“catgets\(\) — Read a program message” on page 239](#)

cbt(), cbtft(), cbttl() — Calculate the cube root

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double cbrt(double x);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

float cbrtf(float x);
long double cbrtl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float cbrt(float x);
long double cbrt(long double x);
```

General description

The cbrt() function calculates the real cube root of its argument x.

Note: The following table shows which functions work in IEEE Binary Floating-Point format and which work in hexadecimal floating-point format. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| cbrt | X | X |
| cbrtf | X | X |
| cbrtl | X | X |

Returned value

The cbrt functions return x to the 1/3 power.
cbrt() does not fail.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

cbtrd32(), cbtrd64(), cbtrd128() – Calculate the cube root

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 cbtrd32(_Decimal32 x);
_Decimal64 cbtrd64(_Decimal64 x);
```

```

_Decimal128 cbrtd128(_Decimal128 x);

_Decimal32  cbrt(_Decimal32 x);      /* C++ only */
_Decimal64  cbrt(_Decimal64 x);      /* C++ only */
_Decimal128 cbrt(_Decimal128 x);     /* C++ only */

```

General description

The `cbrt()` function calculates the real cube root of its argument `x`.

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) IEEE Decimal Floating-Point for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Example

```

/* CELEBC52

   This example illustrates the cbrtd64() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

void main(void)
{
    _Decimal64 x, y;

    x = 1000.0DD;
    y = cbrtd64(x);

    printf("cbrtd64( %Df ) = %Df\n", x, y);
}

```

Returned value

The `cbrt` functions return `x` to the $1/3$ power.

`cbrt()` does not fail.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

cclass() — Return characters in a character class

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```

#include <collate.h>

int cclass(char *class, coll_t **list);

```

General description

Finds all the collating elements of the class, *class*. The list is updated to point to the array of collating elements found. The list is valid until the next call to `setlocale()`.

The function supports user-defined character classes. In C Library programs, the function also supports POSIX.2 character classes.

Returned value

If successful, `cclass()` returns the number of elements in the list pointed to by *list*.

If the first argument specifies a class that does not exist in the LC_CTYPE category of the current locale, `cclass()` returns -1.

Example

CELEBC02

```
/* CELEBC02
*/

#include <stdio.h>
#include <collate.h>

int main(void)
{
    collat_t *list;      /* ptr to the digit class collation weights */
    int      weights;    /* no. of class collation class weights found */
    int      i;

    weights = cclass("digit", &list);

    printf("weights=%d\n", weights);
    for (i=0; i<weights; i++)
        printf("(list + %d) = %d\n", i, *(list + i) );
}
```

Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“locale.h — Locale settings” on page 36](#)
- [“Internationalization: Locales and Character Sets” in *z/OS XL C/C++ Programming Guide*](#)
- [“collequiv\(\) — Return a list of equivalent collating elements” on page 300](#)
- [“collorder\(\) — Return list of collating elements” on page 301](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“colltostr\(\) — Return a string for a collating element” on page 304](#)
- [“getmccoll\(\) — Get next collating element from string” on page 736](#)
- [“getwmccoll\(\) — Get next collating element from wide string” on page 803](#)
- [“ismccollet\(\) — Identify a multicharacter collating element” on page 915](#)
- [“maxcoll\(\) — Return maximum collating element” on page 1043](#)
- [“setlocale\(\) — Set locale” on page 1547](#)
- [“strtcoll\(\) — Return collating element for string” on page 1757](#)
- [“wctype\(\) — Obtain handle for character property classification” on page 2042](#)

ccos(), ccosf(), ccosl() – Calculate the complex cosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex ccos(double complex z);
float complex ccosf(float complex z);
long double complex ccosl(long double complex z);
```

General description

The ccos() family of functions compute the complex cosine of z.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| ccos | X | X |
| ccosf | X | X |
| ccosl | X | X |

Returned value

The ccos() family of functions return the complex cosine value.

Example

For an example of a similar function see cacos(), cexp() or cpow().

Related information

- [“complex.h – Complex math functions” on page 85](#)
- [“ccosh\(\), ccoshf\(\), ccoshl\(\) – Calculate the complex hyperbolic cosine” on page 246](#)
- [“casinh\(\), casinhf\(\), casinhl\(\) – Calculate the complex arc hyperbolic sine” on page 235](#)
- [“casin\(\), casinf\(\), casinl\(\) – Calculate the complex arc sine” on page 235](#)
- [“csin\(\), csinf\(\), csinl\(\) – Calculate the complex sine” on page 349](#)
- [“csinh\(\), csinhf\(\), csinhl\(\) – Calculate the complex hyperbolic sine” on page 350](#)

ccosh(), ccoshf(), ccoshl() – Calculate the complex hyperbolic cosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#define _ISOC99_SOURCE
#include <complex.h>

double complex ccosh(double complex z);
float complex ccoshf(float complex z);
long double complex ccoshl(long double complex z);
```

General description

The `ccosh()` family of functions compute the complex hyperbolic cosine of z .

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>ccosh</code> | X | X |
| <code>ccoshf</code> | X | X |
| <code>ccoshl</code> | X | X |

Returned value

The `ccosh()` family of functions return the complex hyperbolic cosine value.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h – Complex math functions”](#) on page 85
- [“ccos\(\), ccoshf\(\), ccoshl\(\) – Calculate the complex cosine”](#) on page 245
- [“cacosh\(\), cacoshf\(\), cacoshl\(\) – Calculate the complex arc hyperbolic cosine”](#) on page 231
- [“cacos\(\), cacosf\(\), cacosl\(\) – Calculate the complex arc cosine”](#) on page 230
- [“csin\(\), csinf\(\), csinl\(\) – Calculate the complex sine”](#) on page 349
- [“csinh\(\), csinhf\(\), csinhl\(\) – Calculate the complex hyperbolic sine”](#) on page 350

__CcsidType() – Return coded character set ID type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R2 |

Format

```
#include <_Ccsid.h>

__csType __CcsidType(__ccsid_t Ccsid);
```

General description

__CcsidType() returns a __csType value which indicates the corresponding coded character set ID type.

Returned value

If *Ccsid* is valid, __CcsidType() returns one of the following __csType values, which are defined in <_Ccsid.h>:

- _CSTYPE_EBCDIC
- _CSTYPE_ASCII
- _CSTYPE_UCS2
- _CSTYPE_UTF8
- _CSTYPE_UTF16
- _CSTYPE_UTF32

If *Ccsid* is not valid, __CcsidType() returns _CSTYPE_INVALID.

Related information

- [“_Ccsid.h – CCSID to codeset name conversion” on page 17](#)
- [“__CSNameType\(\) – Return codeset name type” on page 351](#)
- [“__toCcsid\(\) – Convert codeset name to coded character set ID” on page 1881](#)
- [“__toCSName\(\) – Convert coded character set ID to codeset name ” on page 1882](#)

cds() – Compare double and swap

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <stdlib.h>

int cds(cds_t *oldptr, cds_t *curptr, cds_t newwords);
```

General description

The `cds()` built-in function compares the 8-byte value pointed to by *oldptr* to the 8-byte value pointed to by *curptr*. If they are equal, the 8-byte value *newwords* is copied into the location pointed to by *curptr*. If they are unequal, the value pointed to by *curptr* is copied into the location pointed to by *oldptr*.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The function uses the COMPARE DOUBLE AND SWAP (CDS) instructions, which can be used in multiprogramming or multiprocessing environments to serialize access to counters, flags, control words, and other common storage areas. For a detailed description, see [Function support table on number representation and instruction](#).

Returned value

`cds()` returns 0 if the 8-byte value pointed to by *oldptr* is equal to the 8-byte value pointed to by *curptr*. Otherwise `cds()` returns 1.

Related information

- *z/Architecture Principles of Operation*
- [“stdlib.h — Standard library functions” on page 65](#)
- [“cs\(\) — Compare and swap” on page 348](#)

cdump() — Request a main storage dump

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <ctest.h>

int cdump(char *dumptitle);
```

General description

1. Creates a display of the activation stack, by calling `trace` in the same way as the `ctrace()` function does.
2. Displays the Language Environment-formatted dump.
3. If the source file was compiled with `TEST (SYM)`, `cdump()` displays the contents of the user's variables. The output is identified with *dumptitle*. See the CEE3DMP Language Environment callable service in [z/OS Language Environment Programming Guide](#) to determine where the output is written to.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

When `cdump()` is invoked from a user routine, the C/C++ library issues an OS SNAP macro to obtain a dump of virtual storage. The first invocation of `cdump()` results in a SNAP identifier of 0. For each successive invocation, the ID is increased by one to a maximum of 256, after which the ID is reset to 0.

The output of the dump is directed to the CEESNAP data set. The DD definition for CEESNAP is as follows:

```
//CEESNAP DD SYSOUT= *
```

If the data set is not defined, or is not usable for any reason, `cdump()` returns a failure code of 1. This occurs even if the call to `CEE3DMP` is successful. For more information see "Debugging C/C++ Routines " in [z/OS Language Environment Debugging Guide](#).

Returned value

If successful, `cdump()` returns 0.

If unsuccessful, `cdump()` returns nonzero.

Related information

- [“ctest.h — Debug and diagnostics” on page 17](#)
- [“csnap\(\) — Request a condensed dump” on page 352](#)
- [“ctrace\(\) — Request a traceback” on page 363](#)

ceil(), ceilf(), ceill() — Round up to integral value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double ceil(double x);
float ceil(float x);           /* C++ only */
long double ceil(long double x); /* C++ only */
float ceilf(float x);
long double ceill(long double x);
```

General description

Computes the smallest integer that is greater than or equal to x .

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

Returns the calculated value as a double, float, or long double value.

If there is an overflow, the function sets `errno` to `ERANGE` and returns `HUGE_VAL`.

Special behavior for IEEE: The `ceil()` functions are always successful.

Example

CELEBC04

```
/* CELEBC04

This example sets y to the smallest integer greater than
1.05, and then to the smallest integer greater than -1.05.

The results are 2.0 and -1.0, respectively.

*/
#include <math.h>
#include <stdio.h>
int main(void)
{
    double y, z;

    y = ceil(1.05);          /* y = 2.0 */
    z = ceil(-1.05);         /* z = -1.0 */
    printf("y = %f\n z = %f\n", y, z);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“floor\(\), floorf\(\), floorl\(\) — Round down to integral value” on page 554](#)

ceild32(), ceild64(), ceild128() — Round up to integral value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 ceild32(_Decimal32 x);
_Decimal64 ceild64(_Decimal64 x);
_Decimal128 ceild128(_Decimal128 x);
_Decimal32 ceil(_Decimal32 x); /* C++ only */
_Decimal64 ceil(_Decimal64 x); /* C++ only */
_Decimal128 ceil(_Decimal128 x); /* C++ only */
```

General description

Computes the smallest integer that is greater than or equal to x.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

These functions are always successful.

Example

```

/* CELEBC50

   This example illustrates the ceild32() function.

   This example sets y to the smallest integer greater than
   1.05, and then to the smallest integer greater than -1.05.

   The results are 2.0 and -1.0, respectively.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal32 y, z;

    y = ceild32(+1.05DF);      /* y = +2.0 */
    z = ceild32(-1.05DF);      /* z = -1.0 */

    printf("ceild32(+1.05) = % Hf\n"
           "ceild32(-1.05) = % Hf\n", y, z);
}

```

Related information

- “[math.h — Floating-point math functions](#)” on page 40
- “[floord32\(\), floord64\(\), floord128\(\) — Round down to integral value](#)” on page 555

__certificate() — Register, deregister, or authenticate a digital certificate

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R7 |

Format

```

#define _OPEN_SYS
#include <unistd.h>

int __certificate(int function_code,
                  int certificate_length,
                  char *certificate,...);

```

General description

The `__certificate()` function allows the user to register or deregister a digital certificate with or from the userid that is associated with the current security environment, or to authenticate a security environment using a digital certificate in lieu of a userid/password combination.

The function takes at least the following arguments:

function_code

Specifies one of the following functions:

__CERTIFICATE_REGISTER

Register the passed certificate to the user. No new security environment is created, and no authentication of the user is done.

__CERTIFICATE_DEREGISTER

Deregister the passed certificate from the user. Certificate must have been previously registered to the user.

__CERTIFICATE_AUTHENTICATE

As of z/OS V1R4, authenticate the passed certificate for this caller. The certificate must have already been registered.

certificate_length

The length of the digital certificate. A zero length will cause -1 return value with errno set to EINVAL.

certificate

The certificate must be a single BER encoded X.509 certificate. PKCS7, PEM, or Base64 encoded certificates are allowed.

Note: Only a single BER encoded X.509 certificate is supported for the authenticate function.

As of z/OS V1R4, the __CERTIFICATE_AUTHENTICATE function code requires the following additional parameters to be specified on the function call:

buflen (size_t)

Specifies the size of the buffer pointed to by buf. Up to buflen bytes of userid (including the NULL terminator) will be copied into the buffer. Note that truncation may occur if the buffer is too small. The buffer size should be large enough for any userid on the system. A value less than 1 will cause -1 return value with errno set to EINVAL.

buf (char *)

Pointer to character buffer where __certificate() will place the userid associated with the digital certificate. A value of NULL will cause -1 return value with errno set to EINVAL.

Usage notes

1. The __certificate function is intended for servers that support the automatic registration of certificates for clients they are supporting (on the World Wide Web for example).
2. The __CERTIFICATE_REGISTER function code will associate the passed certificate with whatever user identity is present. If the task level identity is present the certificate is associated with the task. Task level security can be created by pthread_security_np(), __login() or by any other means of creating a task level ACEE. If no task level identity (ACEE) is present, the certificate will be associated with the address space identity.
3. The __certificate() function calls the z/OS z/OS UNIX System Services BPX1SEC service. For a more detailed description of the BPX1SEC service, see [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

Restrictions

A security manager supporting digital certificate registration and deregistration must be installed and operational.

Returned value

If successful, __certificate() returns 0.

If unsuccessful, __certificate() returns -1 and sets errno to one of the following values:

Error Code

Description

EACCES

Permission is denied.

EINVAL

A parameter is not valid.

EMVSERR

An MVS environmental error or internal error occurred.

EMVSSAF2ERR

An error occurred in the security product. Certificate is already defined for another process or certificate is not valid or certificate does not meet required format. Also, realized when an internal error has occurred.

ENOSYS

The function is not implemented or installed.

EPERM

The operation was not permitted. Calling process may not be authorized in BPX.DAEMON facility class.

Use `__errno2()` to obtain a more detailed reason code (in most cases) when `__certificate()` fails.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“__login\(\), __login_applid\(\) — Create a new security environment for process” on page 1000](#)
- [“pthread_security_np\(\), pthread_security_applid_np\(\) — Create or delete thread-level security” on page 1331](#)

cexp(), cexpf(), cexpl() — Calculate the complex exponential

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex cexp(double complex z);
float complex cexpf(float complex z);
long double complex cexpl(long double complex z);
```

General description

The `cexp()` family of functions compute the complex base-e exponential of `z`.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|--------------------|-----|------|
| <code>cexp</code> | X | X |
| <code>cexpf</code> | X | X |
| <code>cexpl</code> | X | X |

Returned value

The cexp() family of functions return the complex base-e exponential value.

Example

```
/*
 * This example illustrates the complex exponential
 * function
 */
#include <complex.h>
#include <stdio.h>

void main()
{
    double complex z=6.0146 + I*(-2.41958),
               res;

    res = cexp(z);
    printf("cexp(%f + (%f)*I) = %f + (%f)*I\n",creal(z),
    cimag(z),creal(res),cimag(res));
}

Output:

cexp(6.014600 + (-2.419580)*I) = -307.216850 + (-270.545937)*I
```

Related information

- [“complex.h — Complex math functions” on page 85](#)
- [“clog\(\), clogf\(\), clogl\(\) — Calculate the complex natural logarithm” on page 289](#)

cfgetispeed() – Determine the input baud rate

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

speed_t cfgetispeed(const struct termios *termpr);
```

General description

Extracts the input baud rate from the termios structure indicated by **termpr*. The termios structure contains information about a terminal. A program should first use tcgetattr() to get the termios structure, and then use cfgetispeed() to extract the speed from the structure. The program can then use cfgetispeed() to set a new baud rate in the structure and tcsetattr() to pass the changed value to the system.

Although in a z/OS UNIX application valid speeds can be set with `cfsetispeed()` and passed to the system with `tcsetattr()`, the speed has no effect on the operation of a pseudoterminal. However, the operation will have an effect if issued for an OCS remote terminal.

Returned value

`cfgetispeed()` returns a code indicating the baud rate; see [Table 19 on page 255](#). These codes are defined in the `termios.h` header file and have an unsigned integer type.

There are no documented `errno` values.

Table 19. Baud Rate Codes

| | |
|---------------|-------------|
| B0 | Hang up |
| B50 | 50 baud |
| B75 | 75 baud |
| B110 | 110 baud |
| B134 | 134.5 baud |
| B150 | 150 baud |
| B200 | 200 baud |
| B300 | 300 baud |
| B600 | 600 baud |
| B1200 | 1200 baud |
| B1800 | 1800 baud |
| B2400 | 2400 baud |
| B4800 | 4800 baud |
| B9600 | 9600 baud |
| B19200 | 19,200 baud |
| B38400 | 38,400 baud |

Example

CELEBC05

```
/* CELEBC05

   This example determines the speed of stdin.

*/
#define _POSIX_SOURCE
#include <termios.h>
#include <stdio.h>

char *see_speed(speed_t speed) {
    static char  SPEED[20];
    switch (speed) {
        case B0:      strcpy(SPEED, "B0");
                       break;
        case B50:     strcpy(SPEED, "B50");
                       break;
        case B75:     strcpy(SPEED, "B75");
                       break;
        case B110:    strcpy(SPEED, "B110");
                       break;
        case B134:    strcpy(SPEED, "B134");
                       break;
        case B150:    strcpy(SPEED, "B150");
```

```

        case B200:      break;
                        strcpy(SPEED, "B200");
                        break;
        case B300:      strcpy(SPEED, "B300");
                        break;
        case B600:      strcpy(SPEED, "B600");
                        break;
        case B1200:     strcpy(SPEED, "B1200");
                        break;
        case B1800:     strcpy(SPEED, "B1800");
                        break;
        case B2400:     strcpy(SPEED, "B2400");
                        break;
        case B4800:     strcpy(SPEED, "B4800");
                        break;
        case B9600:     strcpy(SPEED, "B9600");
                        break;
        case B19200:    strcpy(SPEED, "B19200");
                        break;
        case B38400:    strcpy(SPEED, "B38400");
                        break;
        default:        sprintf(SPEED, "unknown (%d)", (int) speed);
    }
    return SPEED;
}

main() {
    struct termios term;
    speed_t speed;

    if (tcgetattr(0, &term) != 0)
        perror("tcgetattr() error");
    else {
        speed = cfgetispeed(&term);
        printf("cfgetispeed() says the speed of stdin is %s\n",
               see_speed(speed));
    }
}
```

Output

```
cfgetispeed() says the speed of stdin is B0
```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“cfgetospeed\(\) — Determine the output baud rate” on page 256](#)
- [“cfsetispeed\(\) — Set the input baud rate in the termios” on page 258](#)
- [“cfsetospeed\(\) — Set the output baud rate in the termios” on page 260](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)

cfgetospeed() — Determine the output baud rate

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

speed_t cfgetospeed(const struct termios *term_ptr);
```

General description

Extracts the output baud rate from the `termios` structure indicated by *term_ptr*. The `termios` structure contains information about a terminal. A program should first use `tcgetattr()` to get the `termios` structure, and then use `cfgetospeed()` to extract the speed from the structure. The program can then use `cfsetospeed()` to set a new baud rate in the structure and `tcsetattr()` to pass the changed value to the system.

Although in a z/OS UNIX application valid speeds can be set with `cfsetospeed()` and passed to the system with `tcsetattr()`, the speed has no effect on the operation a pseudoterminal. However, the operation will have an effect if issued for an OCS remote terminal.

Returned value

`cfgetospeed()` returns a code indicating the baud rate. The codes are defined in the `termios.h` header file and have an unsigned integer type. [Table 19 on page 255](#) shows the codes to set the baud rate.

There are no documented `errno` values.

Example

CELEBC06

```
/* CELEBC06

   This example determines the speed of stdout.

*/
#define _POSIX_SOURCE
#include <termios.h>
#include <stdio.h>

char *see_speed(speed_t speed) {
    static char SPEED[20];
    switch (speed) {
        case B0:      strcpy(SPEED, "B0");
                       break;
        case B50:     strcpy(SPEED, "B50");
                       break;
        case B75:     strcpy(SPEED, "B75");
                       break;
        case B110:    strcpy(SPEED, "B110");
                       break;
        case B134:    strcpy(SPEED, "B134");
                       break;
        case B150:    strcpy(SPEED, "B150");
                       break;
        case B200:    strcpy(SPEED, "B200");
                       break;
        case B300:    strcpy(SPEED, "B300");
                       break;
        case B600:    strcpy(SPEED, "B600");
                       break;
        case B1200:   strcpy(SPEED, "B1200");
                       break;
        case B1800:   strcpy(SPEED, "B1800");
                       break;
        case B2400:   strcpy(SPEED, "B2400");
                       break;
        case B4800:   strcpy(SPEED, "B4800");
                       break;
        case B9600:   strcpy(SPEED, "B9600");
                       break;
        case B19200:  strcpy(SPEED, "B19200");
                       break;
```

```

    case B38400:    strcpy(SPEED, "B38400");
                    break;
    default:        sprintf(SPEED, "unknown (%d)", (int) speed);
    }
    return SPEED;
}

main() {
    struct termios term;
    speed_t speed;

    if (tcgetattr(1, &term) != 0)
        perror("tcgetattr() error");
    else {
        speed = cfgetospeed(&term);
        printf("cfgetospeed() says the speed of stdout is %s\n",
               see_speed(speed));
    }
}
```

Output

```
cfgetospeed() says the speed of stdout is B0
```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“cfgetispeed\(\) — Determine the input baud rate” on page 254](#)
- [“cfsetispeed\(\) — Set the input baud rate in the termios” on page 258](#)
- [“cfsetospeed\(\) — Set the output baud rate in the termios” on page 260](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)

cfsetispeed() — Set the input baud rate in the termios

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

int cfsetispeed(struct termios *termpptr, speed_t speed);
```

General description

Specifies a new input baud rate for the `termios` control structure, `*termpptr`. `cfsetispeed()` records this new baud rate in the control structure but does not actually change the terminal device file. The program must call `tcsetattr()` to modify the terminal device file to reflect the settings in the `termios` structure.

A program should first use `tcgetattr()` to get the `termios` structure. Then it should use `cfsetispeed()` to set the speed in `termios` and `tcsetattr()` to pass the modified `termios` structure to the system.

Although in a z/OS UNIX application valid speeds can be set with `cfsetispeed()` and passed to the system with `tcsetattr()`, the speed has no effect on the operation of a pseudoterminal. However, the operation will have an effect if issued for an OCS remote terminal.

The *speed* argument indicates the new baud rate with one of the following codes, defined in the `termios.h` header file. The codes have an unsigned integer type. [Table 19 on page 255](#) shows the codes to set the baud rate.

Returned value

If successful, `cfsetispeed()` sets the baud rate in the control structure and returns 0.

If unsuccessful, `cfsetispeed()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

An unsupported value for *speed*

Example

CELEBC07

```
/* CELEBC07

   This example specifies a new input baud rate.

*/
#define _POSIX_SOURCE
#include <termios.h>
#include <stdio.h>

main() {
    struct termios term;

    if (tcgetattr(0, &term) != 0)
        perror("tcgetattr() error");
    else if (cfsetispeed(&term, B0) != 0)
        perror("cfsetispeed() error");
    else if (tcsetattr(0, TCSANOW, &term) != 0)
        perror("tcsetattr() error");
}
```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“cfgetispeed\(\) — Determine the input baud rate” on page 254](#)
- [“cfgetospeed\(\) — Determine the output baud rate” on page 256](#)
- [“cfsetospeed\(\) — Set the output baud rate in the termios” on page 260](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)

cfsetospeed() — Set the output baud rate in the termios

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

int cfsetospeed(struct termios *termpttr, speed_t speed);
```

General description

Specifies a new output baud rate for the `termios` control structure, **termpttr*. `cfsetospeed()` records this new baud rate in the control structure, but does not actually change the terminal device file. The program must call `tcsetattr()` to modify the terminal device file to reflect the settings in the `termios` structure.

A program should first use `tcgetattr()` to get the `termios` structure. It should then use `cfsetospeed()` to set the speed in `termios` and `tcsetattr()` to pass the modified `termios` structure to the system.

Although in a z/OS UNIX application valid speeds can be set with `cfsetospeed()` and passed to the system with `tcsetattr()`, the speed has no effect on the operation of a pseudoterminal. However, the operation will have an effect if issued for an OCS remote terminal.

The *speed* argument should be a code indicating the new baud rate. These codes are defined in the `termios.h` header file and have an unsigned integer type. [Table 19 on page 255](#) shows the codes to set the baud rate.

Returned value

If successful, `cfsetospeed()` sets the baud rate for the structure and returns 0.

If unsuccessful, `cfsetospeed()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value *speed* is not supported by the hardware or software.

Example

CELEBC08

```
/* CELEBC08

   This example specifies a new output baud rate.

*/
#define _POSIX_SOURCE
#include <termios.h>
#include <stdio.h>

main() {
    struct termios term;
    if (tcgetattr(1, &term) != 0)
```

```

    perror("tcgetattr() error");
    else if (cfsetospeed(&term, B38400) != 0)
        perror("cfsetospeed() error");
    else if (tcsetattr(1, TCSANOW, &term) != 0)
        perror("tcsetattr() error");
}

```

Related information

- “[termios.h — POSIX terminal I/O functions](#)” on page 74
- “[cfgetispeed\(\)](#) — Determine the input baud rate” on page 254
- “[cfgetospeed\(\)](#) — Determine the output baud rate” on page 256
- “[cfsetispeed\(\)](#) — Set the input baud rate in the termios” on page 258
- “[tcgetattr\(\)](#) — Get the attributes for a terminal” on page 1823
- “[tcsetattr\(\)](#) — Set the attributes for a terminal” on page 1835

__chattr(), __chattr64() — Change the attributes of a file or directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R2 |

Format

__chattr:

```

#define _OPEN_SYS_FILE_EXT 1
#include <sys/stat.h>

int __chattr(char* pathname, attrib_t *attributes, int attributes_len);

```

__chattr64:

```

#define _LARGE_TIME_API
#define _OPEN_SYS_FILE_EXT 1
#include <sys/stat.h>

int __chattr64(char *pathname, attrib64_t *attributes, int attributes_len);

```

Compile requirement: Use of the __chattr64 function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The __chattr() function modifies the attributes that are associated with a file. It can be used to change the mode, owner, access time, modification time, change time, reference time, audit flags, general attribute flags, file tag, and file format and size. The file to be impacted is defined by the *pathname* argument.

The *attributes* argument is the address of an `attrib_t` structure that is used to identify the attributes to be modified and the new values desired. The `attrib_t` type is an `f_attributes` structure as defined in `<sys/stat.h>` for use with the __chattr() function. For proper behavior the user should ensure that this structure has been initialized to zeros before it is populated. Available elements of the `f_attributes` structure are defined in [Table 20 on page 262](#):

Table 20. Struct *f_attributes* Element Descriptions

| Element | Data Type | General Description |
|--|-----------|-----------------------------------|
| Bit Flags Indicating Which Attributes to Change | | |
| att_modechg:1 | int | 1=Change to mode indicated |
| att_ownerchg:1 | int | 1=Change to Owner indicated |
| att_setgen:1 | int | 1=Set General Attributes |
| att_trunc:1 | int | 1=Truncate Size |
| att_atimechg:1 | int | 1=Change the Atime |
| att_atimetod:1 | int | 1=Change Atime to Cur.Time |
| att_mtimechg:1 | int | 1=Change the Mtime |
| att_mtimetod:1 | int | 1=Change Mtime to Cur.Time |
| att_maaudit:1 | int | 1=Modify auditor audit info |
| att_muaudit:1 | int | 1=Modify user audit info |
| att_ctimechg:1 | int | 1=Change the Ctime |
| att_ctimetod:1 | int | 1=Change Ctime to Cur.Time |
| att_reftimechg:1 | int | 1=Change the RefTime |
| att_reftimetod:1 | int | 1=Change RefTime to Cur.Time |
| att_filefmtchg:1 | int | 1=Change File Format |
| att_filetagchg:1 | int | 1=Change File Tag |
| att_seclabelchg:1 | int | 1=Change Seclabel |
| Modified Values for Indicated Attributes to Change | | |
| att_mode | mode_t | File Mode |
| att_uid | int | User ID of the owner of the file |
| att_gid | int | Group ID of the Group of the file |
| att_sharelibmask:1 | int | 1=Shared Library Mask |
| att_noshareasmask:1 | int | 1=No Shareas Flag Mask |
| att_apfauthmask:1 | int | 1=APF Authorized Flag Mask |
| att_progctlmask:1 | int | 1=Prog. Controlled Flag Mask |
| att_sharelib:1 | int | 1=Shared Library Flag |
| att_noshareas:1 | int | 1=No Shareas Flag |
| att_apfauth:1 | int | 1=APF Authorized Flag |
| att_progctl:1 | int | 1=Program Controlled Flag |
| att_size | off_t | File size |
| att_atime | time_t | Time of last access |
| att_mtime | time_t | Time of last data modification |
| att_auditoraudit | int | Area for auditor audit info |

Table 20. Struct *f_attributes* Element Descriptions (continued)

| Element | Data Type | General Description |
|---------------|-----------------|---------------------------------|
| att_useraudit | int | Area for user audit info |
| att_ctime | time_t | Time of last file status change |
| att_reftime | time_t | Reference Time |
| att_filefmt | char | File Format |
| att_filetag | struct file_tag | File Tag |
| att_seclabel | char | Security Label |

Note: If you set `att_nodelfilesmask`, `att_sharelibmask`, `att_nodelfiles`, `att_sharelib`, `att_noshareasmask`, `att_apfauthmask`, `att_progctlmask`, `att_noshareas`, `att_apfauth` or `att_progctl`, then `att_setgen` must also be set. The `att_setgen` flag is a required indicator when setting "general" attributes.

The `__chattr64()` function behaves exactly like `__chattr()` except `__chattr64()` uses struct `attrib64_t` instead of struct `attrib_t` to support time beyond 03:14:07 UTC on January 19, 2038.

The type of `attrib64_t` is an `f_attributes64` structure as defined in `<sys/stat.h>` for use with the `__chattr64()` function.

The use of the `f_attributes64` structure is exactly like `f_attributes` structure except that the types of `att_atime`, `att_mtime`, `att_ctime`, and `att_reftime` are `time64_t`.

Returned value

If successful, `__chattr()` returns 0.

If unsuccessful, `__chattr()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EACCES

The calling process did not have appropriate permissions. Possible reasons include:

- The calling process was attempting to set access time or modification time to current time, and the effective UID of the calling process does not match the owner of the file; the process does not have write permission for the file; or the process does not have appropriate privileges.
- The calling process was attempting to truncate the file, and it does not have write permission for the file.

ECICS

An attempt was made to change file tag attributes under non-OTE CICS and file tagging is not supported in that environment.

EFBIG

The calling process was attempting to change the size of a file, but the specified length is greater than the maximum file size limit for the process.

EINVAL

The attributes structure containing the requested changes is not valid.

ELOOP

A loop exists in symbolic links that were encountered during resolution of the *pathname* argument. This error is issued if more than 24 symbolic links are detected in the resolution of *pathname*.

ENAMETOOLONG

pathname is longer than 1023 characters, or a component of the *pathname* is longer than 255 characters. (File name truncation is not supported.)

ENOENT

No file named *pathname* was found.

ENOTDIR

Some component of *pathname* is not a directory.

EPERM

The operation is not permitted for one of the following reasons:

- The calling process was attempting to change the mode or the file format but the effective UID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.
- The calling process was attempting to change the owner but it does not have appropriate privileges.
- The calling process was attempting to change the general attribute bits but it does not have write permission for the file.
- The calling process was attempting to set a time value (not current time) but the effective UID does not match the owner of the file, and it does not have appropriate privileges.
- The calling process was attempting to set the change time or reference time to current time but it does not have write permission for the file.
- The calling process was attempting to change auditing flags but the effective UID of the calling process does not match the owner of the file and the calling process does not have appropriate privileges.
- The calling process was attempting to change the Security Auditor's auditing flags but the user does not have auditor authority.

EROFS

pathname specifies a file that is on a read-only file system.

Example

```
#define _POSIX_SOURCE 1
#define _OPEN_SYS_FILE_EXT 1
#include <stdio.h>
#include <fcntl.h>
#include <sys/stat.h>

int main(int argc, char *argv[]) {

    int fd;
    attrib_t myAtt;
    struct stat attr;
    char filename[] = "chattr.testfile";

    /* Create an empty file */
    if ( (fd = creat(filename, S_IRWXU | S_IRGRP | S_IROTH)) < 0) {
        perror("Failed to create testfile");
        exit(1);
    }
    close(fd);

    /* Clear myAtt structure */
    memset(&myAtt, 0, sizeof(myAtt));

    /* Update myAtt to request file tag change and set file tag values */
    myAtt.att_filetagchg = 1;
    myAtt.att_filetag.ft_ccsid = 12345;
    myAtt.att_filetag.ft_txtflag = 1;

    /* Change Attributes */
    if ( __chattr(filename, &myAtt, sizeof(myAtt)) != 0 ) {
        perror("Failed to change attributes for testfile");
        exit(2);
    }
}
```

```

/* Verify Change */
if ( stat(filename,&attr) !=0 ) {
    perror("Failed to acquire statistics for testfile");
    exit(3);
}

if ((attr.st_tag.ft_ccsid == 12345)
    && (attr.st_tag.ft_txtflag == 1)) {
    printf("File attributes changed successfully\n");
}
}

```

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“__fchattr\(\), __fchattr64\(\) — Change the attributes of a file or directory by file descriptor” on page 471](#)
- [“__lchattr\(\), __lchattr64\(\) — Change the attributes of a file or directory when they point to a symbolic or external link” on page 935](#)

__chattrrat(), __chattrrat64() — Change the attributes of a file or directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

__chattrrat:

```

#define _OPEN_SYS_FILE_EXT 1
#include <sys/stat.h>
#include <fcntl.h>

int __chattrrat(int dirfd, char *pathname, attrib_t *attributes, int attributes_len, int flags);

```

__chattrrat64:

```

#define _LARGE_TIME_API
#define _OPEN_SYS_FILE_EXT 1
#include <sys/stat.h>
#include <fcntl.h>

int __chattrrat64(int dirfd, char *pathname, attrib64_t *attributes, int attributes_len, int flags);

```

Compile requirement: Use of the __chattrrat64 function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

__chattrrat() modifies the attributes that are associated with a file. It can be used to change the mode, owner, access time, modification time, change time, reference time, audit flags, general attribute flags, file tag, and file format and size. The file to be impacted is defined by the *pathname* argument.

The __chattrrat() function operates in the same way as __chattr().

The __chattrrat64() function behaves exactly like __chattrrat() except that __chattrrat64() uses struct attrib64_t instead of struct attrib_t to support time beyond 03:14:07 UTC on January 19, 2038. The type of attrib64_t is an f_attributes64 structure as defined in <sys/stat.h> for use with the __chattrrat64() function.

The use of the `f_attributes64` structure is exactly like `f_attributes` structure except that the types of `att_atime`, `att_mtime`, `att_ctime`, and `att_reftime` are `time64_t`.

Parameter Description

pathname

If *pathname* is relative, then it is interpreted relative to the directory referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by `__chattr()` for a relative path name).

If *pathname* is relative and *dirfd* is the special value `AT_FDCWD`, then *pathname* is interpreted relative to the current working directory of the calling process (same as `__chattr()`).

If *pathname* is absolute, then *dirfd* is ignored.

If *pathname* is a symbolic link, operate on the link itself instead of dereferencing it. (By default, `__chattrat()` dereferences symbolic links.)

attributes

The *attributes* argument is the address of an `attrib_t` structure that is used to identify the attributes to be modified and the new values desired. The `attrib_t` type is an `f_attributes` structure as defined in `<sys/stat.h>` for use with the `__chattrat()` function. For proper behavior, you must ensure that this structure is initialized to zeros before it is populated. For available elements of the `f_attributes` structure, see [Table 20 on page 262](#).

flags

flags can either be 0 or include the following flag: `AT_SYMLINK_NOFOLLOW`.

Returned value

If successful, `__chattrat()` and `__chattrat64()` return 0.

If unsuccessful, `__chattrat()` and `__chattrat64()` return -1 and set `errno` to one of the following values:

Error Code Description

EACCES

The calling process did not have appropriate permissions. Possible reasons include:

- The calling process attempts to set access time or modification time to current time, and the effective UID of the calling process does not match the owner of the file; the process does not have write permission for the file; or the process does not have appropriate privileges.
- The calling process attempts to truncate the file, and it does not have write permission for the file.

EBADF

- *pathname* is relative but *dirfd* is `AT_FDCWD` or a valid file descriptor.
- *fd* is not a valid file descriptor.

EBUSY

The file is opened by a remote NFS client with a share reservation that conflicts with the requested operation.

EFBIG

The calling process attempts to change the size of a file, but the specified length is greater than the maximum file size limit for the process.

EINVAL

- The attributes structure containing the requested changes is not valid.
- Invalid value in *flags*.
- *pathname* is NULL, *dirfd* is not `AT_FDCWD`, and *flags* contains `AT_SYMLINK_NOFOLLOW`.

ELOOP

A loop exists in symbolic links that are encountered during resolution of the *pathname* argument.
More than 24 symbolic links are detected in the resolution of *pathname*.

EMVSERR

An MVS environmental error or internal error occurs.

ENAMETOOLONG

pathname is longer than 1023 characters, or a component of the *pathname* is longer than 255 characters. (File name truncation is not supported.)

ENOENT

No file that is named *pathname* is found.

ENOSYS

The function is not supported for the specified file.

ENOTDIR

Some component of *pathname* is not a directory.

EPERM

The operation is not permitted for one of the following reasons:

- The calling process attempts to change the mode or the file format but the effective UID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.
- The calling process attempts to change the owner but it does not have appropriate privileges.
- The calling process attempts to change the general attribute bits but it does not have write permission for the file.
- The calling process attempts to set a time value (not current time) but the effective UID does not match the owner of the file, and it does not have appropriate privileges.
- The calling process attempts to set the change time or reference time to current time but it does not have write permission for the file.
- The calling process attempts to change auditing flags but the effective UID of the calling process does not match the owner of the file and the calling process does not have appropriate privileges.
- The calling process attempts to change the Security Auditor's auditing flags but the user does not have auditor authority.

EROFS

pathname specifies a file that is on a read-only file system.

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“__chattr\(\), __chattr64\(\) — Change the attributes of a file or directory” on page 261](#)
- [“__fchattr\(\), __fchattr64\(\) — Change the attributes of a file or directory by file descriptor” on page 471](#)
- [“__lchattr\(\), __lchattr64\(\) — Change the attributes of a file or directory when they point to a symbolic or external link” on page 935](#)

chaudit() — Change audit flags for a file by path

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS 1
#include <sys/stat.h>

int chaudit(const char *pathname, unsigned int flags,
            unsigned int option);
```

General description

Changes the audit flags for a file to indicate the type of requests the security product should audit. `chaudit()` can change user audit flags or security auditor audit flags, depending on the *option* specified.

pathname is the name of the file for which the audit flags are to be changed.

flags is the setting for the audit flags:

AUDTREADFAIL

Audit the failing read requests.

AUDTREADSUCC

Audit the successful read requests.

AUDTWRITEFAIL

Audit the failing write requests.

AUDTWritesucc

Audit the successful write requests.

AUDTEXECFAIL

Audit the failing execute or search requests.

AUDTEXECsucc

Audit the successful execute or search requests. The bitwise inclusive-OR of any or all of these can be used to set more than one type of auditing.

option indicates whether the user audit flags or the security-auditor audit flags are to be changed:

AUDT_USER (0)

Change user flags. The user must be the file owner or have appropriate authority to change the user audit flags for a file.

AUDT_AUDITOR (1)

Change security auditor audit flags. The user must have security-auditor authority to modify the security auditor audit flags for a file.

Returned value

If successful, `chaudit()` returns 0.

If unsuccessful, `chaudit()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The calling process does not have permission to search some component of *pathname*.

EINVAL

option is not `AUDT_USER` or `AUDT_AUDITOR`.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of *pathname* is greater than `POSIX_SYMLINK` (a value defined in the `limits.h` header file).

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters or a component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of

the *pathname* string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values are determined using `pathconf()`.

ENOENT

There is no file named *pathname*, or *pathname* is an empty string.

ENOTDIR

A component of the path prefix is not a directory.

EPERM

The effective user ID (UID) of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.

EROFS

pathname specifies a file that is on a read-only file system.

Example

CELEBC09

```
/* CELEBC09

   This example changes the audit flags.

*/

#define _OPEN_SYS
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _OPEN_SYS
#include <stdio.h>

main() {
    int fd;
    char fn[]="chaudit.file";

    if ((fd = creat(fn, S_IRUSR|S_IWUSR)) < 0)
        perror("creat() error");
    else {
        close(fd);
        if (chaudit(fn, AUDTREADFAIL, AUDT_USER) != 0)
            perror("chaudit() error");
        unlink(fn);
    }
}
```

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“access\(\) — Determine whether a file can be accessed” on page 115](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“fchmod\(\) — Change audit flags for a file by descriptor” on page 473](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)

chdir() – Change the working directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int chdir(const char *pathname);
```

General description

Makes *pathname* your new working directory.

Returned value

If successful, chdir() changes the working directory and returns 0.
If unsuccessful, chdir() does not change the working directory, returns -1, and sets errno to one of the following values:

Error Code

Description

- EACCES**
The process does not have search permission on one of the components of *pathname*.
- ELOOP**
A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of *pathname* is greater than POSIX_SYMLLOOP (a value defined in the limits.h header file).
- ENAMETOOLONG**
pathname is longer than **PATH_MAX** characters, or some component of *pathname* is longer than **NAME_MAX** characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the *pathname* string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values are determined using pathconf().
- ENOENT**
pathname is an empty string, or the specified directory does not exist.
- ENOTDIR**
Some component of *pathname* is not a directory.

Example

CELEBC10

```
/* CELEBC10 */
#define _POSIX_SOURCE
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    if (chdir("/tmp") != 0)
        perror("chdir() to /tmp failed");
}
```



```

    if (chdir("/chdir/error") != 0)
        perror("chdir() to /chdir/error failed");
}

```

Output

```
chdir() to /chdir/error failed: No such file or directory
```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“getcwd\(\) — Get path name of the working directory” on page 697](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)

__check_resource_auth_np() — Determine access to MVS resources

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#include <unistd.h>

int __check_resource_auth_np( char *principal_uuid,
                             char *cell_uuid,
                             char *userid,
                             char *security_class,
                             char *entity_name,
                             int access_type);

```

General description

The `__check_resource_auth_np()` function is used to check the access that a user has to an MVS resource.

For authorization to use this function, the caller must have read permission to the BPX.SERVER Facility class, or if BPX.SERVER is not defined, the caller must be a superuser (UID=0).

The user identity can be specified in several forms. The identities are scanned in the following order , and the access check is made with the first identity that is found:

- `userid`
- Principal UUID and if known, a cell UUID
- Caller's thread-level (task) security context, if one exists
- Caller's process-level (address space) security context

Note:

- When no identity is specified by the caller and the caller's task has an ACEE that is created with `pthread_security_np()` for a SURROGATE (nonpassword) client, both the task and address space level ACEEs are used in determining the type of access that is permitted to a resource.
- The `__check_resource_auth_np()` function supports the general resources only. In particular, the `security_class` parameter cannot specify DATASET. For system that uses RACF, the class name that is specified must be in the RACF class descriptor table.

The parameters that are supported are:

principal_uuid

Specifies a 36-byte principal UUID. A value of NULL indicates that no principal UUID is specified.

cell_uuid

Specifies a 36-byte cell UUID. A value of NULL indicates that no cell UUID is specified.

userid

Specifies a user ID. A value of NULL indicates that no user ID is specified. The *userid* must be 1-8 characters in length.

security_class

Specifies the name of a class of resources. The access check is made on a resource in this security class. The *security_class* must be 1-8 characters in length.

entity_name

Specifies the name of a resource profile name. The access check is made on the resource that is specified by the resource profile name. The *entity_name* must be 1-246 characters in length.

access

Specifies a numeric value that identifies the type of access to check for. Possible access values are:

__READ_RESOURCE

Check if the specified user has read access to the resource.

__UPDATE_RESOURCE

Check if the specified user has update access to the resource.

__CONTROL_RESOURCE

Check if the specified user has control access to the resource.

__ALTER_RESOURCE

Check if the specified user has altered access to the resource.

Returned value

If successful, `__check_resource_auth_np()` returns 0.

If unsuccessful, `__check_resource_auth_np()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

One of the following errors is detected:

- *access_type* that is specified is undefined.
- *userid* is not 1 to 8 characters in length.
- *security_class* is not 1 to 8 characters in length.
- *entity_name* is not 1 to 246 characters in length.

EMVSERR

An MVS internal or environmental error occurred.

EMVSSAF2ERR

One of the following errors was detected:

- Received an unexpected return code for the security product.

- The security product detected an error in the input parameters.
- An internal error occurred in the security product.

ENOSYS

One of the following errors was detected:

- No security product is installed on the system.
- The security product does not have support for this function.

EPERM

One of the following errors was detected:

- The caller is not permitted to use this service.
- Do not have the *access_type* that is specified to the resource.
- Not permitted in address spaces where a load from an unauthorized library has been performed.

ESRCH

One of the following errors was detected:

- No mapping exists between a UUID and *userid*.
- The resource that is specified is not defined to the security product.
- The DCEUUIDS class is not active.
- The *userid* is not defined to the security product.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

CheckSchEnv() — Check WLM scheduling environment

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/_wlm.h>

int CheckSchEnv(const char *sched_env,
                const char *system_name);
```

General description

The CheckSchEnv() function provides the ability for an application to connect to check the WLM scheduling environment.

***sched_env**

Points to a 16 byte character string that represents the WLM scheduling environment to be queried. If the environment name is less than 16 characters, the name should be right padded with blanks.

***sys_name**

Points to a 8 bytes character string that represents the system name to be queried. If the system name is less than 8 characters, the name should be right padded with blanks.

Returned value

If successful, CheckSchEnv() returns 0.

If unsuccessful, CheckSchEnv() returns -1 and sets errno to one of the following values:

Error Code
Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM check scheduling environment failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class if it is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h – WorkLoad Manager functions” on page 73](#)
- [“ConnectServer\(\) – Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) – Connect to WLM as a work manager” on page 318](#)
- [“ContinueWorkUnit\(\) – Continue WLM work unit” on page 325](#)
- [“CreateWorkUnit\(\) – Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) – Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) – Disconnect from WLM server” on page 384](#)
- [“JoinWorkUnit\(\) – Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) – Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) – Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) – Query WLM scheduling environment” on page 1373](#)

chmod() – Change the mode of a file or directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/stat.h>

int chmod(const char *pathname, mode_t mode);
```

General description

Changes the mode of the file or directory specified in *pathname*.

The *mode* argument is created with one of the following symbols defined in the `sys/stat.h` header file.

Any mode flags that are not defined will be turned off, and the function will be allowed to proceed.

S_IRGRP

Read permission for the file's group.

S_IROTH

Read permission for users other than the file owner.

S_IRUSR

Read permission for the file owner.

S_IRWXG

Read, write, and search or execute permission for the file's group. `S_IRWXG` is the bitwise inclusive-OR of `S_IRGRP`, `S_IWGRP`, and `S_IXGRP`.

S_IRWXO

Read, write, and search or execute permission for users other than the file owner. `S_IRWXO` is the bitwise inclusive-OR of `S_IROTH`, `S_IWOTH`, and `S_IXOTH`.

S_IRWXU

Read, write, and search, or execute, for the file owner; `S_IRWXG` is the bitwise inclusive-OR of `S_IRUSR`, `S_IWUSR`, and `S_IXUSR`.

S_ISGID

Privilege to set group ID (GID) for execution. When this file is run through an `exec` function, the effective group ID of the process is set to the group ID of the file. The process then has the same authority as the file owner, rather than the authority of the actual invoker.

S_ISUID

Privilege to set the user ID (UID) for execution. When this file is run through an `exec` function, the effective user ID of the process is set to the owner of the file. The process then has the same authority as the file owner, rather than the authority of the actual invoker.

S_ISVTX

The sticky bit indicating shared text. Keep loaded as an executable file in storage.

S_IWGRP

Write permission for the file's group.

S_IWOTH

Write permission for users other than the file owner.

S_IWUSR

Write permission for the file owner.

S_IXGRP

Search permission (for a directory) or execute permission (for a file) for the file's group.

S_IXOTH

Search permission for a directory, or execute permission for a file, for users other than the file owner.

S_IXUSR

Search permission (for a directory) or execute permission (for a file) for the file owner.

Special behavior for XPG4.2: If a directory is writable and the mode bit `S_ISVTX` is set on the directory, a process may remove or rename files within that directory only if one or more of the following is true:

- The effective user ID of the process is the same as that of the owner ID of the file.
- The effective user ID of the process is the same as that of the owner ID of the directory.
- The process has appropriate privileges.

A process can set mode bits only if the effective user ID of the process is the same as the file's owner or if the process has appropriate privileges (superuser authority). `chmod()` automatically clears the `S_ISGID` bit in the file's mode bits if all these conditions are true:

- The calling process does not have appropriate privileges, that is, superuser authority (UID=0).
- The group ID of the file does not match the group ID or supplementary group IDs of the calling process.
- One or more of the S_IXUSR, S_IXGRP, or S_IXOTH bits of the file mode are set to 1.

Returned value

If successful, chmod() marks for update the st_ctime field of the file and returns 0.

If unsuccessful, chmod() returns -1 and sets errno to one of the following values:

Error Code

Description

EACCES

The process does not have search permission on some component of the *pathname* prefix.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of *pathname* is greater than POSIX_SYMLINK_MAX (a value defined in the limits.h header file).

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters, or some component of *pathname* is longer than **NAME_MAX** characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the *pathname* string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values are determined using pathconf().

ENOENT

There is no file named *pathname*, or the *pathname* argument is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EPERM

The effective user ID (UID) of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges (superuser authority).

EROFS

pathname is on a read-only file system.

Example

CELEBC11

```
/* CELEBC11

   This example changes the permission from the file owner to the file's
   group.

*/
#define _POSIX_SOURCE
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    char fn[] = "./temp.file";
    FILE *stream;
    struct stat info;

    if ((stream = fopen(fn, "w")) == NULL)
        perror("fopen() error");
    else {
        fclose(stream);
        stat(fn, &info);
        printf("original permissions were: %08x\n", info.st_mode);
        if (chmod(fn, S_IRWXU|S_IRWXG) != 0)
            perror("chmod() error");
        else {
            stat(fn, &info);
```

```

        printf("after chmod(), permissions are: %08x\n", info.st_mode);
    }
    unlink(fn);
}
}

```

Output

```

original permissions were: 030001b6
after chmod(), permissions are: 030001f8

```

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“fchmod\(\) — Change the mode of a file or directory by descriptor” on page 476](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“mkfifo\(\) — Make a FIFO special file” on page 1075](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)

chown() — Change the owner or group of a file or directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _POSIX_SOURCE
#include <unistd.h>

int chown(const char *pathname, uid_t owner, gid_t group);

```

General description

Changes the owner or group (or both) of a file. *pathname* is the name of the file whose owner or group you want to change. *owner* is the user ID (UID) of the new owner of the file. *group* is the group ID (GID) of the new group for the file.

If `_POSIX_CHOWN_RESTRICTED` is defined in the `unistd.h` header file, a process can change the group of a file only if one of these is true:

1. The process has appropriate privileges.
2. Or all of the following are true:
 - a. The effective user ID of the process is equal to the user ID of the file owner.
 - b. The *owner* argument is equal to the user ID of the file owner or `(uid_t) -1`,
 - c. The *group* argument is either the effective group ID or a supplementary group ID of the calling process.

If *pathname* is a regular file and one or more of the S_IXUSR, S_IXGRP, or S_IXOTH bits of the file mode are set, chown() clears the set-user-ID (S_ISUID) and set-group-ID (S_ISGID) bits of the file mode and returns successfully.

If *pathname* is not a regular file and one or more of the S_IXUSR, S_IXGRP, or S_IXOTH bits of the file mode are set, chown() clears the set-user-ID (S_ISUID) and set-group-ID (S_ISGID) bits of the file.

When chown() completes successfully, it marks the st_ctime field of the file to be updated.

Special behavior for XPG4.2: If *owner* or *group* is specified as (uid_t) -1 or (gid_t) -1 respectively, the corresponding ID of the file is unchanged.

Returned value

If successful, chown() updates the owner, group, and change time for the file and returns 0.

If unsuccessful, chown() returns -1 and sets errno to one of the following values:

Error Code Description

EACCES

The process does not have search permission on some component of the *pathname* prefix.

EINTR

Added for XPG4.2: The chown() function was interrupted by a signal which was caught.

EINVAL

owner or *group* is not a valid user ID (UID) or group ID (GID).

EIO

Added for XPG4.2: An I/O error occurred while reading or writing to the file system.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of *pathname* is greater than POSIX_SYMLINK_MAX (a value defined in the limits.h header file).

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters, or some component of *pathname* is longer than **NAME_MAX** characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the *pathname* string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using pathconf().

ENOENT

There is no file named *pathname*, or the *pathname* argument is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EPERM

The effective user ID of the calling process does not match the owner of the file, or the calling process does not have appropriate privileges, that is, superuser authority (UID=0).

EROFS

pathname is on a read-only file system.

Example

CELEBC12

```
/* CELEBC12
   This example changes the owner and group of a file.
*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <sys/stat.h>
#include <sys/types.h>
#undef _POSIX_SOURCE
```



```
#include <stdio.h>

main() {
    char fn[] = "./temp.file";
    FILE *stream;
    struct stat info;

    if ((stream = fopen(fn, "w")) == NULL)
        perror("fopen() error");
    else {
        fclose(stream);
        stat(fn, &info);
        printf("original owner was %d and group was %d\n", info.st_uid,
              info.st_gid);
        if (chown(fn, 25, 0) != 0)
            perror("chown() error");
        else {
            stat(fn, &info);
            printf("after chown(), owner is %d and group is %d\n",
                  info.st_uid, info.st_gid);
        }
        unlink(fn);
    }
}
```

Output

```
original owner was 0 and group was 0
after chown(), owner is 25 and group is 0
```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“fchown\(\) — Change the owner or group by file descriptor” on page 479](#)
- [“fstat\(\), fstat64\(\) — Get status information about a file” on page 649](#)
- [“lstat\(\), lstat64\(\) — Get status of file or symbolic link” on page 1025](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)

chpriority() — Change the scheduling priority of a process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SOURCE 2
#include <sys/resource.h>

int chpriority(int which, id_t who, int prioritytype, int priority);
```

General description

The `chpriority()` function changes the scheduling priority of a process, process group or user.

Processes are specified by the values of the *which* and *who* arguments. The *which* argument may be one of the following values: `PRIO_PROCESS`, `PRIO_PGRP`, or `PRIO_USER`, indicating that the *who* argument is to be interpreted as a process ID, a process group ID, or a user ID, respectively. A 0 (zero) value for the *who* argument specifies the current process, process group or user ID.

If more than one process is specified, the `chpriority()` function changes the priorities of all of the specified processes.

The default priority is 0; negative priorities cause more favorable scheduling. The range of legal priority values is -20 to 19. If the `CPRIO_ABSOLUTE` value is specified for the *prioritytype* argument and the priority value specified to `chpriority()` is less than the system's lowest supported priority value, the system's lowest supported value is used; if it is greater than the system's highest supported value, the system's highest supported value is used. If the `CPRIO_RELATIVE` value is specified on the *prioritytype* argument, request for values above or below the legal limits result in the priority value being set to the corresponding limit.

The changing of a process's scheduling priority value has the equivalent effect of a process's nice value, since they both represent the process's relative CPU priority. For example, changing one's scheduling priority value using the `chpriority()` function to its maximum value (19) has the equivalent effect of increasing one's nice value to its maximum value $2^{\{NZERO\}-1}$, and will be reflected on the `nice()`, `getpriority()`, `chpriority()`, and `setpriority()` functions.

Only a process with appropriate privilege can lower its priority. In addition to lowering the priority value, a process with appropriate privilege has the ability to change the priority of any process regardless of the process's saved set-user-ID value.

Returned value

If successful, `chpriority()` returns 0.

If unsuccessful, `chpriority()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCESS

The priority is being changed to a lower value and the current process does not have the appropriate privilege.

EINVAL

The value of the *which* argument was not recognized, or the value of the *who* argument is not a valid process ID, process group ID or user ID, or the value of the *prioritytype* argument was not recognized.

ENOSYS

The system does not support this function.

EPERM

A process was located, but the save set-user-ID of the executing process does not match the saved set-user-ID of the process whose priority is to be changed.

ESRCH

No process could be located using the *which* and *who* argument values specified.

Related information

- [“sys/resource.h — XSI resource operations” on page 70](#)
- [“getpriority\(\) — Get process scheduling priority” on page 756](#)
- [“nice\(\) — Change priority of a process” on page 1150](#)
- [“setpriority\(\) — Set process scheduling priority” on page 1563](#)

chroot() — Change root directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE
#include <unistd.h>

int chroot(const char *path);
```

General description

The *path* argument points to a path name naming a directory. The `chroot()` function causes the named directory to become the root directory, that is the starting point for path searches for path names beginning with `/`. The process's working directory is unaffected by `chroot()`. Only a superuser can request `chroot()`.

The dot-dot entry in the root directory is interpreted to mean the root directory. Thus, dot-dot cannot be used to access files outside the subtree rooted at the root directory.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `chroot()` changes the root directory, and returns 0.

If unsuccessful, `chroot()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Search permission is denied for a component of *path*

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of path name is greater than `POSIX_SYMLLOOP` (a value defined in the `limits.h` header file).

ENAMETOOLONG

Path name is longer than **PATH_MAX** characters, or some component of path name is longer than **NAME_MAX** characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the path name string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values are determined using `pathconf()`.

ENOENT

A component of *path* does not name an existing directory or *path* is an empty string.

ENOTDIR

A component of the *path* name is not a directory.

EPERM

The effective user ID does not have appropriate privileges.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chdir\(\) — Change the working directory” on page 270](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“opendir\(\) — Open a directory” on page 1168](#)

cimag(), cimagf(), cimagl() — Calculate the complex imaginary part

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double cimag(double complex z);
float cimagf(float complex z);
long double cimagl(long double complex z);
```

General description

The cimag() family of functions compute the imaginary part of z.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| cimag | X | X |
| cimagf | X | X |
| cimagl | X | X |

Returned value

The cimag() family of functions return the imaginary part value (as a real).

Example

For an example of a similar function see cacos(), cexp() or cpow().

Related information

- [“complex.h — Complex math functions” on page 85](#)
- [“carg\(\), cargf\(\), cargl\(\) — Calculate the argument” on page 234](#)
- [“conj\(\), conjf\(\), conjl\(\) — Calculate the complex conjugate” on page 311](#)

- “[cproj\(\), cprojf\(\), cprojl\(\)](#) — Calculate the projection” on page 340
- “[creal\(\), crealf\(\), creall\(\)](#) — Calculate the complex real part” on page 341

clearenv() — Clear environment variables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------------------|----------|--------------|
| POSIX.1a Language Environment | both | |

Format

POSIX - C only:

```
#define _POSIX1_SOURCE 2
#include <env.h>

int clearenv(void);
```

Non-POSIX:

```
#include <stdlib.h>

int clearenv(void);
```

General description

Clears all environment variables from the environment table and frees the associated storage.

`clearenv()` also resets all behavior modified by IBM z/OS C/C++ specific environment variables back to their defaults. For example, if a binary file was opened, then it would support seeking by byte offsets, regardless of record format. If the file is a Variable Record format MVS DASD file, then clearing the environment variable causes seeking by encoded values the next time it is opened.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

For details about environment variables, see “Using Environment Variables” in [z/OS XL C/C++ Programming Guide](#).

Special behavior for POSIX C: `clearenv()` can change the value of the pointer `environ`. Therefore, a copy of that pointer made before a call to `clearenv()` may no longer be valid after the call to `clearenv()`.

Returned value

If successful, `clearenv()` returns 0.

If unsuccessful, `clearenv()` returns nonzero and sets `errno` to one of the following values:

Error Code

Description

ENOMEM

The process requires more space than is available.

Example

CELEBC13

```

/* CELEBC13

   This C/MVS example needs to be run with POSIX(ON).
   It clears the process environment variable list.

*/
#define _POSIX_SOURCE 1
#include <env.h>
#include <stdio.h>

extern char **environ;

int count_env() {
    int num;

    for (num=0; environ[num] != NULL; num++);
    return num;
}

main() {
    printf("before clearenv(), there are %d environment variables\n",
        count_env());
    if (clearenv() != 0)
        perror("clearenv() error");
    else {
        printf("after clearenv(), there are %d environment variables\n",
            count_env());
        setenv("var1", "value1", 1);
        setenv("var-two", "Value Two", 1);
        printf("after setenv()'s, there are %d environment variables\n",
            count_env());
        if (clearenv() != 0)
            perror("clearenv() error");
        else
            printf("after clearenv(), there are %d environment variables\n",
                count_env());
    }
}

```

Output

```

before clearenv(), there are 9 environment variables
after clearenv(), there are 0 environment variables
after setenv()'s, there are 2 environment variables
after clearenv(), there are 0 environment variables

```

CELEBC14

```

/* CELEBC14

   This example is for a non-POSIX environment, and thus will work under
   C++/MVS.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    char *x;

    /* set 3 environment variables to "Y" */
    setenv("_EDC_ANSI_OPEN_DEFAULT", "Y", 1);
    setenv("_EDC_BYTE_SEEK", "Y", 1);
    setenv("_EDC_COMPAT", "3", 1);

    /* query the setting of _EDC_BYTE_SEEK */
    x = getenv("_EDC_BYTE_SEEK");

    if (x != NULL)
        printf("_EDC_BYTE_SEEK = %s\n", x);
    else
        printf("_EDC_BYTE_SEEK is undefined\n");
}

```

```
/* clear the environment variable table */
clearenv();

/* query the setting of _EDC_BYTE_SEEK */
x = getenv("_EDC_BYTE_SEEK");

if (x != NULL)
    printf("_EDC_BYTE_SEEK = %s\n",x);
else
    printf("_EDC_BYTE_SEEK is undefined\n");
}
```

Output

```
_EDC_BYTE_SEEK = Y
_EDC_BYTE_SEEK is undefined
```

Related information

- “Using Environmental Variables” in *z/OS XL C/C++ Programming Guide*
- “env.h – Set and clear environment variables” on page 19
- “stdlib.h – Standard library functions” on page 65
- “getenv() – Get value of environment variables” on page 705
- “__getenv() – Get an environment variable” on page 706
- “putenv() – Change or add an environment variable” on page 1354
- “setenv() – Add, delete, and change environment variables” on page 1523

clearerr() – Reset error and end of file (EOF)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

void clearerr(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

void clearerr_unlocked (FILE *stream);
```

General description

Resets the error indicator and EOF indicator for the stream that `stream` points to. Generally, the indicators for a stream remain set until your program calls `clearerr()` or `rewind()`.

`clearerr_unlocked()` is functionally equivalent to `clearerr()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking

thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

Returned value

clearerr() returns no values.

Example

CELEBC15

```
/* CELEBC15

This example reads a data stream and then checks that a read
error has not occurred.

*/
#include <stdio.h>

int main(void)
{
    char string[100];
    FILE *stream;
    int eofvalue;

    stream = fopen("myfile.dat", "r");

    /* scan an input stream until an end-of-file character is read */
    while (!feof(stream))
        fscanf(stream,"%s",&string[0]);

    /* print EOF value: will be nonzero */
    eofvalue=feof(stream);
    printf("feof value=%i\n",eofvalue);

    /* print EOF value-after clearerr, will be equal to zero */
    clearerr(stream);
    eofvalue=feof(stream);
    printf("feof value=%i\n",eofvalue);
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“feof\(\) — Test end of file \(EOF\) indicator” on page 510](#)
- [“ferror\(\) — Test for read and write errors” on page 512](#)
- [“fseek\(\) — Change file position” on page 638](#)
- [“rewind\(\) — Set file position to beginning of file” on page 1449](#)

clock() — Determine processor time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <time.h>

clock_t clock(void);
```

General description

Approximates the processor time used by the program, since the beginning of an implementation-defined time period that is related to the program invocation. To measure the time spent in a program, call the `clock()` function at the start of the program, and subtract its returned value from the value returned by subsequent calls to `clock()`. Then, to obtain the time in seconds, divide the value returned by `clock()` by `CLOCKS_PER_SEC`.

If you use the `system()` function in your program, do not rely on `clock()` for program timing, because calls to `system()` may reset the clock.

In a multithread POSIX C application, if you are creating threads with a function that is based on a POSIX.4a draft standard, the `clock()` function is thread-scoped.

Returned value

If the time is available and can be represented, `clock()` returns the calculated time.

If unsuccessful, `clock()` returns `(clock_t)-1`. `clock()` may return -1 when running with STIMER REAL TQE present on MVS/ESA Version 3 Release 1 Modification 2 (or earlier) system.

Special behavior for XPG4: If `_XOPEN_SOURCE` or `_XOPEN_SOURCE_EXTENDED` are defined when your application is compiled, `CLOCKS_PER_SEC` is defined as 1000000. Also, in this case, the following C/370 pragma in the `<time.h>` header is used to compile your application:

```
#pragma map ( clock(), "@@OCLCK")
```

Because of this pragma, when your application executes, it will attempt to access an XPG4 version of `clock()` which returns a `clock_t` value in units of 1000000 `CLOCKS_PER_SEC`. The XPG4 version of `clock()` is only available if `POSIX(ON)` is specified for execution of your application.

If `_XOPEN_SOURCE` or `_XOPEN_SOURCE_EXTENDED` are defined when you compile your program AND your application is run with `POSIX(OFF)`, `clock()` will return `(clock_t) -1`.

If neither `_XOPEN_SOURCE` or `_XOPEN_SOURCE_EXTENDED` are defined when you compile your application, the historical C/370 value of `CLOCKS_PER_SEC` will be used and `clock()` calls in your application will be mapped to the historical C/370 version of `clock()` which returns a `clock_t` value in historical C/370 `CLOCKS_PER_SEC` units whether your application executes with `POSIX(ON)` or `POSIX(OFF)`.

Example

```
/* This example prints the time elapsed since the program was invoked. */
#include <time.h>
#include <stdio.h>

double time1, timedif; /* use doubles to show small values */

int main(void)
{
    time1 = (double) clock(); /* get initial time */
    time1 = time1 / CLOCKS_PER_SEC; /* in seconds */
    :
    /* call clock a second time */
    timedif = ( ((double) clock()) / CLOCKS_PER_SEC) - time1;
    printf("The elapsed time is %f seconds\n", timedif);
}
```

Related information

- [“time.h — Time and date” on page 75](#)
- [“time\(\),time64\(\) — Determine current UTC time” on page 1865](#)

clock_gettime() — Retrieve the time of the specified clock

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2001 POSIX.1-2008 Single UNIX Specification, Version 2 | both | |

Format

```
#define _XOPEN_SOURCE 500
#include <time.h>
int clock_gettime(clockid_t clockid, struct timespec *tp);
```

General description

The clock_gettime() function retrieves the time of the specified clock identifier. The clockid argument specifies the clock identifier, which can be one of the following values:

CLOCK_MONOTONIC

Clock that represents monotonic time since some unspecified starting point.

CLOCK_REALTIME

System-wide real-time clock.

The tp argument is a timespec structure that is defined in <time.h>:

```
struct timespec {
    time_t    tv_sec;        /* seconds */
    long      tv_nsec;       /* nanoseconds */
};
```

Returned value

If successful, clock_gettime() returns 0.

If unsuccessful, clock_gettime() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

tp points outside the accessible address space.

EINVAL

clockid does not refer to a valid instance of a clock object or is not supported.

EMVSTODNOTSET

System TOD clock is not set.

Related information

- [“time.h — Time and date” on page 75](#)

clog(), clogf(), clogl() – Calculate the complex natural logarithm

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex clog(double complex z);
float complex clogf(float complex z);
long double complex clogl(long double complex z);
```

General description

The `clog()` family of functions compute the complex natural (base-e) logarithm of `z`, with a branch cut along the negative real axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|--------------------|-----|------|
| <code>clog</code> | X | X |
| <code>clogf</code> | X | X |
| <code>clogl</code> | X | X |

Returned value

The `clog()` family of functions return the complex natural logarithm value, in the range of a strip, mathematically unbounded along the real axis and in the interval $[-i\pi, +i\pi]$ along the imaginary axis.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h – Complex math functions” on page 85](#)
- [“cexp\(\), cexpf\(\), cexpl\(\) – Calculate the complex exponential” on page 253](#)

clone() – Create a child process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | AMODE 64 |

Format

```
#define _XPLATFORM_SOURCE
#include <sched.h>

int clone(int (*fn)(void *), void *stack, int flags, void *arg, ...);
```

General description

`clone()` create a new ("child") process, in a manner similar to `fork()`.

Comparing to `fork()`, `clone()` provides more precise control over what pieces of execution context are shared between the calling process and the child process. For example, by using `clone()`, the caller can control whether the two processes share the same namespace and the same parent process ID.

When the child process is created with `clone()`, it commences execution by calling the function that is pointed to by the argument `fn`. (This differs from `fork()`, where execution continues in the child from the point of the `fork()` call.) The `arg` argument is passed as the argument of the function `fn`. The stack argument is ignored.

When the `fn(arg)` function returns, the child process terminates. The integer that is returned by `fn` is the exit status for the child process. The child process might also terminate explicitly by calling `exit()` or after receiving a fatal signal.

`clone()` allow a flags bit mask that modifies its behavior and allows the caller to specify what is shared between the calling process and the child process. The `flags` mask is specified as a bitwise-OR of zero or more of the following constants:

CLONE_NEWIPC

- If `CLONE_NEWIPC` is set, then create the process in a new IPC namespace.
- If `CLONE_NEWIPC` is not set, (as with `fork()`), the process is created in the same IPC namespace as the calling process.

CLONE_NEWNS

- If `CLONE_NEWNS` is set, the cloned child is started in a new mount namespace, initialized with a copy of the namespace of the parent.
- If `CLONE_NEWNS` is not set, the child lives in the same mount namespace as the parent.

CLONE_PARENT

- If `CLONE_PARENT` is set, the parent of the new child (as returned by `getppid()`) is the same as that of the calling process.
- If `CLONE_PARENT` is not set, (as with `fork()`), the child's parent is the calling process.

The parent process that is returned by `getppid()` is signaled when the child terminates, so if `CLONE_PARENT` is set, the parent of the calling process, rather than the calling process itself, is signaled.

The `CLONE_PARENT` flag cannot be used in clone calls by the global `init` process (PID 1 in the initial PID namespace) and `init` processes in other PID namespaces.

CLONE_NEWPID

- If `CLONE_NEWPID` is set, create the process in a new PID namespace.
- If `CLONE_NEWPID` is not set, (as with `fork()`), the process is created in the same PID namespace as the calling process. This flag cannot be specified in `CLONE_PARENT`.

CLONE_NEWUTS

- If `CLONE_NEWUTS` is set, create the process along with a new UTS namespace, whose identifiers are initialized by duplicating the identifiers from the UTS namespace of the calling process.
- If `CLONE_NEWUTS` is not set, (as with `fork()`), the process is created in the same UTS namespace as the calling process.

Usage note

A child termination signal can be specified in the *flag* parameter. SIGCHLD is the only supported signal and it must be specified.

If a UNIX set-user-ID or set-group-ID privileged program that switched the caller's effective UID or GID invokes the clone service, the child process that is created inherits the privilege of the set-user-ID or setgroup-ID program.

The child process is a duplicate of the process that calls the clone service (called the calling process), except for the following:

- The child process has a unique process ID (PID) in its namespace and each of any ancestor namespaces, that does not match any active process group ID.
- The child has a different parent process ID (the process ID of the process that calls `clone()`) unless `CLONE_PARENT` is specified. If the new process is created in a PID namespace other than the PID namespace of the caller, the child appears to have no parent process (PPID=0) from its view within the namespace.
- The child is created in the same namespaces as the calling process, unless one or more of the `CLONE_NEWxxx` flags are set or a prior call to `unshare()` or `setns()` with flag `CLONE_NEWPID` was issued by the calling process.
- The child has its own copy of the parent's file descriptors. Each file descriptor in the child refers to the same open file description as the corresponding file descriptor in the parent.
- The child has its own copy of the parent's open directory streams. Each child's open directory stream can share directory stream positioning with the corresponding parent's directory stream.
- If the file has its `FD_CLOFORK` flag set on, it is not inherited by the child process. This flag is set with a call to `fcntl()`.
- The process and system utilization times for the child are set to zero.
- The following elements in the `tms` structure are set to 0 in the child:
 - `tms_utime`
 - `tms_stime`
 - `tms_cutime`
 - `tms_cstime`

For more information about these elements, see [“times\(\) — Get process and child process times” on page 1867](#).

- The child does not inherit any file locks previously set by the parent.
- The child process has no alarms set (similar to the results of a call to `alarm()` with an argument value of `Wait_time` specified as 0).
- The child has no pending signals.
- The child process has only a single thread. That thread is a copy of the thread in the parent that called `clone()`. The child process has a different thread ID. If the parent process was multithreaded (invoked `pthread_create()` at least once), the child process can only safely invoke `async-signal-safe` functions before it invokes an `exec()` family function. (This restriction also applies to any process created as the result of the child invoking `clone()` before it invokes an `exec()` family function because the child process is considered multithreaded.) The child process does not inherit `pthread` attributes or `pthread` security environment. See [Table 28 on page 578](#) for a list of `async-signal-safe` functions.

When the clone requests the process to be added in one or more new namespaces (one of the `CLONE_NEWxxx` flags was specified) the caller must be authorized by being a superuser or having, at least, `READ` access to the `CONTAINERS` resource in the `UNIXPRIV` class.

The child process inherits all key 8 shared memory segments that are attached to the calling process. The internal values of the number of processes that are attached to each shared memory segment (`shm_nattch`) are incremented. The function `clone()` only supports the propagation of key 8 storage;

therefore, `clone()` does not propagate to the child any shared memory segments that reside in a storage key other than key 8.

The child address space inherits the following address space attributes of the parent address space:

- Region size
- Time limit

The child process inherits the `MEMLIMIT` of the calling process.

If the parent process is multithreaded, it is the responsibility of the application to ensure that the application data is in a consistent state when the `clone()` occurs. For example, mutexes that are used to serialize updates to application data may need to be locked before the `clone()` and unlocked afterward.

For more information on `clone()`, see [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

You can use MVS memory files from a z/OS UNIX program. However, use of the `clone()` function from the program removes access from a hiperspace memory file for the child process. Use of an `exec` function from the program clears a memory file when the process address space is cleared.

The child process that results from a `clone()` in a multithreaded environment can only invoke `async-signal-safe` functions.

An `async-signal-safe` function is defined as a function that might be invoked, without restriction, from signal-catching functions.

Interoperability restriction: For POSIX resources, `clone()` behaves as described. But in general, MVS resources that exist in the parent do not exist in the child. This is true for open streams in MVS data sets and assembler-accessed MVS facilities, such as `STIMERS`. In addition, MVS allocations (through `JCL`, `SVC99`, or `ALLOCATE`) are not passed to the child process.

Special behavior for z/OS UNIX System Services:

1. A prior loaded copy of an HFS program in the same address space is reused under the same circumstances that apply to the reuse of a prior loaded MVS unauthorized program from an unauthorized library by the MVS XCTL service with the following exceptions:
 - If the calling process is in `Ptrace` debug mode, a prior loaded copy is not reused.
 - If the calling process is not in `Ptrace` debug mode, but the only prior loaded usable copy that is found of the HFS program is in storage modifiable by the caller, the prior copy is not reused.
2. If the specified file name represents an external link or a sticky bit file, the program is loaded from the caller's MVS load library search order. For an external link, the external name is only used if the name is eight characters or less, otherwise the caller receives an error from the `loadhfs` service. For a sticky bit program, the file name is used if it is eight characters or less. Otherwise, the program is loaded from the HFS.
3. If the calling task is in a WLM enclave, the resulting task in the new process image is joined to the same WLM enclave. This allows WLM to manage the old and new process images as one 'business unit of work' entity for system accounting and management purposes.

Returned value

If successful, the process ID of the child process is returned to the calling (parent) process.

If unsuccessful, -1 is returned and no child process is created, `errno` is set to indicate the error.

Error Code

Description

EAGAIN

The required resources to create another process are not available, or the maximum number of processes that are allowed to run is reached.

EINVAL

The argument *flags* is not valid (A bit other than the supported flags is on, or the child termination signal is not SIGCHLD, or both CLONE_NEWPID and CLONE_PARENT are specified), or CLONE_PARENT is specified from an INIT process, or CLONE_NEWPID specified, however a setns CLONE_NEWPID is done for the current process.

ENOMEM

The process requires more space than is available.

ENOSPC

A system limit is reached.

EPERM

The calling process does not have appropriate privileges.

Related information

- [“sched.h — Manipulate and examine process execution scheduling” on page 57](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“setns\(\) — Allow for a thread to join a descendant namespace” on page 1558](#)
- [“unshare\(\) — Isolate a process from one or more of its namespaces” on page 1949](#)

close() — Close a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int close(int filde);
```

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int close(int socket);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <unistd.h>

int close(int socket);
```

General description

Closes a file descriptor, *filde*. This frees the file descriptor to be returned by future open() calls and other calls that create file descriptors. The *filde* argument must represent a z/OS UNIX file.

close

When the last open file descriptor for a file is closed, the file itself is closed. If the file's link count is 0 at that time, its space is freed and the file becomes inaccessible.

When the last open file descriptor for a pipe or FIFO file is closed, any data remaining in the pipe or FIFO file is discarded.

close() unlocks (removes) all outstanding record locks that a process has on the associated file.

Behavior for sockets: close() call shuts down the socket associated with the socket descriptor *socket*, and frees resources allocated to the socket. If *socket* refers to an open TCP connection, the connection is closed. If a stream socket is closed when there is input data queued, the TCP connection is reset rather than being cleanly closed.

Parameter Description

socket

The descriptor of the socket to be closed.

Note: All sockets should be closed before the end of your process. You should issue a shutdown() call before you issue a close() call for a socket.

For AF_INET and AF_INET6 stream sockets (SOCK_STREAM) using SO_LINGER socket option, the socket does not immediately end if data is still present when a close is issued. The following structure is used to set or unset this option, and it can be found in **sys/socket.h**.

```
struct linger {
    int l_onoff;      /* zero=off, nonzero=on */
    int l_linger;     /* time is seconds to linger */
};
```

If the l_onoff switch is nonzero, the system attempts to deliver any unsent messages. If a linger time is specified, the system waits for *n* seconds before flushing the data and terminating the socket.

For AF_UNIX, when closing sockets that were bound, you should also use unlink() to delete the file created at bind() time.

Special behavior for XPG4.2: If a STREAMS-based *fildes* is closed and the calling process was previously registered to receive a SIGPOLL signal for events associated with that STREAM, the calling process will be unregistered for events associated with the STREAM. The last close() for a STREAM causes the STREAM associated with *fildes* to be dismantled. If O_NONBLOCK is not set and there have been no signals posted for the STREAM, and if there is data on the module's write queue, close() waits for an unspecified time (for each module and driver) for any output to drain before dismantling the STREAM. The time delay can be changed using an I_SETCLTIME ioctl() request. If the O_NONBLOCK flag is set, or if there are any pending signals, close() does not wait for output to drain, and dismantles the STREAM immediately.

Note: z/OS UNIX services do not supply any STREAMS devices or pseudodevices. See [“open\(\) — Open a file” on page 1157](#) for more information.

If *fildes* refers to the manager side of a pseudoterminal, a SIGHUP signal is sent to the process group, if any, for which the subsidiary side of the pseudoterminal is the controlling terminal.

If *fildes* refers to the subsidiary side of a pseudoterminal, a zero-length message will be sent to the manager.

If *fildes* refers to a socket, close() causes the socket to be destroyed. If the socket is connection-oriented and the SO_LINGER option is set for the socket and the socket has untransmitted data, then close() will block for up to the current linger interval until all data is transmitted.

Returned value

If successful, close() returns 0.

If unsuccessful, close() returns -1 and sets errno to one of the following values:

Error Code Description

EAGAIN

The call did not complete because the specified socket descriptor is currently being used by another thread in the same process.

For example, in a multithreaded environment, `close()` fails and returns `EAGAIN` when the following sequence of events occurs (1) thread is blocked in a `read()` or `select()` call on a given file or socket descriptor and (2) another thread issues a simultaneous `close()` call for the same descriptor.

EBADF

fildev is not a valid open file descriptor, or the *socket* parameter is not a valid socket descriptor.

EBUSY

The file cannot be closed because it is blocked.

EINTR

`close()` was interrupted by a signal. The file may or may not be closed.

EIO

Added for XPG4.2: An I/O error occurred while reading from or writing to the file system.

ENXIO

fildev does not exist. The minor number for the file is incorrect.

Example

```
#define _POSIX_SOURCE
#include <fcntl.h>
#include <unistd.h>
#include <stdio.h>
#include <string.h>

main() {
    int fd;
    char out[20]="Test string";
    if ((fd = creat("./myfile", S_IRUSR | S_IWUSR)) < 0)
        perror("creat error");
    else {
        if (write(fd, out, strlen(out)+1) == -1)
            perror("write() error");

        if (fd = 0) perror("write() error");
        close(fd);
    }
}
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“exec functions” on page 442](#)
- [“fclose\(\) — Close file” on page 482](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“shutdown\(\) — Shut down all or part of a duplex connection” on page 1600](#)

- [“unlink\(\) — Remove a directory entry” on page 1945](#)

closedir() — Close a directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <dirent.h>

int closedir(DIR *dir);
```

General description

Closes the directory indicated by *dir*. It frees the buffer that `readdir()` uses when reading the directory stream.

Returned value

If successful, `closedir()` returns 0.
If unsuccessful, `closedir()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EBADF
dir does not refer to an open directory stream.

EINTR
`closedir()` was interrupted by a signal. The directory may or may not be closed.

Example

CELEBC18

```
/* CELEBC18

   This example closes a directory.

*/
#define _POSIX_SOURCE
#include <dirent.h>
#include <sys/types.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    DIR *dir;
    struct dirent *entry;
    int count;

    if ((dir = opendir("/")) == NULL)
        perror("opendir() error");
    else {
        count = 0;
        while ((entry = readdir(dir)) != NULL) {
```

```

        printf("directory entry %03d: %s\n", ++count, entry->d_name);
    }
    closedir(dir);
}
}

```

Output

```

directory entry 001: .
directory entry 002: ..
directory entry 003: bin
directory entry 004: dev
directory entry 005: etc
directory entry 006: lib
directory entry 007: tmp
directory entry 008: u
directory entry 009: usr

```

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)
- [“fdopendir\(\) — Opens directory associated with file descriptor” on page 502](#)
- [“fdclosedir\(\) — Closes directory associated with file descriptor” on page 494](#)

closelog() — Close the control log

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _XOPEN_SOURCE_EXTENDED 1
#include <syslog.h>

void closelog(void);

```

General description

The `closelog()` function closes the log file.

Returned value

`closelog()` neither accepts an input nor returns a result. The system control log is closed for this process.

No errors are defined.

Related information

- [“syslog.h — System error logging” on page 67](#)
- [“openlog\(\) — Open the system control log” on page 1172](#)
- [“setlogmask\(\) — Set the mask for the control log” on page 1555](#)
- [“syslog\(\) — Send a message to the control log” on page 1798](#)

clrmemf() — Clear memory files

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>

int clrmemf(int level);
```

General description

Removes memory files created by the current program and any program that was called using a non-POSIX system() call. clrmemf() can remove memory files regardless of whether they are open or not.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The argument *level* indicates which memory files are to be removed. The level can be one of the following:

- __LOWER**
Removes memory files that were created in other programs and called from this program using system().
- __CURRENT**
Removes only the memory files created at the current level.
- __CURRENT_LOWER**
Removes all the memory files created by the current program and by all the programs called at the current level.

Special behavior for multiple shared PIC1 C environments: Only files created by the C environment from which the clrmemf() function is called will be cleared.

Returned value

If successful, clrmemf() returns 0.
If unsuccessful, clrmemf() returns nonzero.

Example

```
/*
   In this example, when Program2 calls clrmemf(__CURRENT) only
   A3.FILE and A4.FILE will be removed.
*/
```

```

/***** Program1 *****/
:
:   fp1 = fopen ("A1.FILE", "w,type=memory(hiperspace)");
:   fp2 = fopen ("A2.FILE", "w,type=memory(hiperspace)");
:   system("Program2");
:
/***** Program2 *****/
:
:   fp3 = fopen("A3.FILE", "w,type=memory");
:   fp4 = fopen("A4.FILE", "w,type=memory");
:   system("Program3");
:
:   clrmemf(__CURRENT);
:
/***** Program3 *****/
:
:   fp5 = fopen("A5.FILE", "w,type=memory");
:   fp6 = fopen("A6.FILE", "w,type=memory");
:
:

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“system\(\) — Execute a command” on page 1800](#)

__cnvblk() — Convert block

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#define _XOPEN_SOURCE
#include <unistd.h>

void __cnvblk(char bits[8], char bytes[64], int flag);

```

General description

The `__cnvblk()` function maps an 8 character array, *bits*, of bits to or from a 64 character array, *bytes*, of bytes depending on the value of *flag*.

If the value of *flag* is 0, `__cnvblk()` sets all bytes in the *bytes* array to 0x00 for which the corresponding bits in the *bits* array have value 0, and it sets all bytes in the *bytes* array to 0x01 for which the corresponding bits in the *bits* array have value 1.

If the value of *flag* is **not** 0, `__cnvblk()` sets all bits in the *bits* array to 0 for which corresponding bytes in the *bytes* array have value 0x00, and it sets all bits in the *bits* array to 1 for which the corresponding bytes in the *bytes* array have value 0x01.

This function may be used to prepare input to `setkey()` or `encrypt()` functions and to map results back to 8 bit characters.

Returned value

If the value of *flag* is zero, `__cnvblk()` functions without error checking.

If the value of *flag* is nonzero, `__cnvblk()` checks for errors, and if found, sets `errno` to one of the following values:

Error Code Description

EINVAL

The value of a byte in the array *bytes* is not 0x00 or 0x01.

Note: Because `__cnvblk()` returns no values, applications wishing to check for errors should set `errno` to 0, call `__cnvblk()`, then test `errno` and, if it is nonzero, assume an error has occurred.

Related information

- “[unistd.h — Implementation-specific functions](#)” on page 77
- “[encrypt\(\) — Encoding function](#)” on page 418
- “[setkey\(\) — Set encoding key](#)” on page 1546

collequiv() — Return a list of equivalent collating elements

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <collate.h>

int collequiv(collel_t c, collel_t **list);
```

General description

Finds all the collating elements whose primary weight is the same as the primary weight of *c*. It then updates the list to point to the first element of the array in which all the found elements are stored. The list of elements is valid until the next call to `setlocale()`, with categories `LC_ALL`, `LC_COLLATE`, or `LC_CTYPE`.

Another call to `collequiv()` may override the current list.

For information about the effect of `setlocale()` and `locale.h`, see “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#).

Returned value

If successful, `collequiv()` returns the number of collating elements found.

If the value of *c* is not in the valid range of collating elements in the current locale, `collequiv()` returns -1.

Notes:

1. If the collating element passed is specified with the weight of `IGNORE` in the `LC_COLLATE` category, the list returned will contain all the characters specified as `IGNORE`.
2. The list will only contain characters defined in the charmap file in the current locale.

Example

CELEBC22

```
/* CELEBC22

This example prints the collating elements that have an
equivalent weight as the collating element passed in
```

```

    argv[1].

    */
#include "stdio.h"
#include "locale.h"
#include "collate.h"
#include "stdlib.h"
#include "wctype.h"
#include "wchar.h"

main(int argc, char *argv[]) {
    collet_t e, *rp;
    int i;

    setlocale(LC_ALL, "");
    if ((e = strtocoll(argv[1])) == (collet_t)-1) {
        printf("'%'s' collating element not defined\n", argv[1]);
        exit(1);
    }
    if ((i = collequiv(e, &rp)) == -1) {
        printf("Invalid collating element '%s'\n", argv[1]);
        exit(1);
    }
    for (; i-- > 0; rp++) {
        if (ismccollet(*rp))
            printf("'%'s' ", colltostr(*rp));
        else if (iswprint(*rp))
            printf("'%'lc' ", *rp);
        else
            printf("'%'x' ", *rp);
    }
}

```

Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“cclass\(\) — Return characters in a character class” on page 243](#)
- [“collorder\(\) — Return list of collating elements” on page 301](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“colltostr\(\) — Return a string for a collating element” on page 304](#)
- [“getmccoll\(\) — Get next collating element from string” on page 736](#)
- [“getwmccoll\(\) — Get next collating element from wide string” on page 803](#)
- [“ismccollet\(\) — Identify a multicharacter collating element” on page 915](#)
- [“maxcoll\(\) — Return maximum collating element” on page 1043](#)
- [“strtocoll\(\) — Return collating element for string” on page 1757](#)

collorder() — Return list of collating elements

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```

#include <collate.h>

int collorder(collet_t **list);

```

General description

Finds the number of collating elements in the collate order list and sets a pointer to the list. The list returned is valid until another call to `setlocale()`.

Notes:

1. Collating elements specified with the weight of IGNORE in the LC_COLLATE category are defined as having the lowest weight.
2. The list will only contain characters defined in the charmap file in the current locale.

Example

CELEBC23

```
/* CELEBC23

   This example creates a list of all the collating elements using
   the &collo. function.

*/
#include <stdio.h>
#include <locale.h>
#include <collate.h>
#include <wchar.h>
#include <wctype.h>

main(int argc, char *argv[]) {
    collat_t e, *rp;
    int i;

    setlocale(LC_ALL, "TEXAN.IBM-1024");
    i = collorder(&rp);
    for (; i-- > 0; rp++) {
        if (ismccollet(*rp))
            printf("%s' ", colltostr(*rp));
        else if (iswprint(*rp))
            printf("%lc' ", *rp);
        else
            printf("%x' ", *rp);
    }
}
```

Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“cclass\(\) — Return characters in a character class” on page 243](#)
- [“collequiv\(\) — Return a list of equivalent collating elements” on page 300](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“colltostr\(\) — Return a string for a collating element” on page 304](#)
- [“getmccoll\(\) — Get next collating element from string” on page 736](#)
- [“getwmccoll\(\) — Get next collating element from wide string” on page 803](#)
- [“ismccollet\(\) — Identify a multicharacter collating element” on page 915](#)
- [“maxcoll\(\) — Return maximum collating element” on page 1043](#)
- [“strtcoll\(\) — Return collating element for string” on page 1757](#)

collrange() – Calculate the range list of collating elements

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <collate.h>

int collrange(collel_t start, collel_t end, collel_t **list);
```

General description

Finds a list of collating elements whose primary weights are between the *start* and *end* points, inclusive. The number returned is the number of elements in the list, whose pointer is returned.

This value will be zero if the end point collates earlier than the *start* point. The list returned is valid until the next call to `setlocale()`.

Returned value

If successful, `collrange()` returns the number of elements in the list, whose pointer is returned.

If either *start* or *end* are out of range, `collrange()` returns -1.

Notes:

1. Collating elements specified with the weight of IGNORE in the LC_COLLATE category are defined having the lowest weight. Therefore, such elements can only be specified as the starting collating element.
2. The list will only contain characters defined in the charmap file in the current locale.

Example

CELEBC24

```
/* CELEBC24

   This example prints the collating elements in the range
   between the start and end points passed in
   argv[1] and argv[2], using the
   &collrap. function.

*/
#include <stdio.h>
#include <locale.h>
#include <collate.h>
#include <stdlib.h>
#include <wctype.h>
#include <wchar.h>

main(int argc, char *argv[]) {
    collel_t s, e, *rp;
    int i;

    setlocale(LC_ALL, "TEXAN.IBM-1024");
    if ((s = strtocoll(argv[1])) == (collel_t)-1) {
        printf("%s' collating element not defined\n", argv[1]);
        exit(1);
    }
    if ((e = strtocoll(argv[2])) == (collel_t)-1) {
        printf("%s' collating element not defined\n", argv[2]);
        exit(1);
    }
}
```

```
if ((i = collrange(s, e, &rp)) == -1) {
    printf("Invalid range for '%s' to '%s'\n", argv[1], argv[2]);
    exit(1);
}
for (; i-- > 0; rp++) {
    if (ismccollet(*rp))
        printf("%s' ", colltostr(*rp));
    else if (iswprint(*rp))
        printf("%lc' ", *rp);
    else
        printf("%x' ", *rp);
}
}
```

Related information

- [“collate.h – Current locale's collating properties” on page 17](#)
- [“cclass\(\) – Return characters in a character class” on page 243](#)
- [“collequiv\(\) – Return a list of equivalent collating elements” on page 300](#)
- [“collorder\(\) – Return list of collating elements” on page 301](#)
- [“colltostr\(\) – Return a string for a collating element” on page 304](#)
- [“getmccoll\(\) – Get next collating element from string” on page 736](#)
- [“getwmccoll\(\) – Get next collating element from wide string” on page 803](#)
- [“ismccollet\(\) – Identify a multicharacter collating element” on page 915](#)
- [“maxcoll\(\) – Return maximum collating element” on page 1043](#)
- [“strtcoll\(\) – Return collating element for string” on page 1757](#)

colltostr() – Return a string for a collating element

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <collate.h>
char *colltostr(collet_t c);
```

General description

Converts c to the string of the collating element. The colltostr() function is the inverse of strtocoll().

An application program can use the returned array from collrange() or collequiv(), calling ismccollet() on each element, only calling colltostr() if ismccollet() is true for the element. The string returned is valid until another call to setlocale().

Returned value

If a value is passed representing a single character or a value that is not in range, colltostr() returns NULL.

Example

CELEBC25

```
/* CELEBC25
```

This example prints all the collating elements in the collating sequence, using the `&colltop` function to get the string for the multi-character collating elements.

```
*/
#include <collate.h>
#include <locale.h>
#include <stdio.h>
#include <wchar.h>
#include <wctype.h>

main(int argc, char *argv[]) {
    collat_t e, *rp;
    int i;

    setlocale(LC_ALL, "");
    i = collorder(&rp);
    for (; i-- > 0; rp++) {
        if (ismccollet(*rp))
            printf("%s' ", colltostr(*rp));
        else if (iswprint(*rp))
            printf("%lc' ", *rp);
        else
            printf("%x' ", *rp);
    }
}
```

Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“cclass\(\) — Return characters in a character class” on page 243](#)
- [“collequiv\(\) — Return a list of equivalent collating elements” on page 300](#)
- [“collorder\(\) — Return list of collating elements” on page 301](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“getmccoll\(\) — Get next collating element from string” on page 736](#)
- [“getwmccoll\(\) — Get next collating element from wide string” on page 803](#)
- [“ismccollet\(\) — Identify a multicharacter collating element” on page 915](#)
- [“maxcoll\(\) — Return maximum collating element” on page 1043](#)
- [“strtcoll\(\) — Return collating element for string” on page 1757](#)

compile() — Compile regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```
#define INIT declarations
#define GETC() getc_code
#define PEEK() peek_code
#define UNGETC() ungetc_code
#define RETURN(ptr) return_code
#define ERROR(val) error_code

#define _XOPEN_SOURCE
#include <regex.h>

char *compile(char *instring, char *expbuf, const char *endbuf, int eof);
```

General description

Restriction: This function is not supported in AMODE 64.

The `compile()` function takes as input a simple regular expression and produces a compiled expression that can be used with the `step()` and `advance()` functions.

The first parameter *instring* is never used explicitly by `compile()`. It is a pointer to a character string defining a source regular expression. It is useful for programs that pass down different pointers to input characters. Programs which invoke functions to input characters or have characters in an external array can pass down **(char *)0** for this parameter.

expbuf is a pointer to the place where the compiled regular expression will be placed.

endbuf points to one more than the highest address where the compiled regular expression may be placed. If the compiled expression cannot fit in (*endbuf-expbuf*) bytes, a call to `ERROR(50)` is made. (See "Returned Value" below.)

eof is the character which marks the end of the regular expression.

The z/OS UNIX services implementation of the `compile()` function does **not** accept internationalized simple expressions as input. Internationalized simple expressions (for example, `[[=c=]]` (an equivalence class)) may yield unpredictable results.

Programs must have the following five macros declared before the **#include <regexp.h>** statement. The macros `GETC()`, `PEEK()` and `UNGETC()` operate on the regular expression given as input to `compile()`.

GETC()

This macro returns the value of the next character (byte) in the regular expression pattern. Successive calls to `GETC()` should return successive characters of the regular expression.

PEEK()

This macro returns the next character (byte) in the regular expression pattern. Immediate successive calls to `PEEK()` should return the same byte, which should also be the next character returned by `GETC()`.

UNGETC(c)

This macro causes the argument *c* to be returned by the next call to `GETC()`. No more than one character is ever needed and this character is guaranteed to be the last character read by `GETC()`. The value of the macro `UNGETC()` is always ignored.

RETURN(ptr)

This macro is used on normal exit of the `compile()` function. The value of the argument *ptr* is a pointer to the character after the last character of the compiled regular expression.

ERROR(val)

This macro is the abnormal return from `compile()`. The argument *val* is an error number. (See "Returned Value" below for meanings.) This call should never return.

Notes:

1. z/OS UNIX services do not provide any default macros if the above user macros are not provided.
2. Each program that includes the **<regexp.h>** must have a **#define** statement for `INIT`. It is used for dependent declarations and initializations. For example, it can be used to set a variable to point to the beginning of the regular expression so that this variable can be used in the declarations for `GETC()`, `PEEK()`, and `UNGETC()`.
3. The external variables *cirf*, *sed*, and *nbra* are reserved.
4. The application must provide the proper serialization for the `compile()`, `step()`, and `advance()` functions if they are run under a multithreaded environment.

Simple regular expressions

A Simple Regular Expression (SRE) specifies a set of character strings. The simplest form of regular expression is a string of characters with no special meaning. A small set of special characters, known as metacharacters, do have special meaning when encountered in patterns.

Expression Meaning

c

The character *c* where *c* is not a special character.

|c

The character *c* where *c* is any special character. For example, *a\ . e* is equivalent to *a . e*.

^

The beginning of the string being compared

\$

The dollar symbol matches the end of the string.

.

The period symbol matches any one character.

[string]

A string within square brackets specifies any of the characters in *string*. Thus, *[abc]*, if compared to other strings, would match any which contained *a*, *b*, or *c*.

The *]* (right bracket) can be used alone within a pair of brackets, but only if it immediately follows either the opening left bracket or if it immediately follows *[^*.

Ranges may be specified as *c-c*. The hyphen symbol, within square brackets, means "through". It fills in the intervening characters according to the collating sequence. For example, *[a-z]* is equivalent to *[abc...xyz]*. If the end character in the range is lower in collating sequence to the start character, then only the range start and range end characters are accepted in the search pattern. For example, *[9-1]* is equivalent to *[91]*. Note that ranges in Simple Regular Expressions are only valid if the LC_COLLATE category is set to the C locale.

The *-* (hyphen) can be used by itself, but only if it is the first or last character in the expression. For example, the expression *[]a-f]* matches either the *]* or one of the characters *a* through *f*.

[^string]

The caret symbol, when inside square brackets, negates the characters within the square brackets. Thus, *[^abc]*, if compared to other strings, would *fail* to match any which contains even one *a*, *b*, or *c*.

Note: Characters *.*, ***, *[*, and ** (period, asterisk, left square bracket, and backslash, respectively) have special meaning, except when they appear within square brackets (*[]*), or are preceded by **.

The asterisk symbol indicates 0 or more of any preceding characters. For example, *(a*e)* will match any of the following: *e*, *ae*, *aae*, *aaae*, The longest leftmost match is chosen.

rx

The occurrence of regular expression *r* followed by the occurrence of regular expression *x*.

\{m\} \{m,\} \{m,u\}

Integer values enclosed in *\{\}* indicate the number of times to apply the preceding regular expression. *m* is the minimum number and *u* is the maximum number. *u* must be less than 256. If you specify only *m*, it indicates the exact number of times to apply the regular expression.

\{m,\} is equivalent to *\{m,255\}*. They both match *m* or more occurrences of the expression. The ***** (asterisk) operation is equivalent to *\{0,\}*.

The maximum number of occurrences is matched.

\(r\)

The regular expression *r*. The *\(* and *\)* sequences are ignored.

\n

When *|n* (where $1 \leq n \leq 9$) appears in a concatenated regular expression, it stands for the regular expression *x*, where *x* is the *n*th regular expression enclosed in *\(* and *\)* sequences that appeared

earlier in the concatenated regular expression. For example, in the pattern `\(c\)onc\(\(ate\)n\2`, the `\2` is equivalent to `ate`, giving *concatenate*.

The character `^` at the beginning of an expression permits a successful match only immediately after a newline or at the beginning of each of the string to which a match is to be applied. The character `$` at the end of an expression requires a trailing newline.

Notes:

1. The `compile()` function is physically embedded in the **regex.h** header. This header will be protected from multiple invocations just like other C headers.
2. The `compile()`, `step()`, and `advance()` functions are provided for historical reasons. These functions were part of the Legacy Feature in Single UNIX Specification, Version 2. They have been withdrawn and are not supported as part of Single UNIX Specification, Version 3. New applications should use the newer functions `fnmatch()`, `glob()`, `regcomp()` and `regexexec()`, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001.

Returned value

If successful, `compile()` exits using the user-provided macro `RETURN(ptr)`. The value of the argument *ptr* is a pointer to the character after the last character of the compiled regular expression.

If unsuccessful, `compile()` exits using the user-provided macro `ERROR(val)`. The argument *val* is an error number identifying the error. The following error numbers are defined:

Errcode

Description String

| | |
|-----------|---|
| 11 | Range endpoint too large |
| 16 | Bad number |
| 25 | <code>\digit</code> out of range |
| 36 | Illegal or missing delimiter |
| 41 | No remembered search string |
| 42 | <code>\(\)</code> imbalance |
| 43 | Too many <code>\(</code> |
| 44 | More than two numbers given in <code>\{ \}</code> |
| 45 | <code>}</code> expected after <code>\</code> |
| 46 | First number exceeds second in <code>\{ \}</code> |
| 49 | <code>[]</code> imbalance |
| 50 | Regular expression overflow |

Related information

- [“regex.h — Regular expression declarations” on page 57](#)
- [“advance\(\) — Pattern match given a compiled regular expression” on page 143](#)

- “[fnmatch\(\)](#) — Match file name or path name” on page 569
- “[glob\(\)](#) — Generate path names matching a pattern” on page 808
- “[regcomp\(\)](#) — Compile regular expression” on page 1416
- “[regexexec\(\)](#) — Execute compiled regular expression” on page 1421
- “[step\(\)](#) — Pattern match with regular expression” on page 1715

confstr() — Get configurable variables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <unistd.h>

size_t confstr(int name, char *buf, size_t len);
```

General description

The `confstr()` function provides a method for applications to get configuration-defined string values. Its use and purpose are similar to the `sysconf()` function, but it is used where string values rather than numeric values are returned.

The *name* argument represents the system variable to be queried. It may be any one of the following symbolic constants, defined in `<unistd.h>`:

_CS_PATH

Request the value of the **PATH** environment variable that will find all standard utilities.

_CS_POSIX_V6_ILP32_OFF32_CFLAGS

Request the value of the set of initial options to be given to the c99 utility to build an application using a programming model with 32-bit types.

_CS_POSIX_V6_ILP32_OFF32_LDFLAGS

Request the value of the set of final options to be given to the c99 utility to build an application using a programming model with 32-bit types.

_CS_POSIX_V6_ILP32_OFF32_LIBS

Request the value of the set of libraries to be given to the c99 utility to build an application using a programming model with 32-bit int, long, pointer, and off_t types.

_CS_POSIX_V6_ILP32_OFFBIG_CFLAGS

Request the value of the set of initial options to be given to the c99 utility to build an application using a programming model with 32-bit int, long, and pointer types, and an off_t type using at least 64 bits.

_CS_POSIX_V6_ILP32_OFFBIG_LDFLAGS

Request the value of the set of final options to be given to the c99 utility to build an application using a programming model with 32-bit int, long, and pointer types, and an off_t type using at least 64 bits.

_CS_POSIX_V6_ILP32_OFFBIG_LIBS

Request the value of the set of libraries to be given to the c99 utility to build an application using a programming model with 32-bit int, long, and pointer types, and an off_t type using at least 64 bits.

_CS_POSIX_V6_LP64_OFF64_CFLAGS

Request the value of the set of initial options to be given to the c99 utility to build an application using a programming model with 32-bit int and 64-bit long, pointer, and off_t types.

_CS_POSIX_V6_LP64_OFF64_LDFLAGS

Request the value of the set of final options to be given to the c99 utility to build an application using a programming model with 32-bit int and 64-bit long, pointer, and off_t types.

_CS_POSIX_V6_LP64_OFF64_LIBS

Request the value of the set of libraries to be given to the c99 utility to build an application using a programming model with 32-bit int and 64-bit long, pointer, and off_t types.

_CS_POSIX_V6_LPBIG_OFFBIG_CFLAGS

Request the value of the set of initial options to be given to the c99 utility to build an application using a programming model with an int type using at least 32 bits and long, pointer, and off_t types using at least 64 bits.

_CS_POSIX_V6_LPBIG_OFFBIG_LDFLAGS

Request the value of the set of final options to be given to the c99 utility to build an application using a programming model with an int type using at least 32 bits and long, pointer, and off_t types using at least 64 bits.

_CS_POSIX_V6_LPBIG_OFFBIG_LIBS

Request the value of the set of libraries to be given to the c99 utility to build an application using a programming model with an int type using at least 32 bits and long, pointer, and off_t types using at least 64 bits.

_CS_POSIX_V6_WIDTH_RESTRICTED_ENVS

Request the list of names of programming environments supported by the implementation in which the widths of the blksize_t, cc_t, mode_t, nfd_t, pid_t, ptrdiff_t, size_t, speed_t, ssize_t, suseconds_t, tflag_t, useconds_t, wchar_t, and wint_t types are no greater than the width of type long.

z/OS UNIX services use the following constant:

_CS_SHELL

Request the fully qualified name of the default shell.

If the *len* argument is not zero, and if the *name* argument has a configuration-defined value, confstr() copies that value into the buffer pointed to by the *buf* argument. If the value to be returned is longer than *len* bytes, including the . terminating NULL, then confstr() truncates the string to *len*-1 bytes and NULL-terminates the results. The application can detect that the string was truncated by comparing the value returned by confstr() with *len*.

If the *len* argument is zero, and the *buf* argument is a NULL pointer, then confstr() still returns the integer value defined below, but does not return a string. If the *len* argument is zero, but the *buf* argument is not a NULL pointer the results are unspecified.

Returned value

If *name* has a configuration-defined value, confstr() returns the size of the buffer that would be needed to hold the entire configuration-defined string value. If this return value is greater than *len*, the string returned in *buf* is truncated.

If *name* does not have a configuration-defined value, confstr() returns 0 and leaves errno unchanged.

If *name* is not valid, confstr() returns 0 and sets errno to one of the following values:

Error Code**Description****EINVAL**

The value of the *name* argument is not valid.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

- [“fpathconf\(\) — Determine configurable path name variables”](#) on page 587
- [“pathconf\(\) — Determine configurable path name variables”](#) on page 1179
- [“sysconf\(\) — Determine system configuration options”](#) on page 1794

conj(), conjf(), conjl() — Calculate the complex conjugate

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex conj(double complex z);
float complex conjf(float complex z);
long double complex conjl(long double complex z);
```

General description

The `conj()` family of functions compute the complex conjugate of `z` by reversing the sign of its imaginary part.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|--------------------|-----|------|
| <code>conj</code> | X | X |
| <code>conjf</code> | X | X |
| <code>conjl</code> | X | X |

Returned value

If successful, they return the complex conjugate value.

Example

```
/*
 * This example illustrates the complex conjugate function
 */
#include <complex.h>
#include <stdio.h>

void main()
{
    long double complex z = -2.99 - I*3.99, zres;
    zres = conjl(z);
    printf("The complex conjugate of %Lf + %Lf*I is %Lf + %Lf*I\n",creall(z), cimagl(z), zres);
}

Output
The complex conjugate of -2.990000 + -3.990000*I is -2.990000 + 3.990000*I
```

Related information

- [“complex.h — Complex math functions” on page 85](#)
- [“carg\(\), cargf\(\), cargl\(\) — Calculate the argument” on page 234](#)
- [“cimag\(\), cimagf\(\), cimagl\(\) — Calculate the complex imaginary part” on page 282](#)
- [“cproj\(\), cprojf\(\), cprojl\(\) — Calculate the projection” on page 340](#)
- [“creal\(\), crealf\(\), creall\(\) — Calculate the complex real part” on page 341](#)

connect() — Connect a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int connect(int socket, const struct sockaddr *address, socklen_t address_len);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>

int connect(int socket, struct sockaddr *address, int address_len);
```

General description

For stream sockets, the connect() call attempts to establish a connection between two sockets. For datagram sockets, the connect() call specifies the peer for a socket. The *socket* parameter is the socket used to originate the connection request. The connect() call performs two tasks when called for a stream socket. First, it completes the binding necessary for a stream socket (in case it has not been previously bound using the bind() call). Second, it attempts to make a connection to another socket.

Note: For the X/Open socket function, the *socket* description applies to *socket*, *address* to *address*, and *address_len* to *address_len*. **const** is added to **struct sockaddr**.

Parameter
Description

socket
The socket descriptor.

address
The pointer to a socket address structure containing the address of the socket to which a connection will be attempted.

address_len
The size of the socket address pointed to by *address* in bytes.

The connect() call on a stream socket is used by the client application to establish a connection to a server. The server must have a passive open pending. A server that is using sockets must successfully call

`bind()` and `listen()` before a connection can be accepted by the server with `accept()`. Otherwise, `connect()` returns -1 and the error code is set to `ECONNREFUSED`.

If *socket* is in blocking mode, the `connect()` call blocks the caller until the connection is set up, or until an error is received. If *socket* is in non-blocking mode, the `connect` returns immediately with a return code of -1 and an `errno` of `EINPROGRESS`. The caller can test the completion of the connection setup by calling `select()` and testing for the ability to write to the socket.

When called for a datagram socket, `connect()` specifies the peer with which this socket is associated. This gives the application the ability to use data transfer calls reserved for sockets that are in the connected state. In this case, `read()`, `write()`, `readv()`, `writv()`, `send()`, and `recv()` calls are then available in addition to `sendto()`, `recvfrom()`, `sendmsg()`, and `recvmsg()` calls. Stream sockets can call `connect()` only once, but datagram sockets can call `connect()` multiple times to change their association. Datagram sockets can dissolve their association by connecting to an incorrect address, such as the NULL address (all fields zeroed).

The *address* parameter is a pointer to a buffer containing the name of the peer to which the application needs to connect. The *address_len* parameter is the size, in bytes, of the buffer pointed to by *address*.

Servers in the AF_INET domain: If the server is in the `AF_INET` domain, the format of the name buffer is expected to be `sockaddr_in`, as defined in the include file `netinet/in.h`.

```
struct in_addr
{
    ip_addr_t s_addr;
};

struct sockaddr_in {
    unsigned char  sin_len;
    unsigned char  sin_family;
    unsigned short sin_port;
    struct in_addr sin_addr;
    unsigned char  sin_zero[8];
};
```

The *sin_family* field must be set to `AF_INET`. The *sin_port* field is set to the port to which the server is bound. It must be specified in network byte order. The *sin_zero* field is not used and must be set to all zeros.

Servers in the AF_INET6 domain: If the server is in the `AF_INET6` domain, the format of the name buffer is expected to be `sockaddr_in6`, as defined in the `netinet/in.h`:

```
struct sockaddr_in6 {
    uint8_t char  sin6_len;
    sa_family_t  sin6_family;
    in_port_t    sin6_port;
    uint32_t     sin6_flowinfo;
    struct in6_addr sin6_addr;
    uint32_t     sin6_scope_id;
};
```

The *sin6_family* must be set to `AF_INET6`.

Servers in the AF_UNIX domain: If the server is in the `AF_UNIX` domain, the format of the name buffer is expected to be `sockaddr_un`, as defined in the include file `un.h`.

```
struct sockaddr_un {
    unsigned char  sun_len;
    unsigned char  sun_family;
    char          sun_path[108]; /* path name */
};
```

The *sun_family* field is set to `AF_UNIX`. The *sun_path* field contains the NULL-terminated path name, and *sun_len* contains the length of the path name.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Note: The connect() function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, connect() returns 0.

If unsuccessful, connect() returns -1 and sets errno to one of the following values:

Error Code

Description

EADDRNOTAVAIL

The specified address is not available from the local machine.

EAFNOSUPPORT

The address family is not supported.

EALREADY

The socket descriptor *socket* is marked nonblocking, and a previous connection attempt has not completed.

EBADF

The *socket* parameter is not a valid socket descriptor.

ECONNREFUSED

The connection request was rejected by the destination host.

EFAULT

Using *address* and *address_len* would result in an attempt to copy the address into a portion of the caller's address space to which data cannot be written.

EINTR

The attempt to establish a connection was interrupted by delivery of a signal that was caught. The connection will be established asynchronously.

EINVAL

The *address_len* parameter is not a valid length.

EIO

There has been a network or a transport failure.

EISCONN

The socket descriptor *socket* is already connected.

ENETUNREACH

The network cannot be reached from this host.

ENOTSOCK

The descriptor refers to a file, not a socket.

EOPNOTSUPP

The *socket* parameter is not of type SOCK_STREAM.

EPERM

connect() caller was attempting to extract a user's identity and the caller's process was not verified to be a server. To be server-verified, the caller's process must have permission to the BPX.SERVER profile (or superuser and BPX.SERVER is undefined) and have called either the __passwd() or pthread_security_np() services before calling connect() to propagate identity.

EPROTOTYPE

The protocol is the wrong type for this socket.

ETIMEDOUT

The connection establishment timed out before a connection was made.

The following are for AF_UNIX only:

Error Code

Description

EACCES

Search permission is denied for a component of the path prefix, or write access to the named socket is denied.

EIO

An I/O error occurred while reading from or writing to the file system.

ELOOP

Too many symbolic links were encountered in translating the path name in *address*.

ENAMETOOLONG

A component of a path name exceeded NAME_MAX characters, or an entire path name exceeded PATH_MAX characters.

ENOENT

A component of the path name does not name an existing file or the path name is an empty string.

ENOTDIR

A component of the path prefix of the path name in *address* is not a directory.

Example

The following are examples of the connect() call. The Internet address and port must be in network byte order. To put the port into network byte order, the htons() utility routine is called to convert a short integer from host byte order to network byte order. The *address* field is set using another utility routine, inet_addr(), which takes a character string representing the dotted-decimal address of an interface and returns the binary Internet address representation in network byte order. Finally, it is a good idea to zero the structure before using it to ensure that the name requested does not set any reserved fields. These examples could be used to connect to the servers shown in the examples listed with the call, [“bind\(\) — Bind a name to a socket” on page 213](#).

```
int s;
struct sockaddr_in inet_server;
struct sockaddr_un unix_server;
int rc;
int connect(int s, struct sockaddr *name, int namelen);

/* Connect to server bound to a specific interface in the
Internet domain */
/* make sure the sin_zero field is cleared */
memset(&inet_server, 0, sizeof(inet_server));
inet_server.sin_family = AF_INET;
inet_server.sin_addr.s_addr = inet_addr("129.5.24.1");
/* specific interface */
inet_server.sin_port = htons(1024);
:
rc = connect(s, (struct sockaddr *) &inet_server,
sizeof(inet_server));

/* Connect to a server bound to a name in the UNIX domain */
/* make sure the sun_addr, sun_port, sun_nodeid fields are cleared
*/
memset(&unix_server, 0, sizeof(unix_server));
unix_server.sun_family = AF_UNIX;
strncpy(unix_server.sun_path, "mysocket");
unix_server.sun_len = sizeof(unix_server.sun_len);
strncpy(mvsservername.sunix_name, "APPL", 8);
:
rc = connect(s, (struct sockaddr *)
&unix_server, sizeof(unix_server));
```

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“htons\(\) — Translate an unsigned short integer into network byte order” on page 820](#)
- [“inet_addr\(\) — Translate an Internet address into network byte order” on page 854](#)

- “listen() — Prepare the server for incoming client requests” on page 977
- “select(), pselect() — Monitor activity on files or sockets and message queues” on page 1472
- “selectex() — Monitor activity on files or sockets and message queues” on page 1480
- “socket() — Create a socket” on page 1677

ConnectExportImport() — WLM connect for export or import use

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R9 |

Format

```
#include <sys/__wlm.h>

unsigned long ConnectExportImport(const char *subsystype,
                                const char *subsysname);
```

AMODE 64:

```
#include <sys/__wlm.h>

unsigned int ConnectExportImport(const char *subsystype,
                                const char *subsysname);
```

General description

Provides the ability for an application to connect to WLM to use the ExportWorkUnit(), UndoExportWorkUnit(), ImportWorkUnit(), and UndoImportWorkUnit() functions.

Note that if you need to use the CreateWorkUnit() function, you should use ConnectWorkMgr() instead.

The ConnectExportImport() function uses the following parameters:

***subsystype**

Points to a NULL-terminated character string containing the subsystem type by which to identify the connector. The export and import functions do not use the string. A meaningful string should be used since it can appear in WLM DATA IPCS reports. The character string can be up to 4 bytes in length.

***subsysname**

Points to a NULL-terminated character string containing the subsystem name by which to identify the connector. The export and import functions do not use the string. A meaningful string should be used since it can appear in WLM DATA IPCS reports. The character string can be up to 8 bytes in length.

Returned value

If successful, ConnectExportImport() returns 0.

If unsuccessful, ConnectExportImport() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained a value that is not correct.

EMVSWLMERROR

A WLM service failed. Use __errno2() to obtain the WLM service reason code for the failure.

Related information

- [“sys/ __wlm.h — WorkLoad Manager functions” on page 73](#)
- [“ExportWorkUnit\(\) — WLM export service” on page 458](#)
- [“ImportWorkUnit\(\) — WLM import service” on page 838](#)
- [“QueryWorkUnitClassification\(\) — WLM query enclave classification service” on page 1374](#)
- [“UnDoExportWorkUnit\(\) — WLM undo export service” on page 1938](#)
- [“UnDoImportWorkUnit\(\) — WLM undo import service” on page 1939](#)
- For more information, see [z/OS MVS Programming: Workload Management Services](#).

ConnectServer() — Connect to WLM as a server manager

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/ __wlm.h>

unsigned long ConnectServer(const char *subsystype,
                           const char *subsysname,
                           const char *applenv,
                           int *paralleleu);
```

AMODE 64:

```
#include <sys/ __wlm.h>

unsigned int ConnectServer(const char *subsystype,
                           const char *subsysname,
                           const char *applenv,
                           int *paralleleu);
```

General description

The ConnectServer function provides the ability for an application to connect to WLM as a WLM server manager to perform WLM server manager functions.

***subsystype**

Points to a NULL-terminated character string containing the generic subsystem type (CICS, IMS, WEB, etc.). This is the primary category under which WLM classification rules are grouped. The character string can be up to 4 bytes in length.

***subsysname**

Points to a NULL-terminated character string containing the subsystem name used for classifying work requests. The character string can be up to 8 bytes in length.

***applenv**

Points to a NULL-terminated character string that contains the name of the application environment under which work requests are processed. The character string can be up to 32 bytes in length.

***paralleleu**

Points to an integer which contains the maximum number of tasks within the address space which will be created to process concurrent work requests.

Returned value

If successful, ConnectServer() returns a nonzero value representing a WLM connect token.

If unsuccessful, ConnectServer() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM connect failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSERVER Facility class. The caller's address space must be permitted to the BPX.WLMSERVER Facility class if it is defined. If BPX.WLMSERVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectWorkMgr\(\) — Connect to WLM as a work manager” on page 318](#)
- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“CreateWorkUnit\(\) — Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

ConnectWorkMgr() — Connect to WLM as a work manager

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/_wlm.h>

unsigned long ConnectWorkMgr(const char *subsys_type,
                           const char *subsys_name);
```

AMODE 64:

```
#include <sys/_wlm.h>
```



```
unsigned int ConnectWorkMgr(const char *subsysname,
                           const char *subsysname);
```

General description

The ConnectServer function provides the ability for an application to connect to WLM as a WLM work manager to perform WLM work manager functions.

*subsysname

Points to a NULL-terminated character string containing the generic subsystem type (CICS, IMS, WEB, etc.). This is the primary category under which WLM classification rules are grouped. The character string can be up to 4 bytes in length.

*subsysname

Points to a NULL-terminated character string containing the subsystem name used for classifying work requests. The character string can be up to 8 bytes in length.

Returned value

If successful, ConnectServer() returns a nonzero value representing a WLM connect token.

If unsuccessful, ConnectServer() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM connect failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class if it is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) — Connect to WLM as a server manager” on page 317](#)
- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“CreateWorkUnit\(\) — Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

__console() – Console communication services

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/__messag.h>

int __console(struct __cons_msg *cons, char *modstr, int *concmd);
```

General description

The `__console()` function is used to communicate with the operator's console. The `__console()` function allows users to send messages to the operator's console and to wait on a modify/stop request from the console.

The parameters supported are:

cons

If the argument is not NULL, it points to a structure specifying the message that is to be sent to the operator's console. If the argument is NULL then no message is sent.

modstr

Specifies the string where `__console()` returns the data entered at the operator's console. If `modstr` is not NULL the invoker will wait until an operator MODIFY's the invoking job and specifies 'APPL=' parameter. The length of `modstr` should be 128-byte. See [z/OS MVS System Commands](#) for more information on the MODIFY console command. If the argument is NULL then the `__console()` function will not wait on operator console commands.

concmd

If a console command was issued against the invoking job, the `__console()` function will set the command type. Valid types are, `_CC_modify` (function received a modify request) and `_CC_stop` (function received a stop request).

The `cons` structure is defined in the `<sys/__messag.h>` header and has the following format.

```
struct __cons_msg {
    short __reserved0;
    char __reserved1[2];
    union {
        struct {
            int __msg_length;
            char *__msg;
            char __reserved2[8];
        } __f1;
    } __format;
};
```

__reserved0

Reserved for future use.

__reserved1[2]

Reserved for future use.

__format.__f1.__msg_length

Length of message, not including the NULL terminator.

__format.__f1.__msg

A character string containing the message to be sent to the operator console.

__format.__f1.__reserved2[8]

Reserved for future use.

Note: The length of the message must be between 1 and 17850 characters for invokers with appropriate privileges, and between 1 and 17780 for invokers without appropriate privileges. The number of lines written to the console is limited to 255. In the case of an unprivileged user, one of those lines is used for the message ID and the invoker's login name. If the message length is exceeded, no lines are written and the service returns an EINVAL. If the number of lines is exceeded, the service returns an EINTR, but the first 255 lines are written to the console.

Returned value

If successful, __console() returns 0.

If unsuccessful, __console() returns -1 and sets errno to one of the following values:

Error Code**Description****EFAULT**

One of the following errors was detected:

- All or part of the cons structure is not addressable by the caller.
- All or part of the modstr string is not addressable by the caller.

EINTR

__console() was interrupted by a signal.

EINVAL

The cons structure contains errors.

EMVSERR

z/OS environmental or internal error has occurred.

Example**CELEBC41**

```
/* CELEBC41

   This example prints a simple message to the console using the
   __console() function.

*/
#include <sys/__messag.h>
#include <errno.h>
#include <string.h>
#include <stdio.h>

int main(int argc, char** argv) {
    struct __cons_msg cmsg;
    char buf[256] = "A message on the console";
    int rc;
    int cmsg_cmd = 0;

    /* fill in the __cons_msg structure */
    cmsg.__format.__f1.__msg = buf;
    cmsg.__format.__f1.__msg_length = strlen(buf);

    rc = __console(&cmsg, NULL, &cmsg_cmd);
    if(rc == -1) {
        printf("__console() failed\n");
        printf("%s\n", strerror(errno));
    }
    else {
        printf("__console() successful. Check console for message.\n");
    }

    return 0;
}
```

Related information

- “[sys/_messag.h — __console\(\) and __console2\(\) functions](#)” on page 69
- “[__console2\(\) — Enhanced console communication services](#)” on page 322

__console2() — Enhanced console communication services

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R10 |

Format

```
#include <sys/_messag.h>

int __console2(struct __cons_msg2 *cons, char *modstr, int *concmd);
```

General description

The `__console2()` function is used to communicate with the operator console. The `__console2()` function allows users to send messages to the operator console with the ability to specify routing codes and message descriptor codes, wait on a modify or stop request from the console, and to delete messages from operator console using either a message ID or token.

The `__console2()` function parameters are as follows:

cons

Specifies the address of the structure containing the console communication information. The mapping of the structure is provided below. If this parameter is NULL, then no message is sent to the operator console and no messages are deleted from the console.

modstr

Address of a 128-byte buffer that is to be used to receive a string of EBCDIC data from the console MODIFY command. All characters that appear to the right of the "APPL=" are placed into this buffer, left justified. The data returned is folded to uppercase. If this parameter is NULL, then the `__console2()` function does not wait on operator console commands.

concmd

Address of a 32-bit integer where the `__console2()` function returns the type of command that was issued on the console. If this parameter is set to NULL, the `__console2()` function will fail with EFAULT. The command types are:

_CC_modify

Function received a modify request.

_CC_stop

Function received a stop request.

The console communication information is specified in a structure pointed to by the `cons` parameter. The structure contains the following fields:

__cm2_format

Specifies the format of the structure. This field must be set to one of the following:

__CONSOLE_FORMAT_2

Used to indicate structure format 2.

__CONSOLE_FORMAT_3

Used to indicate structure format 3.

__cm2_msglength

The length of the message to be written to the console. A value of zero indicates that no message is to be sent to the operator console.

Notes:

1. The length of the message must be between 1 and 17850 characters for authorized users, and between 1 and 17780 for unauthorized users. The number of lines written to the console is limited to 255. In the case of an unauthorized user, one of those lines is used for the message ID and the user ID of the user. If the message length is exceeded, no lines are written and the service returns an EINVAL error code. If the number of lines is exceeded, the service returns an EINVAL error code, but the first 255 lines are written to the console.
2. An authorized user is one with appropriate privileges, as described in the "Authorization" topic in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.

__cm2_msg

Pointer to a NULL terminated string containing the message to be written to the console. A value of NULL indicates no message is to be sent to the operator console.

__cm2_routcde

Pointer to an unsigned integer array containing the routing codes to be assigned to the message. The array is terminated by a zero value. Allowable routing codes are 1 to 128 for authorized users, and 1 to 28 for unauthorized users. For more information on routing codes, see *z/OS MVS Programming: Authorized Assembler Services Reference SET-WTO*.

Note: An authorized user is one with appropriate privileges, as described in the "Authorization" topic in *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.

__cm2_descr

Pointer to an unsigned integer array containing the message descriptor codes to be assigned to the message. The array is terminated by a zero value. Allowable descriptor codes are 1 to 13. Descriptor codes 1 through 6, 11, and 12 are mutually exclusive. Codes 7 through 10, and 13 can be assigned in combination with any other code. For more information on descriptor codes, see *z/OS MVS Programming: Authorized Assembler Services Reference SET-WTO*.

__cm2_mcsflag

Specifies one or more of the following flags:

__CONSOLE_HRDCPY

Queue the message for hard copy only. The message will not be displayed on the console.

__cm2_token

Specifies a 4-byte token to be associated with this message. This field is used to identify a group of messages which can be deleted using the DOM feature of the `__console2()` function. The token must be unique within an address space and can be any value. A token value of zero indicates no token is specified and the message issued will not be associated with any token.

__cm2_msgid

An unsigned 32-bit integer field where the `__console2()` function will place the message ID associated with the message last sent to the console. This message ID can be used to delete a message when it is no longer needed by specifying it using the DOM feature of the `__console2()` function. A value of NULL indicates that the message ID is not to be returned.

Note: The value returned in `__cm2_msgid` is an internal message identifier associated with the message written to the console. The value is not text and it should not be confused with any textual part of a message that might otherwise be considered a message ID.

__cm2_dom_token

Specifies a 4-byte token which represents a message or group of messages to be deleted from the console. All messages previously issued with this token will be deleted from the console. This field is mutually exclusive with `__cm2_dom_msgid`. A value of zero indicates that no token is specified.

__cm2_dom_msgid

Pointer to an unsigned integer array containing message IDs to be deleted from the console. A maximum of 60 message IDs can be in the array. The array is terminated by a zero value. The array

terminator is not part of the 60 message IDs. This field is mutually exclusive with `__cm2_dom_token`. A value of NULL indicates that no message IDs are specified.

The console communication information structure includes the following additional fields when using the `__CONSOLE_FORMAT_3` format. These fields are not available when using the `__CONSOLE_FORMAT_2` format.

__cm2_mod_cartptr

Pointer to the 8-byte command and response token (CART) returned by a MODIFY or STOP command.

__cm2_mod_consldptr

Pointer to the 4-byte console ID returned by a MODIFY or STOP command.

__cm2_msg_cart

Specifies an 8-byte CART to be used on WTO when the message is issued.

__cm2_msg_consld

Specifies a 4-byte console ID to be used on WTO when the message is issued.

Note: All operations can be done in a single request. The order of operation is to issue messages, delete messages, and then wait for a MODIFY or STOP command.

Returned value

If successful, `__console2()` returns 0.

If unsuccessful, `__console2()` returns -1 and sets `ERRNO` to one of the following values:

Error Code

Description

EFAULT

The `__console2()` function was unable to address all or part of the *cons* structure, all or part of the routing codes array, all or part of the descriptor codes array, all or part of the array of DOM message IDs, all or part of the *modstr*, or the *concmd* parameter was NULL.

Another possible cause is that `__cm2_msgid` points to storage which is not accessible.

EINTR

The `__console2()` function was interrupted by a signal.

EINVAL

The structure pointed to by *cons* contains errors.

For example, mutually exclusive parameters were specified, a non-valid routing code was specified, a non-valid descriptor code or mutually exclusive descriptor codes were specified, or there were more than 60 entries in the array of DOM message IDs.

EMVSERR

A z/OS environmental or internal error has occurred. Use the `__errno2()` function to obtain diagnostic information that will help determine the cause of the problem.

EPERM

An unauthorized user specified a routing code in the range 29 through 128. Only authorized (superuser) users (UID=0) can specify routing codes in that range.

Example

CELEBC42

```
/* CELEBC42

This example prints a simple message to the console using the
__console2() function. A routing and descriptor code are also
assigned to the message.

*/
#include <sys/__messag.h>
#include <errno.h>
```

```

#include <string.h>
#include <stdio.h>

int main(int argc, char** argv) {
    struct __cons_msg2 cmsg;
    char buf[256] = "A message on the console";
    int rc;
    int cmsg_cmd;
    unsigned int cmsg_rout[2] = {1,0};
    unsigned int cmsg_desc[2] = {12,0};

    /* Fill in the __cons_msg2 struct */
    cmsg.__cm2_format = __CONSOLE_FORMAT_2;
    cmsg.__cm2_msg = buf;
    cmsg.__cm2_msglength = strlen(buf);
    cmsg.__cm2_routcde = cmsg_rout;
    cmsg.__cm2_descr = cmsg_desc;
    cmsg.__cm2_token = 0;
    cmsg.__cm2_msgid = NULL;
    cmsg.__cm2_dom_token = 0;

    rc = __console2(&cmsg, NULL, &cmsg_cmd);
    if(rc == -1) {
        printf("__console2() failed\n");
        printf("%s\n", strerror(errno));
    }
    else {
        printf("__console2() successful. Check console for message\n");
    }

    return 0;
}

```

Related information

- [“sys/__messag.h — __console\(\) and __console2\(\) functions” on page 69](#)
- [“__console\(\) — Console communication services” on page 320](#)

ContinueWorkUnit() — Continue WLM work unit

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#include <sys/__wlm.h>

int ContinueWorkUnit(wlmetok_t *enclavetoken);

```

General description

The ContinueWorkUnit function provides the ability for an application to create a WLM work unit that represents a continuation of the work unit associated with the current home address space.

***enclavetoken**

Points to a data field of type wlmetok_t where the ContinueWorkUnit() function is to return the WLM work unit enclave token.

Returned value

If successful, ContinueWorkUnit() returns 0.

If unsuccessful, ContinueWorkUnit() returns -1 and sets errno to one of the following values:

**Error Code
Description****EFAULT**

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM create enclave failed. Use `__errno2()` to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSERVER Facility class. The caller's address space must be permitted to the BPX.WLMSERVER Facility class if it is defined. If BPX.WLMSERVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) — Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) — Connect to WLM as a work manager” on page 318](#)
- [“CreateWorkUnit\(\) — Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“ExtractWorkUnit\(\) — Extract enclave service” on page 463](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

__convert_id_np() — Convert between DCE UUID and user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <unistd.h>

int __convert_id_np(int function_code,
                   char *principal_uuid,
                   char *cell_uuid,
                   char *userid);
```

General description

The `__convert_id_np()` function is used to retrieve the DCE UUID associated with a userid or the userid associated with a DCE UUID.

This function is intended for DCE servers which process requests from multiple clients. For example, DCE RPC requests from clients are identified by a DCE UUID only. This function enables servers to extract the userid of the requester.

The parameters supported are:

function_code

Identifies whether extracting a userid or UUID. Possible function codes are:

__GET_USERID

Return the userid associated with the specified UUIDs.

__GET_UUID

Return the UUIDs associated with the specified userid.

principal_uuid

When *__GET_USERID* is specified, *principal_uuid* contains the UUID of the user for the specified userid. When *__GET_UUID* is specified, *principal_uuid* returns the extracted UUID for the userid specified. The caller must provide a 36-byte field for the returned *principal_uuid*.

cell_uuid

When *__GET_USERID* is specified, *cell_uuid* should contain the cell UUID if known. If not known, *cell_uuid* must be NULL. When *__GET_UUID* is specified, *cell_uuid* will return the extracted cell UUID, if it is defined for the specified userid. The caller must provide a 36-byte field for the returned *cell_uuid*.

userid

When *__GET_USERID* is specified, *userid* will return the extracted userid for the specified UUID. The caller must provide a 9 byte field for the returned userid. When *__GET_UUID* is specified, *userid* contains the userid for whom the UUID should be extracted. The userid must be 1 to 8 characters in length.

Returned value

If successful, *__convert_id_np()* returns 0.

If unsuccessful, *__convert_id_np()* returns -1 and sets *errno* to one of the following values:

Error Code

Description

EINVAL

One of the following errors was detected:

- *function_code* specified is undefined.
- *__GET_UUID* was specified and *userid* is not in the range 1 to 8 characters long.
- *__GET_USERID* was specified and *userid* was not 9 character long

EMVSERR

An MVS environmental or internal error occurred.

EMVSSAF2ERR

One of the following errors was detected:

- Received an unexpected return code for the security product.
- The security product detected an error in the input parameters.
- An internal error occurred in the security product.

ENOSYS

One of the following errors was detected:

- No security product is installed on the system.
- The security product does not have support for this function.

ESRCH

One of the following errors was detected:

- No mapping exists between a UUID and Userid.
- No mapping exists between a Userid and UUID.
- The DCEUUIDS class is not active.
- `__GET_UUID` was specified and no cell UUID is defined for the userid.
- The userid is not defined to the security product.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

copysign(), copysignf(), copysignl() – Copy the sign from one floating-point number to another

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Language Environment C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | OS/390 V2R6 |

Format

```
#define _AIX_COMPATIBILITY
#include <math.h>
#include <float.h>

double copysign(double x, double y);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>
#include <float.h>

float copysignf(float x, float y);
long double copysignl(long double x, long double y);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float copysign(float x, float y);
long double copysign(long double x, long double y);
```

General description

The `copysign` functions produce a value with the magnitude of `x` and the sign of `y`.

Restriction: The `copysignf()` function does not support the `_FP_MODE_VARIABLE` feature test macro.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|------------------------|-----|------|
| <code>copysign</code> | X | X |
| <code>copysignf</code> | X | X |

| Function | Hex | IEEE |
|-----------|-----|------|
| copysignl | X | X |

Returned value

The copysign functions return a value with the magnitude of *x* and the sign of *y*.

Related information

- [“float.h — ISO C/C++ constants for floating-point data types” on page 24](#)
- [“math.h — Floating-point math functions” on page 40](#)
- [“ilogb\(\), ilogbf\(\), ilogbl\(\) — Integer unbiased exponent” on page 834](#)
- [“logb\(\), logbf\(\), logbl\(\) — Unbiased exponent” on page 996](#)
- [“nextafter\(\), nextafterf\(\), nextafterl\(\) — Next representable double float” on page 1141](#)
- [“scalb\(\) — Load exponent” on page 1465](#)

copysignd32(), copysignd64(), copysignd128() — Copy the sign from one floating-point number to another

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 copysignd32(_Decimal32 x, _Decimal32 y);
_Decimal64 copysignd64(_Decimal64 x, _Decimal64 y);
_Decimal128 copysignd128(_Decimal128 x, _Decimal128 y);

_Decimal32 copysign(_Decimal32 x, _Decimal32 y); /*C++ only */
_Decimal64 copysign(_Decimal64 x, _Decimal64 y); /*C++ only */
_Decimal128 copysign(_Decimal128 x, _Decimal128 y); /*C++ only */
```

General description

The copysign functions produce a value with the magnitude of *x* and the sign of *y*.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The copysign functions return a value with the magnitude of *x* and the sign of *y*.

Example

```
/* CELEBC47
```

```
This example illustrates the copysignd64() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 x = 1.2DD, y = -1.0DD , z;

    z = copysignd64(x, y);

    printf("The result of copysignd64(%Df,%Df) is %Df\n",x,y,z);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“copysign\(\), copysignf\(\), copysignl\(\) — Copy the sign from one floating-point number to another” on page 328](#)
- [“ilogbd32\(\), ilogbd64\(\), ilogbd128\(\) — Integer unbiased exponent” on page 835](#)
- [“logbd32\(\), logbd64\(\), logbd128\(\) — Unbiased exponent” on page 998](#)
- [“nextafterd32\(\), nextafterd64\(\), and nextafterd128\(\) — Next representable decimal floating-point value” on page 1142](#)

cos(), cosf(), cosl() — Calculate cosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double cos(double x);
float cos(float x);           /* C++ only */
long double cos(long double x); /* C++ only */
float cosf(float x);
long double cosl(long double x);
```

General description

Calculates the cosine of x. The value x is expressed in radians.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

Returns the calculated value.

If x is outside prescribed limits, the value is not calculated. Instead, the function returns 0 and sets the `errno` to `ERANGE`. If the correct value would cause an underflow, zero is returned and the value `ERANGE` is stored in `errno`.

Special behavior for XPG4.2: The following error is added:

Error Code

Description

EDOM

The argument exceeded an internal limit for the function (approximately 2^{50}).

Example

CELEBC26

```
/* CELEBC26

   This example calculates y to be the cosine of
   x.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y;

    x = 7.2;
    y = cos(x);

    printf("cos( %lf ) = %lf\n", x, y);
}
```

Output

```
cos( 7.200000 ) = 0.608351
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“atanh\(\), atanhf\(\), atanh\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)
- [“sinh\(\), sinh\(\), sinhl\(\) — Calculate hyperbolic sine” on page 1664](#)
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent” on page 1809](#)
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent” on page 1812](#)

cosd32(), cosd64(), cosd128() – Calculate cosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 cosd32(_Decimal32 x);
_Decimal64 cosd64(_Decimal64 x);
_Decimal128 cosd128(_Decimal128 x);

_Decimal32 cos(_Decimal32 x); /* C++ only */
_Decimal64 cos(_Decimal64 x); /* C++ only */
_Decimal128 cos(_Decimal128 x); /* C++ only */
```

General description

Calculates the cosine of x . The value x is expressed in radians.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

Returns the calculated value.

If x is outside prescribed limits, the value is not calculated. Instead, the function returns 0 and sets `errno` to `EDOM`.

Example

```
/* CELEBC48

   This example illustrates the cosd128() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x, y;

    x = 7.2DL;
    y = cosd128(x);

    printf("cosd128(%DDf) = %DDf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)

- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine”](#) on page 1663

cosh(), coshf(), coshl() — Calculate hyperbolic cosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double cosh(double x);
float cosh(float x);           /* C++ only */
long double cosh(long double x); /* C++ only */
float coshf(float x);
long double coshl(long double x);
```

General description

Calculates the hyperbolic cosine of x . The value x is expressed in radians.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

Returned value

If the result overflows, the function returns +HUGE_VAL and sets `errno` to `ERANGE`.

Example

CELEBC27

```
/* CELEBC27
   This example calculates y to be the hyperbolic cosine of x.
*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x,y;

    x = 7.2;
    y = cosh(x);

    printf("cosh( %lf ) = %lf\n", x, y);
}
```

Output

```
cosh( 7.200000 ) = 669.715755
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“atanh\(\), atanhf\(\), atanh\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)
- [“sinh\(\), sinh\(\), sinhl\(\) — Calculate hyperbolic sine” on page 1664](#)
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent” on page 1809](#)
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent” on page 1812](#)

coshd32(), coshd64(), coshd128() - Calculate hyperbolic cosine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 coshd32(_Decimal32 x);
_Decimal64 coshd64(_Decimal64 x);
_Decimal128 coshd128(_Decimal128 x);
_Decimal32 cosh(_Decimal32 x); /* C++ only */
_Decimal64 cosh(_Decimal64 x); /* C++ only */
_Decimal128 cosh(_Decimal128 x); /* C++ only */
```

General description

Calculates the hyperbolic cosine of x . The value x is expressed in radians.

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If the result overflows, the function returns +HUGE_VAL_D32, +HUGE_VAL_D64 or +HUGE_VAL_D128 and sets `errno` to `ERANGE`.

Example

CELEBC51

```
/* CELEBC51
```


This example illustrates the coshd128() function.

This example calculates y to be the hyperbolic cosine of x.

```
*/
#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x, y;

    x = 7.2DL;
    y = coshd128(x);

    printf("coshd128( %Ddf ) = %Ddf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acosd32\(\), acosd64\(\), acosd128\(\) - Calculate arccosine” on page 139](#)
- [“acoshd32\(\), acoshd64\(\), acoshd128\(\) - Calculate hyperbolic arccosine” on page 142](#)
- [“asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine” on page 184](#)
- [“asinhd32\(\), asinhd64\(\), asinhd128\(\) - Calculate hyperbolic arcsine” on page 187](#)
- [“atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent” on page 192](#)
- [“atanhd32\(\), atanh64\(\), atanh128\(\) - Calculate hyperbolic arctangent” on page 195](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine” on page 1663](#)
- [“sinhd32\(\), sinhd64\(\), sinhd128\(\) - Calculate hyperbolic sine” on page 1666](#)
- [“tand32\(\), tand64\(\), tand128\(\) - Calculate tangent” on page 1810](#)
- [“tanh32\(\), tanhd64\(\), tanhd128\(\) - Calculate hyperbolic tangent” on page 1813](#)

__cospid32(), __cospid64(), __cospid128() — Calculate cosine of pi * x

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 __cospid32(_Decimal32 x);
_Decimal64 __cospid64(_Decimal64 x);
_Decimal128 __cospid128(_Decimal128 x);
```

General description

Calculates the cosine of pi * x. The value x is expressed in radians.

Notes:

- 1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
- 2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

Returns the calculated value.

If x is outside the prescribed limits, the value is not calculated. Instead, the function either returns 1, or returns 0 and sets errno to ERANGE.

Example

```
/* CELEBC49

   This example illustrates the __cospid32() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal32 x, y;

    x = 1.0DF;
    y = __cospid32(x);

    printf("__cospid32(%Hf) = %Hf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“__sinpid32\(\), __sinpid64\(\), __sinpid128\(\) — Calculate sine of pi * x” on page 1667](#)

__cotan(), __cotanf(), __cotanl() — Calculate cotangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | z/OS V1R5 |

Format

```
#include <math.h>

double __cotan(double x);
float __cotanf(float x);
long double __cotanl(long double x);
```

General description

The __cotan functions compute the cotangent of x.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| __cotan | X | X |
| __cotanf | X | X |
| __cotanl | X | X |

Returned value

The __cotan functions return the cotangent of x.

Related information

- [“math.h — Floating-point math functions”](#) on page 40

__cpl() — CPL interface service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | OS/390 V2R9 |

Format

```
#include <sys/__cpl.h>

int __cpl(int functioncode, int bufferlen, char *buffer);
```

General description

__cpl() is an interface to the BPX1CPL assembler callable service. __cpl() allows callers with appropriate system authorization facility (SAF) access to perform functions related to coupling facilities (CFs) and the structures that reside in them, such as sizing CF structures and querying CF and structure attributes.

functioncode

A value that specifies what function BPX1CPL will perform. The following function codes are defined.

- CPL_QUERY (equates to a value of 1)
- CPL_CFSIZER (equates to a value of 2)
- CPL_CFSIZER_W_LVL (equates to a value of 3)
- CPL_CFSIZER_VPL (equates to a value of 4)
- CPL_IXLCSF (equates to a value of 5)
- CPL_IXLMSG (equates to a value of 6)
- CPL_IXCQUERY (equates to a value of 7)

bufferlen

The length of the input/output storage area (*buffer*) for BPX1CPL

buffer

Storage area for input/output for BPX1CPL

For more information on parameters and behavior of BPX1CPL, please refer to [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

Returned value

If successful, `__cpl()` returns 0.

If unsuccessful, `__cpl()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EFAULT

One of the parameters contained an address that was not accessible to the caller.

EINVAL

The *functioncode* parameter contains a value that is not correct.

EMVSCPLERROR

A `__cpl()` service failed.

EMVSERR

A z/OS environmental or internal error has occurred.

ENOMEM

Not enough space is available.

ENOSYS

The `__cpl()` service failed because the system is not at the correct level.

EPERM

The calling thread's address space is not permitted.

Usage notes

1. Access to `__cpl()` is controlled using SAF class profile BPX.CF. Requestors must have read access to this profile.
2. CFLevel8 or higher is required to use the structure size computation function. Because structure size is a function of CFLevel, all structure size computations that are performed by a given `__cpl()` call apply to the same CFLevel.

Related information

- [“sys/_cpl.h — __cpl\(\) function and symbolic constants” on page 67](#)

cpow(), cpowf(), cpowl() – Calculate the complex power

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex cpow(double complex x, double complex y);
float complex cpowf(float complex x, float complex y);
long double complex cpowl(long double complex x, long double complex y);
```

General description

The cpow() family of functions computes the complex value of x to the power of y, with a branch cut for the first parameter along the negative real axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| cpow | X | X |
| cpowf | X | X |
| cpowl | X | X |

Returned value

The cpow() family of functions return the complex power value.

Example

```
/*
 * This example illustrates the complex power of complex number 'z'
 */
#include <complex.h>
#include <stdio.h>

void main()
{
    long double complex z1=-0.5 + I*0.5,  zpowl=(long double complex)3.0;
    double complex zd=(double complex)z1, zpowd=(double complex)zpowl;
    float complex zf=(float complex)zd,  zpowf=(float complex)zpowl;

    long double resl;
    double resd;
    float resf;

    printf("Illustrates the cpow function. Expected result is 0.25 in all cases\n");
    resd = cpow(zd,zpowd);
    resf = cpowf(zf,zpowf);
    resl = cpowl(z1,zpowl);
    printf("\tcpow(%f + I*%f,%f + I*%f) = %f\n",creal(zd), cimag(zd),
                                                creal(zpowd), cimag(zpowd), resd);
    printf("\tcpowf(%f + I*%f,%f + I*%f) = %f\n",crealf(zd), cimagf(zd),
                                                crealf(zpowf), cimagf(zpowf), resf);
    printf("\tcpowl(%Lf + I*%Lf,%Lf + I*%Lf) = %Lf\n",creall(z1), cimagl(z1),
                                                creall(zpowl), cimagl(zpowl), resl);
}
Output
Illustrates the cpow function. Expected result is 0.25
cpow(-0.500000 + I*0.500000,3.000000 + I*0.000000) = 0.250000
cpowf(-0.500000 + I*0.500000,3.000000 + I*0.000000) = 0.250000
cpowl(-0.500000 + I*0.500000,3.000000 + I*0.000000) = 0.250000
```

Related information

- [“complex.h — Complex math functions”](#) on page 85
- [“cabs\(\), cabsf\(\), cabsl\(\) — Calculate the complex absolute value”](#) on page 228

cproj(), cprojf(), cprojl() – Calculate the projection

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex cproj(double complex z);
float complex cprojf(float complex z);
long double complex cprojl(long double complex z);
```

General description

The `cproj()` family of functions compute a projection of `z` onto the Riemann sphere: `z` projects to `z` except that all complex infinities (even those with one infinite part and one NaN part) project to positive infinity on the real axis. If `z` has an infinite part, then `cproj(z)` is equivalent to:

`INFINITY + I * copysign(0.0, cimag(z))`

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>cproj</code> | X | X |
| <code>cprojf</code> | X | X |
| <code>cprojl</code> | X | X |

Returned value

The `cproj()` family of functions return the value of the projection onto the Riemann sphere.

For a variable `z` of complex type, `z == creal(z) + cimag(z)*I`.

Special behavior for hex: On hexadecimal floating point mode, `cproj(z)` family of functions always returns `z`.

Example

```
#include <complex.h>
#include <stdio.h>

/*
 * Illustrates complex function cproj().
 *
 * NOTE:      When compiled in HEX(FLOAT), cproj(z) should
 *            always return z
 */

#define INFINITEL 1.0L/0.0L    /* An infinite number */

void InitReal ( long double complex *z, long double RealPart)
{
    union LongDoubleComplexMap {
        long double complex w;
        long double ldarray[2];
    }
```

```

    }z1;

    z1.w = *z;
    z1.ldarray[0] = RealPart;
    *z = z1.w;
}

main() {
    long double complex z,w;
    z = 2.5 + I*(-3.999);

    printf("Illustrates function cproj() ");

#ifdef __BFP__
    printf ("(IEEE mode)");
#else
    printf ("(HFP mode)");
#endif

    printf("\n\n z = %Lf + I*%Lf\n\n",creall(z), cimagl(z));
    w = cprojl(z);
    printf(" cproj(z) = %Lf + I*%Lf\n",creall(w), cimagl(w));

    printf(" Initializing z(real) with infinity ...\n");
    InitReal(z,INFINITEL);
    printf(" z = %Lf + %Lf*I\n",creall(z),cimagl(z));

    w = cprojl(z);
    printf(" cproj(z) = %Lf + %Lf*I\n",creall(w),cimagl(w));
}

```

Output

```

Illustrates function cproj() (IEEE mode)

z = 2.500000 + I*-3.999000

cproj(z) = 2.500000 + I*-3.999000
Initializing z(real) with infinity ...
z = INF + -3.999000*I
cproj(z) = INF + -0.000000*I

```

Related information

- [“complex.h – Complex math functions” on page 85](#)
- [“carg\(\), cargf\(\), cargl\(\) – Calculate the argument” on page 234](#)
- [“cimag\(\), cimagf\(\), cimagl\(\) – Calculate the complex imaginary part” on page 282](#)
- [“conj\(\), conjf\(\), conjl\(\) – Calculate the complex conjugate” on page 311](#)
- [“creal\(\), crealf\(\), creall\(\) – Calculate the complex real part” on page 341](#)

creal(), crealf(), creall() – Calculate the complex real part

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>
```

```
double creal(double complex z);
float crealf(float complex z);
long double creall(long double complex z);
```

General description

The `creal()` family of functions compute the real part of `z`.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>creal</code> | X | X |
| <code>crealf</code> | X | X |
| <code>creall</code> | X | X |

Returned value

The `creal()` family of functions return the real part value (as a real).

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h – Complex math functions”](#) on page 85
- [“carg\(\), cargf\(\), cargl\(\) – Calculate the argument”](#) on page 234
- [“cimag\(\), cimagf\(\), cimagl\(\) – Calculate the complex imaginary part”](#) on page 282
- [“conj\(\), conjf\(\), conjl\(\) – Calculate the complex conjugate”](#) on page 311
- [“cproj\(\), cprojf\(\), cprojl\(\) – Calculate the projection”](#) on page 340

creat() – Create a new file or rewrite an existing one

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <fcntl.h>

int creat(const char *pathname, mode_t mode);
```


General description

The function call: `creat(pathname, mode)` is equivalent to the call:

```
open(pathname, O_CREAT|O_WRONLY|O_TRUNC, mode);
```

Thus the file named by *pathname* is created, unless it already exists. The file is then opened for writing only, and is truncated to zero length. See “[open\(\) — Open a file](#)” on page 1157 for further information.

The *mode* argument specifies the file permission bits to be used in creating the file. Here is a list of symbols that can be used for a mode:

S_IRGRP

Read permission for the file's group.

S_IROTH

Read permission for users other than the file owner.

S_IRUSR

Read permission for the file owner.

S_IRWXG

Read, write, and search, or execute permission for the file's group. S_IRWXG is the bitwise inclusive-OR of S_IRGRP, S_IWGRP, and S_IXGRP.

S_IRWXO

Read, write, and search, or execute permission for users other than the file owner. S_IRWXO is the bitwise inclusive-OR of S_IROTH, S_IWOTH, and S_IXOTH.

S_IRWXU

Read, write, and search, or execute, for the file owner; S_IRWXG is the bitwise inclusive-OR of S_IRUSR, S_IWUSR, and S_IXUSR.

S_ISGID

Privilege to set group ID (GID) for execution. When this file is run through an exec function, the effective group ID of the process is set to the group ID of the file, so that the process has the same authority as the file owner rather than the authority of the actual invoker.

S_ISUID

Privilege to set the user ID (UID) for execution. When this file is run through an exec function, the effective user ID of the process is set to the owner of the file, so that the process has the same authority as the file owner rather than the authority of the actual invoker.

S_ISVTX

Indicates shared text. Keep loaded as an executable file in storage.

S_IWGRP

Write permission for the file's group.

S_IWOTH

Write permission for users other than the file owner.

S_IWUSR

Write permission for the file owner.

S_IXGRP

Search permission (for a directory) or execute permission (for a file) for the file's group.

S_IXOTH

Search permission for a directory, or execute permission for a file, for users other than the file owner.

S_IXUSR

Search permission (for a directory) or execute permission (for a file) for the file owner.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are

enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `creat()` returns a file descriptor for the open file.

If unsuccessful, `creat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

One of the following error conditions exists:

- The process did not have search permission on a component in *pathname*.
- The file exists but the process did not have appropriate permissions to open the file in the way specified by the flags.
- The file does not exist, and the process does not have write permission on the directory where the file is to be created.
- `O_TRUNC` was specified, but the process does not have write permission on the file.

EINTR

`open()` was interrupted by a signal.

EISDIR

pathname is a directory, and *options* specifies write or read/write access.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of *pathname* is greater than `POSIX_SYMLINK_MAX`.

EMFILE

The process has reached the maximum number of file descriptors it can have open.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, this error occurs if the length of a *pathname* string substituted for a symbolic link in the *pathname* argument exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined with `pathconf()`.

ENFILE

The system has reached the maximum number of file descriptors it can have open.

ENOENT

`O_CREAT` is specified, and either the path prefix does not exist or the *pathname* argument is an empty string.

ENOSPC

The directory or file system intended to hold a new file has insufficient space.

ENOTDIR

A component of *pathname* is not a directory.

EOVERFLOW

The named file is a regular file and the size of the file cannot be represented correctly in an object of type `off_t`.

EROFS

pathname is on a read-only file system.

Example

CELEBC28

```
/* CELEBC28
```

This example creates a file.

```

*/
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    char fn[]="creat.file", text[]="This is a test";
    int fd;

    if ((fd = creat(fn, S_IRUSR | S_IWUSR)) < 0)
        perror("creat() error");
    else {
        write(fd, text, strlen(text));
        close(fd);
        unlink(fn);
    }
    return(fd);
}

```

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“close\(\) — Close a file” on page 293](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

CreateWorkUnit() — Create WLM work unit

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#include <sys/__wlm.h>

int CreateWorkUnit(wlmetok_t *enclavetoken,
                  server_classify_t classify,
                  char *arrival_time,
                  char *func_name);

```

General description

The CreateWorkUnit function provides the ability for an application to create a WLM work unit.

***enclavetoken**

Points to a data field of type wlmetok_t where the CreateWorkUnit() function is to return the WLM work unit enclave token.

***classify**

Points to a server_classify_t structure that contains the classification information for the work request macro.

***arrival_time**

Address of a doubleword (unsigned long long) field that contains the arrival time of the work request in STCK format.

***func_name**

Points to a NULL-terminated character string that represents the descriptive function name of the associated work request.

Returned value

If successful, CreateWorkUnit() returns a pointer to work unit enclave token of type wlmelok_t.

If unsuccessful, CreateWorkUnit() returns -1 and sets errno to one of the following values:

Error Code**Description****EFAULT**

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM create failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class if it is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) — Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) — Connect to WLM as a work manager” on page 318](#)
- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“ExtractWorkUnit\(\) — Extract enclave service” on page 463](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

crypt() — String encoding function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <unistd.h>

char *crypt(const char *key, const char *salt);
```

General description

The `crypt()` function encodes the string pointed to by the *key* argument. It perturbs the Data Encryption Standard (DES) encryption algorithm with the first two characters in the string pointed to by the *salt* argument to perform this encoding. The first two *salt* characters must be chosen from the set:

```
a b c d e f g h i j k l m n o p q r s t u v w x y z
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z
0 1 2 3 4 5 6 7 8 9 . /
```

This function can be called from any thread.

Returned value

If successful, `crypt()` returns a pointer to a thread specific encoded string. The first two characters of the returned value are those of the *salt* argument.

Notes:

1. The return value of `crypt()` points to a thread-specific buffer which is overwritten each time `crypt()` is called from the same thread.
2. The values returned by `crypt()` are not portable to other X/Open-conforming systems.

If unsuccessful, `crypt()` returns a NULL pointer and sets `errno` to indicate the error.

Special behavior for z/OS UNIX Services: The `crypt()` function will set `errno` to one of the following values:

Error Code

Description

EINVAL

First two characters of *salt* argument are not from the *salt* set.

ENOMEM

Storage for `crypt()` output buffer is not available for thread from which `crypt()` has been invoked.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“encrypt\(\) — Encoding function” on page 418](#)
- [“setkey\(\) — Set encoding key” on page 1546](#)

cs() – Compare and swap

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdlib.h>

int cs(cs_t *oldptr, cs_t *curptr, cs_t newword);
```

General description

The `cs()` built-in function compares the 4-byte value pointed to by *oldptr* to the 4-byte value pointed to by *curptr*. If they are equal, the 4-byte value, *newword*, is copied into the location pointed to by *curptr*. If they are unequal, the value pointed to by *curptr* is copied into the location pointed to by *oldptr*.

If this function is used in a multi-threading environment, then it is the users responsibility to protect the *oldptr* variable. The user can create a local variable per thread to contain this value or provide locking code to protect the global variable used. The *oldptr* variable may not reflect the *curptr* variable if the *curptr* variable changes via another thread before the user has a chance to examine *oldptr*.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The function uses the COMPARE SWAP (CS) instructions, which can be used in multiprogramming or multiprocessing environments to serialize access to counters, flags, control words, and other common storage areas. For a detailed description, refer to the appendixes in the *z/Architecture Principles of Operation* on number representation and instruction.

Returned value

`cs()` returns 0 if the 4-byte value pointed to by *oldptr* is equal to the 4-byte value pointed to by *curptr*.

If the value is not equal, `cs()` returns 1.

Related information

- *z/Architecture Principles of Operation*
- [“stdlib.h – Standard library functions” on page 65](#)
- [“cdouble – Compare double and swap” on page 247](#)

csid() – Character set ID for multibyte character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdlib.h>

int csid(const char *c)
```

External entry point: @@CSID, __csid;

General description

Determines the character set identifier for the specified multibyte character pointed to by *c*, that begins in the initial shift state.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Returned value

If successful, `csid()` returns the character-set identifier for the multibyte character.

If the character is not valid, `csid()` returns -1.

Note: The multibyte character passed must begin in the initial shift state.

Example

CELEBC29

```
/* CELEBC29

   This example checks character set ID for a character.

*/
#include "locale.h"
#include "stdio.h"
#include "stdlib.h"

main() {
    char *string = "A";
    int    rc;

    rc = csid(string);
    printf("character '%s' is in character set id %i\n", string, rc);
}
```

Output

```
character 'A' is in character set id 0
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)

csin(), csinf(), csinl() — Calculate the complex sine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex csin(double complex z);
float complex csinf(float complex z);
long double complex csinl(long double complex z);
```

General description

The csin() family of functions compute the complex sine of z.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| csin | X | X |
| csinf | X | X |
| csinl | X | X |

Returned value

The csin() family of functions return the complex sine value.

Example

For an example of a similar function see cacos(), cexp() or cpow().

Related information

- [“complex.h – Complex math functions”](#) on page 85
- [“csinh\(\), csinhf\(\), csinhl\(\) – Calculate the complex hyperbolic sine”](#) on page 350
- [“casinh\(\), casinhf\(\), casinhl\(\) – Calculate the complex arc hyperbolic sine”](#) on page 235
- [“casin\(\), casinf\(\), casinl\(\) – Calculate the complex arc sine”](#) on page 235
- [“ccos\(\), ccosf\(\), ccosl\(\) – Calculate the complex cosine”](#) on page 245
- [“ccosh\(\), ccoshf\(\), ccoshl\(\) – Calculate the complex hyperbolic cosine”](#) on page 246

csinh(), csinhf(), csinhl() – Calculate the complex hyperbolic sine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex csinh(double complex z);
float complex csinhf(float complex z);
long double complex csinhl(long double complex z);
```


General description

The `csinh()` family functions compute the complex hyperbolic sine of z .

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>csinh</code> | X | X |
| <code>csinhf</code> | X | X |
| <code>csinhl</code> | X | X |

Returned value

The `csinh()` family functions return the complex hyperbolic sine value.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h — Complex math functions”](#) on page 85
- [“csin\(\), csinf\(\), csinl\(\) — Calculate the complex sine”](#) on page 349
- [“casinh\(\), casinhf\(\), casinhl\(\) — Calculate the complex arc hyperbolic sine”](#) on page 235
- [“casin\(\), csinf\(\), csinl\(\) — Calculate the complex arc sine”](#) on page 235
- [“ccos\(\), ccoshf\(\), ccoshl\(\) — Calculate the complex cosine”](#) on page 245
- [“ccosh\(\), ccoshf\(\), ccoshl\(\) — Calculate the complex hyperbolic cosine”](#) on page 246
- [“cacos\(\), cacoshf\(\), cacoshl\(\) — Calculate the complex arc cosine”](#) on page 230
- [“cacosh\(\), cacoshf\(\), cacoshl\(\) — Calculate the complex arc hyperbolic cosine”](#) on page 231

__CSNameType() — Return codeset name type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R2 |

Format

```
#include <_Ccsid.h>

__csType __CSNameType(char *codesetName);
```

General description

The `__CSNameType()` function returns a `__csType` value which indicates the corresponding codeset name type.

Returned value

If *codesetName* is valid, `__CSNameType()` returns one of the following `__csType` values, which are defined in `<_Ccsid.h>`:

- `_CSTYPE_EBCDIC`
- `_CSTYPE_ASCII`
- `_CSTYPE_UCS2`
- `_CSTYPE_UTF8`
- `_CSTYPE_UTF16`
- `_CSTYPE_UTF32`

If *codesetName* is not valid, `__CSNameType()` returns `_CSTYPE_INVALID`.

Related information

- [“_Ccsid.h — CCSID to codeset name conversion” on page 17](#)
- [“__CcsidType\(\) — Return coded character set ID type” on page 247](#)
- [“__toCcsid\(\) — Convert codeset name to coded character set ID” on page 1881](#)
- [“__toCSName\(\) — Convert coded character set ID to codeset name” on page 1882](#)

csnap() — Request a condensed dump

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <ctest.h>

int csnap(char *dumptitle);
```

General description

Creates a display of the activation stack, including the Dynamic Storage Area (DSA), for each presently active function. Other environmental control blocks that may be required by IBM Service are also displayed. Under Language Environment, these consist of the Common Anchor Area (CAA) and the IBM z/OS C++ CAA information. The output is identified with *dumptitle*. See the CEE3DMP Language Environment callable service in [z/OS Language Environment Programming Guide](#) to determine where the output is written to.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Returned value

If successful, `csnap()` returns 0.

If unsuccessful, `csnap()` returns nonzero.

Example

```
#include <ctest.h>

int main(void) {
    int rc;
    rc = csnap("Sample csnap output");
}
```

Related information

- [z/OS Language Environment Programming Guide](#)
- [“ctest.h — Debug and diagnostics” on page 17](#)
- [“cdump\(\) — Request a main storage dump” on page 248](#)
- [“ctrace\(\) — Request a traceback” on page 363](#)

__csplist — Retrieve CSP parameters

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | C only | |

Format

```
#include <csp.h>

__csplist;
```

General description

Restriction: This function is not supported in AMODE 64.

__csplist is a macro intended to be used to access the parameter list passed from Cross System Product (CSP) to your C Library program. The macro evaluates to the address of the first element of the parameter list. You can use array indexing to extract the subsequent parameters, casting each parameter to the expected type, as shown in the example below. If no parameters are passed, __csplist[0] equals NULL.

You must include the `#pragma runopts(plist(ims))` directive if CSP is used to invoke a IBM z/OS C program.

argc will always be 1.

If you are expecting an integer and then a structure of type `s_type`, you should have the statements:

```
int_var = (int *) __csplist[0];
s_var   = (s_type *) __csplist[1];
```

Related information

- [“csp.h — Define __csplist macro” on page 17](#)

csqrt(), csqrtf(), csqrtl() – Calculate the complex square root

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```

#include <complex.h>

double complex csqrt(double complex z);
float complex csqrtf(float complex z);
long double complex csqrtl(long double complex z);

```

General description

The `csqrt()` family of functions compute the complex square root of z , with a branch cut along the negative real axis.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>csqrt</code> | X | X |
| <code>csqrtf</code> | X | X |
| <code>csqrtl</code> | X | X |

Returned value

The `csqrt()` family of functions return the complex square root value, in the range of the right half-plane (including the imaginary axis).

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h – Complex math functions”](#) on page 85
- [“cabs\(\), cabsf\(\), cabsl\(\) – Calculate the complex absolute value”](#) on page 228
- [“cpow\(\), cpowf\(\), cpowl\(\) – Calculate the complex power”](#) on page 338

ctan(), ctanf(), ctanl() – Calculate the complex tangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex ctan(double complex z);
float complex ctanf(float complex z);
long double complex ctanl(long double complex z);
```

General description

The `ctan()` family of functions compute the complex tangent of z .

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|--------------------|-----|------|
| <code>ctan</code> | X | X |
| <code>ctanf</code> | X | X |
| <code>ctanl</code> | X | X |

Returned value

The `ctan()` family of functions return the complex tangent value.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h — Complex math functions”](#) on page 85
- [“ctanh\(\), ctanhf\(\), ctanhl\(\) — Calculate the complex hyperbolic tangent”](#) on page 355
- [“catanh\(\), catanhf\(\), catanhl\(\) — Calculate the complex arc hyperbolic tangent”](#) on page 237
- [“catan\(\), catanf\(\), catanl\(\) — Calculate the complex arc tangent”](#) on page 236
- [“csin\(\), csinf\(\), csinl\(\) — Calculate the complex sine”](#) on page 349
- [“csinh\(\), csinhf\(\), csinhl\(\) — Calculate the complex hyperbolic sine”](#) on page 350

ctanh(), ctanhf(), ctanhl() — Calculate the complex hyperbolic tangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R7 a compiler that is designed to support C99 |

Format

```
#include <complex.h>

double complex ctanh(double complex z);
float complex ctanhf(float complex z);
long double complex ctanhl(long double complex z);
```

General description

The `ctanh()` family of functions compute the complex hyperbolic tangent of z .

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>ctanh</code> | X | X |
| <code>ctanhf</code> | X | X |
| <code>ctanhl</code> | X | X |

Returned value

The `ctanh()` family of functions return the complex hyperbolic tangent value.

Example

For an example of a similar function see `cacos()`, `cexp()` or `cpow()`.

Related information

- [“complex.h — Complex math functions”](#) on page 85
- [“ctan\(\), ctanf\(\), ctanl\(\) — Calculate the complex tangent”](#) on page 354
- [“catan\(\), catanf\(\), catanl\(\) — Calculate the complex arc tangent”](#) on page 236
- [“catanh\(\), catanhf\(\), catanhl\(\) — Calculate the complex arc hyperbolic tangent”](#) on page 237
- [“casinh\(\), casinhf\(\), casinhl\(\) — Calculate the complex arc hyperbolic sine”](#) on page 235
- [“casin\(\), casinf\(\), casinl\(\) — Calculate the complex arc sine”](#) on page 235
- [“csin\(\), csinf\(\), csinl\(\) — Calculate the complex sine”](#) on page 349
- [“csinh\(\), csinhf\(\), csinhl\(\) — Calculate the complex hyperbolic sine”](#) on page 350
- [“ccos\(\), ccosf\(\), ccosl\(\) — Calculate the complex cosine”](#) on page 245
- [“ccosh\(\), ccoshf\(\), ccoshl\(\) — Calculate the complex hyperbolic cosine”](#) on page 246
- [“cacos\(\), cacosf\(\), cacosl\(\) — Calculate the complex arc cosine”](#) on page 230
- [“cacosh\(\), cacoshf\(\), cacoshl\(\) — Calculate the complex arc hyperbolic cosine”](#) on page 231

ctdli() — Call to DL/I

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | |

Format

C only:

```
#pragma runopts(env(IMS),plist(OS))
#include <ims.h> /* or #include <cics.h> */

#define _CTDLI_PARMCOUNT /* First arg is an explicit parameter count */
int ctdli(int parmcount, const char *function, ...);
```

```

or

#define _CTDLI_NOPARMCOUNT          /*Parameter count is implicit in varargs */
int ctdli(const char *function,...);

```

C++:

```

#include <ims.h>                                /* or #include <cics.h> */

int ctdli(int parmcount, const char *function, ...);

or

#define _CTDLI_NOPARMCOUNT
int ctdli(const char *function, ...);

```

General description

Restriction: This function is not supported in AMODE 64.

Invokes DL/I facilities. The *parmcount* argument is optional. The *parmcount* value specifies the number of arguments in the variable argument list for the ctdli() call to function.

In C, when specifying a *parmcount*, use the _CTDLI_PARMCOUNT feature test macro. Otherwise, for C or C++, define _CTDLI_NOPARMCOUNT and make *function* the first argument. If the compile unit contains both types of call (sometimes passing *parmcount* and sometimes not), and if you want to avoid messages when compiling with the checkout option, define _CTDLI_NOPARMCOUNT and always cast the first argument to (const char *).

The *function* argument specifies the DL/I function you want to perform. Because the format of the ctdli() call depends on the function selected, all of the variations are not given here. For complete details on the available functions, refer to the COBOL publications.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

To invoke ctdli() from an IMS transaction, you need to specify the target operating system release that generates object code to run under the Information Management System (IMS) subsystem and specify that the original operating system parameter list should be available and the parameters are passed without restructuring, and the standard calling conventions of the operating system are used..

Returned value

The Program Control Block (PCB) status field (2 bytes) is stored as an unsigned int and used as the returned value for ctdli().

If the PCB status field contains blanks (hex '4040'), ctdli() returns 0.

Example

```

/* The following program demonstrates the use of the ctdli() function.
   It is a skeleton of a message processing program that calls ctdli()
   to retrieve messages and data.

   Specify the target release that generates object code to run under the Information
   Management System (IMS) subsystem
   and specify that the original operating system parameter list should be available and the
   parameters are passed without restructuring, and
   the standard calling conventions of the operating system are used.
*/
#ifdef __cplusplus
#pragma runopts(env(ims),plist(os))
#endif

#include <stdlib.h>
#include <ims.h>

```

```
#define n      20          /* I/O area size - Application dependent */
typedef struct {PCB_STRUCT(10)} PCB_10_TYPE;

int main(void)
{
    /* Function codes for ctdli */
    static const char func_GU[4]  = "GU  ";
    static const char func_ISRT[4] = "ISRT";

    char ssa_name[] = "ORDER    (ORDERKEY    = 666666)";

    int rc;

    char msg_seg_io_area[n];
    char db_seg_io_area[n];
    char alt_msg_seg_out[n];

    PCB_STRUCT_8_TYPE *alt_pcb;
    PCB_10_TYPE *db_pcb;
    IO_PCB_TYPE *io_pcb;

    io_pcb = (IO_PCB_TYPE *) (__pcblist)[0];
    alt_pcb = __pcblist[1];
    db_pcb = (PCB_10_TYPE *) __pcblist[2];
:
    /* Get first message segment from message region */
    rc = ctdli(func_GU, io_pcb, msg_seg_io_area);
:
    /* Get the data from the database having the specified key value */
    rc = ctdli(func_GU, db_pcb, db_seg_io_area, ssa_name);
:
    /* Build output message in program's I/O area */
    rc = ctdli(func_ISRT, alt_pcb, alt_msg_seg_out);
:
:
}
```

Related information

- [“ims.h — Invoke IMS facilities” on page 28](#)

ctermid() — Generate path name for controlling terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

char *ctermid(char *string);
```

General description

string points to a memory location where the ctermid() function stores the name of the current controlling terminal. The memory location must be able to hold at least L_ctermid characters, where L_ctermid is a symbol defined in the stdio.h header file.

ctermid() returns a string that can be used as a path name to refer to the controlling terminal for the current process. If *string* is not NULL, ctermid() stores the path name in the specified location and returns the value of *string*. Otherwise, ctermid() uses a location of its own and returns a pointer to that location.

The path name returned can be used to access the controlling terminal, if the process has a controlling terminal.

Returned value

`ctermid()` is always successful; it returns a string that can be used as a path name to refer to the controlling terminal for the current process.

There are no documented `errno` values.

Example

CELEBC32

```
/* CELEBC32

   This example refers to the controlling terminal for
   the current process.

*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <stdio.h>

main() {
    char termid[1025];

    if (ctermid(termid) == NULL)
        perror("ctermid() error");
    else
        printf("The control terminal is %s\n", termid);
}
```

Output

```
The control terminal is /dev/tty
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“ttyname\(\) — Get the name of a terminal” on page 1913](#)

ctest() — Start debug tool

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <ctest.h>

int ctest(char *command);
```

General description

Invokes the Debug Tool from your application program. The parameter *command* is a character pointer to a list of valid Debug Tool commands, that `ctest()` uses to invoke Debug Tool.

If you choose not to compile your program with hooks, you can use well-placed `ctest()` function calls instead. (A *hook* is a conditional exit that transfers control to the debugger, when the code is run under the debugger.) You would create a hook when you compile with the `TEST` option, causing the exit to be in your generated code waiting to run. A hook has minimal effect on a program that is running without the debugger.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Returned value

If successful, `ctest()` returns 0.
If unsuccessful, `ctest()` returns nonzero.

Examples

To let the debug tool gain control of your program, issue the command: `ctest(NULL)`.
To display the call chain from within a program and then let the program continue execution, issue the function call: `ctest("list calls; go;")`. To set a breakpoint from within a `ctest()` call, try:

```
char *cmd = "at line 17 list my_struct; go;";
ctest(cmd);
```

Related information

- [“ctest.h – Debug and diagnostics” on page 17](#)

ctime(), ctime64() – Convert time to character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <time.h>

char *ctime(const time_t *timer);

#define _LARGE_TIME_API
#include <time.h>

char *ctime64 (const time64_t *timer);
```

General description

Converts the calendar time pointed to by *timer* to local time in the form of a character string. A value for *timer* is usually obtained by a call to the `time()` function.

The `ctime()` function is equivalent to the function call: `asctime(localtime(timer))`

The function `ctime64()` will behave exactly like `ctime()` except it will convert a `time64_t` value pointing to a calendar time beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Returned value

If successful, `ctime()` returns a pointer to a date and time string. The string returned by `ctime()` contains exactly 26 characters and has the format:

```
"%.3s %.3s%3d %.2d:%.2d:%.2d %d\n"
```

For example: `Mon Jul 16 02:03:55 1987\n\0`

If an error occurs, `ctime()` returns no value.

Notes:

1. This function is sensitive to time zone information which is provided by:
 - The TZ environmental variable when POSIX(ON) and TZ is correctly defined, or by the _TZ environmental variable when POSIX(OFF) and _TZ is correctly defined.
 - The LC_TOD category of the current locale if POSIX(OFF) or TZ is not defined.

The time zone external variables `tzname`, `timezone`, and `daylight` declarations remain feature test protected in `time.h`.
2. The calendar time returned by a call to the `time()` function begins at epoch, which was at 00:00:00 Coordinated Universal Time (UTC), January 1, 1970.
3. The `ctime()` function uses a 24-hour clock format.
4. The days are abbreviated to: Sun, Mon, Tue, Wed, Thu, Fri, and Sat.
5. The months are abbreviated to: Jan, Feb, Mar, Apr, May, Jun, Jul, Aug, Sep, Oct, Nov, and Dec.
6. All fields have a constant width.
7. Dates with only one digit are padded with a blank space. Single digit time values are padded with a zero.
8. The newline character (`\n`) and the NULL character (`\0`) occupy the last two positions of the string.
9. The `asctime()`, `ctime()`, and other time functions may use a common, statically allocated buffer for holding the return string. Each call to one of these functions may destroy the result of the previous call.

When neither TZ nor _TZ is defined, the current locale is interrogated for time zone information. If neither TZ nor _TZ is defined and LC_TOD time zone information is not present in the current locale, a default value is applied to local time. POSIX programs simply default to Coordinated Universal Time (UTC), while non-POSIX programs establish an offset from UTC based on the setting of the system clock.

For more information about customizing a time zone to work with local time, see [Customizing a time zone](#) in *z/OS XL C/C++ Programming Guide*.

Error Code

| Description |
|------------------|
| EOverflow |

EOverflow

The result cannot be represented.

Example

CELEBC33

```
/* CELEBC33

This example polls the system clock by using the library
function &time..
It then prints a message giving the current date and time.
```

```
*/
#include <time.h>
#include <stdio.h>

int main(void)
{
    time_t ltime;

    time(&ltime);
    printf("the time is %s", ctime(&ltime));
}
```

Output

```
the time is Fri Jun 16 16:03:38 2006
```

Related information

- [“locale.h – Locale settings” on page 36](#)
- [“time.h – Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) – Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) – Convert date and time to a character string” on page 182](#)
- [“ctime_r\(\), ctime64_r\(\) – Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) – Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) – Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) – Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) – Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) – Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) – Convert local time” on page 1084](#)
- [“strftime\(\) – Convert to formatted time” on page 1735](#)
- [“time\(\), time64\(\) – Determine current UTC time” on page 1865](#)
- [“tzset\(\) – Set the time zone” on page 1918](#)

ctime_r(), ctime64_r() – Convert time value to date and time character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 Language Environment | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <time.h>

char *ctime_r(const time_t *clock, char *buf);

#define _LARGE_TIME_API
#include <time.h>
```

```
char *ctime64_r (const time64_t *clock, char *buf);
```

General description

The `ctime_r()` function converts the calendar time pointed to by *clock* to local time in exactly the same form as `ctime()` and puts the string into the array pointed to by *buf*. (which contains at least 26 bytes) and returns *buf*.

Unlike `ctime()`, the thread-safe version `ctime_r()` is not required to set *tzname*.

The function `ctime64_r()` will behave exactly like `ctime_r()` except it will convert a `time64_t` value pointing to a calendar time beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Returned value

If successful, `ctime_r()` returns a pointer to the string pointed to by *buf*.

If unsuccessful, `ctime_r()` returns a NULL pointer.

There are no documented `errno` values.

Related information

- [“locale.h — Locale settings” on page 36](#)
- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) — Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)
- [“time\(\), time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

ctrace() — Request a traceback

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <ctest.h>

int ctrace(char *dumptitle);
```

General description

Requests a traceback. The output is identified with *dumptitle*. ctrace() invokes the CEE3DMP Language Environment callable service with the following options: TRACEBACK, NOFILE, NOBLOCK, NOVARIABLE, NOSTORAGE, STACKFRAME(ALL), NOCOND, NOENTRY. See the CEE3DMP Language Environment callable service in [z/OS Language Environment Programming Guide](#). to determine where the output is written to.

This function can [list stored line numbers](#), along with the traceback.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Note: The offsets displayed by ctrace() are from the beginning of the functions, whereas by default, compiler listings show offsets from the beginning of the source file. You can override the displayed offsets and [list function relative offset addresses](#).

Returned value

If successful, ctrace() returns 0.
If unsuccessful, ctrace() returns nonzero.

Example

CELEBC34

```
/* CELEBC34

   This example shows how ctrace() is used and the output produced.

*/
#include <ctest.h>
int main(void) {

    int rc;
    rc = ctrace("Sample ctrace output");
}
```

Output for C++:

CEE3DMP: Sample ctrace output
for MVS
06/16/95 6:13:31 PMPage: 1

Information for enclave ????????

Information for thread 8000000000000000

Traceback:
DSA Addr Program Unit PU Addr PU Offset Entry E Addr E Offset Statement
Status
00065280 05337708 +0000011C __ctrace 05337708 +0000011C Call
000651E0 052005A8 +0000006C main 052005A8 +0000006C Call
000650C8 0533FA26 +000000B4 @@MNINV 0533FA26 +000000B4 Call
00065018 CEEBBEXT 000079D8 +0000013C CEEBBEXT 000079D8 +0000013C Call

Output for C:

CEE3DMP: Sample ctrace output
for MVS
06/16/95 6:12:47 PMPage: 1

Information for enclave ????????

Information for thread 8000000000000000

Traceback:
DSA Addr Program Unit PU Addr PU Offset Entry E Addr E Offset Statement
Status

```

00065268      05337708 +0000011C __ctrace      05337708 +0000011C
Call
000651E0      052006B8 +0000005E main        052006B8 +0000005E
Call
000650C8      0533FA26 +000000B4 @@MNINV     0533FA26 +000000B4
Call
00065018 CEEBBEXT 000079D8 +0000013C CEEBBEXT     000079D8 +0000013C
Call

```

Related information

- [z/OS Language Environment Programming Guide](#)
- [“ctest.h — Debug and diagnostics” on page 17](#)
- [“cdump\(\) — Request a main storage dump” on page 248](#)
- [“csnap\(\) — Request a condensed dump” on page 352](#)

cuserid() — Return character login of the user

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```

#define _XOPEN_SOURCE
#include <stdio.h>

char *cuserid(char *s);

```

General description

The `cuserid()` function generates a character representation of the name associated with the real or effective user ID of the process.

If `s` is a NULL pointer, this representation is generated in an area that may be overwritten by subsequent calls to `cuserid()`. A pointer to the area is returned. If `s` is not a NULL pointer, `s` is assumed to point to an array of at least `{L_cuserid}` bytes; the representation is deposited in this array. The symbolic constant `{L_cuserid}` is defined in `<stdio.h>` and has a value greater than 0.

Note:

This function and constant `L_cuserid` are kept for historical reasons. They were part of the Legacy Feature in Single UNIX Specification, Version 2, but have been withdrawn and are not supported as part of Single UNIX Specification, Version 3. New applications should use `getpwuid()` instead of `cuserid()`.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If `s` is not a NULL pointer, `cuserid()` returns `s`.

If `s` is not a NULL pointer and the login name cannot be found, the NULL byte `'\0'` will be placed at `*s`.

If `s` is a NULL pointer and the login name cannot be found, `cuserid()` returns a NULL pointer.

If *s* is a NULL pointer and the login name can be found, `cuserid()` returns the address of a buffer local to the calling thread containing the login name.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“geteuid\(\) — Get the effective user ID” on page 708](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“getpwnam\(\) — Access the user database by user name” on page 761](#)
- [“getpwuid\(\) — Access the user database by user ID” on page 764](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)

dbm_clearerr() — Clear database error indicator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>

int dbm_clearerr(DBM *db);
```

General description

The `dbm_clearerr()` function clears the error condition of the database. The argument *db* is a handle to a database previously obtained by `dbm_open()`. Note that this does not correct any problems with the database due to previous failures. It simply allows `dbm_` operations to proceed. The database may be in an inconsistent or damaged state.

Special behavior for z/OS UNIX Services: In a multithreaded environment, the database error indicator is global to all threads using the database handle. Thus, clearing the error indicator affects all threads using the database handle.

Returned value

The return value is unspecified by X/Open.

If successful, `dbm_clearerr()` returns 0.

If unsuccessful, `dbm_clearerr()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

Non-valid database descriptor specified.

Related information

- [“ndbm.h — ndbm database operations” on page 45](#)
- [“dbm_close\(\) — Close a database” on page 367](#)

- [“dbm_delete\(\) — Delete database record” on page 368](#)
- [“dbm_error\(\) — Check database error indicator” on page 369](#)
- [“dbm_fetch\(\) — Get database content” on page 369](#)
- [“dbm_firstkey\(\) — Get first key in database” on page 370](#)
- [“dbm_nextkey\(\) — Get next key in database” on page 371](#)
- [“dbm_open\(\) — Open a database” on page 373](#)
- [“dbm_store\(\) — Store database record” on page 374](#)

dbm_close() — Close a database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>

void dbm_close(DBM *db);
```

General description

The `dbm_close()` function closes a database. The `db` argument is the database handle returned by a previous call to `dbm_open()`.

Special behavior for z/OS UNIX Services: A `dbm_close()` function call removes access to the specified database handle to all threads within the process.

Returned value

`dbm_close()` returns no values.

Related information

- [“ndbm.h — ndbm database operations” on page 45](#)
- [“dbm_clearerr\(\) — Clear database error indicator” on page 366](#)
- [“dbm_delete\(\) — Delete database record” on page 368](#)
- [“dbm_error\(\) — Check database error indicator” on page 369](#)
- [“dbm_fetch\(\) — Get database content” on page 369](#)
- [“dbm_firstkey\(\) — Get first key in database” on page 370](#)
- [“dbm_nextkey\(\) — Get next key in database” on page 371](#)
- [“dbm_open\(\) — Open a database” on page 373](#)
- [“dbm_store\(\) — Store database record” on page 374](#)

dbm_delete() – Delete database record

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>

int dbm_delete(DBM *db, datum key);
```

General description

The `dbm_delete()` function deletes a record and its key from the database. The `db` argument specifies the database handle returned by a previous call to `dbm_open()`. The `key` argument identifies the record the program is deleting. The `key` datum must contain a `dptr` pointer to the key, and the key length in `dsize`.

After calling `dbm_delete()`, during a pass through the keys by `dbm_firstkey()` and `dbm_nextkey()`, the application positioning must be reset by calling `dbm_firstkey()`. If not, unpredictable results may occur including retrieval of the same key multiple times, or not at all.

File space is not physically reclaimed by a `dbm_delete()` operation. That is, the file size is not reduced. However, the space is available for reuse, subject to hashing.

Special behavior for z/OS UNIX Services: In a multithreaded environment, changes made to the database by a `dbm_delete()` operation affect all threads using the database handle. Thus, all other threads must also reset their positioning by using the `dbm_firstkey()` function before using `dbm_nextkey()`. A previously executed `dbm_fetch()` operation by **another** thread for the same `key` still has correct buffer pointers to the previous data. The `dbm_delete()` operation does not affect this. All other operations on other threads, such as `dbm_fetch()` to this (now) deleted `key` will fail.

Returned value

If successful, `dbm_delete()` returns 0.

If unsuccessful, `dbm_delete()` returns -1 and sets the error value in `errno`. Also, the database error indicator may be set.

Related information

- [“ndbm.h – ndbm database operations” on page 45](#)
- [“dbm_clearerr\(\) – Clear database error indicator” on page 366](#)
- [“dbm_close\(\) – Close a database” on page 367](#)
- [“dbm_error\(\) – Check database error indicator” on page 369](#)
- [“dbm_fetch\(\) – Get database content” on page 369](#)
- [“dbm_firstkey\(\) – Get first key in database” on page 370](#)
- [“dbm_nextkey\(\) – Get next key in database” on page 371](#)
- [“dbm_open\(\) – Open a database” on page 373](#)
- [“dbm_store\(\) – Store database record” on page 374](#)

dbm_error() – Check database error indicator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>

int dbm_error(DBM *db);
```

General description

The `dbm_error()` function returns the error condition of the database. The argument `db` is a handle to a database previously obtained by `dbm_open()`.

Special behavior for z/OS UNIX Services: In a multithreaded environment, the database error indicator is global to all threads using the database handle. Thus, the database error indicator may be set as a result of a database operation by another thread.

Returned value

`dbm_error()` returns 0 if the error condition is not set.

`dbm_error()` returns nonzero if the error condition is set.

Related information

- [“ndbm.h – ndbm database operations” on page 45](#)
- [“dbm_clearerr\(\) – Clear database error indicator” on page 366](#)
- [“dbm_close\(\) – Close a database” on page 367](#)
- [“dbm_delete\(\) – Delete database record” on page 368](#)
- [“dbm_fetch\(\) – Get database content” on page 369](#)
- [“dbm_firstkey\(\) – Get first key in database” on page 370](#)
- [“dbm_nextkey\(\) – Get next key in database” on page 371](#)
- [“dbm_open\(\) – Open a database” on page 373](#)
- [“dbm_store\(\) – Store database record” on page 374](#)

dbm_fetch() – Get database content

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>

datum dbm_fetch(DBM *db, datum key);
```

General description

The `dbm_fetch()` function reads a record from the database. The argument *db* is a handle to a database previously obtained by `dbm_open()`. The argument *key* is a datum that has been initialized by the application program to the value of the key that matches the key of the record the program is fetching. A datum is a structure that consists of two members, `dptr` and `dsize`. The member `dptr` is a char pointer to an array of data that is `dsize` bytes in length. (The data is arbitrary binary data and is not NULL-terminated.)

The `dptr` is valid only until the next `dbm_` operation by this thread.

Special behavior for z/OS UNIX Services: In a multithreaded environment, the `dbm_fetch()` function returns a `dptr` in the datum structure to a data area that is thread-specific. This data area is not affected by other threads operations on the database, with the exception of a `dbm_close()` operation, which invalidates the *datum*.

Returned value

If successful, `dbm_fetch()` returns the datum containing a pointer to the data content `dptr`, and the data length `dsize`.

If unsuccessful, `dbm_fetch()` returns a NULL pointer in `dptr` and returns the error value in `errno`. Also, the database error indicator may be set.

Related information

- [“ndbm.h – ndbm database operations” on page 45](#)
- [“dbm_clearerr\(\) – Clear database error indicator” on page 366](#)
- [“dbm_close\(\) – Close a database” on page 367](#)
- [“dbm_delete\(\) – Delete database record” on page 368](#)
- [“dbm_error\(\) – Check database error indicator” on page 369](#)
- [“dbm_firstkey\(\) – Get first key in database” on page 370](#)
- [“dbm_nextkey\(\) – Get next key in database” on page 371](#)
- [“dbm_open\(\) – Open a database” on page 373](#)
- [“dbm_store\(\) – Store database record” on page 374](#)

dbm_firstkey() – Get first key in database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>
```

```
datum dbm_firstkey(DBM *db);
```

General description

The `dbm_firstkey()` function returns the first key in the database. The argument *db* is a handle to a database previously obtained by `dbm_open()`. Since the keys are arbitrary binary data, the order of key return by `dbm_firstkey()` and `dbm_nextkey()` does not reflect any lexical ordering. In addition, the return order does not reflect record insertion ordering. All keys can be retrieved from the database by executing a loop such as:

```
for (key = dbm_firstkey(db); key.dptr != NULL; key = dbm_nextkey(db))
```

That is, establish positioning to the beginning by use of the `dbm_firstkey()` function, then loop doing `dbm_nextkey()` function calls until a NULL `dptr` is returned in the *datum*.

The returned `dptr` is valid only until the next `dbm_` operation by this thread.

Special behavior for z/OS UNIX Services: In a multithreaded environment, the `dbm_firstkey()` function returns a pointer to data that is thread-specific. In addition, each thread maintains its own positioning information for `dbm_nextkey()` operations. However, other threads making modifications to the database, for example using `dbm_store()` or `dbm_delete()` can cause unpredictable results for threads executing `dbm_nextkey()`, including keys retrieved multiple times or not at all. The application must reset positioning to the beginning using `dbm_firstkey()` if another thread has done a modification to the database.

Returned value

If successful, `dbm_firstkey()` returns the *datum* containing a pointer to the key `dptr`, and the key length `dsize`.

If unsuccessful, `dbm_firstkey()` returns a NULL pointer in `dptr` and returns the error value in `errno`. Also, the database error indicator may be set.

Related information

- [“ndbm.h — ndbm database operations” on page 45](#)
- [“dbm_clearerr\(\) — Clear database error indicator” on page 366](#)
- [“dbm_close\(\) — Close a database” on page 367](#)
- [“dbm_delete\(\) — Delete database record” on page 368](#)
- [“dbm_error\(\) — Check database error indicator” on page 369](#)
- [“dbm_fetch\(\) — Get database content” on page 369](#)
- [“dbm_nextkey\(\) — Get next key in database” on page 371](#)
- [“dbm_open\(\) — Open a database” on page 373](#)
- [“dbm_store\(\) — Store database record” on page 374](#)

dbm_nextkey() — Get next key in database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>

datum dbm_nextkey(DBM * db);
```

General description

The `dbm_nextkey()` function returns the next key in the database. The argument *db* is a handle to a database previously obtained by `dbm_open()`. Since the keys are arbitrary binary data, the order of key return by `dbm_firstkey()` and `dbm_nextkey()` does not reflect any lexical ordering. In addition, the return order does not reflect record insertion ordering. All keys can be retrieved from the database by executing a loop such as:

```
for (key = dbm_firstkey(db); key.dptr !=NULL; key = dbm_nextkey(db))
```

That is, establish positioning to the beginning by use of the `dbm_firstkey()` function, then loop doing `dbm_nextkey()` function calls until a NULL `dptr` is returned in *datum*.

The returned `dptr` is valid only until the next `dbm_` operation by this thread.

Special behavior for z/OS UNIX Services: In a multithreaded environment, the `dbm_nextkey()` function returns a pointer to data that is thread-specific. In addition, each thread maintains its own positioning information for `dbm_nextkey()` operations. However, other threads making modifications to the database, for example using `dbm_store()` or `dbm_delete()` can cause unpredictable results for threads executing `dbm_nextkey()`, including keys retrieved multiple times or not at all. The application must reset positioning to the beginning using `dbm_firstkey()` if another thread has done a modification to the database.

Returned value

If successful, `dbm_nextkey()` returns the *datum* containing a pointer to the key `dptr`, and the key length `dsize`.

If unsuccessful, `dbm_nextkey()` returns a NULL pointer in `dptr` and returns the error value in `errno`. Also, the database error indicator may be set.

Related information

- [“ndbm.h — ndbm database operations” on page 45](#)
- [“dbm_clearerr\(\) — Clear database error indicator” on page 366](#)
- [“dbm_close\(\) — Close a database” on page 367](#)
- [“dbm_delete\(\) — Delete database record” on page 368](#)
- [“dbm_error\(\) — Check database error indicator” on page 369](#)
- [“dbm_fetch\(\) — Get database content” on page 369](#)
- [“dbm_firstkey\(\) — Get first key in database” on page 370](#)
- [“dbm_open\(\) — Open a database” on page 373](#)
- [“dbm_store\(\) — Store database record” on page 374](#)

dbm_open() – Open a database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>

DBM *dbm_open(const char *file, int open_flags, mode_t file_mode);
```

General description

The `dbm_open()` function opens a database. The *file* argument is the path name of the database, not including the filename suffix (the part after the `.`). The database is stored in two files. One file is a directory containing a bit map of blocks in use and has `.dir` as its suffix. The second file contains all the data and has `.pag` as its suffix. The *open_flags* argument has the same meaning as the *flags* argument of `open()` except that a database opened for write-only access opens the files for read and write access. The *file_mode* argument has the same meaning as the third argument of `open()`.

The number of records that can be stored in the database is limited by the file space available for the `.dir` and `.pag` files, and by the underlying key hashing. If multiple keys hash to the same 32 bit hash value, the number of keys for that hash value is limited to the amount of data (key sizes plus content sizes plus overhead) that can be stored in a single logical block of 1024 bytes.

Special behavior for z/OS UNIX Services: In a multithreaded environment, the `dbm_` functions have both POSIX process wide and thread-specific characteristics. z/OS UNIX services provide the following multithreaded behavior:

1. A database handle returned by the `dbm_open()` function is a process wide resource. This means that multiple threads within the process can access the database using the same database handle.
2. Each thread using a given database handle has its own positioning information for `dbm_firstkey()` and `dbm_nextkey()` operations. This means that multiple threads can each be executing a `dbm_nextkey()` loop.
3. Each thread using a given database handle has its own buffering for `dbm_fetch()` operations. This means that a pointer to a keys content (as returned by `dbm_fetch()`) remains valid, even if other threads modify the database.
4. Database modifications are automatically reflected to all of the threads using the same database handle. For example, if a thread adds a key/data pair using `dbm_store()`, a `dbm_fetch()` of that key by another thread will be successful.
5. Operations which modify the database, such as `dbm_store()` and `dbm_delete()`, can cause unpredictable results to threads executing `dbm_nextkey()`. If a database modification is done, all threads should reset positioning using a `dbm_firstkey()` call before executing `dbm_nextkey()`.
6. A `dbm_close()` operation removes access to the database for all threads that use the database handle.
7. Multiple `dbm_open()` operations, whether by a single thread, multiple threads within a process, or by multiple processes are permitted, but for read access only. No protection is provided for database modification, and modification can result in unpredictable results, including database destruction.

Returned value

If successful, `dbm_open()` returns a pointer to the database descriptor.

If unsuccessful, dbm_open() returns a NULL pointer and stores the error value in errno.

Related information

- [“ndbm.h — ndbm database operations” on page 45](#)
- [“dbm_clearerr\(\) — Clear database error indicator” on page 366](#)
- [“dbm_close\(\) — Close a database” on page 367](#)
- [“dbm_delete\(\) — Delete database record” on page 368](#)
- [“dbm_error\(\) — Check database error indicator” on page 369](#)
- [“dbm_fetch\(\) — Get database content” on page 369](#)
- [“dbm_firstkey\(\) — Get first key in database” on page 370](#)
- [“dbm_nextkey\(\) — Get next key in database” on page 371](#)
- [“dbm_store\(\) — Store database record” on page 374](#)
- [“open\(\) — Open a file” on page 1157](#)

dbm_store() — Store database record

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ndbm.h>

int dbm_store(DBM *db, datum key, datum content, int store_mode);
```

General description

The dbm_store() function writes a record to a database. The *db* argument specifies the database handle returned by a previous call to dbm_open(). The *key* argument identifies the record the program is deleting. The *key* datum must contain a dptr pointer to the key, and the key length in dsize. The argument *content* is a datum. that describes the data record being stored. record the program is writing. The *content* datum. contains a dptr pointer to the data, and the data length in dsize.

The argument *store_mode* controls whether dbm_store() replaces a already existing record that has the same key. The *store_mode* argument may be any one of the following set of symbols defined in the <ndbm.h> include file:

DBM_INSERT

Do not add the *key* and *content* pair if the *key* already exists in the database. If the *key* doesn't already exist, add the new *key* and *content* pair.

DBM_REPLACE

Replace the *key* and *content* pair in the database with the new pair if the *key* already exists. If the *key* doesn't already exist, add the new *key* and *content* pair.

After calling dbm_store(), during a pass through the keys by dbm_firstkey() and dbm_nextkey(), the application positioning must be reset by calling dbm_firstkey(). If not, unpredictable results may occur including retrieval of the same key multiple times, or not at all.

The number of records that can be stored in the database is limited by the file space available for the .dir and .pag files, and by the underlying key hashing. If multiple keys hash to the same 32 bit hash value, the number of keys for that hash value is limited to the amount of data (key sizes plus content sizes plus overhead) that can be stored in a single logical block of 1024 bytes.

Special behavior for z/OS UNIX Services: In a multithreaded environment, changes made to the database by a `dbm_store()` operation affect all threads using the database handle. Thus, all other threads must also reset their positioning by using the `dbm_firstkey()` function before using `dbm_nextkey()`. A previously executed `dbm_fetch()` operation by **another** thread for the same *key* still has correct buffer pointers to the previous data. The `dbm_store()` operation does not affect this. All other operations, such as `dbm_fetch()` or `dbm_delete()`, will automatically have access to the new *key* and *content* pair.

Returned value

If successful, `dbm_store()` returns 0. If `DBM_INSERT` is specified, and the *key* already exists, `dbm_store()` returns 1.

If unsuccessful, `dbm_store()` returns -1 and sets `errno` to one of the following values. Also, the database error indicator may be set.

Error Code Description

EFBIG

Seek/Write operation failed attempting to write new block. This `errno` is not part of the `errno` set described by X/Open for this function. You may be able to store other *key* and *content* pairs when the *key* hashes to a different value.

ENOSPC

key plus *content* plus block overhead does not fit into a block. This `errno` is not part of the `errno` set described by X/Open for this function. The *key* plus *content* underlying data lengths need be less or equal to 1012 bytes in length.

Related information

- [“ndbm.h — ndbm database operations” on page 45](#)
- [“dbm_clearerr\(\) — Clear database error indicator” on page 366](#)
- [“dbm_close\(\) — Close a database” on page 367](#)
- [“dbm_delete\(\) — Delete database record” on page 368](#)
- [“dbm_error\(\) — Check database error indicator” on page 369](#)
- [“dbm_fetch\(\) — Get database content” on page 369](#)
- [“dbm_firstkey\(\) — Get first key in database” on page 370](#)
- [“dbm_nextkey\(\) — Get next key in database” on page 371](#)
- [“dbm_open\(\) — Open a database” on page 373](#)

decabs() — Decimal absolute value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | C only | |

Format

```
#include <decimal.h>

decimal(n,p) decabs(decimal(n,p) pdec);
```

General description

The built-in function decabs() accepts a decimal type expression as an argument and returns the absolute value of the decimal argument, in the same decimal type as the argument. The function does not change the content of the argument.

The parameter *n* can be any integral value between 1 and DEC_DIG. The parameter *p* can be any integral value between 0 and DEC_PRECISION, although it must be less than or equal to *n*. DEC_DIG and DEC_PRECISION are defined inside decimal.h.

If the content of the given argument is not in native packed decimal format, behavior is undefined.

Example

CELEBD01

```
/* CELEBD01 */
#include <decimal.h>

decimal(10,2) p1, p2;
int main(void) {
    p2 = -1234.56d;
    p1 = decabs(p2);
    printf("p1 = %D(10,2), p2 = %D(10,2)\n", p1, p2);
    return(0);
}
```

Output

```
p1 = 1234.56, p2 = -1234.56
```

Related information

- [“decimal.h — Fixed-point decimal operations” on page 18](#)
- [“decchk\(\) — Check for valid decimal types” on page 376](#)
- [“decfix\(\) — Fix up a nonpreferred sign variable” on page 378](#)

decchk() — Check for valid decimal types

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | C only | |

Format

```
#include <decimal.h>

int decchk(decimal(n,p) pdec);
```

General description

The built-in function `decchk()` accepts a decimal type expression as an argument and returns a status value of type `int`.

The status can be interpreted as follows:

DEC_VALUE_OK

A valid decimal representation value (including the less-preferred but valid sign, A-F).

DEC_BAD_NIBBLE

The leftmost half-byte is not 0 in a decimal type number that has an even number of digits. For example, 123 is stored in `decimal(2,0)`. If such a number is packed, then it is used.

DEC_BAD_DIGIT

Digits not allowed (not 0-9). If such a number is packed, then it is used.

DEC_BAD_SIGN

Sign not allowed (not A-F). If such a number is packed, then it is used.

The function return status can be masked to return multiple status.

The parameter *n* can be any integral value between 1 and `DEC_DIG`. The parameter *p* can be any integral value between 0 and `DEC_PRECISION`, although it must be less than or equal to *n*. `DEC_DIG` and `DEC_PRECISION` are defined inside `decimal.h`.

If the content of the given argument is not in native packed decimal format, the behavior is undefined.

Example

```
#include <decimal.h>

decimal(10,2) p1;
char mem2[3] = { 0x12, 0x34, 0x5c }; /* bad half-byte */
char mem3[3] = { 0x02, 0xa4, 0x5c }; /* bad digit */
char mem4[3] = { 0x02, 0x34, 0x56 }; /* bad sign */
char mem5[3] = { 0x12, 0xa4, 0x56 }; /* bad half-byte, digit and sign */
decimal(4,0) *pp2;
decimal(4,0) *pp3;
decimal(4,0) *pp4;
decimal(4,0) *pp5;
int main(void) {
    p1 = 123456.78d;
    pp2 = (decimal(4,0) *) mem2;
    pp3 = (decimal(4,0) *) mem3;
    pp4 = (decimal(4,0) *) mem4;
    pp5 = (decimal(4,0) *) mem5;

    if (decchk(p1) == DEC_VALUE_OK) {
        printf("p1 is a valid decimal representation value.\n");
    }
    if (decchk(*pp2) == DEC_BAD_NIBBLE) {
        printf("pp2 points to a bad half-byte value!\n");
    }
    if (decchk(*pp3) == DEC_BAD_DIGIT) {
        printf("pp3 points to an illegal digit!\n");
    }
    if (decchk(*pp4) == DEC_BAD_SIGN) {
        printf("pp4 points to an illegal sign!\n");
    }
    /* The wrong way ----- */
    if (decchk(*pp5) == DEC_BAD_SIGN) {
        printf("YOU SHOULD NOT GET THIS!!!!\n");
    }
    /* The right way ----- */
    if ((decchk(*pp5) & DEC_BAD_SIGN) == DEC_BAD_SIGN) {
        printf("pp5 points to an illegal sign!\n");
    }
    return(0);
}
```

Output

```
p1 is a valid decimal representation value.  
pp2 points to a bad half-byte value!  
pp3 points to an illegal digit!  
pp4 points to an illegal sign!  
pp5 points to an illegal sign!
```

Related information

- [“decimal.h — Fixed-point decimal operations” on page 18](#)
- [“decabs\(\) — Decimal absolute value” on page 375](#)
- [“decfix\(\) — Fix up a nonpreferred sign variable” on page 378](#)

decfix() — Fix up a nonpreferred sign variable

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | C only | |

Format

```
#include <decimal.h>  
  
decimal(n,p) decfix(decimal(n,p) pdec);
```

General description

The built-in function `decfix()` accepts a decimal type expression as an argument and returns a decimal value that has the same type and same value as the argument with the correct preferred sign. The function does not change the content of the argument.

The parameter *n* can be any integral value between 1 and `DEC_DIG`. The parameter *p* can be any integral value between 0 and `DEC_PRECISION`, though it must be less than or equal to *n*. `DEC_DIG` and `DEC_PRECISION` are defined inside `decimal.h`.

If the content of the given argument is not in native packed decimal format, behavior is undefined.

Example

```
#include <decimal.h>  
  
char *ptr;  
char mem[3] = { 0x01, 0x23, 0x4A };  
decimal(4,0) *pp;  
decimal(4,0) p;  
int main(void) {  
    pp = (decimal(4,0) *) mem;  
    p = decfix(*pp);  
    ptr = (char *) p;  
    printf("Before decfix : %X%X%X\n", mem[0], mem[1], mem[2]);  
    printf("After decfix : %X%X%X\n", ptr[0], ptr[1], ptr[2]);  
    return(0);  
}
```

Output

```
Before decfix : 1234A  
After decfix : 1234C
```

Related information

- [“decimal.h — Fixed-point decimal operations” on page 18](#)
- [“decabs\(\) — Decimal absolute value” on page 375](#)
- [“decchk\(\) — Check for valid decimal types” on page 376](#)

DeleteWorkUnit() — Delete a WLM work unit

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/_wlm.h>

int DeleteWorkUnit(wlmetok_t *enclavetoken);
```

General description

The DeleteWorkUnit() function provides the ability for an application to delete a WLM work unit.

***enclavetoken**

Points to a work unit enclave token that was returned from a call to CreateWorkUnit() or ContinueWorkUnit().

Returned value

If successful, DeleteWorkUnit() returns 0.

If unsuccessful, DeleteWorkUnit() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM delete enclave failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class if it is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) — Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) — Connect to WLM as a work manager” on page 318](#)

- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“ExtractWorkUnit\(\) — Extract enclave service” on page 463](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

difftime(), difftime64() — Compute time difference

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

Format of the difftime() function:

```
#include <time.h>

double difftime(time64_t time2, time_t time1);
```

Format of the difftime64() function:

```
#define _LARGE_TIME_API
#include <time.h>

double difftime64(time64_t time2, time64_t time1);
```

General description

Computes the difference in seconds between *time2* and *time1*, which are calendar times returned by `time()`.

The `difftime()` function returns the difference between two calendar times as a double. The return value is hexadecimal floating-point or IEEE Binary Floating-Point format depending on the floating-point mode of the thread invoking `difftime()`. The `difftime()` function uses `__isBFP()` to determine which floating-point format (hexadecimal floating-point or IEEE Binary Floating-Point) to return on the invoking thread.

The function `difftime64()` will behave exactly like `difftime()` except it will support calendar times beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Returned value

Returns the elapsed time in seconds from *time1* to *time2* as a double.

Example

CELEBD04

```

/* CELEBD04

   This example shows a timing application using &diff..
   The example calculates how long, on average, it takes a
   user to input some data to the program.

*/
#include <time.h>
#include <stdio.h>

int main(void)
{
    time_t start, finish;
    int i, n, num;
    int answer;

    printf("11 x 55 = ? Enter your answer below\n");
    time(&start);
    scanf("%d",&answer);
    time(&finish);
    printf("You answered %s in %.0f seconds.\n",
           answer == 605 ? "correctly" : "incorrectly",
           difftime(finish,start));
}

```

Output

```

11 x 55 = ? Enter your answer below
605
You answered correctly in 20 seconds

```

Related information

- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)
- [“time\(\),time64\(\) — Determine current UTC time” on page 1865](#)

dirfd() — Get directory stream file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 4 POSIX.1-2008 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <dirent.h>

int dirfd(DIR *dirp);
```

General description

The `dirfd()` function returns the file descriptor that is associated with the directory stream *dirp*. This file descriptor must be closed by a call to `closedir()`. If any attempt is made to close the file descriptor or to modify the state of the associated description, the behavior is undefined unless `closedir()`, `readdir()`, `readdir_r()`, `rewinddir()`, or `seekdir()` is used.

Returned value

If successful, `dirfd()` returns a file descriptor, which is a non-negative integer. If unsuccessful, `dirfd()` returns -1 and sets `errno` to the following value:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EINVAL
The *dirp* argument does not refer to a valid directory stream.

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)

dirname() — Report the parent directory of a path name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <libgen.h>

char *dirname(char *path);
```


General description

The `dirname()` function takes a pointer to a character string that contains a path name, and returns a pointer to a string that is a path name of the parent directory of that file. Trailing '/' characters in the path are not counted as part of the path.

If *path* does not contain a '/' then `dirname()` returns a pointer to the string ".". If *path* is a NULL pointer or points to an empty string, `dirname()` returns a pointer to the string ".".

The `dirname()` function may modify the string pointed to by *path*.

Examples:

| Input String | Output String |
|--------------|---------------|
| "/usr/lib" | "/usr" |
| "/usr/" | "/" |
| "usr" | ." |
| "/" | "/" |
| "." | ." |
| ".." | ." |

Returned value

If successful, `dirname()` returns a pointer to a string that is the parent directory of *path*.

If *path* is a NULL pointer or points to an empty string, `dirname()` returns a pointer to a string ".".

There are no `errno` values defined.

Related information

- [“libgen.h — Pattern matching functions” on page 34](#)
- [“basename\(\) — Return the last component of a path name” on page 210](#)

__discarddata() — Release pages backing virtual storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | OS/390 V2R10 |

Format

```
#include <stdlib.h>

int __discarddata(void *addr, size_t size);
```

General description

The `__discarddata()` function is used to release segments of real storage backing virtual storage. Segments backing virtual storage are released beginning at location *addr* for a length of *size*. For AMODE 31, the *addr* must begin on a page (4K) boundary and *size* must be a multiple of 4K. For AMODE 64, the *addr* must begin on a segment (1 MB) boundary and *size* must be a multiple of 1 MB.

Returned value

If successful, `__discarddata()` returns 0.

If unsuccessful, because *addr* does not begin on a page (4K) boundary or *size* is not a multiple of 4K, `__discarddata()` returns -1.

There are no `errno` values defined.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)

DisconnectServer() — Disconnect from WLM server

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/__wlm.h>

int DisconnectServer(unsigned long *conn_tkn);
```

AMODE 64

```
#include <sys/__wlm.h>

int DisconnectServer(unsigned int *conn_tkn);
```

General description

The `DisconnectServer` function provides the ability for an application to disconnect from WLM.

***conn_tkn**

Specifies the connect token that represents the WLM connection that is to be disconnected.

Returned value

If successful, `DisconnectServer()` returns 0.

If unsuccessful, `DisconnectServer()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM disconnect failed. Use `__errno2()` to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class if it is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) — Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) — Connect to WLM as a work manager” on page 318](#)
- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“CreateWorkUnit\(\) — Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“ExtractWorkUnit\(\) — Extract enclave service” on page 463](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

div() — Calculate quotient and remainder

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <stdlib.h>

div_t div(int numerator, int denominator);
div_t div(long numerator, long denominator);    /* C++ only */
```

C++ TR1 C99:

```
#define _TR1_C99
#include <inttypes.h>
imaxdiv_t div(intmax_t numerator, intmax_t denominator);

#define _TR1_C99
#include <stdlib.h>
lldiv_t div(long long numerator, long long denominator);
```

General description

Calculates the quotient and remainder of the division of *numerator* by *denominator*.

Special behavior for C++: For C++ applications, `div()` is also overloaded for the type `long`.

Returned value

Returns a structure of type `div_t`, containing both the quotient `int quot` and the remainder `int rem`. This structure is defined in `stdlib.h`. If the returned value cannot be represented, the behavior of `div()` is

undefined. If *denominator* is 0, the same exception will be raised as if you divided by 0. That is, you get the error CEE3209S (Fixed-point divide exception).

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“ldiv\(\) — Compute quotient and remainder of integral division” on page 943](#)

dlclose() — Close a dlopen() object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R6 |

Format

```
#define _UNIX03_SOURCE
#include <dlfcn.h>

int dlclos(void *handle);
```

General description

Inform the system that the dynamic link library (DLL) referenced by a *handle* returned from a previous `dlopen()` invocation is no longer needed by the application. Once a DLL has been closed, an application should assume that its symbols and the symbols of any dependent DLLs are no longer available to `dlsym()`.

Returned value

NULL is returned if the referenced DLL was successfully closed. If the DLL could not be closed, or if *handle* does not refer to an open DLL, a non-zero value will be returned.

Usage notes

1. A conforming application should use a *handle* returned from a `dlopen()` invocation only within a given scope, bracketed by the `dlopen()` and `dlclose()` operations. The value of a *handle* must be treated as an opaque object by the application, used only in calls to `dlsym()` and `dlclose()`.
2. DLLs that are loaded explicitly, that is with `dlopen()`, and are not freed with a corresponding call to `dlclose()`, are freed automatically at enclave termination in LIFO sequence.
3. Non-local C++ static destructors defined in a DLL are executed only once, when the DLL program object is deleted from memory.
4. More detailed diagnostic information is available through `dlerror()`, the `_EDC_DLL_DIAG` environment variable, and the Language Environment DLL Failure control block (CEEDLLF) chain.
5. This function is not available under SPC, MTF and CSP environments.

Example

The following example illustrates use of `dlopen()` and `dlclose()`:

```
...
/* Open a dynamic library and then close it ... */
#include <dlfcn.h>
```

```
void *mylib;
int eret;

mylib = dlopen("mylib.so", RTLD_LOCAL | RTLD_LAZY);
...
eret = dlclose(mylib);
...
```

Related information

- [“dlerror\(\) — Get diagnostic information” on page 387](#)
- [“dlopen\(\) — Gain access to a dynamic link library” on page 388](#)
- [“dlsym\(\) — Obtain the address of a symbol from a dlopen\(\) object” on page 390](#)
- [“dlfcn.h — Define macros for use with dlopen\(\)” on page 18](#)

dlerror() — Get diagnostic information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R6 |

Format

```
#define _UNIX03_SOURCE
#include <dlfcn.h>

void dlerror(void);
```

General description

Returns a null-terminated character string (with no trailing <newline>) that describes the last error that occurred while processing a DLL by `dlopen()`, `dlsym()`, or `dlclose()`. NULL is returned if no errors have occurred since the last invocation of `dlerror()`.

Note: `dlerror()` is thread safe, so the information returned describes the last error that occurred on that thread

Returned value

A null-terminated character string is returned if successful, otherwise NULL is returned.

Usage notes

1. Messages returned by `dlerror()` reside in a static buffer that is overwritten on each new call to `dlerror()` on that thread.
2. Application code should not write to this buffer.
3. Programs wishing to preserve an error message should make their own copies of that message.
4. This function is not available under SPC, MTF and CSP environments.

Example

The following example prints out the last dynamic linking error:

```
...
#include <dlfcn.h>
```

```
char *errstr;

errstr = dlerror();
if (errstr != NULL)
    printf ("A dynamic linking error occurred: (%s)\n", errstr);
...
```

Related information

- [“dlclose\(\) — Close a dlopen\(\) object” on page 386](#)
- [“dlopen\(\) — Gain access to a dynamic link library” on page 388](#)
- [“dlsym\(\) — Obtain the address of a symbol from a dlopen\(\) object” on page 390](#)
- [“dlfcn.h — Define macros for use with dlopen\(\)” on page 18](#)

dlopen() — Gain access to a dynamic link library

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R6 |

Format

```
#define _UNIX03_SOURCE
#include <dlfcn.h>

void *dlopen(const char *file, int mode);
```

General description

Makes the dynamic link library (DLL) specified by *file* available to the calling program.

If the *file* argument contains a single slash ("/"), it is used as the z/OS UNIX file system path name for the DLL. If the environment variable LIBPATH is set, each directory that is listed is searched for the DLL. Otherwise, the current directory is searched.

Note: Searching for a DLL in the z/OS UNIX file system is case-sensitive.

If the *file* argument begins with two slashes ("//"), then an attempt is made to load the DLL from the caller's MVS load library search order (in order: STEPLIB/JOBLIB, LPA, Link List). The DLL name must be 8 characters or less, and is converted to uppercase.

If the *file* argument doesn't begin with one slash (/) or two slashes (//, and doesn't contain a single slash (/) anywhere in the name, then it is ambiguous as to where the DLL resides.

- If the POSIX(ON) runtime option is specified, then the z/OS UNIX file system is searched first for the DLL, and if not found, the MVS load library is searched.
- If the POSIX(OFF) runtime option is specified, then the MVS load library is searched first for the DLL, and if not found, the z/OS UNIX file system is searched.

Under the CICS environment, the search sequence for DLL load modules is the same as that used for dynamically loaded CICS modules. Loading DLLs from the z/OS UNIX file system is not supported under CICS.

For more information about how DLLs are loaded and how the search sequence is used, see the topic about [loading DLLs in z/OS Language Environment Programming Guide](#).

A successful call returns a handle, which the caller can use on subsequent calls to `dlsym()` and `dlclose()`. The value of this handle should not be interpreted in any way by the caller.

Only a single copy of a DLL is brought into the address space, even if invoked multiple times for the same DLL, and even if different values of the *file* parameter are used to reference the same DLL.

The *mode* parameter describes how dlopen() operates on a file regarding the processing of dependent DLLs and the scope of visibility of the symbols that are provided within *file*. If a *file* is specified in multiple invocations, *mode* is interpreted at each invocation. The *mode* is a bitwise-OR of the values specified.

Mode Values

When a DLL is loaded, it might contain implicit references to symbols in another "dependent" DLL, whose addresses are not known until that DLL is loaded. These implicit references must be relocated before the symbols can be accessed, which means loading the DLL containing the references. The *mode* parameter governs when these relocations (and loads) take place and might have the following values:

Value

Description

RTLD_LAZY

When possible, the loading of dependent DLLs, and resolution of symbols contained therein, might be deferred until the first reference to one of those symbols. This is the default behavior.

Note: After *RTLD_NOW* is specified, all relocations will have been completed causing additional *RTLD_NOW* operations to be redundant and any further *RTLD_LAZY* operations irrelevant.

RTLD_NOW

Load all dependent DLLs for the DLL being loaded and resolve all symbols before returning. This may include zero or more levels of nested dependent DLLs, all of which are loaded at this time.

RTLD_GLOBAL

Allows symbols in the DLL being loaded to be visible when resolving symbols through the global symbol object that was opened with dlopen(NULL,0). All dependent DLLs are always implicitly loaded as if RTLD_GLOBAL had been specified. This is the default behavior.

RTLD_LOCAL

Prevents symbols in the DLL being loaded to be visible when resolving symbols through the global symbol object that was opened with dlopen(NULL,0). All dependent DLLs of this DLL continue to be implicitly loaded as if RTLD_GLOBAL had been specified.

If a subsequent call is made for this same DLL with a *mode* of *RTLD_GLOBAL*, then the DLL will maintain the *RTLD_GLOBAL* status regardless of any previous or future specification of *RTLD_LOCAL*, as long as the DLL remains loaded (see dlclose()).

If the value of *file* is NULL, dlopen() returns a "global symbol object" *handle*. This object provides access (via dlsym()) to the symbols exported from:

- The main application and dependent DLLs for the main application that were loaded at program start-up, and
- The set of DLLs loaded using dlopen() with the *RTLD_GLOBAL* flag. This set of DLLs can change dynamically as other DLLs are opened and closed.

Symbols introduced by the call to dlopen() for a DLL, and available through dlsym(), are those which are exported by the DLL. Typically such symbols will be those identified by a #pragma export in C, or with the EXPORTALL compile option. For details on how to specify exported data and functions, for C/C++ as well as other languages, see the topic about building a simple DLL in [z/OS Language Environment Programming Guide](#).

Returned value

NULL is returned if:

- *file* cannot be found or opened for reading.
- *file* is not in correct DLL executable format.
- an error occurred during the process of loading *file*, or relocating its symbolic references.

Error Code
Description

- 253**
A 64-bit caller tried to load a 31-bit DLL.
- 254**
A 31-bit caller tried to load a 64-bit DLL.

Usage notes

- 1. For details on how to create and use DLLs, see [z/OS Language Environment Programming Guide](#).
- 2. The AMODE of the application must be the same as the AMODE of the DLL.
- 3. Non-local C++ static constructors defined in a DLL are executed only once, when the DLL program object is physically loaded into memory.
- 4. More detailed diagnostic information is available through dlerror(), the _EDC_DLL_DIAG environment variable, and the Language Environment DLL Failure control block (CEEDLLF) chain.
- 5. This function is not available under SPC, MTF and CSP environments.

Example

The following example illustrates use of dlopen() and dlclose():

```
...
/* Open a dynamic library and then close it ... */
#include <dlfcn.h>

void *mylib;
int eret;

mylib = dlopen("mylib.so", RTLD_LOCAL | RTLD_LAZY);
...
eret = dlclose(mylib);
...
```

Related information

- [“dlclose\(\) — Close a dlopen\(\) object” on page 386](#)
- [“dlerror\(\) — Get diagnostic information” on page 387](#)
- [“dlsym\(\) — Obtain the address of a symbol from a dlopen\(\) object” on page 390](#)
- [“dlfcn.h — Define macros for use with dlopen\(\)” on page 18](#)

dlsym() — Obtain the address of a symbol from a dlopen() object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R6 |

Format

```
#define _UNIX03_SOURCE
#include <dlfcn.h>

void *dlsym(void *__restrict__ handle, const char *__restrict__ name);
```


General description

Obtains the address of a symbol defined within a dynamic link library (DLL) made accessible through a `dlopen()` call. The *handle* argument is the value returned from a call to `dlopen()` (which has not been released by a call to `dlclose()`), and *name* is the symbol's name as a character string.

The DLL that was loaded by `dlopen()` will be searched for the named symbol. If the symbol is not found in that DLL, then the dependent DLLs of that DLL will be searched, followed by any dependents of those, and continuing in a breadth-first manner until the named symbol is found or all dependent DLLs have been searched. This search order determines how duplicate symbols in different DLLs will be found, although the order in which dependent DLLs at the same level are searched is indeterminate.

Also note that a search of dependent DLLs by `dlsym()` will not result in unloaded dependent DLLs being loaded. Only the dependent DLLs loaded as part of the call to `dlopen()` will be searched. If the full set of dependent DLLs need to be available to subsequent calls to `dlsym()`, make sure the DLL is opened with the `RTLD_NOW` load flag. It is indeterminate which dependent DLLs are loaded when `RTLD_LAZY` is specified

The only exception to this is the global symbol object obtained via a `dlopen(NULL,0)` call, in which case all DLLs (excluding those opened with `RTLD_LOCAL`) are searched in the order in which they were loaded.

Returned value

NULL is returned:

- If *handle* does not refer to a valid DLL opened by `dlopen()`,
- or the named symbol (*name*) cannot be found within any of the DLLs associated with *handle*.

Usage notes

1. The named symbol can be either an exported data item or function.
2. DLLs are enclave level resources. See [z/OS XL C/C++ Programming Guide](#) for more information about the use of DLLs in a multi-threaded environment.
3. C++ symbol names should be passed to `dlsym()` in mangled form; `dlsym()` does not perform any name mangling on behalf of the calling application.
4. More detailed diagnostic information is available through `dlerror()`, the `_EDC_DLL_DIAG` environment variable, and the Language Environment DLL Failure control block (CEEDLLF) chain.
5. This function is not available under SPC, MTF and CSP environments.

Example

The following example shows how `dlopen()` and `dlsym()` can be used to access either function or data objects. For simplicity, error checking has been omitted.

```
void    *handle;
int      *iptr, (*fptr)(int);

/* open the needed object */
handle = dlopen("/usr/home/me/libfoo.so", RTLD_LOCAL | RTLD_LAZY);

/* find the address of function and data objects */
fptr = (int (*)(int))dlsym(handle, "my_function");
iptr = (int *)dlsym(handle, "my_object");

/* invoke function, passing value of integer as a parameter */
(*fptr)(*iptr);
```

Related information

- [“dlclose\(\) — Close a dlopen\(\) object” on page 386](#)
- [“dlerror\(\) — Get diagnostic information” on page 387](#)

- [“dlopen\(\) — Gain access to a dynamic link library”](#) on page 388
- [“dlfcn.h — Define macros for use with dlopen\(\)”](#) on page 18

dllfree() — Free the supplied dynamic link library

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <dll.h>

int dllfree(dllhandle *dllHandle);
```

General description

Frees the supplied dynamic link library (DLL). It also deletes the DLL from memory if the handle was the last handle accessing the DLL.

Returned value

dllfree() returns one of the following values and set errno if the return code is not 0:

Value

Meaning

0

Successful

1

The dllHandle supplied is NULL or dllhandle is inactive.

2

There are no DLLs to be deleted.

3

DLL is not physically deleted because there is another dllHandle for this DLL or there is an implicit reference to the DLL.

4

Delete of DLL failed.

5

No match is found for input dllHandle.

6

Not supported under this environment.

7

C++ destructors are currently running for this DLL. A dllfree() is already in progress.

8

The handle passed to dllfree() was obtained from dlopen().

Usage notes

1. This function is deprecated; use dlclose() instead.
2. This function is not available under SPC, MTF and CSP environments.
3. If a DLL is loaded implicitly, it cannot be deleted with dllfree(). For more information on the implicit use of DLLs, see [z/OS XL C/C++ Programming Guide](#).

4. DLLs that are loaded explicitly, that is with `dllload()`, and are not freed with a corresponding call to `dllfree()`, are freed automatically at enclave termination in LIFO sequence.
5. C++ destructors are executed only once, when the DLL load module is physically deleted.
6. More detailed diagnostic information is available through the `_EDC_DLL_DIAG` environment variable, and the Language Environment DLL Failure control block (CEEDLLF) chain. The default action is to issue an error message to the Language Environment message file.

Example

CELEBDL4

```

/* CELEBDL4

The following example shows how to use dllfree() to free the
dllhandle for the DLL stream.

*/
#include <stdio.h>
#include <dll.h>
#include <stdlib.h>

int main() {
    dllhandle *handle;
    char *name="stream";
    int (*fptr1)(int);
    int (*fptr)(int);
    int *ptr_var1;
    int *ptr_var;
    int rc=0;

    handle = dllload(name); /* call to stream DLL */
    if (handle == NULL) {
        perror("failed on call to stream DLL");
        exit(-1);
    }

    fptr1 = (int (*)(int)) dllqueryfn(handle,"f1");
    /* retrieving f1 function */
    if (fptr == NULL) {
        perror("failed on retrieving f1 function");
        exit(-2);
    }

    ptr_var = dllqueryvar(handle,"var1");
    /* retrieving var1 variable */
    if (ptr_var1 == NULL) {
        perror("failed on retrieving var1 variable");
        exit(-3);
    }

    rc = fptr(*ptr_var1); /* execute DLL function f1 */
    *ptr_var++;           /* increment value of var1 */

    rc = dllfree(handle); /* freeing handle to stream DLL */
    if (rc != 0) {
        perror("failed on dllfree call");
    }
    return (0);
}

```

Related information

- [“dll.h — DLL functions” on page 19](#)
- [“dlclose\(\) — Close a dlopen\(\) object” on page 386](#)
- [“dllload\(\) — Load the dynamic link library and connect it to the application” on page 394](#)
- [“dllqueryfn\(\) — Obtain a pointer to a dynamic link library function” on page 396](#)
- [“dllqueryvar\(\) — Obtain a pointer to a dynamic link library variable” on page 397](#)

dllload() – Load the dynamic link library and connect it to the application

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <dll.h>

dllhandle *dllload(const char *dllName);
```

General description

Note: This function is deprecated; use `dlopen()` instead.

Loads the dynamic link library (DLL) into memory (if it has not been previously loaded) and connects it to the application. The function that called the DLL receives a handle that uniquely identifies the requested DLL for subsequent explicit requests for that DLL.

A different handle is returned for each successful call to `dllload()`. A DLL is physically loaded only once, even though there may be many calls to `dllload()`. C++ constructors are run only once.

The `dllName` identifies the DLL load module to be loaded. It must be a character string terminated with the NULL character. The DLL module must be a member of a PDS or an alias to it.

Note: The AMODE of the application must be the same as the AMODE of the DLL load module.

This function is not available under SPC, MTF and CSP environments.

The `dllName` identifies the DLL load to be loaded. It must be a character string, terminated with the NULL character. The DLL module must be a member of a PDS or an alias to it.

If the file argument contains a single slash ('/'), it is used as the z/OS UNIX file system path name for the DLL. If the environment variable LIBPATH is set, each directory listed will be searched for the DLL. Otherwise, the current directory will be searched.

Note: Searching for a DLL in the z/OS UNIX file system is case-sensitive.

If the file argument begins with two slashes ('//'), then an attempt is made to load the DLL from the caller's MVS load library search order (in order: STEPLIB/JOBLIB, LPA, Link List). The DLL name must be eight characters or less, and is converted to uppercase. Note that qualified DLL names are not supported and the MVS load library search order is used (for example, update or use STEPLIB to specify any number of qualifiers to be included in the search).

If the file argument doesn't begin with one or two slashes ('/' or '//'), and doesn't contain a single slash ('/') anywhere in the name, then it is ambiguous as to where the DLL resides.

- If the POSIX(ON) runtime option is specified, then the z/OS UNIX file system is searched first for the DLL, and if not found, the MVS load library is searched.
- If the POSIX(OFF) runtime option is specified, then the MVS load library is searched first for the DLL, and if not found, the z/OS UNIX file system is searched.

Under CICS environment, the search sequence for DLL load modules is the same as that used for dynamically loaded CICS modules. Loading DLLs from the z/OS UNIX file system is not supported under CICS.

For more information about how DLLs are loaded and how the search sequence is used, see the topic about [loading DLLs in z/OS Language Environment Programming Guide](#).

Returned value

If successful, `dllload()` returns a unique handle that identifies the DLL.

If unsuccessful, `dllload()` returns `NULL` and may set `errno` to one of the following values:

Error Code

Description

253

A 64-bit caller tried to load a 31-bit DLL.

254

A 31-bit caller tried to load a 64-bit DLL.

ELEFENCE

The DLL contains a member language that is not supported on this version of the operating system.

ENOEXEC

The new process image file has the appropriate access permission but is not in the proper format.

Note: Reason codes further qualify the `errno`. For most of the reason codes, see [z/OS UNIX System Services Messages and Codes](#).

For `ENOEXEC`, the reason codes are:

| Reason Code | Explanation |
|-------------|---|
| X'xxxx0C27' | The target z/OS UNIX file system file is not in the correct format to be an executable file. |
| X'xxxx0C31' | The target z/OS UNIX file system file is built at a level that is higher than that supported by the running system. |

Usage notes

1. More detailed diagnostic information is available through the `_EDC_DLL_DIAG` environment variable, and the Language Environment DLL Failure control block (CEEDLLF) chain.

Example

CELEBDL1

```
/* CELEBDL1

The following example shows how to invoke dllload() functions
from a simple C application.

*/
#include <stdio.h>
#include <dll.h>

main() {
    dllhandle *handle;
    char *name="stream";

    handle = dllload(name);
    if (handle == NULL) {
        perror("failed on dllload of stream DLL");
        exit(-1);
    }
}
```

Related information

- [“dll.h — DLL functions” on page 19](#)
- [“dlopen\(\) — Gain access to a dynamic link library” on page 388](#)
- [“dlfree\(\) — Free the supplied dynamic link library” on page 392](#)

- [“dllqueryfn\(\) — Obtain a pointer to a dynamic link library function” on page 396](#)
- [“dllqueryvar\(\) — Obtain a pointer to a dynamic link library variable” on page 397](#)

dllqueryfn() — Obtain a pointer to a dynamic link library function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <dll.h>

void (*dllqueryfn(dllhandle *dllHandle, const char *funcName))();
```

General description

Note: This function is deprecated; use `dlsym()` instead.

Obtains a pointer to a dynamic link library (DLL) function (`funcName`). It uses the `dllHandle` returned from a previous successful call to `dllload()` for input. `funcName` represents the name of an exported function from the DLL. It must be a character string terminated with the NULL character.

This function is not available under the SPC, MTF, and CSP environments.

Returned value

If successful, `dllqueryfn()` returns a pointer to a function, `funcName`, that can be used to invoke the desired function in a DLL.

If unsuccessful, `dllqueryfn()` returns NULL and sets `errno`.

Usage notes

1. More detailed diagnostic information is available through the `_EDC_DLL_DIAG` environment variable, and the Language Environment DLL Failure control block (CEEDLLF) chain.

Example

CELEBDL2

```
/* CELEBDL2

The following example shows how to use dllqueryfn() to obtain
a pointer to a function, f1 that is in DLL load module stream.

*/
#include <stdio.h>
#include <dll.h>

main() {
    dllhandle *handle;
    char *name="stream";
    int (*fptr1)();

    handle = dllload(name);
    if (handle == NULL) {
        perror("failed on dllload of stream DLL");
        exit(-1);
    }

    fptr1 = (int (*)( )) dllqueryfn(handle,"f1");
    if (fptr1 == NULL) {
```

```

        perror("failed on retrieving f1 function");
        exit (-2);
    }
}

```

Related information

- [“dll.h – DLL functions” on page 19](#)
- [“dllfree\(\) – Free the supplied dynamic link library” on page 392](#)
- [“dllload\(\) – Load the dynamic link library and connect it to the application” on page 394](#)
- [“dllqueryvar\(\) – Obtain a pointer to a dynamic link library variable” on page 397](#)

dllqueryvar() – Obtain a pointer to a dynamic link library variable

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```

#include <dll.h>

void* dllqueryvar(dllhandle *dllHandle, const char *varName);

```

General description

Obtains a pointer to a dynamic link library (DLL) variable (*varName*). It uses the *dllHandle* returned from a previous successful call to *dllload()* for input. *varName* represents the name of an exported variable from the DLL. It must be a character string terminated with the NULL character.

This function is not available under SPC, MTF and CSP environments.

Returned value

If successful, *dllqueryvar()* returns a pointer to a variable in the storage of the DLL.

If unsuccessful, *dllqueryvar()* returns NULL and sets *errno*.

Usage notes

1. More detailed diagnostic information is available through the `_EDC_DLL_DIAG` environment variable, and the Language Environment DLL Failure control block (CEEDLLF) chain.

Example

CELEBDL3

```

/* CELEBDL3

The following example shows how to use dllqueryvar() to obtain a
pointer to a variable, var1, that is in DLL load module stream.

*/
#include <stdio.h>
#include <dll.h>

int main() {
    dllhandle *handle;
    char *name="stream";
    int (*fptr1)(int);

```

```

int *ptr_var1;
int rc=0;

handle = dlopen(name);
if (handle == NULL) {
    perror("failed on dlopen of stream DLL");
    exit(-1);
}

fptr1 = (int (*)(int)) dlsym(handle,"f1");
/* retrieving f1 function */
if (fptr1 == NULL) {
    perror("failed on retrieving f1 function");
    exit(-2);
}

ptr_var1 = dlsym(handle,"var1");
if (ptr_var1 == NULL) {
    perror("failed on retrieving var1 variable");
    exit(-3);
}
}

```

Related information

- [“dll.h — DLL functions” on page 19](#)
- [“dlclose\(\) — Free the supplied dynamic link library” on page 392](#)
- [“dlopen\(\) — Load the dynamic link library and connect it to the application” on page 394](#)
- [“dlsym\(\) — Obtain a pointer to a dynamic link library function” on page 396](#)

dn_comp() — Resolver domain name compression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```

#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int dn_comp(const char *exp_dn, u_char *comp_dn, int length,
            u_char **dnptrs, u_char **lastdnptr);

```

General description

The `dn_comp()` function compresses the domain name `exp_dn` and stores it in `comp_dn`. The size of the compressed name is returned or -1 if there were errors. The size of the array pointed to by `comp_dn` is given by `length`. The compression uses an array of pointers `dnptrs` to previously-compressed names in the current message. The first pointer points to the beginning of the message and the list ends with NULL. The limit to the array is specified by `lastdnptr`.

A side effect of `dn_comp()` is to update the list of pointers for labels inserted into the message as the name is compressed. If `dnptr` is NULL, names are not compressed. If `lastdnptr` is NULL, the list of labels is not updated.

Note: The `dn_comp()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support” on page 2123](#) for details.

Returned value

If successful, `dn_comp()` returns the size of the compressed name.

If unsuccessful, `dn_comp()` returns -1 to report the error, when the name to be compressed was not found before the end of the buffer was reached.

There are no documented `errno` values.

Related information

- [“arpa/nameser.h — Construct and inspect DNS requests” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“resolv.h — IP Address Resolution” on page 57](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“dn_expand\(\) — Resolver domain name expansion” on page 399](#)
- [“dn_find\(\) — Resolver domain name find” on page 400](#)
- [“dn_skipname\(\) — Resolver domain name skipping ” on page 401](#)
- [“res_init\(\) — Domain name resolver initialization” on page 1440](#)
- [“res_mkquery\(\) — Make resolver query for domain name servers” on page 1442](#)
- [“res_query\(\) — Resolver query for domain name servers” on page 1443](#)
- [“res_querydomain\(\) — Build domain name and resolver query ” on page 1445](#)
- [“res_search\(\) — Resolver query for domain name servers” on page 1446](#)
- [“res_send\(\) — Send resolver query for domain name servers” on page 1447](#)

dn_expand() — Resolver domain name expansion

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int dn_expand(const u_char *msg, const u_char *eomorig,
              const u_char *comp_dn, char *exp_dn, int length);
```

General description

The `dn_expand()` function expands the compressed domain name *comp_dn* to a full domain name. The compressed name is contained in a query or reply message; *msg* is a pointer to the beginning of the message. The expanded name is placed in the buffer indicated by *exp_dn* which is of size *length*. The size of the expanded name is returned or -1 if there was an error.

Note: The `dn_expand()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, dn_expand() returns the size of the expanded name.

If unsuccessful, dn_expand() returns -1 to report the error, when the name to be expanded was not found before the end of the buffer was reached.

There are no documented errno values.

Related information

- [“arpa/nameser.h — Construct and inspect DNS requests” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“resolv.h — IP Address Resolution” on page 57](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“dn_comp\(\) — Resolver domain name compression” on page 398](#)
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- [“res_init\(\) — Domain name resolver initialization” on page 1440](#)
- [“res_mkquery\(\) — Make resolver query for domain name servers” on page 1442](#)
- [“res_query\(\) — Resolver query for domain name servers” on page 1443](#)
- [“res_querydomain\(\) — Build domain name and resolver query ” on page 1445](#)
- [“res_search\(\) — Resolver query for domain name servers” on page 1446](#)
- [“res_send\(\) — Send resolver query for domain name servers” on page 1447](#)

dn_find() — Resolver domain name find

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int dn_find(u_char *exp_dn, u_char *msg, u_char **dnptrs, u_char **lastdnptr);
```

General description

The dn_find() function will search for the expanded name *exp_dn* in the list of previously compressed names *dnptrs*.

dnptrs is the pointer to the first name in the list, not the pointer to the start of the message. The limit to the array is specified by *lastdnptr*.

Note: The dn_find() function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, `dn_find()` returns the offset of the expanded name *exp_dn* found in the message.

If unsuccessful, `dn_find()` returns -1 to report the error, when the name was not found before the end of the list was reached.

There are no documented `errno` values.

Related information

- [“arpa/nameser.h — Construct and inspect DNS requests” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“resolv.h — IP Address Resolution” on page 57](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“dn_comp\(\) — Resolver domain name compression” on page 398](#)
- [“dn_expand\(\) — Resolver domain name expansion” on page 399](#)
- [“dn_skipname\(\) — Resolver domain name skipping ” on page 401](#)
- [“res_init\(\) — Domain name resolver initialization” on page 1440](#)
- [“res_mkquery\(\) — Make resolver query for domain name servers” on page 1442](#)
- [“res_query\(\) — Resolver query for domain name servers” on page 1443](#)
- [“res_querydomain\(\) — Build domain name and resolver query ” on page 1445](#)
- [“res_search\(\) — Resolver query for domain name servers” on page 1446](#)
- [“res_send\(\) — Send resolver query for domain name servers” on page 1447](#)

dn_skipname() — Resolver domain name skipping

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int dn_skipname(const u_char *comp_dn, u_char *eom);
```

General description

The `dn_skipname()` function skips the compressed domain name *comp_dn* and returns the position in the answer buffer that follows the *comp_dn* compressed domain name. If the information supplied in *comp_dn* is not a compressed domain name, -1 is returned to report the error.

Note: The `dn_skipname()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, `dn_skipname()` returns the position in the answer buffer that follows the *comp_dn* compressed domain name.

If unsuccessful, `dn_skipname()` returns -1 to report the error, when the name to be skipped was not found before the end of the buffer was reached.

There are no documented `errno` values.

Related information

- [“arpa/nameser.h — Construct and inspect DNS requests” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“resolv.h — IP Address Resolution” on page 57](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
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- [“res_query\(\) — Resolver query for domain name servers” on page 1443](#)
- [“res_querydomain\(\) — Build domain name and resolver query ” on page 1445](#)
- [“res_search\(\) — Resolver query for domain name servers” on page 1446](#)
- [“res_send\(\) — Send resolver query for domain name servers” on page 1447](#)

dprintf() — Print to a file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <stdio.h>

int dprintf(int fd, const char *restrict format, ...);
```

General description

`dprintf()` is exact analogs of `fprintf()` and `vfprintf()`, except that `dprintf()` outputs to a file descriptor *fd* instead of to a `stdio` stream.

Returned value

If successful, `dprintf()` returns the number of characters output. The ending NULL character is not counted.

If unsuccessful, `dprintf()` returns a negative and `errno` is set to indicate the error.

Related information

- “fprintf(), printf(), sprintf() — Format and write data” on page 593
- “vprintf() — Format and print data to stdout” on page 1974

drand48() — Pseudo-random number generator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

double drand48(void);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrand48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The functions drand48() and erand48() return nonnegative, double-precision, floating-point values, uniformly distributed over the interval [0.0,1.0). These functions have been extended so that the returned value will be in the proper floating-point format (hexadecimal or IEEE) based on the floating-point mode of the invoking thread.

The functions lrand48() and nrand48() return nonnegative, long integers, uniformly distributed over the interval [0,2**31).

The functions mrand48() and jrand48() return signed long integers, uniformly distributed over the interval [-2**31,2**31).

The drand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \quad n \geq 0$$

The initial values of X, a, and c are:

```
X(0) = 1
a    = 5deece66d (base 16)
c    = b          (base 16)
```

C/370 provides storage to save the most recent 48-bit integer value of the sequence, X(i). This storage is shared by the drand48(), lrand48() and mrand48() functions. The value, X(n), in this storage may be reinitialized by calling the lcong48(), seed48() or srand48() function. Likewise, the values of a and c, may be changed by calling the lcong48() function. Thereafter, whenever the seed48() or srand48() function is called to change X(n), the initial values of a and c are also reestablished.

Special behavior for z/OS UNIX Services: You can make the drand48() function and other functions in the drand48 family thread-specific by setting the environment variable _RAND48 to the value THREAD before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested, and the drand48() function is called from thread t, the drand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(t,i), for the thread t. The sequence of values for a thread is generated according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t))\text{mod}(2^{**}48) \qquad n \geq 0$$

The initial values of X(t), a(t) and c(t) for the thread t are:

$$\begin{aligned} X(t,0) &= 1 \\ a(t) &= 5deece66d \quad (\text{base } 16) \\ c(t) &= b \quad (\text{base } 16) \end{aligned}$$

C/370 provides storage which is specific to the thread t to save the most recent 48-bit integer value of the sequence, X(t,i), generated by the drand48(), lrand48() or mrand48() function. The value, X(t,n), in this storage may be reinitialized by calling the lcong48(), seed48() or srand48() function from the thread t. Likewise, the values of a(t) and c(t) for thread t may be changed by calling the lcong48() function from the thread. Thereafter, whenever the seed48() or srand48() function is called from the thread t to change X(t,n), the initial values of a(t) and c(t) are also reestablished.

Returned value

drand48() transforms the generated 48-bit value, X(n+1), to a double-precision, floating-point value on the interval [0.0,1.0) and returns this transformed value.

Special behavior for z/OS UNIX Services: If thread-specific behavior is requested for the drand48 family and rand48() is called on thread t, drand48() transforms the generated 48-bit value, X(t,n+1), to a double-precision, floating-point value on the interval [0.0,1.0) and returns this transformed value.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“erand48\(\) – Pseudo-random number generator” on page 430](#)
- [“__isBFP\(\) – Determine application floating-point format” on page 905](#)
- [“jrand48\(\) – Pseudo-random number generator” on page 927](#)
- [“lcong48\(\) – Pseudo-random number initializer” on page 939](#)
- [“lrand48\(\) – Pseudo-random number generator” on page 1013](#)
- [“mrand48\(\) – Pseudo-random number generator” on page 1108](#)
- [“nrand48\(\) – Pseudo-random number generator” on page 1153](#)
- [“seed48\(\) – Pseudo-random number initializer” on page 1470](#)
- [“srand48\(\) – Pseudo-random number initializer” on page 1705](#)

dup() – Duplicate an open file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int dup(int filde);
```

General description

Returns a new file descriptor that is the lowest numbered available descriptor. The new file descriptor refers to the same open file as *filde* and shares any locks that may be associated with *filde*.

The following operations are equivalent:

```
fd = dup(filde);
fd = fcntl(filde, F_DUPFD, 0);
```

For further information, see [“fcntl\(\) — Control open file descriptors”](#) on page 483.

Note: When *filde* is an XTI endpoint, the lowest numbered available file descriptor must not exceed 65535.

Returned value

If successful, `dup()` returns a new file descriptor.

If unsuccessful, `dup()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

filde is not a valid open file descriptor.

EMFILE

The process has already reached its maximum number of open file descriptors.

Example

CELEBD05

```
/* CELEBD05

   This example duplicates an open file descriptor, using dup().

*/
#define _POSIX_SOURCE
#include <errno.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

void print_inode(int fd) {
    struct stat info;
    if (fstat(fd, &info) != 0)
        fprintf(stderr, "fstat() error for fd %d: %s\n", fd, strerror(errno));
    else
        printf("The inode of fd %d is %d\n", fd, (int) info.st_ino);
}

main() {
    int fd;
    if ((fd = dup(0)) < 0)
        perror("&dupf error");
    else {
        print_inode(0);
        print_inode(fd);
        puts("The file descriptors are different but");
        puts("they point to the same file.");
        close(fd);
    }
}
```

```
    }
}
```

Output

```
The inode of fd 0 is 30
The inode of fd 3 is 30
The file descriptors are different but
they point to the same file.
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“close\(\) — Close a file” on page 293](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup2\(\) — Duplicate an open file descriptor to another” on page 406](#)
- [“exec functions” on page 442](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)

dup2() — Duplicate an open file descriptor to another

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int dup2(int fd1, int fd2);
```

General description

Returns a file descriptor with the value *fd2*. *fd2* now refers to the same file as *fd1*, and the file that was previously referred to by *fd2* is closed. The following conditions apply:

- If *fd2* is less than 0 or greater than OPEN_MAX, dup2() returns -1 and sets errno to EBADF.
- If *fd1* is a valid file descriptor and is equal to *fd2*, dup2() returns *fd2* without closing it; F_CLOEXEC is not cleared.
- If *fd1* is not a valid file descriptor, dup2() fails and does not close *fd2*.
- If a file descriptor does not already exist, dup2() can be used to create one, a duplicate of *fd1*. F_CLOEXEC is cleared in *fd2*.

Note: If *fd1* is an XTI endpoint, *fd2* must not exceed 65535.

Returned value

If successful, dup2() returns *fd2*.

If unsuccessful, `dup2()` returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|--------------|---|
| EBADF | <i>fd1</i> is not a valid file descriptor, or <i>fd2</i> is less than 0 or greater than OPEN_MAX . |
| EINTR | <code>dup2()</code> was interrupted by a signal. |

Example

CELEBD06

```
/* CELEBD06

   This example duplicates an open file descriptor, using dup2().

*/

#define _POSIX_SOURCE
#include <errno.h>
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

void print_inode(int fd) {
    struct stat info;
    if (fstat(fd, &info) != 0)
        fprintf(stderr, "fstat() error for fd %d: %s\n", fd, strerror(errno));
    else
        printf("The inode of fd %d is %d\n", fd, (int) info.st_ino);
}

main() {
    int fd;
    char fn[]="dup2.file";

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        print_inode(fd);
        if ((fd = dup2(0, fd)) < 0)
            perror("dup2() error");
        else {
            puts("After dup2()...");
            print_inode(0);
            print_inode(fd);
            puts("The file descriptors are different but they");
            puts("point to the same file which is different than");
            puts("the file that the second fd originally pointed to.");
            close(fd);
        }
        unlink(fn);
    }
}
```

Output

```
The inode of fd 3 is 3031
After dup2()...
The inode of fd 0 is 30
The inode of fd 3 is 30
The file descriptors are different but they
point to the same file which is different than
the file that the second fd originally pointed to.
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

- [“close\(\) — Close a file” on page 293](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“exec functions” on page 442](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)

dup3() — Duplicate an open file descriptor with flag setting

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <unistd.h>

int dup3(int oldfd, int newfd, int flags);
```

General description

The interface of `dup3()` is the same as `dup2()` except that:

- The caller can force the close-on-exec flag to be set for the new file descriptor by specifying `O_CLOEXEC` in `flags`.
- If `oldfd` equals `newfd`, `dup3()` fails with the error `EINVAL`.

Returned value

If successful, `dup3()` returns the new file descriptor.

If unsuccessful, `dup3()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

`oldfd` is not an open file descriptor, or `newfd` is out of the allowed range for file descriptors.

EINTR

`dup3()` is interrupted by a signal, or `flags` contain an invalid value, or `oldfd` is equal to `newfd`.

EMFILE

The per-process limit on the number of open file descriptors is reached.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“close\(\) — Close a file” on page 293](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“open\(\) — Open a file” on page 1157](#)

dynalloc() — Allocate a data set

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <dynit.h>

int dynalloc(__dyn_t *dyn_parms);
```

General description

The `dynalloc()` function dynamically allocates a MVS data set using the MVS SVC 99 service and by building an SVC 99 parameter list based on parameters specified in `dyn_parms`. The `dynalloc()` function corresponds to verb code 1 for SVC 99. To use other SVC 99 verb codes, see [“svc99\(\) — Access supervisor call”](#) on page 1781.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The request block extension and the error message parameter list can be used to process the messages returned by SVC99 when an error occurs. To use this feature you must allocate and initialize these structures using the processes described in [z/OS MVS Programming: Authorized Assembler Services Guide](#). You must also make them available to the `dynalloc()` function by assigning their addresses to `__rbx` or `__emsgparmlist`.

Because additional fields have been added to the `__dyn_t` structure, you should recompile existing source code with the latest `dynit.h` header file to access the new fields.

Some values, such as `ddname` and `dsname`, will be converted to uppercase internally when they are used by the `dynalloc()` function.

To dynamically allocate an MVS data set, you should:

- Invoke the `dyninit()` function with a variable of type `__dyn_t`.
- Assign values to the appropriate fields in the variable that will satisfy the `svc99()` request.
- Invoke the `dynalloc()` function with this variable.

[Table 21](#) on page 409 describes the elements that are part of the `__dyn_t` structure, organized as defined in the structure.

Note: For more complete information about the `__dyn_t` structure elements, their usage and restrictions, see the description of SVC 99, the SVC 99 extension block, and the text unit keys and values in [z/OS MVS Programming: Authorized Assembler Services Guide](#) and [z/OS MVS JCL Reference](#).

Table 21. Description of `__dyn_t` Structure Elements

| Element | Text Unit Key | Text Unit Value | Type | Description |
|-----------------------|---------------|-----------------|--------|--|
| <code>__ddname</code> | DALDDNAM | 0001 | char * | ddname (maximum length of 8) ¹ . If 8 question marks (???????) are specified, it means that the request expects a system-generated ddname returned. |
| <code>__dsname</code> | DALDSNAM | 0002 | char * | Fully qualified data-set name (maximum length of 44) ¹ . |

Table 21. Description of __dyn_t Structure Elements (continued)

| Element | Text Unit Key | Text Unit Value | Type | Description |
|--------------|----------------|-----------------|--------|---|
| __sysout | DALYSOU | 0018 | char | The class of the system output data set (for example, SYSOUT=A). Values are: alphabetic character, or the macro __DEF_CLASS, to specify the default class. |
| __sysoutname | DALSPGNM | 0019 | char * | Program name for sysout. The __sysout field must be specified with this field (maximum length of 8) ¹ . |
| __member | DALMEMBR | 0003 | char * | Member of a partitioned data set to be allocated (maximum length of 8) ¹ . |
| __status | DALSTATS | 0004 | char | Data set status. Values are: __DISP_OLD, __DISP_NEW, __DISP_MOD, and __DISP_SHR, which are defined in dynit.h. |
| __normdisp | DALNDISP | 0005 | char | Specifies the normal disposition of a data set. Values are: __DISP_CATLG, __DISP_UNCATLG, __DISP_DELETE, and __DISP_KEEP, which are defined in dynit.h. |
| __condisp | DALCDISP | 0006 | char | Specifies the conditional disposition of a data set. Values are: __DISP_CATLG, __DISP_UNCATLG, __DISP_DELETE, and __DISP_KEEP, which are defined in dynit.h. |
| __unit | DALUNIT | 0015 | char * | Unit name of the device that the data set will (or does, if it already exists) reside on (maximum length of 8) ¹ . |
| __volser | DALVLSER | 0010 | char * | Volume serial number of the device a data set will (or does, if it already exists) reside on (maximum length of 6) ¹ . |
| __dsorg | DALDSORG | 003C | char | Data set organization of a data set. Values are: __DSORG_unknown Unknown __DSORG_VSAM VSAM __DSORG_GS Graphics __DSORG_PO Partitioned organization __DSORG_POU Partitioned organization unmovable __DSORG_DA Direct access __DSORG_DAU Direct access unmovable __DSORG_PS Physical sequential __DSORG_PSU Physical sequential unmovable. |
| __alcunit | DALCYL, DALTRK | 0008, 0007 | char | Unit of space allocation for a data set. Values are: __CYL and __TRK. To specify allocation units in blocks, use the field __avgbk. |
| __primary | DALPRIME | 000A | int | Primary space allocation for a data set. |
| __secondary | DALSECND | 000B | int | Secondary space allocation for a data set. |

Table 21. Description of `__dyn_t` Structure Elements (continued)

| Element | Text Unit Key | Text Unit Value | Type | Description |
|---------------------------|---------------|-----------------|----------------|--|
| <code>__dirblk</code> | DALDIR | 000C | int | Number of directory blocks for a partitioned data set. |
| <code>__avgblk</code> | DALBLKLN | 0009 | int | Specifies the unit of space allocation to be blocks and sets the average block length. |
| <code>__recfm</code> | | 0049 | short | <p>Record format of a data set. The following macros in <code>dynit.h</code> can be added together to determine the <code>__recfm</code> value:</p> <p>_M_ Machine-code printer-control characters</p> <p>_A_ ASA printer-control characters</p> <p>_S_ Standard fixed, spanned variable</p> <p>_B_ Blocked</p> <p>_D_ Variable ASCII records</p> <p>_V_ Variable</p> <p>_F_ Fixed</p> <p>_U_ Undefined</p> <p>_FB_ Fixed blocked</p> <p>_VB_ Variable blocked</p> <p>_FBS_ Fixed blocked standard</p> <p>_VBS_ Variable blocked standard.</p> <p>For example, to specify a <code>recfm</code> of FBA, set: <code>_recfm = _FB_ + _A_</code></p> |
| <code>__blksize</code> | DALBLKSZ | 0030 | short | Block size of a data set. |
| <code>__lrecl</code> | DALLRECL | 0042 | unsigned short | Record length of a data set. |
| <code>__volrefds</code> | DALLVLRDS | 0014 | char * | Fully qualified name of a cataloged data set to be used as a model for obtaining volume serial information (maximum length of 44) ¹ . |
| <code>__dcbrefds</code> | DALDCBDS | 002C | char * | Fully qualified name of a cataloged data set to be used as a model for obtaining DCB information (maximum length of 44) ¹ . |
| <code>__dcbrefdd</code> | DALLDCBDD | 002D | char * | ddname of a data set to be used as a model for obtaining DCB information (maximum length of 9) ¹ . For more information, see <i>z/OS MVS Programming: Authorized Assembler Services Guide</i> . |
| <code>__misc_flags</code> | | | unsigned char | Specifies the attributes. See “ Example ” on page 414 for instructions on how to specify the flags shown below using a logical (OR). |
| <code>__CLOSE</code> | DALCLOSE | 001C | unsigned char | (Flag) Deallocate data set when file is closed. |

Table 21. Description of __dyn_t Structure Elements (continued)

| Element | Text Unit Key | Text Unit Value | Type | Description |
|-------------|---------------|-----------------|-----------------------------|---|
| __RELEASE | DALRLSE | 000D | unsigned char | (Flag) Release unused space when file is closed. |
| __CONTIG | DALSPFRM | 000E | unsigned char | (Flag) Allocate space contiguously. |
| __ROUND | DALROUND | 000F | unsigned char | (Flag) Allocate space in whole cylinders when blocks are requested. |
| __TERM | DALTERM | 0028 | unsigned char | (Flag) Time-sharing terminal is to be used as I/O device. |
| __DUMMY_DSN | DALDUMMY | 0024 | unsigned char | (Flag) Dummy data set is to be allocated. |
| __HOLDQ | DALSHOLD | 0059 | unsigned char | (Flag) Hold queue routing for sysout data set. |
| __PERM | DALPERMA | 0052 | unsigned char | (Flag) Set permanent allocation attribute. |
| __password | DALPASSW | 0050 | char * | Password for a password-protected data set. The dsname field must be specified with this field (maximum length of 8) ¹ . |
| __miscitems | | | char * __ptr32 * __ptr32 | For all other text unit keys not available in __dyn_t, this pointer will let you specify an array of text unit strings. If you specify this field, you must turn the high bit on the last item (as in svc99()). Use the bitwise inclusive-OR (I) operand with the last item and the hexadecimal value 0x80000000. |
| __infocode | | | short | Returns the information code returned by the MVS dynamic allocation functions. For more information, see z/OS MVS Programming: Authorized Assembler Services Guide . |
| __errcode | | | short | Returns the error code returned by the MVS dynamic allocation functions. For more information, see z/OS MVS Programming: Authorized Assembler Services Guide . |
| __storclass | DALSTCL | 8004 | char * | Specifies the storage class of system managed storage. |
| __mgntclass | DALMGCL | 8005 | char * | Specifies the management class of a data set. |
| __dataclass | DALDACL | 8006 | char * | Specifies the data class of a data set. |
| __recorg | DALRECO | 800B | char | Specifies the record organization of a VSAM data set. Values are: __KS, __ES, __RR, __LS. |
| __keyoffset | DALKEYO | 800C | short | Specifies the key offset. The position of the first byte of the key in records of the specified VSAM data set. |
| __keylength | DALKYLEN | 0040 | short | Specifies the length in bytes of the keys used in the data set. |
| __refdd | DALREFD | 800D | char * | Specifies the name of the JCL DD statement from which the attributes are to be copied. For more information, see z/OS MVS Programming: Authorized Assembler Services Guide . |
| __like | DALLIKE | 800F | char * | Specifies the name of the model data set from which the attributes are to be copied. |

Table 21. Description of `__dyn_t` Structure Elements (continued)

| Element | Text Unit Key | Text Unit Value | Type | Description |
|-----------------------------|---------------|-----------------|---|--|
| <code>__dsntype</code> | DALDSNT | 8012 | char | Specifies the type attributes of a data set. Valid types include <code>__DSNT_BASIC</code> , <code>__DSNT_EXTREF</code> , <code>__DSNT_EXTREQ</code> , <code>__DSNT_HFS</code> , <code>__DSNT_LARGE</code> , <code>__DSNT_LIBRARY</code> , <code>__DSNT_PDS</code> , and <code>__DSNT_PIPE</code> . |
| <code>__pathname</code> | DALPATH | 8017 | char * | Pathname (maximum length is 255) ¹ . See z/OS UNIX System Services User's Guide for the pathname format. |
| <code>__pathopts</code> | DALPOPT | 8018 | int | Specifies file options for the z/OS UNIX file. Values are: <code>__PATH_OCREAT</code> , <code>__PATH_OAPPEND</code> , <code>__PATH_OEXCL</code> , <code>__PATH_ONOCTTY</code> , <code>__PATH_OTRUNC</code> , <code>__PATH_ONONBLOCK</code> , <code>__PATH_ORDONLY</code> , <code>__PATH_OWONLY</code> , <code>__PATH_ORDWR</code> . For information about the file options, see z/OS MVS JCL Reference . For information about DYNALLOC, see z/OS MVS Programming: Authorized Assembler Services Guide . |
| <code>__pathmode</code> | DALPMDE | 8019 | int | Specifies the file access attributes for the z/OS UNIX file. Values are: <code>__PATH_SIRUSR</code> , <code>__PATH_SIWUSR</code> , <code>__PATH_SIXUSR</code> , <code>__PATH_SIRWXU</code> , <code>__PATH_SIRGRP</code> , <code>__PATH_SIWGRP</code> , <code>__PATH_SIXGRP</code> , <code>__PATH_SIRWXG</code> , <code>__PATH_SIROTH</code> , <code>__PATH_SIWOTH</code> , <code>__PATH_SIXOTH</code> , <code>__PATH_SIRWXO</code> , <code>__PATH_SISUID</code> , <code>__PATH_SISGID</code> . For information on the file attributes, refer to z/OS MVS JCL Reference . For information on DYNALLOC, refer to z/OS MVS Programming: Authorized Assembler Services Guide . |
| <code>__pathndisp</code> | DALPNDS | 801A | char | Specifies the normal z/OS UNIX file disposition desired. It is either <code>__DISP_KEEP</code> or <code>__DISP_DELETE</code> . |
| <code>__pathcdisp</code> | DALPCDS | 801B | char | Specifies the abnormal z/OS UNIX file disposition desired. It is either <code>__DISP_KEEP</code> or <code>__DISP_DELETE</code> . |
| <code>__rbx</code> | | | <code>__S99rbx_t *</code> <code>__ptr32</code> | For users who make use of the Request Block Extension. |
| <code>__emsgparmlist</code> | | | <code>__S99emparms_t *</code> <code>__ptr32</code> | For users who want to process associated messages with the dynamic allocation. |
| <code>__rls</code> | DALRLS | 801C | char | Specifies the type of record level sharing (RLS) being done for a specific data set. The valid values are <code>__RLS_NRI</code> , <code>__RLS_CR</code> and <code>__RLS_CRE</code> . See z/OS XL C/C++ Programming Guide and z/OS DFSMS Using Data Sets for a description of these VSAM RLS/TVS access modes. |

¹ If an element exceeds its maximum allowable length, it is truncated to that length.

Special behavior for POSIX C: For POSIX C programs, allocations established by the `dynalloc()` function persist neither after an `exec` nor in the child process after `fork()`.

Special behavior for enhanced ASCII: When compiled ASCII, there is one input element in the `__dyn_t` structure that must contain EBCDIC text strings and there is a consideration to note with respect to retrieval of error messages related to a dynamic allocation failure. On input, any character data provided in `__miscitems` must be specified in the EBCDIC codeset. The `__dynalloc()` function does not decode

the text units and convert the character data. The text units are passed directly to the system. When `__emsgparmlist` is specified, indicating intent to retrieve error messages using the IEFDB476 service, it should be noted that all error messages returned by the service will be in the EBCDIC codeset.

Note: The `dynamalloc()` function has a dependency on the level of the enhanced ASCII extensions. See “Enhanced ASCII support” on page 2123 for details.

Special behavior for AMODE 64: The definitions in the `__dyn_t` structure are changed to require three of its pointer elements to be 32 bits wide. This is because the system services that work with these control structures require 31-bit addressable storage. The `__miscitems` are additional text units that are not already supported by elements of the `__dyn_t` structure. These are propagated by the `dynamalloc()` function directly to into an SVC 99 call. The `__rbx` is propagated by the `dynamalloc()` function directly into an SVC 99 call. The `__emsgparmlist` address is designed to be passed as a parameter to the IEFDB476 service, which is an AMODE 31 service, to retrieve messages associated with a dynamic allocation failure. The `__dyn_t` structure itself can be in 64-bit addressable storage. The `__dyn_t` structure must be initialized using the `dyninit()` macro defined in `dyninit.h` to ensure the proper "hidden" version indicator is used. Improper initialization of the `__dyn_t` structure will result in undefined behavior.

Returned value

If successful under the MVS environment, the `dynamalloc()` function returns 0.

If SVC 99 is not supported on your system, or if a text string passed to SVC 99 cannot be built from a field in `dyn_parms`, a negative value is returned.

The value -1 is returned if there is not sufficient storage to process all the text units. Otherwise, the return code is the value returned from SVC 99, and the error and information codes are found in those fields in `dyn_parms`.

For example, if you pass NULL to the `dynamalloc()` function, the return code is nonzero.

For more information about return codes, see [z/OS MVS Programming: Authorized Assembler Services Guide](#).

Example

CELEBD07

```
/* CELEBD07

   This example dynamically allocates a data set.

*/
#include <dynit.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define ZERO 0

int main () {
    __dyn_t ip;

    dyninit(&ip);

    ip.__ddname = "mydd";
    ip.__dsname = "PLIXXX.MY.DATASET";
    ip.__status = __DISP_NEW;
    ip.__normdisp = __DISP_CATLG;
    ip.__alcunit = __CYL;
    ip.__primary = 2;
    ip.__secondary = 1;
    ip.__dirblk = 1;
    ip.__misc_flags = __RELEASE & __CONTIG;
    ip.__dsorg = __DSORG_PO;
    ip.__recfm = __F + __B + __A;
    ip.__lrecl = 121;
    ip.__blksize = 12100;

    /* MYDD DD */
    /* DSN='PLIXXX.MY.DATASET' */
    /* DISP=(NEW,CATLG) */
    /* SPACE=(CYL,(2,1)), */
    /* RLSE,CONTIG) */
    /* DCB=(DSORG=PO, */
    /* RECFM=FBA, */
    /* LRECL=121, */
    /* BLKSIZE=12100) */
}
```



```

    if (dynalloc(&ip) != ZERO)
    {
        printf("Dynalloc failed with error code %d, info code %d\n",
               ip.__errcode, ip.__infocode);
    }
}

```

Related information

- [“dynit.h — Dynamic allocation routines” on page 19](#)
- [“dynfree\(\) — Deallocate a data set” on page 415](#)
- [“dyninit\(\) — Initialize __dyn_t structure” on page 416](#)
- [“svc99\(\) — Access supervisor call” on page 1781](#)

dynfree() — Deallocate a data set

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```

#include <dynit.h>

int dynfree(__dyn_t *dyn_parms);

```

General description

Dynamically deallocates a z/OS data set in accordance with the attributes defined in *dyn_parms*.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The only fields in `__dyn_t` that are used by `dynfree()` are:

```

char *__ddname
char *__dsname
char *__member
char *__pathname
char __normdisp
char __pathndisp
char **__miscitems

```

If any other fields are specified, they will be ignored. For more information on the `__dyn_t` structure, see [Table 21 on page 409](#)

To dynamically deallocate a data set on z/OS, you should:

- Invoke `dyninit()` with a variable of type `__dyn_t`
- Assign values to the appropriate fields that will satisfy the `svc99()` request
- Invoke `dynfree()` with this variable.

Note: The `dynfree()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful under z/OS, dynfree() returns 0.

If unsuccessful, dynfree() returns nonzero. dynfree() returns -1 if there is not sufficient storage to process all the text units.

Example

```
/* This example dynamically deallocates a data set.
 */
#include <dynit.h>

int main(void) {
:
:   __dyn_t ip;
:
:   dyninit(ip);
:   ip.__ddname = "mydd";
:
:   dynfree(&ip);
:
: }
```

Related information

- [“dynit.h — Dynamic allocation routines” on page 19](#)
- [“dynalloc\(\) — Allocate a data set” on page 409](#)
- [“dyninit\(\) — Initialize __dyn_t structure” on page 416](#)
- [“svc99\(\) — Access supervisor call” on page 1781](#)

dyninit() — Initialize __dyn_t structure

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <dynit.h>

int dyninit(__dyn_t *dyn_parms);
```

General description

Initializes the __dyn_t structure that is used to build the parameter lists that are passed to the dynalloc() function and the dynfree() function. If you do not initialize the __dyn_t structure using dyninit(), undefined behavior may result.

The __dyn_t structure is defined in the dynit.h header file. A description of the elements is found in [“dynalloc\(\) — Allocate a data set” on page 409](#).

Returned value

If successful under the [MVS environment](#), dyninit() returns 0.

If unsuccessful, dyninit() returns nonzero.

Example

CELEBD09

```
/* CELEBD09

   This example initializes a __dyn_t
   structure, called ip.

   */
#include <stdio.h>
#include <string.h>
#include <dynit.h>

main() {
    char dsn[]="USER.TEST.DATASET";
    __dyn_t ip;
    int ret;

    dyninit(&ip);
    ip.__ddname  = "TEST";
    ip.__dsname  = dsn;
    ip.__status  = __DISP_NEW;
    ip.__normdisp = __DISP_DELETE;
    ip.__alcunit = __TRK;
    ip.__primary  = 1;
    ip.__unit     = "SYSDA  ";

    if ((ret = dynalloc(&ip)) != 0)
        printf("dynalloc() ret=%d, error code %04x, info code %04x\n",
               ret, ip.__errcode, ip.__infocode);

    else {
        dyninit(&ip);
        ip.__ddname  = "TEST";

        if ((ret = dynfree(&ip)) != 0)
            printf("dynfree() ret=%d, error code %04x, info code %04x\n",
                   ret, ip.__errcode, ip.__infocode);

        else puts("success!");
    }
}
```

Related information

- [“dynit.h — Dynamic allocation routines” on page 19](#)
- [“dynalloc\(\) — Allocate a data set” on page 409](#)
- [“dynfree\(\) — Deallocate a data set” on page 415](#)
- [“svc99\(\) — Access supervisor call” on page 1781](#)

ecvt() — Convert double to string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

char *ecvt(double x, int ndigit, int *__restrict__ decpt, int *__restrict__ sign);
```

General description

The `ecvt()` function converts double floating-point argument values to floating-point output strings. The `ecvt()` function has been extended to determine the floating-point format (hexadecimal floating-point or IEEE Binary Floating-Point) of double argument values by using `__isBFP()`.

IBM z/OS C++ formatted output functions, including the `ecvt()` function, convert IEEE Binary Floating-Point infinity and NaN argument values to special infinity and NaN floating-point number output sequences. See [“fprintf Family of Formatted Output Functions”](#) on `fprintf()`, `printf()`, `sprintf()` — Format and write data for a description of the special infinity and NaN output sequences.

The `ecvt()` function converts `x` to a NULL-terminated string of `ndigit` digits (where `ndigit` is reduced to an unspecified limit determined by the precision of a double) and returns a pointer to the string. The high-order digit is nonzero, unless the value is 0. The low-order digit is rounded. The position of the radix character relative to the beginning of the string is stored in the integer pointed to by `decpt` (negative means left of the returned digits). The radix character is not included in the returned string. If the sign of the result is negative, the integer pointed to by `sign` is nonzero, otherwise it is 0.

The function returns a pointer to a buffer used only by the calling thread which may be overwritten by subsequent calls to `ecvt()`, [“fcvt\(\) — Convert double to string”](#) on page 493 and [“gcvt\(\) — Convert double to string”](#) on page 684.

If the converted value is out of range or is not representable, the function returns NULL.

Note: This function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `sprintf()` function is preferred for portability.

Returned value

If successful, `ecvt()` returns the character equivalent of `x` as specified above.

If unable to allocate the return buffer, or the conversion fails, `ecvt()` returns NULL.

Related information

- [“stdlib.h — Standard library functions”](#) on page 65
- [“fcvt\(\) — Convert double to string”](#) on page 493
- [“gcvt\(\) — Convert double to string”](#) on page 684
- [“__isBFP\(\) — Determine application floating-point format”](#) on page 905

encrypt() — Encoding function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <unistd.h>

void encrypt(char block[64], int edflag);
```

General description

The `encrypt()` function uses an array of 16 48-bit keys produced by the `setkey()` function to encode bytes specified by the *block* argument according to the Data Encryption Standard (DES) encryption algorithm or to decode argument bytes according to the DES decryption algorithm.

The *block* argument of `encrypt()` is an array of length 64 bytes containing only the bytes with numerical value of 0 and 1. The array is modified in place using keys produced by `setkey()`. If *edflag* is 0, the argument is encoded using the DES encryption algorithm. If *edflag* is 1 the argument is decoded using the DES decryption algorithm.

Special behavior for z/OS UNIX Services: The `encrypt()` function is thread-specific. Thus, for each thread from which the `encrypt()` function is called by a threaded application, the `setkey()` function must first be called from the thread to establish a DES key array for the thread.

Returned value

`encrypt()` returns no values.

Special behavior for z/OS UNIX Services: `encrypt()` will set `errno` to one of the following values:

Error Code

Description

EINVAL

64 byte input array contains bytes with values other than 0x00 or 0x01.

ENOMEM

If `setkey()` has not been called or failed to produce a DES key array for the thread from which `encrypt()` is called.

ENOSYS

If DES key array exists for thread from which `encrypt()` is called to decode data.

Note: Because `encrypt()` returns no values, applications wishing to check for errors should set `errno` to 0, call `encrypt()`, then test `errno` and, if it is nonzero, assume an error has occurred.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“__cnvblk\(\) — Convert block” on page 299](#)
- [“crypt\(\) — String encoding function” on page 347](#)
- [“setkey\(\) — Set encoding key” on page 1546](#)

endgrent() — Group database entry functions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <grp.h>

void endgrent(void),
struct group *getgrent (void);
void setgrent(void);
```

General description

The `getgrent()` function returns a pointer to the broken-out fields of a line in the group database, mapped by the **group** structure defined in the `<grp.h>` header file. Repeated calls to `getgrent()` return a pointer to the next **group** structure in the database, until End Of File (EOF), at which point a NULL pointer is returned. `setgrent()` interrupts this sequential search and rewinds the user database to the beginning, such that the next `getgrent()` returns a pointer to the first **group** structure. Use of `setgrent()` is optional after an End Of File (EOF), as the next `getgrent()` after end of file again returns a pointer to the first **group** structure. `endgrent()` is optionally used to close the user database when searching is complete.

The `setgrent()` function effectively rewinds the group database to allow repeated searches.
The `endgrent()` function may be called to close the group database when processing is complete.

Returned value

When first called, `getgrent()` returns a pointer to the next group structure in the group database. Upon subsequent calls it returns a pointer to a group structure, or it returns a NULL pointer on either End Of File (EOF) or an error. The return value may point to static data that is overwritten by each call.
There are no documented `errno` values.

Related information

- [“grp.h — Access group databases” on page 27](#)
- [“getgrgid\(\) — Access the group database by ID” on page 710](#)
- [“getgrgid_r\(\) — Get group database entry for a group ID” on page 711](#)
- [“getgrnam\(\) — Access the group database by name” on page 713](#)
- [“getgrnam_r\(\) — Search group database for a name” on page 714](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“getlogin_r\(\) — Get login name” on page 734](#)
- [“getpwent\(\) — Get user database entry” on page 761](#)
- [“getpwnam\(\) — Access the user database by user name” on page 761](#)
- [“getpwnam_r\(\) — Search user database for a name” on page 763](#)
- [“getpwuid\(\) — Access the user database by user ID” on page 764](#)
- [“getpwuid_r\(\) — Search user database for a user ID” on page 765](#)

endhostent() — Close the host information data set

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

void endhostent(void);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

void endhostent();
```

General description

The `endhostent()` function closes the local host tables, which contains information about known hosts.

You can use the **X_SITE** environment variable to specify different local host tables and override those supplied by the z/OS global resolver during initialization. For more information on these local host tables or the environment variables, see [z/OS Communications Server: IP Configuration Guide](#).

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Related information

- “[netdb.h — Network database operations](#)” on page 45
- “[gethostbyaddr\(\) — Get a host entry by address](#)” on page 718
- “[gethostbyname\(\) — Get a host entry by name](#)” on page 720
- “[gethostent\(\) — Get the next host entry](#)” on page 722
- “[sethostent\(\) — Open the host information data set](#)” on page 1534

endnetent() — Close network information data sets

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**X/Open:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

void endnetent();
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

void endnetent();
```

General description

The `endnetent()` function closes the `tcpip.HOSTS.ADDRINFO` data set. The `tcpip.HOSTS.ADDRINFO` data set contains information about known networks.

You can use the **X_ADDR** environment variable to specify a data set other than `tcpip.HOSTS.ADDRINFO`. For more information on these data sets and environment variables, see [z/OS Communications Server: IP Configuration Guide](#).

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“getnetbyaddr\(\) — Get a network entry by address” on page 741](#)
- [“getnetbyname\(\) — Get a network entry by name” on page 743](#)
- [“getnetent\(\) — Get the next network entry” on page 744](#)
- [“setnetent\(\) — Open the network information data set” on page 1556](#)

endprotoent() — Work with a protocol entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

void endprotoent(void);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

void endprotoent();
```

General description

The `endprotoent()` function closes the */etc/protocol* or the *tcpip.ETC.PROTO* data set, which contains information about the networking protocols (IP, ICMP, TCP, and UDP).

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“getprotobyname\(\) — Get a protocol entry by name” on page 757](#)
- [“getprotoent\(\) — Get the next protocol entry” on page 760](#)
- [“setprotoent\(\) — Open the protocol information data set” on page 1564](#)

endpwent() – User database functions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 z/OS UNIX | Both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <pwd.h>

void endpwent(void),
struct passwd *getpwent(void);
void setpwent(void);

#define _XPLATFORM_SOURCE 1
#include <pwd.h>
int getpwent_r(struct passwd *pwbuf, char *buf, size_t buflen, struct passwd **pwbufp);
```

General description

The `getpwent()` function returns a pointer to the broken-out fields of a line in the user database, which is mapped by the `passwd` structure that is defined in the `<pwd.h>` header file. The `passwd` structure is saved in a thread-specific storage that is reused in each call by the same thread. Repeated calls to `getpwent()` return a pointer to the next `passwd` structure in the database until End Of File (EOF), at which point a NULL pointer is returned.

`setpwent()` interrupts this sequential search and rewinds the user database to the beginning, such that the next `getpwent()` returns a pointer to the first `passwd` structure. Use of `setpwent()` is optional after an End Of File (EOF), as the next `getpwent()` after end of file again returns a pointer to the first `passwd` structure. `endpwent()` is optionally used to close the user database when searching is complete.

The `setpwent()` function effectively rewinds the user database to allow repeated searches.

The `endpwent()` function might be called to close the user database when processing is complete.

The `getpwent_r()` function is the reentrant version of `getpwent()`. The `passwd` structure that is returned as a pointer `pwbufp` is saved in the caller-supplied buffer `pwbuf`. The string fields that are associated with the `passwd` structure are saved in the caller-supplied buffer `buf` of size `buflen`.

Returned value

When first called, `getpwent()` returns a pointer to the next `passwd` structure in the user database. Upon subsequent calls, `getpwent()` returns a pointer to a `passwd` structure, or it returns a NULL pointer on either End Of File (EOF) or an error. The return value might point to static data that is overwritten by each call.

If unsuccessful, `getpwent()` sets `errno` to one of the following values:

Error Code

Description

EMVSSAF2ERR

The system authorization facility (SAF) or RACF Get GMAP service had an error.

EMVSSAFEXTRERR

The SAF or RACF RACROUTE EXTRACT service had an error.

If successful, `getpwent_r()` returns zero with `*pwbufp` set to the pointer of the passwd structure. If unsuccessful, `getpwent_r()` returns a non-zero value with `*pwbufp` set to NULL and sets `errno` to one of the following values:

Error Code
Description

EINVAL
Invalid parameter supplied.

EMVSSAF2ERR
The system authorization facility (SAF) or RACF Get GMAP service had an error.

EMVSSAFEXTRERR
The SAF or RACF RACROUTE EXTRACT service had an error.

ENOENT
No more entries.

ERANGE
Insufficient buffer space supplied. Try again with larger buffer.
`endpwent()` and `setpwent()` do not set `errno`.

Related information

- [“pwd.h – Access user database through password structure” on page 56](#)
- [“getgrent\(\) – Get group database entry” on page 710](#)
- [“getgrgid\(\) – Access the group database by ID” on page 710](#)
- [“getgrnam\(\) – Access the group database by name” on page 713](#)
- [“getlogin\(\) – Get the user login name” on page 732](#)
- [“getpwent\(\) – Get user database entry” on page 761](#)
- [“getpwent_r\(\) – Get user database entry reentrantly” on page 761](#)
- [“getpwnam\(\) – Access the user database by user name” on page 761](#)
- [“getpwuid\(\) – Access the user database by user ID” on page 764](#)

endservent() – Close network services information data sets

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

void endservent(void);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

void endservent();
```

General description

The `endservent()` function closes the `/etc/services` or the `tcpip.ETC.SERVICES` data set, which contains information about network services. Example services are name server, File Transfer Protocol (FTP), and telnet.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Related information

- “[netdb.h — Network database operations](#)” on page 45
- “[getservbyname\(\) — Get a server entry by name](#)” on page 772
- “[getservbyport\(\) — Get a service entry by port](#)” on page 773
- “[getservent\(\) — Get the next service entry](#)” on page 774
- “[setservent\(\) — Open the network services information data set](#)” on page 1570

endutxent() — Close the utmpx database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <utmpx.h>

void endutxent(void);
```

General description

The `endutxent()` function closes the utmpx database for the current thread. The database may be opened by `getutxent()/getutxent64()`, `getutxid()/getutxid64()`, `getutxline()/getutxline64()`, or `pututxline()/pututxline64()`.

Because the `endutxent()` function processes thread-specific data the `endutxent()` function can be used safely from a multithreaded application. If multiple threads in the same process open the database, then each thread opens the database with a different file descriptor. The thread's database file descriptor is closed when the calling thread terminates or the `endutxent()` function is called by the calling thread.

Programs must not reference the data passed back by `getutxent()/getutxent64()`, `getutxid()/getutxid64()`, `getutxline()/getutxline64()`, or `pututxline()/pututxline64()` after `endutxent()` has been called (the storage has been freed.)

After `getutxent()/getutxent64()`, `getutxid()/getutxid64()`, `getutxline()/getutxline64()`, or `pututxline()/pututxline64()`, the utmpx database is open. No other process can do `pututxline()` to this utmpx database until this process issues `endutxent()` or

`__utmpxname()` to close the utmpx database, or this process ends. You can cause all z/OS UNIX user logins/logouts to hang if you fail to `exit()` or issue `endutxent()` or `__utmpxname()`, and you have the `main/etc/utmpx` database open in your process. `endutxent()` resets the name of the next utmpx file to open back to the default. If you want to do additional utmpx operations using a nonstandard utmpx file name, you must reissue `__utmpxname()` after closing the utmpx database with `endutxent()`.

Returned value

`endutxent()` returns no values.

Related information

- [“utmpx.h — User accounting database” on page 78](#)
- [“getutxent\(\), getutxent64\(\) — Read next entry in utmpx database” on page 794](#)
- [“getutxid\(\), getutxid64\(\) — Search by ID utmpx database” on page 795](#)
- [“getutxline\(\), getutxline64\(\) — Search by line utmpx database” on page 797](#)
- [“pututxline\(\), pututxline64\(\) — Write entry to utmpx database” on page 1359](#)
- [“setutxent\(\) — Reset to start of utmpx database” on page 1588](#)
- [“__utmpxname\(\) — Change the utmpx database name” on page 1957](#)

epoll_create(), epoll_create1() — Open an epoll file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/epoll.h>

int epoll_create(int size);
int epoll_create1(int flags);
```

General description

`epoll_create()` creates a new epoll instance and returns a file descriptor referring to that instance. The returned epoll instance can then be used to register interest in particular file descriptors by using the `epoll_ctl()` function.

`epoll_create()` takes a size argument that must be positive to stand for the number of file descriptors that the caller expected to add to the epoll instance.

`epoll_create1()` is similar to `epoll_create()` except that it has a *flags* argument. If *flags* is 0, `epoll_create1()` is the same as `epoll_create()`. The following value can be included in *flags* to obtain different behavior:

EPOLL_CLOEXEC

Set the close-on-exec (FD_CLOEXEC) flag on the new file descriptor.

Returned value

If successful, `epoll_create()` and `epoll_create1()` return a file descriptor (a nonnegative integer).

If unsuccessful, `epoll_create()` and `epoll_create1()` return -1 and sets `errno` to one of the following values:

Error Code Description

EINVAL

Invalid value specified in *flags* when using `epoll_create1()`.

EMFILE

The per-user limit on the number of `epoll` instances has been reached, or the maximum number of file descriptors that can be open is reached.

ENOMEM

Not enough space is available.

Related information

- [“sys/epoll.h — I/O event notification facility functions”](#) on page 68
- [“epoll_ctl\(\) — Control interface for an epoll file descriptor”](#) on page 427

epoll_ctl() — Control interface for an epoll file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/epoll.h>

int epoll_ctl(int epfd, int op, int fd, struct epoll_event *event);
```

Compile requirement: This function must be used under the [extended language level](#).

General description

`epoll_ctl()` adds, modifies, or removes file descriptor entries in the interest list of the `epoll` instance. The wanted I/O event might be registered for the specified file descriptor. The file descriptor can be for character special files, pipes, or sockets. The ready list can be retrieved by using the `epoll_wait()` function.

Interest list is the set of file descriptors that the process list an interest in monitoring. Ready list is the set of file descriptors that are "ready" for I/O. The ready list is a subset of the file descriptors in the interest list. The ready list is dynamically populated by the kernel as a result of I/O activity on those file descriptors.

Parameter Description

epfd

File descriptor of an `epoll` instance.

op

Wanted action to be performed on the provided `epoll` file descriptor. Valid values are:

EPOLL_CTL_ADD

Add an entry to the interest list of the `epoll` file descriptor, *epfd*. The entry includes the file descriptor *fd*, a reference to the corresponding open file description, and the settings specified in event.

EPOLL_CTL_MOD

Change the settings that are associated with *fd* in the interest list to the new settings that are specified in event.

EPOLL_CTL_DEL

Remove (unregister) the target file descriptor *fd* from the interest list.

fd

File descriptor that corresponds to an open file description.

event

The object that is linked to the file descriptor *fd*. The struct `epoll_event` is defined as:

```
typedef union epoll_data {
    void *ptr;
    int fd;
    uint32_t u32;
    uint64_t u64;
} epoll_data_t;

struct epoll_event {
    uint32_t events; /* Epoll events */
    epoll_data_t data; /* User data variable */
};
```

The data member of the `epoll_event` structure specifies data that the kernel must save and then return when this file descriptor becomes ready.

The events member of the `epoll_event` structure is a bit mask that is composed by ORing together zero or more of the following available event types:

EPOLLIN

The associated file is ready for read.

EPOLLOUT

The associated file is ready for write.

EPOLLPRI

Out-of-band data might be received without blocking.

EPOLLERR

An error occurs.

EPOLLHUP

A hang up occurs.

EPOLLONESHOT

Disable monitoring after event notification.

EPOLLEXCLUSIVE

Sets an exclusive wakeup mode for the `epoll` file descriptor. When a wakeup event occurs and multiple `epoll` file descriptors are attached to the same target file by using `EPOLLEXCLUSIVE`, one or more of the `epoll` file descriptors receive an event with `epoll_wait()`. The default in this scenario is for all `epoll` file descriptors to receive an event.

Returned value

If successful, `epoll_ctl()` returns 0.

If unsuccessful, `epoll_ctl()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EBADF**

epfd or *fd* is not a valid file descriptor.

EEXIST

op is `EPOLL_CTL_ADD`, and the supplied file descriptor *fd* is registered with the `epoll` instance.

EINVAL

epfd is not an epoll file descriptor, or *fd* is the same as *epfd*, or the requested operation *op* is not supported.

An invalid event type is specified along with EPOLLEXCLUSIVE in *event*.

op is EPOLL_CTL_MOD and events includes EPOLLEXCLUSIVE.

op is EPOLL_CTL_MOD and the EPOLLEXCLUSIVE flag is applied to the *epfd* and *fd* pair.

EPOLLEXCLUSIVE is specified in *event* and *fd* refers to an epoll instance.

ELOOP

fd refers to an epoll instance and this EPOLL_CTL_ADD operation results in a circular loop of epoll instances monitoring one another or a nesting depth of epoll instances greater than 5.

ENOENT

op is EPOLL_CTL_MOD or EPOLL_CTL_DEL, and *fd* is not registered with this epoll instance.

ENOMEM

Not enough memory is available.

ENOSPC

The per-user limit on how many file descriptors can be registered in the interest list is reached.

EPERM

The target file *fd* does not support epoll.

Related information

- [“sys/epoll.h — I/O event notification facility functions”](#) on page 68
- [“epoll_wait\(\), epoll_pwait\(\) — Wait for an I/O event on an epoll file descriptor”](#) on page 429

epoll_wait(), epoll_pwait() — Wait for an I/O event on an epoll file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/epoll.h>

int epoll_wait(int epfd, struct epoll_event *events, int maxevents, int timeout);
int epoll_pwait(int epfd, struct epoll_event *events, int maxevents, int timeout, const
sigset_t *sigmask);
```

Compile requirement: This function must be used under the [extended language level](#).

General description

`epoll_wait()` waits for the desired I/O events on an interest list that are registered with a provided epoll instance.

`epoll_pwait()` is similar to `epoll_wait()` except that it takes an additional *sigmask* argument that specifies the desired signal mask when `epoll_pwait()` is blocked.

Parameter**Description**

epfd

File descriptor of an `epoll` instance.

events

Buffer that is used to return information from the ready list about file descriptors in the interest list that have some events available.

maxevents

The maximum number of events that might be returned. This value must be greater than zero.

timeout

Timeout value in milliseconds that `epoll_wait()` or `epoll_pwait()` blocks. If the timeout value is 0, `epoll_wait()` or `epoll_pwait()` returns immediately with any file descriptors that are in the ready list, if any. If the timeout value is -1, `epoll_wait()` or `epoll_pwait()` blocks until a file descriptor is in the ready list. If the timeout value is positive, it specifies that the number of milliseconds to wait for a ready list to be populated before returning to the caller.

sigmask

Desired signal mask when `epoll_pwait()` is blocked.

Returned value

If successful, `epoll_wait()` and `epoll_pwait()` return the number of file descriptors that are ready for the requested I/O, or zero if no file descriptor become ready during the requested timeout milliseconds.

If unsuccessful, `epoll_wait()` and `epoll_pwait()` return -1 and set `errno` to one of the following values:

Error Code

Description

EBADF

epfd is not a valid file descriptor.

EFAULT

The memory area pointed to by events is not accessible with write permissions.

EINTR

The call is interrupted by a signal handler before either any of the requested events occurs or the timeout expires.

EINVAL

epfd is not an `epoll` file descriptor, or *maxevents* is less than or equal to zero.

Related information

- [“sys/epoll.h — I/O event notification facility functions” on page 68](#)
- [“epoll_ctl\(\) — Control interface for an epoll file descriptor” on page 427](#)

erand48() — Pseudo-random number generator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

double erand48(unsigned short int x16v[3]);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrand48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The functions drand48() and erand48() return nonnegative, double-precision, floating-point values, uniformly distributed over the interval [0.0,1.0). These functions have been extended so that the returned value will be in the proper floating-point format (hexadecimal or IEEE) based on the floating-point mode of the invoking thread.

The functions lrand48() and nrand48() return nonnegative, long integers, uniformly distributed over the interval [0,2**31).

The functions mrand48() and jrand48() return signed long integers, uniformly distributed over the interval [-2**31,2**31).

The erand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \quad n \geq 0$$

The erand48() function uses storage provided by the argument array, x16v[3], to save the most recent 48-bit integer value in the sequence, X(i). The erand48() function uses x16v[0] for the low-order (rightmost) 16 bits, x16v[1] for the middle-order 16 bits, and x16v[2] for the high-order 16 bits of this value.

The initial values of a, and c are:

```
a  = 5deece66d (base 16)
c  = b         (base 16)
```

The values a and c, may be changed by calling the lcong48() function. The initial values of a and c are restored if either the seed48() or srand48() function is called.

Special behavior for z/OS UNIX Services: You can make the erand48() function and other functions in the drand48 family thread-specific by setting the environment variable _RAND48 to the value THREAD before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested and the erand48() function is called from thread t, the erand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(t,i), for the thread according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t)) \bmod (2^{**}48) \quad n \geq 0$$

The erand48() function uses storage provided by the argument array, x16v[3], to save the most recent 48-bit integer value in the sequence, X(t,i). The erand48() function uses x16v[0] for the low-order (rightmost) 16 bits, x16v[1] for the middle-order 16 bits, and x16v[2] for the high-order 16 bits of this value.

The initial values of a(t) and c(t) on the thread t are:

```
a(t) = 5deece66d (base 16)
c(t) = b         (base 16)
```

The values a(t) and c(t) may be changed by calling the lcong48() function from the thread t. The initial values of a(t) and c(t) are restored if either the seed48() or srand48() function is called from the thread.

Returned value

erand48() saves the generated 48-bit value, X(n+1), in storage provided by the argument array, x16v[3]. erand48() transforms the generated 48-bit value to a double-precision, floating-point value on the interval [0.0,1.0) and returns this transformed value.

Special behavior for z/OS UNIX Services: If thread-specific behavior is requested for the drand48 family and erand48() is called on thread t, erand48() saves the generated 48-bit value, X(t,n+1), in storage provided by the argument array, x16v[3]. erand48() transforms the generated 48-bit value to a double-precision, floating-point value on the interval [0.0,1.0) and returns this transformed value.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“drand48\(\) – Pseudo-random number generator” on page 403](#)
- [“__isBFP\(\) – Determine application floating-point format” on page 905](#)
- [“jrand48\(\) – Pseudo-random number generator” on page 927](#)
- [“lcong48\(\) – Pseudo-random number initializer” on page 939](#)
- [“lrand48\(\) – Pseudo-random number generator” on page 1013](#)
- [“mrand48\(\) – Pseudo-random number generator” on page 1108](#)
- [“nrand48\(\) – Pseudo-random number generator” on page 1153](#)
- [“seed48\(\) – Pseudo-random number initializer” on page 1470](#)
- [“srand48\(\) – Pseudo-random number initializer” on page 1705](#)

erf(), erfc(), erff(), erfl(), erfcf(), erfcl() – Calculate error and complementary error functions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| SAA XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

SAA:

```
#include <math.h>

double erf(double x);
double erfc(double x);
```

This function must be used with the [runtime library extensions](#) or under the [SAA based language constructs](#).

XPG4:

```
#define _XOPEN_SOURCE
#include <math.h>
```

```
double erf(double x);
double erfc(double x);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

float erff(float x);
long double erfl(long double x);
float erfcf(float x);
long double erfcl(long double x)
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float erf(float x);
long double erf(long double x);
float erfc(float x);
long double erfc(long double x);
```

General description

Calculates the error and complementary error functions:

$$2\pi^{-1/2} \int_0^x e^{-t^2} dt$$

Because the erfc() function calculates the value of 1.0 - erf(x), it is used in place of erf() for large values of x.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | SPC | Hex | IEEE |
|----------|-----|-----|------|
| erf | X | X | X |
| erff | | X | X |
| erfl | | X | X |
| erfc | X | X | X |
| erfcf | | X | X |
| erfcl | | X | X |

Returned value

Both erf() and erfc() return the calculated value.

If the correct value would cause underflow, 0 is returned and the value of the macro ERANGE is stored in errno. A range error is returned if x is too large.

Special behavior for IEEE: erf() and erfc() are always successful.

Requirements

This function is exposed by enabling the [long long data type support](#) or using the [runtime library extensions](#).

Example

CELEBE01

```
/* CELEBE01

This example uses &erf. and &erfc. to compute the error
function of two numbers.

*/
#include <stdio.h>
#include <math.h>

double smallx, largex, value;

int main(void)
{
    smallx = 0.1;
    largex = 10.0;

    value = erf(smallx);          /* value = 0.112463 */
    printf("Error value for 0.1: %f\n", value);

    value = erfc(largex);         /* value = 2.088488e-45 */
    printf("Error value for 10.0: %e\n", value);
}
```

Output

```
Error value for 0.1: 0.112463
Error value for 10.0: 2.088488e-45
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“gamma\(\) — Calculate gamma function” on page 683](#)
- [“j0\(\), j1\(\), jn\(\) — Bessel functions of the first kind” on page 929](#)
- [“y0\(\), y1\(\), yn\(\) — Bessel functions of the second kind” on page 2082](#)

erfd32(), erfd64(), erfd128(), erfcd32(), erfcd64(), erfcd128() - Calculate error and complementary error functions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32  erfd32(_Decimal32 x);
_Decimal64  erfd64(_Decimal64 x);
_Decimal128 erfd128(_Decimal128 x);
_Decimal32  erf(_Decimal32 x);          /* C++ only */
_Decimal64  erf(_Decimal64 x);          /* C++ only */
_Decimal128 erf(_Decimal128 x);         /* C++ only */

_Decimal32  erfcd32(_Decimal32 x);
_Decimal64  erfcd64(_Decimal64 x);
_Decimal128 erfcd128(_Decimal128 x);
_Decimal32  erfc(_Decimal32 x);         /* C++ only */
```

```
_Decimal64 erfc(_Decimal64 x);      /* C++ only */
_Decimal128 erfc(_Decimal128 x);    /* C++ only */
```

General description

Calculates the error and complementary error functions:

$$2\pi^{-1/2} \int_0^x e^{-t^2} dt$$

Because the erfc() function calculates the value of 1.0 - erf(x), it is used in place of erf() for large values of x.

These functions work in IEEE decimal floating-point format. See “IEEE decimal floating-point” on page 97 for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

erf() and erfc() are always successful.

Example

CELEBE12

```
/* CELEBE12
   This example illustrates the erfd32() and erfcd32() functions.
*/
#define __STDC_WANT_DEC_FP__
#include <stdio.h>
#include <math.h>

_Decimal32 smallx, largex, value;

int main(void)
{
    smallx = 0.1DF;
    largex = 10.0DF;

    value = erfd32(smallx);
    printf("Error value for 0.1: %Hf\n", value);

    value = erfcd32(largex);
    printf("Error value for 10.0: %He\n", value);
}
```

Related information

- “math.h — Floating-point math functions” on page 40

__err2ad() — Return address of reason code of last failure

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
int *__err2ad(void);
```

General description

The `__err2ad()` function returns the address of the `errno2`. The `errno2` may be set by the z/OS C/C++ runtime library, z/OS UNIX callable services or other callable services.

`__err2ad()` provides assistance in diagnosing problems by allowing an application to reset the `errno2` value prior to calling a function.

Returned value

`__err2ad()` is always successful.

Related information

- “[__errno2\(\) — Return reason code information](#)” on page 436

[__errno2\(\) — Return reason code information](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
int __errno2(void);
```

General description

The `__errno2()` function can be used when diagnosing application problems. This function enables application programs to access additional diagnostic information, `errno2` (`errnoj`), associated with `errno`. The `errno2` may be set by the z/OS C/C++ runtime library, z/OS UNIX callable services or other callable services. The `errno2` is intended for diagnostic display purposes only and it is not a programming interface. The `__errno2()` function is not portable.

Note: Not all functions set `errno2` when `errno` is set. In the cases where `errno2` is not set, the `__errno2()` function may return a residual value. You may use the `__err2ad()` function to clear `errno2` to reduce the possibility of a residual value being returned.

Returned value

The `__errno2()` function is always successful. The returned value is intended for diagnostic display purposes only.

The returned value may input to the BPXMTEXT utility to produce detailed information about the reported error if available.

Example

CELEBE02

```
/* CELEBE02
The following example's output only occurs
```

```

    if the buffer is flushed.

    */
#include <errno.h>
#include <stdio.h>
int main(void) {
    FILE *f;
    f = fopen("notafile", "r");
    if (f==NULL) {
        perror("fopen() failed");
        printf("__errno2 = %08x\n", __errno2());
    }
    return(0);
}

```

Sample output of routine using __errno2(), CELEBE02:

fopen() failed: EDC5129I No such file or directory. __errno2 = 05620062

CELEBE08

```

#pragma runopts(posix(on))
#define _EXT
#include <stdio.h>
#include <errno.h>
#include <stdlib.h>

int main(void){
    FILE *fp;
    /* add errno2 to perror message */
    setenv("_EDC_ADD_ERRNO2", "1", 1);
    fp = fopen("testfile.dat", "r");
    if (fp == NULL)
        perror("fopen() failed");
    return 0;
}

```

Sample output of routine using _EDC_ADD_ERRNO2, CELEBE08:

fopen() failed: EDC5129I No such file or directory. (errno2=0x05620062)

CELEBE09

```

#pragma runopts(posix(on))
#define _EXT
#include <stdio.h>
#include <errno.h>

int main(void){
    FILE *f;
    f = fopen("testfile.dat", "r");
    if (f == NULL){
        perror("fopen() failed");
        printf("__errno2 = %08x\n", __errno2());
    }

    /* reset errno2 to zero */
    *_err2ad() = 0x0;
    printf("__errno2 = %08x\n", __errno2());

    f = fopen("testfile.dat", "r");
    if (f == NULL){
        perror("fopen() failed");
        printf("__errno2 = %08x\n", __errno2());
    }

    return 0;
}

```

Related information

- [“errno.h — Symbolic constants for errno” on page 19](#)
- [“__err2ad\(\) — Return address of reason code of last failure” on page 435](#)

- For more information about the return value, see the [z/OS UNIX System Services Command Reference](#), [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#), and [z/OS Language Environment Debugging Guide](#).
- For more information about _EDC_ADD_ERRNO2 , see [z/OS XL C/C++ Programming Guide](#).

__etoa() – EBCDIC to ISO8859-1 string conversion

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <unistd.h>

int __etoa(char *string);
```

General description

The `__etoa()` function converts an EBCDIC character string *string* to its ISO8859-1 equivalent. The conversion is performed using the codeset page associated with the current locale. The input character string up to, but not including, the NULL character is changed from the current locale to an ISO8859-1 representation.

The argument *string* points to the EBCDIC character string to be converted to its ISO8859-1 equivalent.

Returned value

If successful, `__etoa()` converts the input EBCDIC string to its equivalent ISO8859-1 value, and returns the length of the converted string.

If unsuccessful, `__etoa()` returns -1 and sets `errno` to one of the following values. (This function internally may call `iconv_open()` and `iconv()`. The `errno`s returned by these functions are propagated without modification.)

Error Code Description

EINVAL

The current locale does not describe a single-byte character set.

ENOMEM

There is insufficient storage to complete the conversion process.

Related information

- [“sys/msg.h – Message queue structures” on page 69](#)
- [“unistd.h – Implementation-specific functions” on page 77](#)
- [“iconv\(\) – Code conversion” on page 824](#)
- [“iconv_open\(\) – Allocate code conversion descriptor” on page 828](#)

__etoa_l() – EBCDIC to ISO8859-1 conversion operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <unistd.h>

int __etoa_l(char *bufferptr, int leng);
```

General description

The `__etoa_l()` function converts *leng* EBCDIC bytes in the buffer pointed to by *bufferptr* to their ISO8859-1 equivalent. The conversion is performed using the codeset page associated with the current locale.

The argument *bufferptr* points to a buffer containing the EBCDIC bytes to be converted to their ISO8859-1 equivalent. The input buffer is treated as a sequence of bytes, and all bytes in the input buffer are converted, including any imbedded NULLs.

Returned value

If successful, `__etoa_l()` converts the input EBCDIC bytes to their equivalent ISO8859-1 value, and returns the number of bytes converted.

If unsuccessful, `__etoa_l()` returns -1 and sets `errno` to one of the following values. (This function may internally call `iconv_open()` and `iconv()`. The `errno`s returned by these functions are propagated without modification.)

Error Code

Description

EINVAL

The current locale does not describe a single-byte character set.

ENOMEM

There is insufficient storage to complete the conversion process.

Related information

- [“sys/msg.h – Message queue structures” on page 69](#)
- [“unistd.h – Implementation-specific functions” on page 77](#)
- [“iconv\(\) – Code conversion” on page 824](#)
- [“iconv_open\(\) – Allocate code conversion descriptor” on page 828](#)

eventfd() – Create a file descriptor for event notification

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/eventfd.h>

int eventfd(unsigned int initval, int flags);
```

General description

`eventfd()` function creates an `eventfd` object that can be used as an event wait/notify mechanism by user applications, and by the kernel to notify user application of events. The object contains an unsigned 64-bit integer counter that is maintained by the kernel. This counter is initialized with the value that is specified in the argument *initval*.

`eventfd()` returns a new file descriptor that can be used to refer to the `eventfd` object. The following values are used in *flags* to change the behavior of `eventfd()`:

EFD_CLOEXEC

Set the close-on-exec (FD_CLOEXEC) flag on the new file descriptor.

EFD_NONBLOCK

Set the O_NONBLOCK file status flag on the open file description referred to by the new file descriptor. Using this flag saves extra calls to `fcntl()` to achieve the same result.

EFD_SEMAPHORE

Provide semaphore-like semantics for reads from the new file descriptor.

The following operations can be performed on the file descriptor that is returned by `eventfd()`:

read()

Each successful `read()` returns an 8-byte integer from the `eventfd` count. A `read()` fails with the error EINVAL if the size of the supplied buffer is less than 8 bytes.

The value that is returned by `read()` is in host byte order.

If the `eventfd` counter is zero at the time of the call to `read()`, then the call either blocks until the counter becomes nonzero (at which time, the `read()` proceeds as described previously) or fails with the error EAGAIN if the file descriptor has been made nonblocking.

write()

A `write()` call adds the 8-byte integer value that is supplied in its buffer to the counter. The maximum value that can be stored in the counter is the largest unsigned 64-bit value minus 1. If the addition causes the counter's value to exceed the maximum, the `write()` either blocks until a `read()` is performed on the file descriptor, or fails with the error EAGAIN if the file descriptor has been made nonblocking.

A `write()` fails with the error EINVAL if the size of the supplied buffer is less than 8 bytes, or if an attempt is made to write the value 0xffffffffffffffff.

poll(), select()

Waits for one or more of the file descriptors to become ready to perform I/O. The returned file descriptor supports `poll()`, as follows:

- The file descriptor is readable (the `select()` readlist argument; the `poll()` POLLIN flag) if the counter has a value greater than 0.
- The file descriptor is writable (the `select()` writelist argument; the `poll()` POLLOUT flag) if it is possible to write a value of at least "1" without blocking.
- If an overflow of the counter value is detected, `select()` indicates the file descriptor as being both readable and writable, and `poll()` returns a POLLERR event.

The `eventfd` file descriptor also supports the other file-descriptor multiplexing APIs: `pselect()`.

close()

When the file descriptor is no longer required, it must be closed. When all file descriptors that are associated with the same `eventfd` object are closed, the resources for object are freed by the kernel.

A copy of the file descriptor that is created by `eventfd()` is inherited by the child that is produced by `fork()`. The duplicate file descriptor is associated with the same `eventfd` object. File descriptors that are created by `eventfd()` are preserved across `exec` functions, unless the `close-on-exec` flag is set.

Parameter Description

initval

The initialized value for the counter that is maintained by the kernel.

flags

Flag to change the behavior of the `eventfd` object.

Returned value

If successful, `eventfd()` returns a new `eventfd` file descriptor.

If unsuccessful, `eventfd()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EINVAL

An unsupported value is specified in `flags`.

EMFILE

The per-process limit on the number of open file descriptors is reached.

ENFILE

The system-wide limit on the total number of open files is reached.

ENODEV

Unable to mount (internal) anonymous inode device.

ENOMEM

No sufficient memory to create a new `eventfd` file descriptor.

Example

```
#include <sys/eventfd.h>
#include <unistd.h>
#include <inttypes.h>          /* Definition of PRIu64 & PRIx64 */
#include <stdlib.h>
#include <stdio.h>
#include <stdint.h>           /* Definition of uint64_t */

#define handle_error(msg) do { perror(msg); exit(EXIT_FAILURE); } while (0)

int main(int argc, char *argv[]) {
    int efd;
    uint64_t u;
    ssize_t s;

    if (argc < 2) {
        fprintf(stderr, "Usage: %s <num>...\n", argv[0]);
        exit(EXIT_FAILURE);
    }

    efd = eventfd(0, 0);
    if (efd == -1)
        handle_error("eventfd");

    switch (fork()) {
    case 0:
        for (int j = 1; j < argc; j++) {
            printf("Child writing %s to efd\n", argv[j]);
            u = strtoull(argv[j], NULL, 0); /* strtoull() allows various bases */
            s = write(efd, &u, sizeof(uint64_t));
            if (s != sizeof(uint64_t))
                handle_error("write");
        }
        printf("Child completed write loop\n");
        exit(EXIT_SUCCESS);
```

```
        default:
            sleep(2);

            printf("Parent about to read\n");
            s = read(efd, &u, sizeof(uint64_t));
            if (s != sizeof(uint64_t))
                handle_error("read");
            printf("Parent read %"PRIu64" (%#"PRIx64") from efd\n", u, u);
            exit(EXIT_SUCCESS);

        case -1:
            handle_error("fork");
        }
    }
```

Related information

- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“poll\(\) — Monitor activity on file descriptors and message queues” on page 1196](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“close\(\) — Close a file” on page 293](#)

exec functions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>
extern char **environ;

int execl(const char *path, const char *arg, ..., NULL);
int execlp(const char *path, const char *arg, ..., NULL, char *const envp[]);
int execlp(const char *file, const char *arg, ..., NULL);
int execv(const char *path, char *const argv[]);
int execve(const char *path, char *const argv[], char *const envp[]);
int execvp(const char *file, char *const argv[]);
```

Note: Although POSIX.1 does not require that the `unistd.h` include file be included, it is recommended that you include it for portability.

General description

All `exec` functions run a new program by replacing the current process image with a new process image obtained from a file in the z/OS UNIX file system.

For information on specifying names for MVS data sets and z/OS UNIX files, see [z/OS XL C/C++ Programming Guide](#).

A successful `exec` function never returns control because the calling process is overwritten with the new process.

The argument *path* is a string giving the absolute or relative path name of a file. This file contains the image of the process to be run.

file is a string that is used in determining the path name of the file containing the image of the process to be run. If *file* contains a slash character (/), it is assumed to be the absolute or relative path name of the file. If *file* does not contain a slash, the system searches for the given file name under the list of directories given by the PATH environment variable. The system checks under directories in the order they appear in the PATH variable, and executes the first file whose name matches the *file* string. The file must reside in the z/OS UNIX file system.

The exec functions use the following environment variables:

STEPLIB

Supports the creation and propagation of a STEPLIB environment to the new process image. The following are the accepted values for the STEPLIB environment variable and the actions taken for each value:

- STEPLIB=NONE. No Steplib DD is to be created for the new process image.
- STEPLIB=CURRENT. The TASKLIB, STEPLIB or JOBLIB DD data set allocations that are active for the calling task at the time of the call to exec() are propagated to the new process image, if they are found to be cataloged. Uncataloged data sets are not propagated to the new process image.
- STEPLIB=Dsn1:Dsn2;...DsnN. The specified data sets, Dsn1:Dsn2:...DsnN, are built into a STEPLIB DD in the new process image.

Note: The actual name of the DD is not STEPLIB, but is a system-generated name that has the same effect as a STEPLIB DD. The data sets are concatenated in the order specified. The specified data sets must follow standard MVS data set naming conventions. Data sets found to be in violation of this standard are ignored. The data sets are ignored if the data sets do follow the standard, but the following situations exist:

- The caller does not have the proper security access to a data set
- A data set is uncataloged or is not in load library format

The system also ignores the data set and continues allocating other data sets in these situations:

- If the system cannot acquire a shared ENQueue on the data set name because another job has ENQueued it exclusively.
- If the specified data set does not exist, which is similar but not strictly equal to the case of uncataloged data sets.

Because the data sets in error are ignored, the executable file may run without the proper STEPLIB environment. If a data set is in error due to improper security access, a X'913' abend is generated. The dump for this abend can be suppressed by your installation.

The ENQueues on an original STEPLIB DD (from submitting the job) are DEQueued (freed) if this is the last JCL step naming the data set on a STEPLIB or other DD statement. This is standard initiator behavior. The system acquires new ENQueues for the data sets named in the STEPLIB variable each time an exec() type function is called.

If the STEPLIB environment variable is not specified, the exec() default behavior is the same as if STEPLIB=CURRENT were specified.

If the program to be invoked is a set-user-ID or set-group-ID file and the user-ID or group-ID of the file is different from that of the current process image, the data sets to be built into the STEPLIB environment for the new process image must be found in the system sanction list for set-user-id and set-group-id programs. Only those data sets that are found in the sanction list are built into the STEPLIB environment for the new process image. For detailed information regarding the sanction list, and for information on STEPLIB performance considerations, see [z/OS UNIX System Services Planning](#).

_BPX_JOBNAME

Used to change the jobname of the new process image. The jobname change is allowed only if the invoker has appropriate privileges and is running in an address space created by fork. If these

conditions are not met, the environment variable is ignored. Accepted values are strings of 1–8 alphanumeric characters. Incorrect specifications are ignored.

_BPX_ACCT_DATA

Used to change the account data of the new process image. Rules for specifying account data:

- Up to 142 actual account data characters are allowed, including any commas
- Sub-parameters must be separated by commas.
- There is no restriction on the character set.
- If the account data is greater than 142 characters, the data is ignored.

_BPXK_JOBLOG

The `_BPXK_JOBLOG` environment variable can be used to specify that WTO messages are to be written to an open job log file. The following are the allowable values:

Value

Description

nn

Job log messages are to be written to open file descriptor nn.

STDERR

Job log messages are to be written to the standard error file descriptor, 2.

None

Job log messages are not to be written. This is the default.

The file that is used to capture messages can be changed at any time by calling the `oe_env_np` service (BPX1ENV) and specifying `_BPXK_JOBLOG` with a different file descriptor.

Message capturing is turned off if the specified file descriptor is marked for close on a fork or exec.

Message capturing is process-related. All threads under a given process share the same job log file. Message capturing may be initiated by any thread under that process.

Multiple processes in a single address space can each have different files active as the JOBLOG file; some or all of them can share the same file; and some processes can have message capturing active while others do not.

Only files that can be represented by file descriptors may be used as job log files; MVS data sets are not supported.

Message capturing will be propagated on a `fork()` or `spawn()`. In the case where a file descriptor was specified, the physical file must be the same for message capturing to continue in the forked or spawned process. If `STDERR` was specified, the file descriptor may be re-mapped to a different physical file.

Message capturing may be overridden on `exec()` or `spawn()` by specifying the `_BPXK_JOBLOG` environment variable as a parameter to the `exec()` or `spawn()`.

Message capturing will only work in forked (BPXAS) address spaces.

Note: This is not true joblog support, messages that would normally go to the JESYSMSG data set are captured, but messages that go to JESMSGLOG are not captured.

Special behavior for XPG4: If this file is not a valid executable object, the `execlp()` and `execvp()` functions invoke `/bin/sh` with the invoker's path name and the rest of the input arguments. It is similar to invoking:

```
execl("/bin/sh",
      "sh",
      "--",
      fully_expanded_pathname,
      arg1, arg2, ..., argn,
      NULL
      );
```

where `arg1`, `arg2`, ..., `argn` are the caller's arguments to `execlp()` or `execvp()`, and `fully_expanded_pathname` is the path name of the shell script found by searching the directories in the current `PATH`.

`arg`, ..., `NULL` is a series of pointers to NULL-terminated character strings specifying arguments for the process being invoked. If the new process is a `main()`, these strings are stored in an array, and a pointer to the array is passed in the `argv` parameter. The first argument is required, and it should point to a string containing the name of the file that is associated with the process that `exec` is starting. A NULL pointer must follow the last argument string pointer.

`argv[]` is a pointer to an array of pointers to NULL-terminated character strings. There must be a NULL pointer after the last character string to mark the end of the array. These strings are used as arguments for the process being invoked. `argv[0]` should point to a string containing the name of a file associated with the process being started by `exec`. `envp[]` is a pointer to an array of pointers to NULL-terminated character strings. There must be a NULL pointer after the last character string to mark the end of the array. The strings of `envp` provide the environment variables for the new process.

All the forms of `exec` functions provide a way to locate the file containing the new process you want to run and a collection of arguments that should be passed to the new process. Each form of `exec` has its own method for specifying this information.

Some `exec` calls explicitly pass an environment using an `envp` argument. In versions where an environment is not passed explicitly—`execl()`, `execlp()`, `execv()`, and `execvp()`—the system uses the entire environment of the caller. The caller's environment is assumed to be the *environment variables* that the *external variable* `**environ` points to.

The variable **ARG_MAX**, obtained from z/OS UNIX services by an invocation of `sysconf(_SC_ARG_MAX)`, specifies the maximum number of bytes that can be used for arguments and environment variables passed to the process being invoked. The number of bytes includes the NULL terminator on each string.

A process started by an `exec` function has all of the open file descriptors that were present in the caller, except for those files opened with the close-on-exec flag `FD_CLOEXEC`. See [“fcntl\(\) — Control open file descriptors”](#) on page 483 for more information about this flag. In file descriptors that remain open, all attributes remain unchanged (including file locks).

Directory streams that are open in the calling process image are closed in the new process image.

The state of conversion descriptors and message catalog descriptors is undefined.

Signals set to be ignored in the caller, `SIG_IGN`, are set to be ignored in the new process image. Be careful to take care of signals that are being ignored. Although `sigaction()` specifying a handler is not passed by, `SIG_IGN` is. Blocking of signals is also passed by. All other signals are set to the default action, `SIG_DFL`, in the new process image, no matter how the caller handled such signals.

The real user ID (UID), real group ID (GID), and supplementary group IDs of the new process are the same as those of the caller. If the set-user-ID mode bit of the program file is on, the effective user ID of the new process is set to the file's owner. Similarly, if the set-group-ID mode bit of the program file is on, the effective group ID of the new process is set to the file's group. The effective user ID of the new process image is saved as the saved set-user-ID, and the effective group ID of the new process image is saved as the saved set-group-ID.

Any shared memory segments attached to the calling process image will not be attached to the new process image, see [“shmat\(\) — Shared memory attach operation”](#) on page 1593. Any shared memory segments attached to the calling process image will be detached (that is, the value of `shm_nattch` decremented by one). If this is the last thread attached to the shared memory segment and a `shmctl()` `RMID` has been issued, the segment will be removed from the system.

Special behavior for XPG4.2: Interval timers are preserved across an `exec`.

The new process also inherits the following from the caller:

- Controlling terminal (**XPG4.2**)
- Nice value (see [“nice\(\) — Change priority of a process”](#) on page 1150) (**XPG4**)

- `semadj` values (see [“semop\(\) — Semaphore operations”](#) on page 1488) (**XPG4**)
- Process ID
- Parent process ID
- Process group ID
- Resource limits (see [“setrlimit\(\) — Control maximum resource consumption”](#) on page 1568 and [“ulimit\(\) — Get or set process file size limits”](#) on page 1924) (**XPG4.2**)
- Session membership
- Time left until an alarm clock signal
- Working directory
- Root directory
- File mode creation mask
- File size limit (see [“ulimit\(\) — Get or set process file size limits”](#) on page 1924) (**XPG4**)
- Process signal mask
- Pending signals
- `tms_utime`, `tms_stime`, `tms_cstime`, and `tms_cutime`. See [“times\(\) — Get process and child process times”](#) on page 1867 for more about these qualities.

A successful `exec` function automatically opens the specified program file, and updates the access time `st_atime` for that file. The program file is closed automatically after the program has been read from the file. The precise time of this close operation is undefined.

Special behavior for z/OS UNIX Services:

1. A prior loaded copy of an HFS program in the same address space is reused under the same circumstances that apply to the reuse of a prior loaded MVS unauthorized program from an unauthorized library by the MVS XCTL service with the following exceptions:
 - If the calling process is in Ptrace debug mode, a prior loaded copy is not reused.
 - If the calling process is not in Ptrace debug mode, but the only prior loaded usable copy found of the HFS program is in storage modifiable by the caller, the prior copy is not reused.
2. If the specified file name represents an external link or a sticky bit file, the program is loaded from the caller's MVS load library search order. For an external link, the external name is only used if the name is eight characters or less, otherwise the caller receives an error from the `loadhfs` service. For a sticky bit program, the file name is used if it is eight characters or less. Otherwise, the program is loaded from the HFS, and the following restriction exists for sticky bit programs that have the `set-user-ID` or `set-group-ID` attribute:

If the program is found in the MVS program search order, the MVS program name must have a `BPX.STICKYSUG.program_name` resource profile defined in the RACF FACILITY class. See [z/OS UNIX System Services Planning](#) for details on defining the resource profile. Failure to follow this restriction will cause the abend EC6 with code `xxxxE055`.
3. If the calling task is in a WLM enclave, the resulting task in the new process image is joined to the same WLM enclave. This allows WLM to manage the old and new process images as one 'business unit of work' entity for system accounting and management purposes.

Note: If you are expecting this function to take advantage of the z/OS UNIX magic number support, the Language Environment runtime option to `POSIX(ON)` must have been set when the process was initialized. Attempting to use magic number support with a process initialized with `POSIX(OFF)` may produce undesirable effects. See [z/OS UNIX System Services Planning](#) and [z/OS UNIX System Services User's Guide](#) for details and uses of the z/OS UNIX magic number.

Returned value

If successful, an `exec` function never returns control because the calling process is overwritten with the new process.

If unsuccessful, an exec function returns -1 and sets errno to one of the following values:

Error Code Description

E2BIG

The combined argument list and environment list of the new process has more bytes than the system-defined length. See [“sysconf\(\) — Determine system configuration options”](#) on page 1794 for information about the system-defined length.

EACCES

The process did not have appropriate permissions to run the specified file, for one of these reasons:

- The process did not have permission to search a directory named in your *path*.
- The process did not have execute permission for the file to be run.
- The system cannot run files of this type.

EFAULT

A bad address was received as an argument of the call, or the user exit program checked.

Consult Reason Code to determine the exact reason the error occurred. The following reason code can accompany the return code: JRExecParmErr and JRExitRtnError.

EINVAL

The new process image file has the appropriate permission and has a recognized format, but the system does not support execution of a file with this format.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of the *path* or *file* argument is greater than POSIX_SYMLoop (a value defined in the limits.h header file)

ELEMULTITHREAD

The exec function was invoked from a multithreaded AMODE 31 environment.

EMVSSAF2ERR

The executable file is a set-user-ID or set-group-ID file, and the file owner's UID or GID is not defined to RACF.

ENAMETOOLONG

All or part of the file name is too long. This can happen if:

- A *path* or *file* argument exceeds the value of **PATH_MAX**, or an element of your *path* exceeds **PATH_MAX**.
- Any *pathname* component is greater than **NAME_MAX**, and **_POSIX_NO_TRUNC** is in effect.
- The length of a path name string substituted for a symbolic link in the *path* argument exceeds **PATH_MAX**.

The **PATH_MAX** and **NAME_MAX** values are determined with pathconf().

ENOENT

One or more *pathname* components in *path* or *file* does not exist. This error is also issued if *path* or *file* is a NULL string.

ENOEXEC

The new process image file has the appropriate access permission but has an unrecognized format. This errno can be returned from any one of the exec family of functions, except for execlp() and execvp().

Note: Reason codes further qualify the errno. For most of the reason codes, see [z/OS UNIX System Services Messages and Codes](#).

For ENOEXEC, the reason codes are:

| Reason Code | Explanation |
|-------------|--|
| X'xxxx0C27' | The target file is not in the correct format to be an executable file. |

| Reason Code | Explanation |
|-------------|---|
| X'xxxx0C31' | The target file is built at a level that is higher than that supported by the running system. |

ENOMEM

The new process requires more memory than is permitted by the operating system.

ENOTDIR

A directory component of *path* or *file* is not really a directory.

Example**CELEBE03**

```

/* CELEBE03

   This example runs a program, using the execl() function.

   */
#define _POSIX_SOURCE
#include <stdio.h>
#include <sys/wait.h>          /*FIX: used be <wait.h>*/
#include <sys/types.h>
#include <unistd.h>

main() {
    pid_t pid;
    int status;

    if ((pid = fork()) == 0) {
        execl("/bin/false", NULL);
        perror("The execl() call must have failed");
        exit(255);
    }
    else {
        wait(&status);
        if (WIFEXITED(status))
            printf("child exited with status of %d\n", WEXITSTATUS(status));
        else
            puts("child did not exit successfully\n");
    }
}

```

Output

```
child exited with status of 1
```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“signal.h — Exception handling” on page 58](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getrlimit\(\) — Get current or maximum resource consumption” on page 767](#)
- [“nice\(\) — Change priority of a process” on page 1150](#)
- [“putenv\(\) — Change or add an environment variable” on page 1354](#)
- [“semop\(\) — Semaphore operations” on page 1488](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)

- “[shmat\(\)](#) — Shared memory attach operation” on page 1593
- “[sigaction\(\)](#) — Examine or change a signal action” on page 1605
- “[sigpending\(\)](#) — Examine pending signals” on page 1641
- “[sigprocmask\(\)](#) — Examine or change a thread” on page 1643
- “[stat\(\)](#), [stat64\(\)](#) — Get file information” on page 1706
- “[system\(\)](#) — Execute a command” on page 1800
- “[times\(\)](#) — Get process and child process times” on page 1867
- “[ulimit\(\)](#) — Get or set process file size limits” on page 1924
- “[umask\(\)](#) — Set and retrieve file creation mask” on page 1929

exit() — End program

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 C11 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

__noreturn__ void exit(int status);
```

General description

The `exit()` function:

1. Calls all functions registered with the `atexit()` function, and destroys C++ objects with static storage duration, all in last-in-first-out (LIFO) order. C++ objects with static storage duration are destroyed in the reverse order of the completion of their constructor. (Automatic objects are not destroyed as a result of calling `exit()`.)

Functions registered with `atexit()` are called in the reverse order of their registration. A function registered with `atexit()`, before an object `obj1` of static storage duration is initialized, will not be called until `obj1`'s destruction has completed. A function registered with `atexit()`, after an object `obj2` of static storage duration is initialized, will be called before `obj2`'s destruction starts.

2. Flushes all buffers, and closes all open files.
3. All files opened with `tmpfile()` are deleted.
4. Returns control to the host environment from the program.

Process termination in `_exit()` is equivalent to program termination in `exit()`.

The argument *status* can have a value from 0 to 255 inclusive or be one of the macros `EXIT_SUCCESS` or `EXIT_FAILURE`. The value of `EXIT_SUCCESS` is defined in `stdlib.h` as 0; the value of `EXIT_FAILURE` is 8.

This function is also available to C applications in a stand-alone Systems Programming C (SPC) Environment.

In a POSIX C program, `exit()` returns control to the kernel with the value of *status*. The kernel then performs normal process termination.

POSIX-level thread cleanup routines are *not* executed. These includes cleanup routines created with `pthread_cleanup_push()` and destructor routines created with `pthread_key_create()`.

Special behavior for C++: If `exit()` is called in a IBM z/OS C++ program, the program terminates without leaving the current block, and therefore destructors are not called for local (automatic) variables. Destructors for initialized static objects will be called in the reverse order of the completion of their constructors.

Functions registered with `atexit()` are called in the reverse order of their registration. A function registered with `atexit()`, before an object `obj1` of static storage duration is initialized, will not be called until `obj1`'s destruction has completed. A function registered with `atexit()`, after an object `obj2` of static storage duration is initialized, will be called before `obj2`'s destruction starts.

Returned value

`exit()` returns no values.

`exit()` returns control to its host environment, with the returned value *status*.

For example, if program A invokes program B using a call to the `system()` function, and program B calls the `exit()` function, then program B returns to its host environment, which is program A.

Example

```
/* This example flushes all buffers, closes any open files, and ends the
   program if it cannot open the file myfile.
*/
#include <stdio.h>
#include <stdlib.h>

FILE *stream;

int main(void)
{
    :
    if ((stream = fopen("myfile.dat", "r")) == NULL)
    {
        printf("Could not open data file\n");
        exit(EXIT_FAILURE);
    }
}
```

Related information

- “System Programming C (SPC) Facilities” in [z/OS XL C/C++ Programming Guide](#)
- “Using Runtime User Exits” in [z/OS XL C/C++ Programming Guide](#)
- “`stdlib.h` — Standard library functions” on page 65
- “`abort()` — Stop a program” on page 103
- “`atexit()` — Register program termination function” on page 197
- “`_exit()` — End a process and bypass the cleanup” on page 451
- “`_Exit()` — Terminate a process” on page 452
- “`signal()` — Handle interrupts” on page 1635
- “`wait()` — Wait for a child process to end” on page 1978
- “`waitpid()` — Wait for a specific child process to end” on page 1981

`_exit()` — End a process and bypass the cleanup

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

void _exit(int status);
```

General description

Ends the current process and makes an exit status value for the process available to the system.

The argument *status* specifies a return status for the process that is ending. Ending the process has the following results:

- `_exit()` closes all open file descriptors and directory streams in the caller.
- If the caller's parent is currently suspended because of `wait()` or `waitpid()`, the low-order 8 bits of *status* become available to the parent. For a discussion on accessing those 8 bits, refer to [“waitpid\(\) — Wait for a specific child process to end”](#) on page 1981.
- If the caller's parent is not currently suspended because of `wait()` or `waitpid()`, `_exit()` saves the *status* value so that it can be returned to the parent if the parent calls `wait()` or `waitpid()`.
- A SIGCHLD signal is sent to the parent process.
- If the process calling `_exit()` is a controlling process, the SIGHUP signal is sent to each process in the foreground process group of the controlling terminal belonging to the caller.
- If the process calling `_exit()` is a controlling process, `_exit()` disassociates the associated controlling terminal from the session. A new controlling process can then acquire the terminal.
- Exiting from a process does not end its child processes directly. The SIGHUP signal may end children in some cases. Children that survive when a process ends are assigned a new parent process ID. The new parent process ID is always 1, indicating the root ancestor of all processes.
- If a process ends and orphans a process group and if a member of that group is stopped, each member of the group is sent a SIGHUP signal, followed by a SIGCONT signal.
- All threads are ended, and their resources cleaned up. (*Threads* are MVS tasks that call a z/OS UNIX callable service.) POSIX-level thread cleanup routines are *not* executed. These include cleanup routines created with `pthread_cleanup_push()` and destructor routines created with `pthread_key_create()`.

These results occur whenever a process ends. `_exit()` does not cause C runtime library cleanup to be performed; therefore, stream buffers are not necessarily flushed.

Note: If `_exit()` is issued from a TSO/E address space, it ends the calling task and all its subtasks.

Special behavior for C++: If `_exit()` is called in a C++ program, the program terminates without leaving the current block, and destructors are not called for local (automatic) variables. In addition, unlike `exit()`, destructors for global (static) variables are not called.

Returned value

`_exit()` is always successful and returns no values.

No value is stored in `errno` for this function.

Example

CELEBE05

```
/* CELEBE05

   This example ends a process.

*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <stdio.h>

main() {
    puts("Remember that stream buffers are not automatically");
    puts("flushed before _exit()!");
    fflush(NULL);
    _exit(0);
}
```

Output

```
Remember that stream buffers are not automatically
flushed before _exit()!
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“abort\(\) — Stop a program” on page 103](#)
- [“atexit\(\) — Register program termination function” on page 197](#)
- [“close\(\) — Close a file” on page 293](#)
- [“exit\(\) — End program” on page 449](#)
- [“_Exit\(\) — Terminate a process” on page 452](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)

_Exit() — Terminate a process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 C11 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <stdlib.h>

__noreturn__ void _Exit(int status);
```

General description

When running POSIX(OFF), the `_Exit()` function is equivalent to `exit()` with the exception that it does not run `atexit()` registered routines or signal handlers registered using `signal()`.

When running POSIX(ON), the `_Exit()` function is equivalent to `_exit()`.

Returned value

The `_Exit()` function does not return to its caller.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“exit\(\) — End program” on page 449](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)

exp(), expf(), expl() — Calculate exponential function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double exp(double x);
float expf(float x);           /* C++ only */
long double exp(long double x); /* C++ only */
float expf(float x);
long double expl(long double x);
```

General description

Calculates the exponent of x , defined as e^x , where e equals 2.718281828....

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

If successful, the function returns the calculated value.

If an overflow occurs, the function returns HUGE_VAL. If an underflow occurs, it returns 0. Both overflow and underflow set errno to ERANGE.

Example

CELEBE06

```
/* CELEBE06

   This example calculates y as the exponential function of x.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y;

    x = 5.0;
    y = exp(x);

    printf("exp( %f ) = %f\n", x, y);
}
```

Output

```
exp( 5.000000 ) = 148.413159
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“log\(\), logf\(\), logl\(\) — Calculate natural logarithm” on page 995](#)
- [“log10\(\), log10f\(\), log10l\(\) — Calculate base 10 logarithm” on page 1005](#)
- [“pow\(\), powf\(\), powl\(\) — Raise to power” on page 1204](#)

expd32(), expd64(), expd128() — Calculate exponential function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 expd32(_Decimal32 x);
_Decimal64 expd64(_Decimal64 x);
_Decimal128 expd128(_Decimal128 x);
_Decimal32 exp(_Decimal32 x); /* C++ only */
_Decimal64 exp(_Decimal64 x); /* C++ only */
_Decimal128 exp(_Decimal128 x); /* C++ only */
```

General description

Calculates the exponent of x, defined as e**x, where e equals 2.17128128....

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See [“IEEE binary floating-point” on page 97](#) for more information

Returned value

If successful, the function returns the calculated value.

If an overflow occurs, the function returns HUGE_VAL_D32, HUGE_VAL_D64, or HUGE_VAL_D128. If an underflow occurs, it returns 0. Both overflow and underflow set errno to ERANGE.

Example

```
/* CELEBE11
   This example illustrates the expd64() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 x, y;

    x = 5.0DD;
    y = expd64(x);

    printf("expd64(%Df) = %Df\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“exp\(\), expf\(\), expl\(\) — Calculate exponential function” on page 453](#)
- [“logd32\(\), logd64\(\), logd128\(\) — Calculate natural logarithm” on page 999](#)
- [“log10d32\(\), log10d64\(\), log10d128\(\) — Calculate base 10 logarithm” on page 1006](#)
- [“powd32\(\), powd64\(\), powd128\(\) — Raise to power” on page 1205](#)

expm1(), expm1f(), expm1l() — Exponential minus one

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>
```

```
double expm1(double x);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

float expm1f(float x);
long double expm1l(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float expm1(float x);
long double expm1l(long double x);
```

General description

The expm1() functions calculate the function:
 $e^x - 1.0$

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| expm1 | X | X |
| expm1f | X | X |
| expm1l | X | X |

Returned value

If successful, expm1() returns the above function calculated on x.

If unsuccessful, expm1() may fail as follows:

- If x is negative and exceeds an internally defined large value, expm1() functions will return -1.0.
- If the value of the function overflows, expm1() functions will return HUGE_VAL or HUGE_VALF or HUGE_VALL as appropriate, and set errno to ERANGE.

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“exp\(\), expf\(\), expl\(\) — Calculate exponential function”](#) on page 453
- [“ilogb\(\), ilogbf\(\), ilogbl\(\) — Integer unbiased exponent”](#) on page 834
- [“log1p\(\), log1pf\(\), log1pl\(\) — Natural log of x+1”](#) on page 1002

[expm1d32\(\), expm1d64\(\), expm1d128\(\) — Exponential minus one](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 expm1d32(_Decimal32 x);
_Decimal64 expm1d64(_Decimal64 x);
_Decimal128 expm1d128(_Decimal128 x);

_Decimal32 expm1(_Decimal32 x);      /* C++ only */
_Decimal64 expm1(_Decimal64 x);      /* C++ only */
_Decimal128 expm1(_Decimal128 x);    /* C++ only */
```

General description

The `expm1()` functions calculate the function:

$e^x - 1.0$

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point”](#) on page 97 [IEEE Decimal Floating-Point](#) for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, `expm1()` returns the above function calculated on `x`.

If unsuccessful, `expm1()` may fail as follows:

- If `x` is negative and exceeds an internally defined large value, `expm1()` functions will return `-1.0`.
- If the value of the function overflows, `expm1()` functions will return `HUGE_VAL_D32` or `HUGE_VAL_D64` or `HUGE_VAL_D128` as appropriate, and set `errno` to `ERANGE`.

Example

```
/* CELEBE13
   This example illustrates the expm1d32() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

void main(void)
{
    _Decimal32 x, y;

    x = 2.5DF;
    y = expm1d32(x);

    printf("expm1d32(%Hf) = %Hf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“expd32\(\), expd64\(\), expd128\(\) — Calculate exponential function”](#) on page 454
- [“ilogbd32\(\), ilogbd64\(\), ilogbd128\(\) — Integer unbiased exponent”](#) on page 835
- [“log1pd32\(\), log1pd64\(\), log1pd128\(\) — Natural log of x+1”](#) on page 1003

ExportWorkUnit() – WLM export service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R9 |

Format

```
#include <sys/__wlm.h>

int ExportWorkUnit(wlmetok_t *enclavetoken,
                  wlmxtok_t *exporttoken,
                  unsigned long *conntoken);
```

AMODE 64:

```
#include <sys/__wlm.h>

int ExportWorkUnit(wlmetok_t *enclavetoken,
                  wlmxtok_t *exporttoken,
                  unsigned int *conntoken);
```

General description

Exports an enclave to all systems in a parallel sysplex, enabling dispatchable units on other systems to join the enclave.

The ExportWorkUnit() function uses the following parameters:

***enclavetoken**

Points to a work unit enclave token that was returned from a call to CreateWorkUnit() or ContinueWorkUnit().

***exporttoken**

Points to a data field of type wlmxtok_t where the ExportWorkUnit() function is to return the WLM work unit export token.

***conntoken**

Specifies the connect token that represents the connection to WLM.

Returned value

If successful, ExportWorkUnit() returns 0.

If unsuccessful, ExportWorkUnit() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained a value that is not correct.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

A WLM service failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class, if the BPX.WLMSEVER

class is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“UnDoExportWorkUnit\(\) — WLM undo export service” on page 1938](#)
- For more information, see [z/OS MVS Programming: Workload Management Services](#).

exp2(), exp2f(), exp2l() — Calculate the base-2 exponential

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double exp2(double x);
float exp2f(float x);
long double exp2l(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float exp2(float x);
long double exp2(long double x);
```

General description

The exp2 functions compute the base-2 exponential of x .

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| exp2 | X | X |
| exp2f | X | X |
| exp2l | X | X |

Returned value

The exp2 functions return 2 to the power x .

Related information

- [“math.h — Floating-point math functions” on page 40](#)

exp2d32(), exp2d64(), exp2d128() – Calculate the base-2 exponential

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 exp2d32(_Decimal32 x);
_Decimal64 exp2d64(_Decimal64 x);
_Decimal128 exp2d128(_Decimal128 x);

_Decimal32 exp2(_Decimal32 x);      /* C++ only */
_Decimal64 exp2(_Decimal64 x);      /* C++ only */
_Decimal128 exp2(_Decimal128 x);     /* C++ only */
```

General description

The exp2() functions compute the base-2 exponential of x.

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) IEEE Decimal Floating-Point for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

The exp2() functions return 2 to the power x.

Example

```
/* CELEBE14
   This example illustrates the exp2d128() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

void main(void)
{
    _Decimal128 x, y;

    x = 4.785DL;
    y = exp2d128(x);

    printf("exp2d128(%DDf) = %DDf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)

extlink_np() – Create an external symbolic link

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <unistd.h>

int extlink_np(const char *ename, const char *elink);
```

General description

Creates the external symbolic link file named by *elink* with the object specified by *ename*. The *ename* is not resolved, and refers to an object outside z/OS UNIX. The variable *elink* is the name of the external symbolic link file created, and *ename* is the name of the object contained within that file.

Returned value

If successful, `extlink_np()` returns 0.

If unsuccessful, `extlink_np()` returns -1, does not affect any file it names, and sets `errno` to one of the following values:

Error Code

Description

EACCES

A component of the *elink* path prefix denies search permission.

EEXIST

The file named by *elink* already exists.

EINVAL

elink has a slash as its last component, which indicates that the preceding component will be a directory. An external link cannot be a directory.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links encountered during resolution of the *elink* argument is greater than `POSIX_SYMLINK_MAX`.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters, or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the *pathname* string substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined with `pathconf()`.

ENOTDIR

A component of the path prefix of *elink* is not a directory.

ENOSPC

The new external link cannot be created because there is no space left on the file system to contain it.

EROFS

The file named by *elink* cannot be created on a read-only file system.

Example

CELEBE07

```

/* CELEBE07

   This example creates an external symbolic link.

*/
#include <stdio.h>
#include <fcntl.h>
#include <errno.h>
#include <unistd.h>
#include <stdlib.h>
#include <sys/stat.h>
#include <sys/types.h>

main( argc, argv )
    int  argc ;
    char *argv ;
{
    int  i_rc ;
    int  i_fd ;
    char ac_mvds[] = "SYS1.LINKLIB" ;
    char ac_mvds sextsymlnk[] = "sys1.linklib.extsymlnk" ;

    i_rc = unlink( ac_mvds sextsymlnk ) ;

    if ( ( i_rc == -1 ) && ( errno == ENOENT ) ) {
    }
    else
    {
        perror( "unlink() error" ) ;
        return( -1 ) ;
    }

    printf( "Before extlink_np() call ...\n" ) ;
    system( "ls -il sys1.*" ) ;

    i_rc = extlink_np( ac_mvds, ac_mvds sextsymlnk ) ;

    if ( i_rc == -1 )
    {
        perror( "extlink_np() error" ) ;
        return( -1 ) ;
    }

    printf( "After extlink_np() call ...\n" ) ;
    system( "ls -il sys1.*" ) ;

    i_rc = unlink( ac_mvds sextsymlnk ) ;
}

```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“lstat\(\), lstat64\(\) — Get status of file or symbolic link” on page 1025](#)
- [“readlink\(\) — Read the value of a symbolic link” on page 1390](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

ExtractWorkUnit() – Extract enclave service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R8 |

Format

```
#include <sys/__wlm.h>

int ExtractWorkUnit(wlmetok_t *enclavetoken);
```

General description

The ExtractWorkUnit() function will allow the task to retrieve the enclaves token for the purpose of performance management.

The ExtractWorkUnit() function uses the following parameter:

***enclavetoken**

Points to a data field of type wlmetok_t where the ExtractWorkUnit() function is to return the WLM work unit token to which the current process is joined.

Returned value

If successful, ExtractWorkUnit() returns 0.

If unsuccessful, ExtractWorkUnit() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

An argument of this service contained an address that was not accessible to the caller.

EINVAL

The Functioncode parm contains a value that is not correct or the function parmlist data is incorrect.

EMVSSAF2ERR

An error occurred in the security product. Consult the reason code, which can be retrieved using the __errno2() function.

EMVSWLMERROR

A WLM service failed. Consult the reason code, which can be retrieved using the __errno2() function.

EPERM

Do not have appropriate permissions and privilege.

ESRCH

A WLM_EXTRACT_WORKUNIT request was issued but the WLM enclave token was not returned.

Related information

- [“sys/__wlm.h – WorkLoad Manager functions” on page 73](#)

__e2a_l() – Convert characters from EBCDIC to ASCII

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | z/OS V1R2 |

Format

```
#include <unistd.h>

size_t __e2a_l(char *bufptr, size_t szLen)
```

General description

The `__e2a_l` function converts *szLen* characters in *bufptr* between IBM-1047 and ISO8859-1, returning the number of characters converted if successful or -1 if not. Conversion occurs in place in the buffer. `__e2a_l` is not sensitive to the locale, and only converts between ISO8859-1 and IBM-1047.

Note: This function is valid for applications compiled XPLINK only.

Returned value

If successful, `__e2a_l` returns the number of characters converted.

If unsuccessful, `__e2a_l` returns -1 and sets `errno` to the following value:

Error Code

Description

EINVAL

The pointer to *bufptr* is NULL or *szLen* is a negative value.

Related information

- [“unistd.h – Implementation-specific functions” on page 77](#)
- [“__a2e_l\(\) – Convert characters from ASCII to EBCDIC” on page 208](#)
- [“__a2e_s\(\) – Convert string from ASCII to EBCDIC” on page 209](#)
- [“__e2a_s\(\) – Convert string from EBCDIC to ASCII” on page 464](#)

__e2a_s() – Convert string from EBCDIC to ASCII

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | z/OS V1R2 |

Format

```
#include <unistd.h>

size_t __e2a_s(char *string)
```

General description

The `__e2a_s()` function converts a string between IBM-1047 and ISO8859-1, returning the string length if successful or -1 if not. Conversion occurs in place in the string. `__e2a_s()` is not sensitive to the locale, and only converts between ISO8859-1 and IBM-1047.

Note: This function is valid for applications compiled XPLINK only.

Returned value

If successful, `__e2a_s()` returns the string length.

If unsuccessful, `__e2a_s()` returns -1 and sets `errno` to the following value:

Error Code

Description

EINVAL

The pointer to string is NULL.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“__a2e_l\(\) — Convert characters from ASCII to EBCDIC” on page 208](#)
- [“__a2e_s\(\) — Convert string from ASCII to EBCDIC” on page 209](#)
- [“__e2a_l\(\) — Convert characters from EBCDIC to ASCII” on page 464](#)

`fabs()`, `fabsf()`, `fabsl()` — Calculate floating-point absolute value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double fabs(double x);
float fabsf(float x);           /* C++ only */
long double fabsl(long double x); /* C++ only */
float fabsf(float x);
long double fabsl(long double x);
```

General description

The `fabs()` functions calculate the absolute value of a floating-point argument.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

Returns the absolute value of the float input.

Example

```
/* This example calculates y as the absolute value of x. */
#include <math.h>

int main(void)
{
    double x, y;

    x = -5.6798;
    y = fabs(x);

    printf("fabs( %f ) = %f\n", x, y);
}
```

Output

```
fabs( -5.679800 ) = 5.679800
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“abs\(\), absf\(\), absl\(\) — Calculate integer absolute value” on page 105](#)
- [“labs\(\) — Calculate long absolute value” on page 934](#)

fabsd32(), fabsd64(), fabsd128() — Calculate floating-point absolute value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 fabsd32(_Decimal32 x);
_Decimal64 fabsd64(_Decimal64 x);
_Decimal128 fabsd128(_Decimal128 x);
_Decimal32 fabs(_Decimal32 x); /* C++ only */
_Decimal64 fabs(_Decimal64 x); /* C++ only */
_Decimal128 fabs(_Decimal128 x); /* C++ only */
```

General description

The fabs() functions calculate the absolute value of a decimal floating-point argument.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See [“IEEE binary floating-point” on page 97](#) for more information

Returned value

Returns the absolute value of the decimal floating-point input.

Example

```
/* CELEBF75

   This example illustrates the fabstd128() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x, y;

    x = -5.6798DL;
    y = fabstd128(x);

    printf("fabstd128(%DDf) = %DDf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“fabs\(\), fabsf\(\), fabsl\(\) — Calculate floating-point absolute value” on page 465](#)

faccessat() — Determine accessibility of a file relative to directory file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>          /* Definition of AT_* constants */
#include <unistd.h>

int faccessat(int dirfd, const char *pathname, int mode, int flags);
```

General description

`faccessat()` operates in the same way as `access()` except for the following differences:

- If *pathname* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by `access()` for a relative *pathname*).
- If *pathname* is relative and *dirfd* is the special value `AT_FDCWD`, *pathname* is interpreted relative to the current working directory of the calling process (like `access()`).

If *pathname* is absolute, *dirfd* is ignored.

flags is constructed by ORing together zero or more of the following values:

AT_EACCESS

Perform access checks by using the effective user and group IDs. By default, `faccessat()` uses the real IDs (like `access()`).

AT_SYMLINK_NOFOLLOW

If *pathname* is a symbolic link, do not dereference it but return information about the link itself instead.

Returned value

If successful, `faccessat()` returns 0.

If unsuccessful, `faccessat()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCES**

The process does not have appropriate permissions to access the file in the specified way, or does not have search permission on some component of the *pathname* prefix.

EBADF

The *pathname* argument does not specify an absolute path and the *fd* argument is not `AT_FDCWD` or a valid file descriptor that is open for reading or searching.

EINVAL

mode is incorrectly specified or an invalid flag is specified in *flags*.

ELOOP

A loop exists in symbolic links that are encountered during resolution of the *pathname* argument.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters. The `PATH_MAX` value is determined by using `pathconf()`.

ENOENT

No file is named *pathname*, or the *pathname* argument is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EROFS

Write access is requested for a file on a read-only file system.

ETXTBSY

Write access is requested to an executable that is being executed.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“access\(\) — Determine whether a file can be accessed” on page 115](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)

fattach() — Attach a STREAMS-based file descriptor to a file in the file system name space

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stropts.h>

int fattach(int fildev, const char *path);
```

General description

The `fattach()` function attaches a STREAMS-based file descriptor to a file, effectively associating a path name with *fildev*. The *fildev* argument must be a valid open file descriptor associated with a STREAMS file. The *path* argument points to a path name of an existing file. The process must have appropriate privileges, or must be the owner of the file named by *path* and have write permission. A successful call to `fattach()` causes all path names that name the file named by *path* to name the STREAMS file associated with *fildev*, until the STREAMS file is detached from the file. A STREAMS file can be attached to more than one file and can have several path names associated with it.

The attributes of the named STREAMS file are initialized as follows: the permissions, user ID, group ID, and times are set to those of the file named by *path*, the number of links is set to 1, and the size and device identifier are set to those of the STREAMS file associated with *fildev*. If any attributes of the named STREAMS file are subsequently changed (for example, by `chmod()`), neither the attributes of the underlying file nor the attributes of the STREAMS file to which *fildev* refers are affected.

File descriptors referring to the underlying file, opened before an `fattach()` call, continue to refer to the underlying file.

Returned value

If successful, `fattach()` returns 0.

If unsuccessful, `fattach()` returns -1 and sets `errno` to one of the following values.

Note: z/OS UNIX services do not supply any STREAMS devices or pseudodevices. It is impossible for `fattach()` to attach a STREAMS-based file descriptor to a file. It will always return -1 with `errno` set to indicate the failure. See [“open\(\) — Open a file” on page 1157](#) for more information.

Error Code

Description

EACCES

Search permission is denied for a component of the path prefix, or the process is the owner of *path* but does not have write permissions on the file named by *path*.

EBADF

The *fildev* argument is not a valid open file descriptor.

EBUSY

The file named by *path* is currently a mount point or has a STREAMS file attached to it.

EINVAL

The *fildev* argument does not refer to a STREAMS file.

ELOOP

Too many symbolic links were encountered in resolving *path*.

ENAMETOOLONG

The size of *path* exceeds **PATH_MAX**, or a component of *path* is longer than **NAME_MAX**, or path name resolution of a symbolic link produced an intermediate result whose length exceeds **PATH_MAX**.

ENOENT

A component of *path* does not name an existing file or *path* is an empty string.

ENOTDIR

A component of the path prefix is not a directory.

EPERM

The effective user ID of the process is not the owner of the file named by *path* and the process does not have appropriate privilege.

Related information

- [“stropts.h — Stream interface” on page 67](#)
- [“fdetach\(\) — Detach a name from a STREAMS-based file descriptor” on page 497](#)
- [“isastream\(\) — Test a file descriptor” on page 902](#)

__fbufsize() — Retrieve the buffer size of an open stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

size_t __fbufsize(FILE *stream);
```

General description

The `__fbufsize()` function retrieves the buffer size, in bytes, of the specified stream.

Returned value

The `__fbufsize()` function returns the size of the buffer in bytes. Otherwise, the `__fbufsize()` function returns 0. If an error has occurred, `__fbufsize()` returns 0 and sets `errno` to nonzero.

An application wishing to check for error situations should set `errno` to 0, then call `__fbufsize()`, and then check `errno`. If `errno` is nonzero, assume that an error has occurred.

Error Code

Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF87

```

/* CELEBF87

   This example determines the size of the I/O buffer
   for an open stream.

*/

#include <stdio.h>
#include <stdio_ext.h>

void main() {
    FILE *f;
    int bufsize = 0;
    char filename[FILENAME_MAX] = "myfile.dat";

    f = fopen(filename,"wb");
    if (f == NULL) {
        perror("fopen failed\n");
        return;
    }

    bufsize = __fbufsize(f);

    printf("The buffer size for %s is %d\n",filename,bufsize);

    return;
}

```

Output

```
The buffer size for myfile.dat is 4096
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“setbuf\(\) — Control buffering” on page 1518](#)
- [“setvbuf\(\) — Control buffering” on page 1589](#)

__fchattr(), __fchattr64() — Change the attributes of a file or directory by file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R2 |

Format

__fchattr:

```

#define _OPEN_SYS_FILE_EXT 1
#include <sys/stat.h>

int __fchattr(int filedес, attrib_t *attributes, int attributes_len);

```

__fchattr64:

```
#define _LARGE_TIME_API
#define _OPEN_SYS_FILE_EXT 1
#include <sys/stat.h>
```

```
int __fchattr64(int filedes, attrib64_t *attributes, int attributes_len);
```

Compile requirement: Use of the `__fchattr64` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The `__fchattr()` function modifies the attributes that are associated with a file. It can be used to change the mode, owner, access time, modification time, change time, reference time, audit flags, general attribute flags, file tag, and file format and size. The file to be impacted is defined by its file descriptor with the *filedes* argument.

The *attributes* argument is the address of an `attrib_t` structure which is used to identify the attributes to be modified and the new values desired. The `attrib_t` type is an `f_attributes` structure as defined in `<sys/stat.h>` for use with the `__fchattr()` function. For proper behavior, the user should ensure that this structure has been initialized to zeros before it is populated. The `f_attributes` structure is defined as indicated in [Table 20 on page 262](#).

The `__fchattr64()` function behaves exactly like `__fchattr()` except `__fchattr64()` uses `struct attrib64_t` instead of `struct attrib_t` to support time beyond 03:14:07 UTC on January 19, 2038.

The `attrib64_t` type is an `f_attributes64` structure as defined in `<sys/stat.h>` for use with the `__fchattr64()` function.

Returned value

If successful, `__fchattr()` returns 0.

If unsuccessful, `__fchattr()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCES**

The calling process did not have appropriate permissions. Possible reasons include:

- The calling process was attempting to set access time or modification time to current time, and the effective UID of the calling process does not match the owner of the file; the process does not have write permission for the file; or the process does not have appropriate privileges.
- The calling process was attempting to truncate the file, and it does not have write permission for the file.

EBADF

The *filedes* parameter is not a valid file descriptor.

ECICS

An attempt was made to change file tag attributes under non-OTE CICS and file tagging is not supported in that environment.

EFBIG

The calling process was attempting to change the size of a file but the specified length is greater than the maximum file size limit for the process.

EINVAL

The attributes structure containing the requested changes is not valid.

EPERM

The operation is not permitted for one of the following reasons:

- The calling process was attempting to change the mode or the file format but the effective UID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.
- The calling process was attempting to change the owner but it does not have appropriate privileges.
- The calling process was attempting to change the general attribute bits but it does not have write permission for the file.
- The calling process was attempting to set a time value (not current time) but the effective UID does not match the owner of the file, and it does not have appropriate privileges.
- The calling process was attempting to set the change time or reference time to current time but it does not have write permission for the file.
- The calling process was attempting to change auditing flags but the effective UID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.
- The calling process was attempting to change the Security Auditor's auditing flags but the user does not have auditor authority.

EROFS

pathname specifies a file that is on a read-only file system.

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“__chattr\(\), __chattr64\(\) — Change the attributes of a file or directory” on page 261](#)
- [“__lchattr\(\), __lchattr64\(\) — Change the attributes of a file or directory when they point to a symbolic or external link” on page 935](#)

fchaudit() — Change audit flags for a file by descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/stat.h>

int fchaudit(int fildes, unsigned int flags, unsigned int option);
```

General description

Changes the audit flags of a file. The parameter *fildes* is the file descriptor for the open file whose audit flags are to be changed. *flags* specifies what the audit flags should be changed to:

AUDTREADFAIL

Audit failing read requests.

AUDTREADSUCC

Audit successful read requests.

AUDTWRITEFAIL

Audit failing write requests.

AUDTWritesucc

Audit successful write requests.

AUDTEXECFAIL

Audit failing execute or search requests.

AUDTEXECSUCC

Audit successful execute or search requests. The bitwise inclusive-OR of any or all of these can be used to set more than one type of auditing.

The parameter *option* specifies whether the user audit flags or the security auditor audit flags should be changed:

AUDT_USER (0)

User audit flags are changed. The user must be the file owner or have appropriate authority to change the user audit flags for a file.

AUDT_AUDITOR (1)

Security-auditor audit flags are changed. The user must have security auditor authority to change the security auditor audit flags for a file.

Returned value

If successful, fchaudit() returns 0.

If unsuccessful, fchaudit() returns -1 and sets errno to one of the following values:

Error Code**Description****EBADF**

fildev is not a valid open file descriptor.

EINVAL

option does not contain a 0 or 1.

EPERM

The effective user ID (UID) of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.

EROFS

fildev is associated with a file that is on a read-only file system.

Example**CELEBF02**

```
/* CELEBF02

   The following program changes the audit flags of a file.

*/
#define _OPEN_SYS
#include <fcntl.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <unistd.h>
#include <stdio.h>

main() {
    int fd;
    char fn[]="fchaudit.file";

    if ((fd = creat(fn, S_IRUSR|S_IWUSR)) < 0)
        perror("creat() error");
    else {
        if (fchaudit(fd, AUDTREADSUCC, AUDT_USER) != 0)
            perror("fchaudit() error");
        close(fd);
        unlink(fn);
    }
}
```

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“access\(\) — Determine whether a file can be accessed” on page 115](#)
- [“chaudit\(\) — Change audit flags for a file by path” on page 267](#)
- [“fchmod\(\) — Change the mode of a file or directory by descriptor” on page 476](#)
- [“fchown\(\) — Change the owner or group by file descriptor” on page 479](#)
- [“fstat\(\), fstat64\(\) — Get status information about a file” on page 649](#)

fchdir() — Change working directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int fchdir(int fildevs);
```

General description

The `fchdir()` function has the same effect as `chdir()` except that the directory that is to be new current working directory is specified by the file descriptor *fildevs*.

Returned value

If successful, `fchdir()` changes the working directory and returns 0.

If unsuccessful, `fchdir()` does not change the working directory, returns -1, and sets `errno` to one of the following values:

Error Code

Description

EACCES

Search permission is denied for the directory referenced by *fildevs*.

EBADF

The *fildevs* arguments is not an open file descriptor.

ENOTDIR

The open file descriptor *fildevs* does not refer to a directory.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chdir\(\) — Change the working directory” on page 270](#)
- [“chroot\(\) — Change root directory” on page 281](#)

fchmod() — Change the mode of a file or directory by descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1a XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX1_SOURCE 2
#include <sys/stat.h>

int fchmod(int fildes, mode_t mode);
```

General description

Sets the S_ISUID, S_ISGID, and file permission bits of the open file identified by *fil*des, its file descriptor.

The *mode* argument is created with one of the symbols defined in the sys/stat.h header file. For more information on these symbols, refer to [“chmod\(\) — Change the mode of a file or directory” on page 274](#).

Returned value

If successful, fchmod() marks for update the st_ctime field of the file and returns 0.

If unsuccessful, fchmod() returns -1 and sets errno to one of the following values:

Error Code

Description

EBADF

*fil*des is not a valid open file descriptor.

EPERM

The effective user ID (UID) does not match the owner of the file, and the calling process does not have appropriate privileges.

EROFS

The file resides on a read-only file system.

Example

CELEBF03

```
/* CELEBF03
   This example changes a file permission.
*/
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    char fn[]="temp.file";
    int fd;
    struct stat info;

    if ((fd = creat(fn, S_IWUSR)) < 0)
```

```

    perror("creat() error");
else {
    stat(fn, &info);
    printf("original permissions were: %08x\n", info.st_mode);
    if (fchmod(fd, S_IRWXU|S_IRWXG) != 0)
        perror("fchmod() error");
    else {
        stat(fn, &info);
        printf("after fchmod(), permissions are: %08x\n", info.st_mode);
    }
    close(fd);
    unlink(fn);
}
}

```

Output

```

original permissions were: 03000080
after fchmod(), permissions are: 030001f8

```

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“fchown\(\) — Change the owner or group by file descriptor” on page 479](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“mkfifo\(\) — Make a FIFO special file” on page 1075](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)

fchmodat() — Change the mode of a file relative to a directory file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```

#define _POSIX_C_SOURCE 200809L
#include <fcntl.h> /* Definition of AT_* constants */
#include <sys/stat.h>

int fchmodat(int fd, const char *path, mode_t mode, int flag);

```

General description

fchmodat() function is equivalent to the chmod() function except for the following differences:

- If *pathname* is relative, it is interpreted relative to the directory referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by chmod() for a relative *pathname*).
- If *pathname* is relative and *dirfd* is the special value AT_FDCWD, *pathname* is interpreted relative to the current working directory of the calling process (like chmod()).

- If *pathname* is absolute, then *dirfd* is ignored.

flags can either be 0 or include the following list, which is defined in `<fcntl.h>`:

AT_SYMLINK_NOFOLLOW

If *pathname* is a symbolic link, the mode of the symbolic link is changed.

If `fchmodat()` is passed the special value `AT_FDCWD` in the *fd* parameter, the current working directory must be used. In this case, if *flag* is zero, the behavior must be identical to a call to `chmod()`.

Returned value

If successful, `fchmodat()` returns 0.

If unsuccessful, `fchmodat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The calling process does not have permission to search some component of *pathname*.

EBADF

The *pathname* argument does not specify an absolute path and the *fd* argument is not `AT_FDCWD` or a valid file descriptor that is open for reading or searching.

EINVAL

One of the input parameters is not valid.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLINK_MAX` symbolic links are encountered during resolution of the symlink argument.

ENAMETOOLONG

pathname is longer than 1023 characters, or a component of *pathname* is longer than 255 characters. (Filename truncation is not supported.)

ENOENT

A component of *pathname* does not name an existing file or *pathname* is an empty string.

ENOTDIR

A component of the *pathname* prefix is not a directory.

EPERM

The effective UID of the calling process does not match the owner of the file, and the calling process does not have appropriate privilege.

EROFS

The file resides on a read-only file system.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“fchmod\(\) — Change the mode of a file or directory by descriptor” on page 476](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“fchown\(\) — Change the owner or group by file descriptor” on page 479](#)

fchown() — Change the owner or group by file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1a XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX1_SOURCE 2
#include <unistd.h>

int fchown(int fildes, uid_t owner, gid_t group);
```

General description

Changes the owner or group (or both) of a file. *fil*des is the file descriptor for the file. *owner* is the user ID (UID) of the new owner of the file. *group* is the group ID of the new group for the file.

If `_POSIX_CHOWN_RESTRICTED` is defined in the `unistd.h` header file, a process can change the group of a file only if one of the following conditions is true:

1. The process has appropriate privileges.
- Or
2. All of the following are true:
 - a. The effective user ID of the process is equal to the user ID of the file owner.
 - b. The *owner* argument is equal to the user ID of the file owner or `(uid_t)-1`,
 - c. The *group* argument is either the effective group ID or a supplementary group ID of the calling process.

If *fil*des points to a regular file and one or more of the `S_IXUSR`, `S_IXGRP`, or `S_IXOTH` bits of the file mode are set when `fchown()` returns successfully, it clears the set-user-ID (`S_ISUID`) and set-group-ID (`S_ISGID`) bits of the file mode.

If the file referred to by *fil*des is not a regular file and one or more of the `S_IXUSR`, `S_IXGRP`, or `S_IXOTH` bits of the file mode are set, the set-user-ID (`S_ISUID`) and set-group-ID (`S_ISGID`) bits of the file are cleared.

When `fchown()` completes successfully, it marks the `st_ctime` field of the file to be updated.

Returned value

If successful, `fchown()` updates the change time for the file and returns 0.

If unsuccessful, `fchown()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

*fil*des is not a valid open file descriptor.

EPERM

Either the effective user ID does not match the owner of the file, or the calling process does not have appropriate privileges, and `POSIX_CHOWN_RESTRICTED` indicates that such privilege is required.

EROFS

The file resides on a read-only system.

Example**CELEBF04**

```
/* CELEBF04

   This example changes the owner ID and group ID.

*/
#define _POSIX_SOURCE
#include <fcntl.h>
#include <unistd.h>
#include <sys/stat.h>
#include <sys/types.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    char fn[]="temp.file";
    FILE *stream;
    int fd;
    struct stat info;

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        stat(fn, &info);
        printf("original owner was %d and group was %d\n", info.st_uid,
               info.st_gid);
        if (fchown(fd, 25, 0) != 0)
            perror("fchown() error");
        else {
            stat(fn, &info);
            printf("after fchown(), owner is %d and group is %d\n",
                   info.st_uid, info.st_gid);
        }
        close(fd);
        unlink(fn);
    }
}
```

Output

```
original owner was 0 and group was 500
after fchown(), owner is 25 and group is 0
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“fchmod\(\) — Change the mode of a file or directory by descriptor” on page 476](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“mkfifo\(\) — Make a FIFO special file” on page 1075](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)

fchownat() — Change owner and group of a file relative to directory file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <unistd.h>
#include <fcntl.h>

int fchownat(int dirfd, const char *path, uid_t owner, gid_t group, int flag);
```

General description

fchownat() operates in the same way as chown() except for the following differences:

- If the *pathname* is relative, it is interpreted relative to the directory referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by chown() for a relative *pathname*).
- If *pathname* is relative and *dirfd* is the special value AT_FDCWD, *pathname* is interpreted relative to the current working directory of the calling process (like chown()).
- If *pathname* is absolute, *dirfd* is ignored.
- *flags* can either be 0 or include the following flag:

AT_SYMLINK_NOFOLLOW

- If *pathname* is a symbolic link, do not dereference it but operate on the link itself instead (like chown()). By default, fchownat() dereferences symbolic links, like chown().

Returned value

If successful, fchownat() returns 0.

If unsuccessful, fchownat() returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

dirfd is not a valid open file descriptor.

EPERM

Either the effective user ID does not match the owner of the file, or the calling process does not have appropriate privileges, and POSIX_CHOWN_RESTRICTED indicates that such privilege is required.

EROFS

The file resides on a read-only file system.

EINVAL

An invalid flag is specified in *flags*.

ENOTDIR

pathname is relative and *dirfd* is a file descriptor referring to a file other than a directory.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“fchmod\(\) — Change the mode of a file or directory by descriptor” on page 476](#)
- [“fchown\(\) — Change the owner or group by file descriptor” on page 479](#)

fclose() — Close file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

int fclose(FILE *stream);
```

General description

Flushes a stream, and then closes the file associated with that stream. Afterwards, the function releases any buffers associated with the stream. To *flush* means that unwritten buffered data is written to the file, and unread buffered data is discarded.

A pointer to a closed file *cannot* be used as an input value to the `freopen()` function.

Notes:

1. The storage pointed to by the FILE pointer is freed by the `fclose()` function. An attempt to use the FILE pointer to a closed file is not valid. This restriction is true even when `fclose()` fails.
2. If an application has locked a (FILE *) object (with `flockfile()` or `ftrylockfile()`), it is responsible for relinquishing the locked (FILE *) object (with `funlockfile()`) before calling `fclose()`. Failure to relinquish a locked (FILE *) object may cause deadlock (or looping).

Returned value

If successful closing the stream, `fclose()` returns 0.

If a failure occurs in flushing buffers or in outputting data, `fclose()` returns EOF. An attempt will still be made to close the file.

Special behavior for XPG4

`fclose()` sets `errno` to one of the following values:

Error Code

Description

EAGAIN

The `O_NONBLOCK` flag is set and output cannot be written immediately.

EBADF

The underlying file descriptor is not valid.

EFBIG

Writing to the output file would exceed the maximum file size or the process's file size supported by the implementation.

EINTR

The `fclose()` function was interrupted by a signal before it had written any output.

EIO

The process is in a background process group and is attempting to write to its controlling terminal, but `TOSTOP` (defined in the `termio.h` include file) is set, the process is neither ignoring nor blocking `SIGTTOU` signals, and the process group of the process is orphaned.

ENOSPC

There is no free space left on the output device

ENXIO

A request was made of a nonexistent device, or the request was outside the device.

EPIPE

`fclose()` is trying to write to a pipe or FIFO that is not open for reading by any process. This error also generates a `SIGPIPE` signal.

Example

```
/* This example opens a file myfile.dat for reading as a stream and then
   closes the file.
*/
#include <stdio.h>

int main(void)
{
    FILE *stream;

    stream = fopen("myfile.dat", "r");
    :
    if (fclose(stream)) /* Close the stream. */
        printf("fclose error\n");
}
```

Related information

- See the topics about closing files and opening files in [z/OS XL C/C++ Programming Guide](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“freopen\(\) — Redirect an open file” on page 622](#)

fcntl() — Control open file descriptors

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <fcntl.h>

int fcntl(int fil-des, int action, ...);
```

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <unistd.h>
#include <fcntl.h>

int fcntl(int socket, int cmd, ...);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <unistd.h>
#include <fcntl.h>

int fcntl(int socket, int cmd, ...);
```

General description

The `fcntl()` function performs various actions on open file descriptors.

The argument *fil-des* is a file descriptor for the file you want to manipulate. *action* is a symbol indicating the action you want to perform on *fil-des*. These symbols are defined in the `<fcntl.h>` header file. If needed, “...” indicates a third argument. The type of the third argument depends on *action*, and some actions do not need an additional argument.

Behavior for sockets: The operating characteristics of sockets can be controlled with the `fcntl()` call. The operations to be controlled are determined by *cmd*. The *arg* parameter is a variable with a meaning that depends on the value of the *cmd* parameter.

Parameter Description

socket

The socket descriptor.

cmd

The command to perform.

arg

The data associated with *cmd*.

The *action* argument can be one of the following symbols:

F_CLOSF

Closes a range of file descriptors. A third `int` argument must be specified to indicate the upper limit for the range of the file descriptors to be closed, while *fil-des* specifies the lower limit. If -1 is specified for the third argument, all file descriptors greater than or equal to the lower limit are closed.

F_DUPFD

Duplicates the file descriptor. A third `int` argument must be specified. `fcntl()` returns the lowest file descriptor greater than or equal to this third argument that is not already associated with an open file. This file descriptor refers to the same file as *fil-des* and shares any locks. The flags `FD_CLOEXEC` and `FD_CLOFORK` are turned off in the new file descriptor, so that the file is kept open if an `exec` function is called.

Note: If *fil-des* is an XTI endpoint, there must be at least one available file descriptor greater than or equal to the third argument and less than 65536.

F_DUPFD2

Duplicates the file descriptor. A third `int` argument must be specified to indicate which file descriptor to use as the duplicate. This file descriptor is closed if already open and then used as the new file descriptor. The new file descriptor refers to the same file as *fdes* and shares any locks. The flag `FD_CLOEXEC` is turned off in the new file descriptor, so that the file is kept open if an `exec` function is called.

Note:

1. If the third argument refers to the same file descriptor as *fdes*, the file descriptor is not closed and `FD_CLOEXEC` is not turned off.
2. If *fdes* is an XTI endpoint, the third argument must not exceed the limit of 65535.

F_GETFD

Obtains the file descriptor flags for *fdes*. `fcntl()` returns these flags as its result. For a list of supported file descriptor flags, see [“File flags” on page 487](#).

F_SETFD

Sets the file descriptor flags for *fdes*. You must specify a third `int` argument, giving the new file descriptor flag settings. `fcntl()` returns 0 if it successfully sets the flags.

F_GETFL

Obtains the file status flags and file access mode flags for *fdes*. `fcntl()` returns these flags as its result. For a list of supported file status and file access mode flags, see [“File flags” on page 487](#).

Usage of the `F_GETFL` action will return the setting of `O_LARGEFILE` status flag when `fcntl()` has been enabled to operate on large files

Behavior for sockets: This command gets the status flags of socket descriptor *socket*.

With the `_OPEN_SYS` feature test macro you can query the `FNDELAY` flag. With the `_XOPEN_SOURCE_EXTENDED 1` feature test macro you can query the `O_NDELAY` flag. The `FNDELAY` and `O_NDELAY` flags mark *socket* as being in nonblocking mode. If data is not present on calls that can block, such as `read()`, `readv()`, and `recv()`, the call returns with -1, and the error code is set to `EWOULDBLOCK`.

F_SETFL

Sets the file status flags for *fdes*. You must specify a third `int` argument, giving the new file descriptor flag settings. `fcntl()` does not change the file access mode, and file access bits in the third argument are ignored. `fcntl()` returns 0 if it successfully sets the flags.

Behavior for sockets: This command sets the status flags of socket descriptor *socket*. With the `_OPEN_SYS` feature test macro you can set the `FNDELAY` flag. With the `_XOPEN_SOURCE_EXTENDED 1` feature test macro you can set the `O_NDELAY` flag.

F_GETLK

Obtains locking information for a file. See [“File locking” on page 488](#)

F_SETLK

Sets or clears a file segment lock. See [“File locking” on page 488](#)

F_SETLKW

Sets or clears a file segment lock; but if a shared or exclusive lock is blocked by other locks, `fcntl()` waits until the request can be satisfied. See [“File locking” on page 488](#)

F_GETOWN

Behavior for sockets: Obtains the PID for the *filedes* and returns this value. The value returned will be either the process ID or the process group ID that is associated with the socket. If it is a positive integer, it specifies a process ID. If it is a negative integer (other than -1), it specifies a process group ID.

F_SETOWN

Behavior for sockets: Sets either the process ID or the process group ID that is to receive either the `SIGIO` or `SIGURG` signals for the socket associated with *filedes*. The `SIGURG` signal is generated as a result of receiving out-of-band data. Refer to `send()`, `sendto()`, `sendmsg()`, and `recv()`, `recvfrom()` and `recvmsg()` for more information on sending and receiving out-of-band data.

You must specify a third int argument, giving the PID requested. This value can be either a positive integer, specifying a process ID, or a negative integer (other than -1), specifying a process group ID. The difference between specifying a process ID or a process group ID is that in the first case only a single process will receive the signal, while in the second case all processes in the process group will receive the signal.

F_SETTAG

Sets the file tag for the file referred to by file descriptor *fildev*.

The third argument *ftag* is the address of a populated file_tag structure.

If the *ftag* argument supplied to fcntl(F_SETTAG) does not have the ft_deferred bit set ON, fcntl() will immediately set the file's File Tag with the provided *ftag*'s ft_ccsid and ft_txtflag values.

If the *ftag* argument supplied to fcntl(F_SETTAG) has the ft_deferred bit set ON, fcntl() will not set the file's File Tag until first write to the file. The CCSID used to tag the file will be the current Program CCSID at the time of first write, regardless of the *ftag* ft_ccsid value, however the ft_txtflag value will be used.

If the ft_ccsid of the specified file_tag differs from the Program CCSID, automatic file conversion will occur, provided both of the following conditions are met:

- The ft_txtflag is set to ON.
- Environment variable _BPXK_AUTOCVT is ON or ALL; or if _BPXK_AUTOCVT is unset, the BPXPRMxx member AUTOCVT is either ON or ALL.

Restriction: When _BPXK_AUTOCVT is ON, automatic conversion can only take place between IBM-1047 and ISO8859-1 code sets. Other CCSID pairs are not supported for automatic text conversion. To request automatic conversion for any CCSID pairs that Unicode service supports, set _BPXK_AUTOCVT to ALL.

If AUTOCVT(OFF) and _BPXK_AUTOCVT=OFF, the file will be tagged with the specified file_tag's ft_ccsid and ft_txtflag values, but automatic conversion will not occur. See the “Using Environment Variables” chapter in *z/OS XL C/C++ Programming Guide* for more information about the _BPXK_AUTOCVT environment variable.

If the *ftag* argument supplied to fcntl(F_SETTAG) has the ft_deferred bit set ON, pipes and FIFOs are tagged from the write end with the Program CCSID of the first writer.

F_CONTROL_CVT

Controls or queries the conversion status of the open file referred to by file descriptor *fildev*. Conversion control is generally used to provide CCSID information for untagged files or untagged programs.

Character set conversion between a program and a file, pipe or other I/O stream can be enabled or changed with F_CONTROL_CVT. A pair of CCSID's is specified or defaulted, one for the program and one for the data. As the program reads and writes data, the system will convert from one CCSID to the other.

The third f_cnvrt argument is the required address of an f_cnvrt structure. This structure is defined in <fcntl.h> and includes the following members:

Table 22. Struct f_cnvrt Element Descriptions

| Element | Data Type | Description |
|---------|-----------|--|
| pccsid | short | The Program CCSID - This is output from query and input to setting conversion ON. A value of 0 on input indicates to use the previously set value or the current Program CCSID. |
| fccsid | short | The File CCSID - This is output from query and input to setting conversion ON. A value of 0 on input indicates to use the CCSID from the File Tag as stored in the file, specified on mount, or set by a prior call. |

Table 22. Struct `f_cnvrt` Element Descriptions (continued)

| Element | Data Type | Description |
|---------------------|------------------|--|
| <code>cvtcmd</code> | <code>int</code> | <p>Conversion Control Command. The following conversion controls are available:</p> <ul style="list-style-type: none"> • Query Conversion - Returns whether or not conversion is in effect and the Program and File CCSIDs being used. On input, <code>cvtcmd</code> is set to <code>QUERYCVT</code>, and on output, it is changed to either <code>SETCVTON</code>, <code>SETCVTOFF</code>, or <code>SETCVTALL</code> to indicate that conversion is currently ON, OFF, or ALL respectively. The current CCSIDs are also returned in their respective positions in the <code>f_cnvrt</code> structure. • Set Conversion OFF - Turns OFF any conversion that may be in effect. On input, <code>cvtcmd</code> is set to <code>SETCVTOFF</code> and the rest of the <code>f_cnvrt</code> is ignored. There is no output. A program can use this to override an automatic conversion that might be established by the environment within which it is invoked. If conversion is currently in effect, the CCSIDs being used will be remembered while conversion is turned OFF, so that the prior conversion may be resumed without the program having to remember what the prior CCSIDs were. • Set Conversion ON - Turns on enhanced ASCII conversion environment and optionally specifies the CCSIDs to use in place of the Program or File CCSIDs that are currently in effect. On input, <code>cvtcmd</code> is set either to <code>SETCVTON</code> to unconditionally turn on Enhanced ASCII, or to <code>SETAUTOCVTON</code> to turn on it only if <code>_BPXK_AUTOCVT=ON</code> or <code>AUTOCVT(ON)</code> was specified in <code>BPXPRMxx</code>. In this case, automatic conversion can only take place between IBM-1047 and ISO8859-1 code sets. Other CCSID pairs are not supported for automatic text conversion. A value of 0 for the Program CCSID indicates that the current Program CCSID be used. A value of 0 for the file CCSID indicates that no change should be made to the File CCSID. This does not affect the stored File Tag or the current Program CCSID. It only changes the values being used to control conversion on this data stream. • Set Conversion ALL - Turns on Unicode conversion environment and optionally specifies the CCSIDs to use in place of the Program or File CCSIDs that are currently in effect. On input, <code>cvtcmd</code> can be set either to <code>SETCVTALL</code> to unconditionally turn on Unicode conversion, or to <code>SETAUTOCVTALL</code> to turn on it only if <code>_BPXK_AUTOCVT=ALL</code> or <code>AUTOCVT(ALL)</code> was specified in <code>BPXPRMxx</code>. <code>SETCVTALL</code> or <code>SETAUTOCVTALL</code> has no effect after the first read or write of the file. In this case, automatic conversion can take place between any code sets that Unicode service supports. A value of 0 for the Program CCSID indicates that the current Program CCSID be used. A value of 0 for the file CCSID indicates that no change should be made to the File CCSID. This does not affect the stored File Tag or the current Program CCSID. It only changes the values being used to control conversion on this data stream. |

The call fails if a conversion table is not installed for the resulting CCSID pair.



Attention: Flipping the autoconversion mode off and on, or changing the CCSID values when file conversion and/or tagging takes place, or setting the CCSIDs to values that are not compatible with the program or file, can be quite unpredictable.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

File flags

There are several types of flags associated with each open file. Flags for a file are represented by symbols defined in the `<fcntl.h>` header file.

The following *file descriptor* flags can be associated with a file:

FD_CLOEXEC

If this flag is 1, the file descriptor is closed if the process executes one of the exec function calls. If it is 0, the file remains open.

FD_CLOFORK

If this flag is 1 when a fork occurs, the file descriptor will be closed for the child process. If it is 0, the file remains open for the child.

The following *file status* flags can be associated with a file:

O_APPEND

Append mode. If this flag is 1, every write operation on the file begins at the end of the file.

O_ASYNC

If this flag is 1, then asynchronous I/O will be used for the file.

O_CLOEXEC

If this flag is 1, set the `close-on-exec` flag for the new file descriptor. This flag is defined by the `_XPLATFORM_SOURCE` feature test macro.

O_DIRECT

If this flag is 1, try to minimize cache effects of the I/O to and from this file. This flag is defined by the `_XPLATFORM_SOURCE` feature test macro.

O_NONBLOCK

No blocking. If this flag is 1, read and write operations on the file return with an error status if they cannot perform their I/O immediately. If this flag is 0, read and write operations on the file wait (or “block”) until the file is ready for I/O. For more details, see [“read\(\) — Read from a file or socket”](#) on page 1380 and [“write\(\) — Write data on a file or socket”](#) on page 2070.

O_SYNC

Force synchronous update. If the flag is 1, every `write()` operation on the file is written to permanent storage. That is, the file system buffers are forced to permanent storage. (See [“fsync\(\) — Write changes to direct-access storage”](#) on page 655.) If this flag is 0, update operations on the file will not be completed until the data has been written to permanent storage. On return from a function that performs a synchronous update, the program is assured that all data for the file has been written to permanent storage.

The following *file access mode* flags can be associated with a file:

O_RDONLY

The file is opened for reading only.

O_RDWR

The file is opened for reading and writing.

O_WRONLY

The file is opened for writing only.

Two masks can be used to extract flags:

O_ACCMODE

Extracts file access mode flags.

O_GETFL

Extracts file status flags and file access mode flags.

File locking

A process can use `fcntl()` to lock out other processes from a part of a file, so that the process can read or write to that part of the file without interference from others. File locking can ensure data integrity when several processes have a file accessed concurrently. File locking can only be performed on file descriptors

that refer to regular files. Locking is not permitted on file descriptors that refer to directories, FIFOs, pipes, character special files, or any other type of files.

A structure that has the type `struct flock` (defined in the `<fcntl.h>` header file) controls locking operations. This structure has the following members:

short l_type

Indicates the type of lock, using one of the following symbols (defined in the `<fcntl.h>` header file):

F_RDLCK

Indicates a *read lock*, also called a *shared lock*. The process can read the locked part of the file, and other processes cannot obtain write locks for that part of the file in the meantime. More than one process can have a read lock on the same part of a file simultaneously.

To establish a read lock, a process must have the file accessed for reading.

F_WRLCK

Indicates a *write lock*, also called an *exclusive lock*. The process can write on the locked part of the file, and no other process can establish a read lock or write lock on that same part or on an overlapping part of the file. A process cannot put a write lock on part of a file if there is already a read lock on an overlapping part of the file. To establish a write lock, a process must have accessed the file for writing.

F_UNLCK

Unlocks a lock that was set previously. An unlock (`F_UNLCK`) request in which `l_len` is non-zero and the offset of the last byte of the requested segment is the maximum value for an object of type `off_t`, when the process has an existing lock in which `l_len` is 0 and which includes the last byte of the requested segment, is treated as a request to unlock from the start of the requested segment with an `l_len` equal to 0. Otherwise, an unlock (`F_UNLCK`) request attempts to unlock only the requested segment.

short l_whence

One of three symbols used to determine the part of the file that is affected by this lock. These symbols are defined in the `<unistd.h>` header file and are the same as symbols used by `lseek()`:

SEEK_CUR

The current file offset in the file

SEEK_END

The end of the file

SEEK_SET

The start of the file.

off_t l_start

Gives the byte offset used to identify the part of the file that is affected by this lock. The part of the file affected by the lock begins at this offset from the location given by `l_whence`. For example, if `l_whence` is `SEEK_SET` and `l_start` is 10, the locked part of the file begins at an offset of 10 bytes from the beginning of the file.

off_t l_len

Gives the size of the locked part of the file in bytes. If `l_len` is 0, the locked part of the file begins at the position specified by `l_whence` and `l_start`, and extends to the end of the file. If `l_len` is positive, the area affected starts at `l_start` and end at `l_start + l_len - 1`. If `l_len` is negative, the area affected starts at `l_start + l_len` and end at `l_start - 1`. Locks may start and extend beyond the current end of a file, but cannot extend before the beginning of the file. A lock can be set to extend to the largest possible value of the file offset for that file by setting `l_len` to 0. If such a lock also has `l_start` set to 0 and `l_whence` is set to `SEEK_SET`, the whole file is locked.

pid_t l_pid

Specifies the process ID of the process that holds the lock. This is an output field used only with `F_GETLK` actions.

You can set locks by specifying `F_SETLK` as the *action* argument for `fcntl()`. Such a function call requires a third argument pointing to a `struct flock` structure, as in this example:

```
struct flock lock_it;
lock_it.l_type = F_RDLCK;
lock_it.l_whence = SEEK_SET;
lock_it.l_start = 0;
lock_it.l_len = 100;
fcntl(filides, F_SETLK, &lock_it);
```

This example sets up an `flock` structure describing a read lock on the first 100 bytes of a file, and then calls `fcntl()` to establish the lock. You can unlock this lock by setting `l_type` to `F_UNLCK` and making the same call. If an `F_SETLK` operation cannot set a lock, it returns immediately with an error saying that the lock cannot be set.

The `F_SETLKW` operation is similar to `F_SETLK`, except that it waits until the lock can be set. For example, if you want to establish an exclusive lock and some other process already has a lock established on an overlapping part of the file, `fcntl()` waits until the other process has removed its lock. If `fcntl()` is waiting in an `F_SETLKW` operation when a signal is received, `fcntl()` is interrupted. After handling the signal, `fcntl()` returns `-1` and sets `errno` to `EINTR`.

`F_SETLKW` operations can encounter *deadlocks* when process A is waiting for process B to unlock a region, and B is waiting for A to unlock a different region. If the system detects that an `F_SETLKW` might cause a deadlock, `fcntl()` fails with `errno` set to `EDEADLK`.

A process can determine locking information about a file by using `F_GETLK` as the *action* argument for `fcntl()`. In this case, the call to `fcntl()` should specify a third argument pointing to an `flock` structure. The structure should describe the lock operation you want. When `fcntl()` returns, the structure indicated by the `flock` pointer is changed to show the first lock that would prevent the proposed lock operation from taking place. The returned structure shows the type of lock that is set, the part of the file that is locked, and the process ID of the process that holds the lock. In the returned structure:

- `l_whence` is always `SEEK_SET`.
- `l_start` gives the offset of the locked portion from the beginning of the file.
- `l_len` is the length of the locked portion.

If there are no locks that prevent the proposed lock operation, the returned structure has `F_UNLCK` in `l_type`, and is otherwise unchanged.

A process can have several locks on a file simultaneously but only one type of lock set on a given byte. Therefore, if a process puts a new lock on part of a file that it had locked previously, the process has only one lock on that part of the file: the type of the lock is the one specified in the most recent locking operation.

All of a process's locks on a file are removed when the process closes any file descriptor that refers to the locked file. Locks are not inherited by child processes created with `fork()`.

All locks are advisory only. Processes can use locks to inform each other that they want to protect parts of a file, but locks do not prevent I/O on the locked parts. If a process has appropriate permissions on a file, it can perform whatever I/O it chooses, regardless of what locks are set. Therefore, file locking is only a convention, and it works only when all processes respect the convention.

Returned value

If successful, the value `fcntl()` returns will depend on the *action* that was specified.

If unsuccessful, `fcntl()` returns `-1` and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|---------------|---|
| EAGAIN | The process tried to set a lock with <code>F_SETLK</code> , but the lock is in conflict with a lock already set by some other process on an overlapping part of the file. |
|---------------|---|

EBADF

fildes is not a valid open file descriptor; or the process tried to set a read lock on a file descriptor open for writing only; or the process tried to set a write lock on a file descriptor open for reading only; or the *socket* parameter is not a valid socket descriptor.

In an F_DUPFD2 operation, the third argument is negative, or greater than or equal to **OPEN_MAX**, which is the highest file descriptor value allowed for the process.

EDEADLK

The system detected the potential for deadlock in a F_SETLKW operation.

EINTR

fcntl() was interrupted by a signal during a F_SETLKW operation.

EINVAL

In an F_DUPFD operation, the third argument is negative or greater than or equal to **OPEN_MAX**, the highest file descriptor value allowed for the process. The **OPEN_MAX** value can be determined using pathconf().

In a locking operation, *fildes* refers to a file with a type that does not support locking, or the struct flock pointed to by the third argument has an incorrect form.

If an F_CLOSF operation, the third argument, which specifies the upper limit, is less than *filedes* but is not equal to -1.

Behavior for sockets: The *arg* parameter is not a valid flag, or the *cmd* parameter is not a valid command.

EMFILE

In an F_DUPFD operation, the process has already reached its maximum number of file descriptors, or there are no available file descriptors greater than the specified third argument.

ENOLCK

In an F_SETLK or F_SETLKW operation, the specified file has already reached the maximum number of locked regions allowed by the system.

EOVERFLOW

One of the values to be returned cannot be represented correctly.

The *cmd* argument is F_GETLK, F_SETLK or F_SETLKW and the smallest or, if *l_len* is nonzero, the largest offset of any byte in the requested segment cannot be represented correctly in an object of type *off_t*.

EPERM

The operation was F_CLOSF, but all the requested file descriptors were not closed.

Examples

CELEBF06

```
/* CELEBF06

   This example illustrates one use of fcntl().
   The example will compile only with C/MVS.

*/
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <signal.h>
#include <stdio.h>

void catcher(int signum) {
    puts("inside catcher...");
}

main() {
    int p[2], flags;
    struct sigaction sact;
```

```

char c;

if (pipe(p) != 0)
    perror("pipe() error");
else {
    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = catcher;
    sigaction(SIGALRM, &sact, NULL);

    alarm(10);

    if (read(p[0], &c, 1) == -1)
        perror("first read() failed");

    if ((flags = fcntl(p[0], F_GETFL)) == -1)
        perror("first fcntl() failed");
    else if (fcntl(p[0], F_SETFL, flags | O_NONBLOCK) == -1)
        perror("second fcntl() failed");
    else {
        alarm(10);

        if (read(p[0], &c, 1) == -1)
            perror("second read() failed");

        alarm(0);
    }
    close(p[0]);
    close(p[1]);
}
}

```

Output

```

inside catcher...
first read() failed: Interrupted function call
second read() failed: Resource temporarily unavailable

```

Sockets example:

```

#define _OPEN_SYS
int s;
int rc;
int flags;
:
/* Place the socket into nonblocking mode */
rc = fcntl(s, F_SETFL, FNDELAY);

/* See if asynchronous notification is set */
flags = fcntl(s, F_GETFL, 0);
if (flags & FNDELAY)
    /* it is set */
else
    /* it is not */

```

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“close\(\) — Close a file” on page 293](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“dup2\(\) — Duplicate an open file descriptor to another” on page 406](#)
- [“exec functions” on page 442](#)
- [“fsync\(\) — Write changes to direct-access storage” on page 655](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“lseek\(\) — Change the offset of a file” on page 1023](#)

- [“open\(\) — Open a file” on page 1157](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)

fcvt() — Convert double to string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

char *fcvt(double x, int ndigit, int *__restrict__ decpt, int *__restrict__ sign);
```

General description

The `fcvt()` function converts double floating-point argument values to floating-point output strings. The `fcvt()` function has been extended to determine the floating-point format (hexadecimal floating-point or IEEE Binary Floating-Point) of double argument values by using `__isBFP()`.

IBM z/OS C/C++ formatted output functions, including the `fcvt()` function, convert IEEE Binary Floating-Point infinity and NaN argument values to special infinity and NaN floating-point number output sequences. See [“fprintf Family of Formatted Output Functions” on fprintf\(\), printf\(\), sprintf\(\) — Format and write data](#) for a description of the special infinity and NaN output sequences.

The `fcvt()` function converts `x` to a NULL-terminated string which has `ndigit` digits to the right of the radix point (where the total number of digits in the output string is restricted by the precision of a double) and returns a pointer to the string. The function behaves identically to [“ecvt\(\) — Convert double to string” on page 417](#) in all respects other than the number of digits in the return value.

Note: This function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `sprintf()` function is preferred for portability.

Returned value

If successful, `fcvt()` returns the character equivalent of `x` as specified above.

If unable to allocate the return buffer, or the conversion fails, `fcvt()` returns NULL.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“ecvt\(\) — Convert double to string” on page 417](#)
- [“gcvrt\(\) — Convert double to string” on page 684](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)

fdatasync() — Write changes to direct-access storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2001 POSIX.1-2008 Single UNIX Specification, Version 2 | both | |

Format

```
#define _XOPEN_SOURCE 500
#include <unistd.h>

int fdatasync(int fildes);
```

General description

The `fdatasync()` function is equivalent to `fsync()`, which doesn't provide performance advantages.

Returned value

If successful, `fdatasync()` returns 0.

If unsuccessful, `fdatasync()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

*fil*des is not a valid open file descriptor.

EINVAL

The file is not a regular file.

Note: If the `fdatasync()` function fails, outstanding I/O operations are not guaranteed to be completed.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“fsync\(\) — Write changes to direct-access storage” on page 655](#)

fdclosedir() — Closes directory associated with file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX __XPLAT | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <dirent.h>

int fdclosedir(DIR *dirp);
```

General description

The `fdclosedir()` function is equivalent to the `closedir()` function except that `fdclosedir()` returns a directory file descriptor instead of closing it.

Returned value

If successful, `fdclosedir()` returns a file descriptor.

If unsuccessful, `fdopendir()` returns -1 and sets `errno` to indicate the error.

Error Code

Description

ENOTDIR

Not a directory.

Example

```
#define _POSIX_SOURCE
#define _POSIX_C_SOURCE 200809L
#define _XPLATFORM_SOURCE
#include <dirent.h>
#include <stdio.h>

int main() {
    int fd = 0;

    DIR *dir;
    DIR *newdirp;
    struct dirent *entry;
    dir = opendir("/u/userexample/fdopendir");
    fd = dirfd(dir);
    newdirp = fdopendir(fd);
    while ((entry = readdir(newdirp)) != NULL)
        printf(" %s\n", entry->d_name);
    fd = fdclosedir(newdirp);

    return 0;
}
```

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)
- [“fdopendir\(\) — Opens directory associated with file descriptor” on page 502](#)

fdelrec() — Delete a VSAM record

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>

int fdelrec(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fdelrec_unlocked(FILE *stream);
```

General description

Removes the record previously read by `fread()` from the VSAM file associated with `stream`. The `fdelrec()` function can only be used after an `fread()` call has been performed and before any other operation on that file pointer. For example, if you need to acquire the file position using `ftell()` or `fgetpos()`, you can do it either before the `fread()` or after the `fdelrec()`. An `fread()` after an `fdelrec()` will retrieve the next record.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The `fdelrec()` function can be used with *key sequenced data sets* (KSDS), KSDS PATHs, and *relative record data set* (RRDS) opened in an update mode (that is, `rb+ / r+b`, `wb+ / w+b`, or `ab+ / a+b`), with `type=record`.

VSAM does not support deletions from ESDSs.

`fdelrec_unlocked()` is functionally equivalent to `fdelrec()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fdelrec()` returns 0.

If unsuccessful, `fdelrec()` returns nonzero.

Example

```
/* This example shows how a VSAM record is deleted using the fdelrec()
   function.
*/
#include <stdio.h>
FILE *stream;
char buf[80];
int num_read;
int rc;
stream = fopen("DD:MYCLUS", "rb+,type=record");
:
num_read = fread(buf, 1, sizeof(buf), stream);
rc = fdelrec(stream);
:
```

Related information

- “Performing VSAM I/O Operations” in [z/OS XL C/C++ Programming Guide](#)
- “stdio.h — Standard input and output” on page 63
- “flocate() — Locate a VSAM record” on page 549
- “fupdate() — Update a VSAM record” on page 669

fdetach() — Detach a name from a STREAMS-based file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stropts.h>

int fdetach(const char *path);
```

General description

The `fdetach()` function detaches a STREAMS-based file from the file to which it was attached by a previous call to `fattach()`. The *path* argument points to the path name of the attached STREAMS file. The process must have appropriate privileges or be the owner of the file. A successful call to `fdetach()` causes all path names that named the attached STREAMS file to again name the file to which the STREAMS file was attached. All subsequent operations on *path* will operate on the underlying file and not on the STREAMS file.

All open file descriptions established while the STREAMS file was attached to the file referenced by *path*, will still refer to the STREAMS file after the `fdetach()` has taken effect.

If there are no open file descriptors or other references to the STREAMS file, then a successful call to `fdetach()` has the same effect as performing the last `close()` on the attached file.

Returned value

If successful, `fdetach()` returns 0.

If unsuccessful, `fdetach()` returns -1 and sets `errno` to one of the following values.

Note: z/OS UNIX services do not supply any STREAMS devices or pseudodevices. It is impossible for `fdetach()` to detach a file from a STREAMS-based file descriptor. See [“open\(\) — Open a file”](#) on page 1157 for more information.

Error Code Description

EACCES

Search permission is denied on a component of the path prefix.

EINVAL

The *path* argument names a file that is not currently attached.

ELOOP

Too many symbolic links were encountered in resolving *path*.

ENAMETOOLONG

The size of a path name exceeds **PATH_MAX**, or a path name component is longer than **NAME_MAX**, or path name resolution of a symbolic link produced an intermediate result whose length exceeds **PATH_MAX**.

ENOENT

A component of *path* does not name an existing file or *path* is an empty string.

ENOTDIR

A component of the path prefix is not a directory.

EPERM

The effective user ID is not the owner of *path* and the process does not have appropriate privileges.

Related information

- [“stropts.h — Stream interface” on page 67](#)
- [“fattach\(\) — Attach a STREAMS-based file descriptor to a file in the file system name space” on page 469](#)

fdim(), fdimf(), fdiml() — Calculate the positive difference

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R5 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double fdim(double x, double y);
float fdimf(float x, float y);
long double fdiml(long double x, long double y);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float fdim(float x, float y);
long double fdim(long double x, long double y);
```

General description

The fdim functions compute the positive difference between *x* and *y*.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| fdim | X | X |
| fdimf | X | X |
| fdiml | X | X |

Restriction: The `fdimf()` function does not support the `_FP_MODE_VARIABLE` feature test macro.

Returned value

The `fdim` functions return the positive difference between `x` and `y`.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

fdimd32(), fdimd64(), fdimd128() — Calculate the positive difference

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 fdimd32(_Decimal32 x, _Decimal32 y);
_Decimal64 fdimd64(_Decimal64 x, _Decimal64 y);
_Decimal128 fdimd128(_Decimal128 x, _Decimal128 y);
_Decimal32 fdim(_Decimal32 x, _Decimal32 y);      /* C++ only */
_Decimal64 fdim(_Decimal64 x, _Decimal64 y);     /* C++ only */
_Decimal128 fdim(_Decimal128 x, _Decimal128 y);  /* C++ only */
```

General description

The `fdim` functions compute the positive difference between `x` and `y`.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See [“IEEE binary floating-point” on page 97](#) for more information

Returned value

The `fdim` functions return the positive difference between `x` and `y`.

Example

```
/* CELEBF76

   This example illustrates the fdimd32() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal32 x = 56789.70DF, y = 56790.00DF, z;

    z = fdimd32(y, x);
```

```
printf("The result of fdim32(%Hf, %Hf)\n is %Hf\n", y, x, z);
return 0;
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“fdim\(\), fdimf\(\), fdiml\(\) — Calculate the positive difference” on page 498](#)

fdopen() — Associate a stream with an open file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <stdio.h>

FILE *fdopen(int fildes, const char *options);
```

General description

Associates a stream with an open file descriptor. A *stream* is a pointer to a FILE structure that contains information about a file. A stream permits user-controllable buffering and formatted input and output. For a discussion of the z/OS UNIX services implementation of buffering, see [z/OS XL C/C++ Programming Guide](#).

The specified *options* must be permitted by the current mode of the file descriptor. For example, if the file descriptor is open-read-only (O_RDONLY), the corresponding stream cannot be opened write-only (w).

These options are the same as for an fopen() operation.

Special behavior for XPG4.2: The values for options are changed to include binary streams.

Mode

Description

r or rb

Open for reading.

w or wb

Open for writing.

a or ab

Open for appending.

r+ or rb+ or r+b

Open for update (reading and writing).

w+ or wb+ or w+b

Open for update (reading and writing).

a+ or ab+ or a+b

Open for update at End Of File (EOF) (reading and writing).

All these options have the same behavior as the corresponding `fopen()` options, except that `w`, `wb`, `w+`, `wb+` and `w+b` do not truncate the file.

The file position indicator of the new stream is the file offset associated with the file descriptor. The error indicator and end of file (EOF) indicator for the stream are cleared.

Returned value

If successful, `fdopen()` returns a `FILE` pointer to the control block for the new stream.

If unsuccessful, `fdopen()` returns `NULL` and sets `errno` to one of the following values:

Error Code

Description

EBADF

fdes is not a valid open file descriptor.

EINVAL

The specified mode is incorrect or does not match the mode of the open file descriptor.

Example

CELEBF08

```
/* CELEBF08

   This example associates stream with the file descriptor fd which is
   open for the file fdopen.file.
   The association is made in write mode.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>
#include <unistd.h>

main() {
    char fn[]="fdopen.file";
    FILE *stream;
    int fd;

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        if ((stream = fdopen(fd, "w")) == NULL) {
            perror("fdopen() error");
            close(fd);
        }
        else {
            fputs("This is a test", stream);
            fclose(stream);
        }
    }
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fileno\(\) — Get the file descriptor from an open stream” on page 541](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“open\(\) — Open a file” on page 1157](#)

fdopendir() — Opens directory associated with file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| POSIX.1 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <dirent.h>

DIR *fdopendir(int fd);
```

General description

The `fdopendir()` function is equivalent to the `opendir()` function except that the directory is specified by a file descriptor rather than by a name. The file offset that is associated with the file descriptor at the time of the call determines which entries are returned.

Upon successful return from `fdopendir()`, the file descriptor is under the control of the system, and if any attempt is made to close the file descriptor, or to modify the state of the associated description, other than by `closedir()`, `readdir()`, `readdir_r()`, `rewinddir()`, or `seekdir()`, the behavior is undefined.

Upon calling `closedir()`, the file descriptor is closed.

Returned value

If successful, `fdopendir()` returns a pointer to an object of type `DIR`.

If unsuccessful, `fdopendir()` returns a null pointer and sets `errno` to indicate the error.

Error Code Description

EBADF
The *fd* argument is not a valid file descriptor open for reading.

ENOTDIR
Not a directory.

ENOMEM
Insufficient memory to complete the operation.

Example

```
#define _POSIX_SOURCE
#define _POSIX_C_SOURCE 200809L
#include <dirent.h>
#include <stdio.h>

int main() {
    int fd = 0;

    DIR *dir;
    DIR *newdirp;
    struct dirent *entry;
    dir = opendir("/u/userexample/fdopendir");
    fd = dirfd(dir);
    newdirp = fdopendir(fd);
    while ((entry = readdir(newdirp)) != NULL)
        printf(" %s\n", entry->d_name);
}
```



```
    return 0;
}
```

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)
- [“fdclosedir\(\) — Closes directory associated with file descriptor” on page 494](#)

feclearexcept() — Clear the floating-point exceptions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int feclearexcept (int excepts);
```

General description

feclearexcept() clears the supported floating-point exceptions represented by *excepts*.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------|-----|------|
| feclearexcept | | X |

Returned value

If successful, feclearexcept() returns 0 if the argument passed is 0 or if all the exceptions are successfully cleared.

Related information

•

fe_dec_getround() – Get the current rounding mode

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <fenv.h>

int fe_dec_getround(void);
```

General description

The `fe_dec_getround` function gets the current rounding mode for decimal floating-point operations.

The following rounding modes are defined for decimal floating-point, and are located in `fenv.h`:

FE_DEC_DOWNWARD

rounds towards minus infinity

FE_DEC_TONEAREST

rounds to nearest

FE_DEC_TOWARDZERO

rounds toward zero

FE_DEC_UPWARD

rounds toward plus infinity

FE_DEC_TONEARESTFROMZERO

rounds to nearest, ties away from zero

_FE_DEC_AWAYFROMZERO

rounds away from zero

_FE_DEC_TONEARESTTOWARDZERO

rounds to nearest, ties toward zero

_FE_DEC_PREPAREFORSHORTER

rounds to prepare for shorter precision

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, returns the value of the current rounding mode for decimal floating-point operations.

If there is no such rounding mode or the current rounding mode can't be determined returns -1.

Example

```
/* CELEBF77

sample program that issues fe_dec_getround()/setround()

This program calls fe_dec_getround() to get the DFP rounding mode.
```

```

Then it will compare the returned value with FE_DEC_TONEAREST
rounding mode. If not the same, it will call fe_dec_setround() to
set the rounding mode to the desired value FE_DEC_TONEAREST.
*/

#define __STDC_WANT_DEC_FP__
#include <fenv.h>
#include <stdlib.h>
#include <stdio.h>

int main(int argc, char *argv[]){
    int r;
    if ((r = fe_dec_getround()) == -1){
        perror("fe_dec_getround");
        exit (-1);
    }
    printf("The Decimal floating point rounding mode is %d\n", r);
    if (r != FE_DEC_TONEAREST){
        printf("The DFP rounding mode is not FE_DEC_TONEAREST.\n");
        if (fe_dec_setround(FE_DEC_TONEAREST) == -1){
            perror("fe_dec_setround");
            exit (-1);
        }
    }
    printf("The DFP rounding mode has been set to FE_DEC_TONEAREST.\n");
    return 0;
}

```

Related information

- [“fenv.h — Floating-point environment” on page 23](#)
- [“fe_dec_setround\(\) — Set the current rounding mode” on page 505](#)

fe_dec_setround() — Set the current rounding mode

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <fenv.h>

int fe_dec_setround(int round);

```

General description

The `fe_dec_setround` function establishes the rounding mode for decimal floating-point operations represented by its argument *round*. If the argument is not equal to the value of a valid rounding mode, the rounding mode is not changed.

The following rounding modes are defined for decimal floating-point, and are located in `fenv.h`:

FE_DEC_DOWNWARD

rounds towards minus infinity

FE_DEC_TONEAREST

rounds to nearest

FE_DEC_TOWARDZERO

rounds toward zero

FE_DEC_UPWARD

rounds toward plus infinity

FE_DEC_TONEARESTFROMZERO

rounds to nearest, ties away from zero

_FE_DEC_AWAYFROMZERO

rounds away from zero

_FE_DEC_TONEARESTTOWARDZERO

rounds to nearest, ties toward zero

_FE_DEC_PREPAREFORSHORTER

rounds to prepare for shorter precision

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, returns a zero value.

If the argument is not equal to a valid rounding mode, returns -1. The following errnos are defined:

Error Code**Definition****EINVAL**

The rounding mode specified is not a valid Decimal Floating Point rounding mode.

EMVSERR

The function was unable to set the specified rounding mode due to an internal error.

Example

```

/* CELEBF77

sample program that issues fe_dec_getround()/setround()

This program calls fe_dec_getround() to get the DFP rounding mode.
Then it will compare the returned value with FE_DEC_TONEAREST
rounding mode. If not the same, it will call fe_dec_setround() to
set the rounding mode to the desired value FE_DEC_TONEAREST.
*/

#define __STDC_WANT_DEC_FP__
#include <fenv.h>
#include <stdlib.h>
#include <stdio.h>

int main(int argc, char *argv[]){
    int r;
    if ((r = fe_dec_getround()) == -1){
        perror("fe_dec_getround");
        exit (-1);
    }
    printf("The Decimal floating point rounding mode is %d\n", r);
    if (r != FE_DEC_TONEAREST){
        printf("The DFP rounding mode is not FE_DEC_TONEAREST.\n");
        if (fe_dec_setround(FE_DEC_TONEAREST) == -1){
            perror("fe_dec_setround");
            exit (-1);
        }
    }
    printf("The DFP rounding mode has been set to FE_DEC_TONEAREST.\n");
    return 0;
}

```

Related information

- [“fenv.h — Floating-point environment” on page 23](#)
- [“fe_dec_getround\(\) — Get the current rounding mode” on page 504](#)

fegetenv() — Store the current floating-point environment

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int fegetenv(fenv_t *envp);
```

General description

fegetenv() stores the current floating-point environment in the object pointed to by *envp*.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| fegetenv | | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. If the hardware has the Decimal Floating-Point Facility installed, this function will store the decimal floating-point rounding mode.
3. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, fegetenv() returns 0 upon completion of the store.

Related information

- [“fenv.h — Floating-point environment” on page 23](#)
- [“fesetenv\(\) — Set the floating-point environment” on page 514](#)
- [“feholdexcept\(\) — Save the current floating-point environment” on page 509](#)
- [“feupdateenv\(\) — Save the currently raised floating-point exceptions” on page 529](#)

fegetexceptflag() – Store the states of floating-point status flags

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int fegetexceptflag(fexcept_t *flagp, int excepts);
```

General description

fegetexceptflag() stores an implementation defined representation of the states of floating-point status flags indicated by *excepts* in the object pointed to by *flagp*.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|-----------------|-----|------|
| fegetexceptflag | | X |

Returned value

If successful, fegetexceptflag() returns 0 upon completion of the store.

Related information

-

fegetround() – Get the current rounding mode

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int fegetround(void);
```

General description

`fegetround()` gets the current rounding mode.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|-------------------------|-----|------|
| <code>fegetround</code> | | X |

Note: This function will not return or update decimal floating-point rounding mode bits. The `fe_dec_getround()` and `fe_dec_setround()` functions can be used to get and set the current rounding mode for decimal floating-point operations.

Returned value

If successful, `fegetround()` returns the value of the rounding mode macro representing the current rounding mode. Otherwise, returns a negative value if there is no such rounding mode macro or the current rounding mode is not determinable.

Related information

- [“fe_dec_getround\(\) — Get the current rounding mode”](#) on page 504
- [“fe_dec_setround\(\) — Set the current rounding mode”](#) on page 505

feholdexcept() — Save the current floating-point environment

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int feholdexcept(fenv_t *envp);
```

General description

`feholdexcept()` saves the current floating-point environment in the object pointed to by `envp`, clears the floating-point status flags, and then installs a non-stop (continue on floating-point exceptions) mode, if available, for all floating-point exceptions.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------------|-----|------|
| <code>feholdexcept</code> | | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. If the hardware has the Decimal Floating-Point Facility installed, this function will save the decimal floating-point rounding mode.
3. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, `feofexcept()` returns 0 when the non-stop floating-point exception handling was successfully installed.

Related information

- [“fenv.h – Floating-point environment” on page 23](#)
- [“fegetenv\(\) – Store the current floating-point environment” on page 507](#)
- [“fesetenv\(\) – Set the floating-point environment” on page 514](#)
- [“feupdateenv\(\) – Save the currently raised floating-point exceptions” on page 529](#)

feof() – Test end of file (EOF) indicator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

int feof(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int feof_unlocked (FILE *stream);
```

General description

Indicates whether the EOF flag is set for the given stream pointed to by *stream*.

The EOF flag is set when the user attempts to read past the EOF. Thus, a read of the last character in the file does not turn the flag on. A subsequent read attempt reaches the EOF.

For z/OS UNIX files, a simultaneous reader cannot see the extensions automatically. Use `clearerr()` is required to reset the EOF flag.

If the file has a simultaneous writer that extends the file, the flag can be turned on by the reader before the file is extended. After the extension becomes visible to the reader, a subsequent read will get the new data and set the flag appropriately (see `fflush()`). For example, if the read does not read past the EOF, the

flag is turned off. If a file does not have a simultaneous writer that is extending the file, it is not possible to read past EOF.

A successful repositioning in a file (with `fsetpos()`, `rewind()`, `fseek()`) or a call to `clearerr()` resets the EOF flag. For a terminal file, when the EOF flag is set, subsequent reads will continue to deliver no data until the EOF flag is cleared. This can be accomplished by calling `clearerr()` or `rewind()`.

The terminal can only read past the EOF after the `rewind()` function or the `clearerr()` function is called. The EOF flag is cleared by calling `rewind()`, `fsetpos()`, `fseek()`, or `clearerr()` for this stream.

`feof_unlocked()` is functionally equivalent to `feof()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If and only if the EOF flag is set for *stream*, `feof()` returns nonzero.

Otherwise, `feof()` returns 0.

Example

CELEBF09

```
/* CELEBF09
   This example scans the input stream until it reads an EOF character.
*/
#include <stdio.h>
#include <stdlib.h>

main() {
    FILE *stream;
    int rc;
    stream = fopen("myfile.dat", "r");

    /* myfile.dat contains 3 characters "abc" */
    while (1) {
        rc = fgetc(stream);
        if (rc == EOF) {
            if (feof(stream)) {
                printf("at EOF\n");
                break;
            }
            else {
                printf("error\n");
                break;
            }
        }
        else {
            printf("read %c\n", rc);
        }
    }
}
```

Output

```
read a
read b
read c
at EOF
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“clearerr\(\) — Reset error and end of file \(EOF\)” on page 285](#)

- [“fseek\(\) — Change file position” on page 638](#)
- [“fsetpos\(\) — Set file position” on page 647](#)
- [“rewind\(\) — Set file position to beginning of file” on page 1449](#)

feraiseexcept() — Raise the supported floating-point exceptions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int feraiseexcept(int excepts);
```

General description

feraiseexcept() raises the supported floating-point exceptions represented by *excepts*. The order in which these floating-point exceptions are raised is unspecified.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------|-----|------|
| feraiseexcept | | X |

Returned value

If successful, feraiseexcept() returns 0 if the argument passed is 0 or if all the exceptions are successfully raised.

Related information

•

ferror() — Test for read and write errors

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

int ferror(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int ferror_unlocked (FILE *stream);
```

General description

Tests for an error in reading from or writing to the specified *stream*. If an error occurs, the error indicator for the *stream* remains set until you close the *stream*, call `rewind()`, or call `clearerr()`.

If a non-valid parameter is given to an I/O function, the compiler does not turn the error flag on. This case differs from one where parameters are not valid in context with one another.

`ferror_unlocked()` is functionally equivalent to `ferror()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `ferror()` returns a nonzero value to indicate an error for the stream pointed to by *stream*.

If unsuccessful, `ferror()` returns 0.

Example

CELEBF10

```
/* CELEBF10

   This example puts data out to a stream and then checks that
   a write error has not occurred.

*/
#include <stdio.h>

int main(void)
{
    FILE *stream;
    char *string = "Important information";
    stream = fopen("myfile.dat", "w");

    fprintf(stream, "%s\n", string);
    if (ferror(stream))
    {
        printf("write error\n");
        clearerr(stream);
    }
    if (fclose(stream))
        printf("fclose error\n");
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“clearerr\(\) — Reset error and end of file \(EOF\)” on page 285](#)
- [“rewind\(\) — Set file position to beginning of file” on page 1449](#)

fesetenv() – Set the floating-point environment

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8pd |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int fesetenv(const fenv_t *envp);
```

General description

`fesetenv()` establishes the floating-point environment represented by the object pointed to by *envp*. The argument *envp* points to an object set by a call to `fegetenv()` or `feholdexcept()`, or equal to a floating-point environment macro. `fesetenv()` merely installs the state of the floating-point status flags represented through *envp* and does not raise these floating-point exceptions.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|-----------------------|-----|------|
| <code>fesetenv</code> | | X |

Notes:

1. If the hardware has the Decimal Floating-Point Facility installed, this function can be used to set the decimal floating-point rounding mode.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, `fesetenv()` returns 0 if the settings are restored.

If unsuccessful, `fesetenv()` returns -1 and sets one of the following `errno` values:

Error Code

Description

EINVAL

The rounding mode specified is not a valid Decimal Floating Point rounding mode.

EMVSERR

The function was unable to set the specified rounding mode due to an internal error.

Related information

- [“fenv.h – Floating-point environment”](#) on page 23
- [“fegetenv\(\) – Store the current floating-point environment”](#) on page 507
- [“feholdexcept\(\) – Save the current floating-point environment”](#) on page 509

- [“feupdateenv\(\) — Save the currently raised floating-point exceptions”](#) on page 529

fesetexceptflag() — Set the floating-point status flags

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int fesetexceptflag(const fexcept_t *flagp, int excepts);
```

General description

`fesetexceptflag()` sets the floating-point status flags indicated by *excepts* to the states stored in the object pointed to by *flagp*. The value of *flagp* should be set by `fegetexceptflag()`, whose second argument represents the floating-point exceptions indicated by the argument *excepts*. This function does not raise floating-point exceptions, but only sets the state of the flags.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|------------------------------|-----|------|
| <code>fesetexceptflag</code> | | X |

Returned value

If successful, `fesetexceptflag()` returns 0 if *excepts* is 0 or if all selected exceptions are successfully set.

Related information

-

fesetround() — Set the current rounding mode

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>
```

```
int fesetround(int round);
```

General description

fesetround() establishes the rounding mode represented by *round*. If the argument is not equal to the value of a rounding mode macro, the rounding mode is not changed.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|------------|-----|------|
| fesetround | | X |

Note: This function will not return or update decimal floating-point rounding mode bits. The *fe_dec_getround()* and *fe_dec_setround()* functions can be used to get and set the current rounding mode for decimal floating-point operations.

Returned value

If successful, fesetround() returns 0 when *round* is set to a rounding mode.

Related information

- [“fe_dec_getround\(\) — Get the current rounding mode” on page 504](#)
- [“fe_dec_setround\(\) — Set the current rounding mode” on page 505](#)

fetch() — Get a load module

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | C | |

Format

```
#include <stdlib.h>

void (*fetch(const char *name))();
```

General description

Dynamically loads the load module specified by *name* into memory. The load module can then be invoked from a C program. The name or the alias by which the fetchable load module is identified in the load module library must appear in a fetch() library function call.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

You cannot fetch a module that contains a main(). If you do, fetch() will not return a usable pointer. Use of the pointer will result in undefined behavior. To call these types of modules, use the system() library function. Alternatively, when creating the module, you can reset the entry point so that the linkage is provided by the compiler.

When non-reentrant modules have been fetched multiple times, you should release them in the reverse order; otherwise the load modules may not be deleted immediately.

You can fetch modules written in C and C++. For C modules, the source of the fetched module must, in general, contain `#pragma linkage(..., fetchable)` (the exception is described below). To fetch a C++ module, the routine must be declared `extern "C"`, and must be declared in a **`#pragma linkage(..., fetchable)`** directive. See also [“fetchep\(\) — Share writable static”](#) on page 526 for more information about the need for `#pragma linkage`.

Note: For C or C++ modules that are compiled with the XPLINK linkage and are to be fetched, `#pragma linkage(..., fetchable)` is required. They cannot use the technique of resetting the entry point. If an application tries to fetch() an XPLINK routine that did not specify `FETCHABLE`, then an error will be returned.

XPLINK programs can fetch non-XPLINK programs, and vice versa. The function descriptor returned by `fetch()` will contain glue code to support a stack swap and parameter list conversion if necessary. Calls to a fetched routine that do not cross an XPLINK linkage boundary will not incur any glue code overhead.

If the fetched module is compiled as a DLL it can import variables and functions from other DLL modules, but it cannot export variables or functions.

Nested fetching is supported. That is, a fetched module can also invoke the `fetch()` library function to dynamically load a separate fetchable module.

Multiple fetching is also supported. Fetching a module more than once will result in separate fetch pointers. If the module is marked “reentrant”, multiple fetches will not reload the module into storage. In the MVS environment, you can place the reentrant module into the Extended Link Pack Area or the Link Pack Area (ELPA/LPA) to save time on the load. Although multiple copies of the reentrant module are not brought into storage, each fetch returns a separate pointer. If a module is not reentrant, multiple fetches cause multiple loads into storage. Be aware that if you fetch() a non-reentrant module multiple times, the module may not get deleted by `release()` until all fetch instances have been released. Also, you should keep in mind that multiple loads of a non-reentrant module can be costly in terms of storage.

Writable statics are, in general, process-scoped. The exception is that, when a thread calls a fetched module, the writable statics are changed for that thread only, that is, thread-scoped.

In the MVS environment, fetchable (or dynamically loaded) modules must be link-edited and accessible using the standard system search. MVS supports fetching of non-reentrant, serially reusable, and reentrant modules.

Under POSIX, however, the fetchable, dynamically loaded modules cannot be in the z/OS UNIX file system. Note also, that the POSIX and XPG4 external variables are propagated. Refer to [z/OS XL C/C++ Programming Guide](#) for more information on external variables.

Unless your program is naturally reentrant, each reentrant module has a different copy of writable static. Follow these steps to allow the fetching of your reentrant module that has writable static:

1. The compiler needs to [generate reentrant code](#) for the module to be fetched.
2. Using the object module created in step 1, generate a fetchable member. You must specify the entry point as the function you are fetching unless you have included a **`#pragma linkage(..., FETCHABLE)`** directive.

See [Figure 2 on page 518](#) for the program flow of a fetchable module. (FECB refers to a Fetch Control Block, which is a C internal control block used by `fetch()`.)

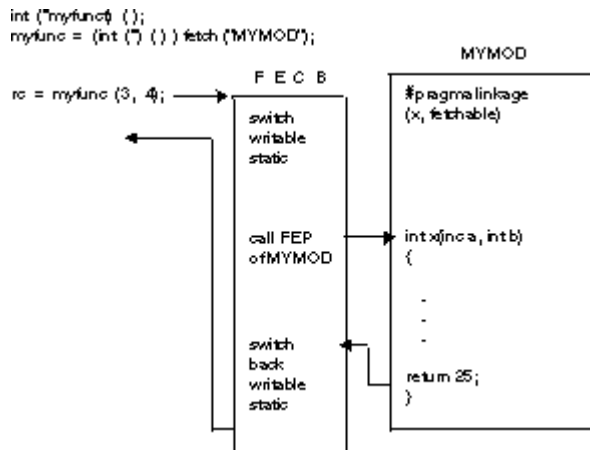


Figure 2. Program Flow of a Fetchable Module

To dynamically fetch a set of functions with shared writable static, you can use the library function `fetchep()`. See “[fetchep\(\) — Share writable static](#)” on page 526 for more details.

Both the module being fetched and the module invoking the `fetch()` library function can be reentrant.

You can fetch modules without specifying the directive, `#pragma linkage(..., FETCHABLE)`, in the fetched module. If you do, then using the fetch pointer will result in calling the entry point for that module. When you link the module, you must reset the entry point. In addition, you cannot have any writable static.

It follows that fetching a reentrant C module containing writable statics requires that you use the `#pragma linkage(..., FETCHABLE)` preprocessor directive in the fetched module.

If the entry point linkage is not a C linkage, you must use a `pragma linkage` with a function pointer defined by a *typedef*. The following sample excerpt would set up a COBOL linkage for a COBOL routine.

```
typedef int COBOL_FUNC ();
#pragma linkage (COBOL_FUNC, COBOL)
:
COBOL_FUNC * fetch_ptr;
fetch_ptr = (COBOL_FUNC *) fetch(module); /* loads fetched module */
fetch_ptr(args); /* sets up the proper linkage for the call */
```

Once the module is fetched, calling the fetched function is similar to making an interlanguage call.

`fetch()` also supports AMODE switching: when the function call is made, AMODE will be switched; upon return, the AMODE will be restored. Beware of calling fetched modules with AMODE=24 that try to access variables or the library above the line.

Notes:

1. You cannot call functions through a function pointer that crosses load module boundaries, except through `fetchep()`. (See “[fetchep\(\) — Share writable static](#)” on page 526 for more information.) For example, you cannot pass the address of a function to a fetched routine and invoke it from the fetched routine because the C writable static will not be swapped.
2. If you need to access code that has to run in a restricted addressing mode (such as a AMODE 24), you can package the code into a module to be fetched. The module can then be linked using the restricted addressing mode, but fetched from a program with an unrestricted addressing mode.
3. A program that invokes `fetch()` many times without releasing all of the load modules may run out of memory.

Link considerations: When linking the function to be fetched, you must link in the necessary libraries and specify the entry point as the function you are fetching unless you have included this directive: `#pragma linkage(..., FETCHABLE)`.

When linking the `main()` C function, you must specify the necessary libraries to use the functions you are fetching. For example, if you are fetching a COBOL function, specify the COBOL library. This requirement does *not* apply to Language Environment.

When running `main()`, specify the runtime libraries you will need for `main()`, as well as the functions you will fetch. This requirement does *not* apply to Language Environment.

Special behavior for C++: a C++ program cannot call `fetch()`. If you attempt to call `fetch()` from a C++ program, the compiler issues an error message. There are three alternatives to `fetch()`:

- You can replace `fetch()` with DLL (dynamic link library) calls.
- You can provide a C DLL module to fetch modules, as shown in examples CELEBF52 and CELEBF53. See [“Examples” on page 519](#).
- C++ programs may statically call a C function that, in turn, fetches another module.

Returned value

If successful, `fetch()` returns a pointer to a stub that will call the entry point to the fetched load module.

If the load fails, `fetch()` returns NULL and may set `errno` to one of the following values:

Error Code

Definition

ELEFENCE

The DLL contains a member language not supported on this version of the operating system.

Examples

Examples of using the `fetch()` function with C: The following example demonstrates how to compile, link, and run a program that fetches a function in another object module that contains the directive: `pragma linkage(..., FETCHABLE)`.

Begin with the main program.

```
#include <stdio.h>
#include <stdlib.h>

typedef int (*funcPtr)(); /* pointer to a function returning an int */

int main(void)
{
    int result;
    funcPtr add;

    printf("fetch module\n");
    add = (funcPtr) fetch("f1a");          /* load module F1A      */

    if (add == NULL) {
        printf("ERROR: fetch failed\n");
    }
    else {
        printf("execute fetched module\n");
        result = (*add)(1,2);             /* execute module F1A    */
        printf("1 + 2 == %d\n", result);
    }
}
```

Then the fetched function:

```
#pragma linkage(func1, fetchable)

int func1(int a, int b)
{
    printf("in fetched module\n");
    return(a+b);
}
```

Next, JCL to compile, link, and run under the MVS environment:

```
>
//F1A      EXEC EDCC,INFILE='userid.TEST.SOURCE(F1A)'
//          OUTFILE='userid.TEST.OBJ(F1A),DISP=SHR',
//          CPARM='NOSEQ,NOMARGIN,RENT'
//F1B      EXEC EDCPL,INFILE='userid.TEST.OBJ(F1A)'
//          OUTFILE='userid.TEST.LOAD(F1A),DISP=SHR'
//F1       EXEC EDCCLG,INFILE='userid.TEST.SOURCE(F1)'
//GO.STEPLIB DD
//          DD DSN=userid.TEST.LOAD,DISP=SHR
```

This example demonstrates the use of `fetch()` with COBOL and how to compile, link, and run the program.

```
/* cob1 */
#include <stdlib.h>
#include <stdio.h>

typedef void funcV();      /* function returning void      */
#pragma linkage(funcV, COBOL) /* establish Cobol linkage */

int main(void)
{
    int var1 = 1;
    int var2 = 2;
    funcV *add;

    printf("fetch module\n");
    add = (funcV *) fetch("cob1a");          /* load module COB1A */

    if (add == NULL)
    {
        printf("ERROR: fetch failed\n");
    }
    else
    {
        printf("execute fetched module\n");
        (*add)(&var1, &var2);              /* execute module COB1A */
        printf("1 + 2 == %d\n", var1);
    }
}
```

Here is the fetched COBOL subroutine COB1A.

```
IDENTIFICATION DIVISION.
PROGRAM-ID. COB1A.
*****
* This subroutine receives 2 integer parameters.      *
* The first is added to the second and the result is stored *
* back into the first.                                  *
*****
ENVIRONMENT DIVISION.
DATA DIVISION.

WORKING-STORAGE SECTION.

LINKAGE SECTION.
01 VAR1          PIC S9(9) COMP.
01 VAR2          PIC S9(9) COMP.
*****
*                PROCEDURE DIVISION                  *
*****

PROCEDURE DIVISION USING VAR1 VAR2.

*
* ADD VAR2 TO VAR1 PLACING THE RESULT IN VAR1.
*

    COMPUTE VAR1 = VAR1 + VAR2.
    GOBACK.
```

Finally, compile, link, and run under the MVS environment:

```
//*=====
//COBCL  PROC CREGSIZ='2048K',
//          INFILE=,
```

```
// OUTFILE='&&GSET(GO),DISP=(MOD,PASS),UNIT=VIO,SPACE=(512,(50,20,1))'
//*
/*-----
/* COBOL Compile Step
/*-----
//COBCOMP EXEC PGM=IGYCRCTL,REGION=&CREGSIZ;
//STEPLIB DD DSN=IGY.V1R3M0.SIGYCOMP,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSIN DD DSN=&INFILE,DISP=SHR
//SYSLIN DD DSN=&&LOADSET,UNIT=SYSDA,
// DISP=(MOD,PASS),SPACE=(TRK,(3,3)),
// DCB=(BLKSIZE=3200)
//SYSUT1 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSUT2 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSUT3 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSUT4 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSUT5 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSUT6 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
//SYSUT7 DD UNIT=SYSDA,SPACE=(CYL,(1,1))
/*
```

```
/*-----
/* COBOL Link-Edit Step
/*-----
//COBLINK EXEC PGM=HEWL,COND=(8,LT,COBCOMP),REGION=1024K
//SYSLIB DD DSN=CEE.V1R3M0.SCEELKED,DISP=SHR
//SYSPRINT DD SYSOUT=*
//SYSLIN DD DSN=&&LOADSET,DISP=(OLD,DELETE)
// DD DDNAME=SYSIN
//SYSLMOD DD DSN=&OUTFILE;
//SYSUT1 DD UNIT=SYSDA,SPACE=(TRK,(10,10))
// PEND
/*
```

```
/*=====
/* Compile and Link-Edit COBOL program COB1A
/*-----
//COB1A EXEC COBCL,
// INFILE='userid.TEST.SOURCE(COB1A)',
// OUTFILE='userid.TEST.LOAD(COB1A),DISP=SHR'
//COBLINK.SYSIN DD *
// ENTRY COB1A
/*
/*
/*-----
/* Compile and Link-Edit C program COB1
/*-----
//COB1 EXEC EDCCLG,
// INFILE='userid.TEST.SOURCE(COB1)',
// CPARM='OPT(0) NOSEQ NOMAR'
//GO.STEPLIB DD
// DD DSN=userid.TEST.LOAD,DISP=SHR
```

Examples of alternatives to `fetch()` under C++: This example shows how to use DLL as an alternative to `fetch()`. Here, `myfunc()` is the function to be dynamically loaded using DLL, and `main()` invokes DLL.

CELEBF52

```
// CELEBF52-part 1 of 2-other file is CELEBF53.

// This example shows how to use DLL as an alternative to fetch().

// C++ program that invokes myfunc using DLL

#include <stdlib.h>
#include <stdio.h>
#include <dll.h>

extern "C" { // needed to indicate C linkage
    typedef int (*funcPtr)(); // pointer to a function returning an int
}

int main (void)
{
    dllhandle *dllh;
    funcPtr fptr;

    if ((dllh = dllload( "celebf53" )) == NULL) {
```

```

    perror( "failed to load celebf53" );
    exit( -1 );
}
if ((fptr = (funcPtr) dllqueryfn( dllh, "myfunc" )) == NULL) {
    perror( "failed to retrieve myfunc" );
    exit( -2 );
}
if ( fptr() != 0 ) {
    perror( "failed to execute myfunc" );
    exit( -3 );
}
if ( dllfree( dllh ) != 0 ) {
    perror( "failed to free celebf53" );
    exit( -4 );
}
return( 0 );
}

```

CELEBF53

```

/* CELEBF53-part 2 of 2-other file is CELEBF52.

   This example shows how to use DLL as an alternative to fetch().

*/
/*

   C function dynamically loaded using DLL

*/
#include <stdio.h>

int myfunc (void)
{
    printf( "Hello world\n" );
    return( 0 );
}

```

The following example shows how a C++ program can dynamically call a function in a C DLL module, to fetch other C modules.

CELEBF54

```

// CELEBF54-part 1 of 3-other files are CELEBF55, CELEBF56.
// This example shows how a C++ program can dynamically call a function
// in a C DLL module, to fetch other C modules

// C++ program that dynamically calls a function in a C DLL module

#include <stdio.h>
#include <stdlib.h>
#include <dll.h>
#include <iostream>
using namespace std;

extern "C" {
    // needed to indicate C linkage
    typedef int (*funcPtr)(); // pointer to a function returning an int
}

int main (void)
{
    dllhandle *dllh;
    funcPtr fptr;

    if ((dllh = dllload( "mydll" )) == NULL) {
        perror( "failed to load mydll" );
        exit( -1 );
    }
    if ((fptr = (funcPtr) dllqueryfn( dllh, "fwrap" )) == NULL) {
        perror( "failed to retrieve fwrap" );
        exit( -2 );
    }
    if ( fptr() != 0 ) {
        perror( "failed to execute fwrap" );
        exit( -3 );
    }
    if ( dllfree( dllh ) != 0 ) {

```

```

        perror( "failed to free mydll" );
        exit( -4 );
    }
    return( 0 );
}

```

CELEBF55

```

/* CELEBF55-part 2 of 3-other files are CELEBF54, CELEBF56.
   This example shows how a C++ program can dynamically call a function
   in a C DLL module, to fetch other C modules

   fwrap function used in a DLL module-it fetches mymod, which
   contains myfunc
*/
#include <stdio.h>
#include <stdlib.h>

typedef int (*funcPtr)(); /* pointer to a function returning an int */

int fwrap (void)
{
    funcPtr    fptr;

    if ((fptr = (funcPtr) fetch( "mymod" )) == NULL) {
        perror( "failed to fetch mymod" );
        return( -1 );
    }
    else
        return(fptr());
}

```

CELEBF56

```

/* CELEBF56-part 3 of 3-other files are CELEBF54, CELEBF55.
   This example shows how a C++ program can dynamically call a function
   in a C DLL module, to fetch other C modules
*/

/*    C function to be fetched    */

#include <stdio.h>
#pragma linkage(myfunc, fetchable)

int myfunc (void)
{
    printf( "in fetched module\n" );
    return( 0 );
}

```

The following example shows how to statically call a C function that in turn fetches other functions. Here, myfunc() is the function to be fetched, fetcher() is a C function that fetches myfunc(), and main() is a function that statically calls fetcher().

CELEBF57

```

// CELEBF57-part 1 of 3-other files are CELEBF58, CELEBF59.
// This example shows how to statically call a C function that
// fetches other functions.

// C++ statically calling a C program that uses fetch()

#include <iostream>
using namespace std;

extern "C" { /* needed to indicate C linkage */
    int fetcher (void);
}

int main (void)
{
    cout << "The fetcher says: ";
    fetcher();
    cout << "and returns";
    return( 0 );
}

```

CELEBF58

```

/* CELEBF58-part 2 of 3-other files are CELEBF57, CELEBF59.
   This example shows how to statically call a C function that fetches
   other functions.
*/

/*
   C function that fetches mymod which contains myfunc
*/
#include <stdio.h>
#include <stdlib.h>

typedef int (*funcPtr)(); /* pointer to a function returning an int */

int fetcher (void)
{
    funcPtr fptr;

    if ((fptr = (funcPtr) fetch( "mymod" )) == NULL) {
        perror( "failed to fetch mymod" );
        return( -1 );
    }
    else {
        fptr(); /* invoke fetched function */
        return( 0 );
    }
}

```

CELEBF59

```

/* CELEBF59-part 3 of 3-other files are CELEBF57, CELEBF58.
   This example shows how to statically call a C function that fetches
   other functions.
*/

/* C function to be fetched */
#include <stdio.h>
#pragma linkage(myfunc, fetchable)

int myfunc (void)
{
    printf( "Hello world " );
    return( 0 );
}

```

Although fetching and using DLL are functionally comparable, there is one subtle difference. Fresh copies of static and global variables are allocated each time a module is fetched, but not each time a DLL load of the same module is done.

The following example shows that, when a module is fetched multiple times, fresh copies of static and global variables are allocated.

CELEBF60

```

/* CELEBF60-part 1 of 2-other file is CELEBF61.
   This example shows how copies of variables are allocated when multiple
   fetches are done.
*/

/*
   C program fetching mymod multiple times--mymod contains myfunc.
*/
#include <stdio.h>
#include <stdlib.h>

typedef int (*funcPtr)(int); /*pointer to a function returning an int*/

int main (void)
{
    funcPtr fptr1, fptr2;

    if ((fptr1 = (funcPtr) fetch( "mymod" )) == NULL) {
        perror( "failed to fetch mymod" );
        return( -1 );
    }
}

```

```

    if ( fptr1(100) != 0 ) {
        perror( "failed to execute myfunc" );
        exit( -2 );
    }
    if ((fptr2 = (funcPtr) fetch( "mymod" )) == NULL) {
        perror( "failed to fetch mymod" );
        return( -3 );
    }
    if ( fptr2(100) != 0 ) {
        perror( "failed to execute myfunc" );
        exit( -4 );
    }
    return( 0 );
}

```

CELEBF61

```

/* CELEBF61-part 2 of 2-other file is CELEBF60.
   This example shows how copies of variables are allocated when multiple
   fetches are done.
*/

/*      C module mymod      */
#include <stdio.h>
#pragma linkage(myfunc, fetchable)

int globvar = 5;

int myfunc (int x)
{
    globvar += x;
    printf( "%d\n", globvar );
    return( 0 );
}

```

Running this example would produce the following results:

```

105
105

```

The following example shows that fresh copies of static and global variables are not allocated for multiple DLL loads of the same module.

CELEBF62

```

// CELEBF62-part 1 of 2-other file is CELEBF63.
// This example shows how copies of variables are allocated when
// multiple DLL loads are done.

// C++ program doing multiple DLL loads of the same module

#include <stdlib.h>
#include <stdio.h>
#include <dll.h>

extern "C" {
    typedef int (*funcPtr)(int); //needed to indicate C linkage
    //pointer to a function returning an int
}

int main (void)
{
    dllhandle *dllh1, *dllh2;
    funcPtr fptr;

    if ((dllh1 = dllload( "mydll" )) == NULL) {
        perror( "failed to load mydll" );
        exit( -1 );
    }
    if ((fptr = (funcPtr) dllqueryfn( dllh1, "myfunc" )) == NULL) {
        perror( "failed to retrieve myfunc" );
        exit( -2 );
    }
    if ( fptr(100) != 0 ) {
        perror( "failed to execute myfunc" );
        exit( -3 );
    }
    if ((dllh2 = dllload( "mydll" )) == NULL) {
        perror( "failed to load mydll" );
    }
}

```

```
    exit( -4 );
}
if ((fptr = (funcPtr) dllqueryfn( dllh2, "myfunc" )) == NULL) {
    perror( "failed to retrieve myfunc" );
    exit( -5 );
}
if ( fptr(100) != 0 ) {
    perror( "failed to execute myfunc" );
    exit( -6 );
}
if ( dllfree( dllh1 ) != 0 ) {
    perror( "failed to free mydll" );
    exit( -7 );
}
return( 0 );
}
```

CELEBF63

```
/* CELEBF63-part 2 of 2-other file is CELEBF62.
   This example shows how copies of variables are allocated when multiple
   DLL loads are done.
*/

/* C function invoked using DLL */

#include <stdio.h>
#include <stdlib.h>

int globvar = 5;
int myfunc (int);

int myfunc (int x)
{
    globvar += x;
    printf( "%d\n", globvar );
    return( 0 );
}
```

Running this example would produce the following results:

```
105
205
```

Related information

- See the topic about processing a program with multithreading in [z/OS XL C/C++ Programming Guide](#).
- [“stdlib.h – Standard library functions” on page 65](#)
- [“fetchep\(\) – Share writable static” on page 526](#)
- [“release\(\) – Delete a load module” on page 1424](#)

fetchep() – Share writable static

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | C only | |

Format

```
#include <stdlib.h>

void ( *fetchep( void ( *entry_point)()))();
```


General description

Dynamically fetches a set of functions with shared writable static variables. `fetchep()` is used to register an entry point. It returns a pointer that may be passed across the fetch boundary and used as if it were the original entry point. Therefore, you can create more than one entry point from a fetched module. A call to the new entry point will use the same writable static as the original fetch pointer uses on each invocation.

`fetchep()` is called within a fetched module but not from the same level as the `fetch()` call. If `fetchep()` is called in the root program that is not a fetched module, `fetchep()` returns a fetch pointer that will use the root program's writable static (if any exists).

If the *entry_point* given as input to `fetchep()` is a function address external to the current module or is an non-valid function address, use of the resulting pointer returned from the call will result in undefined behavior.

If writable static is required, then this directive must be used:

```
#pragma linkage(entry_point, FETCHABLE)
```

In addition, the steps for fetching a reentrant module must be followed as described in “[fetch\(\) — Get a load module](#)” on page 516. If writable static is *not* required, the C module using `fetchep()` need not contain the directive: `#pragma linkage(..., FETCHABLE)`.

You can release the new fetch pointer without any effect on the original or any other fetch pointer created from the original fetch pointer. If the original fetched function is released, however, all the fetch pointers created using the `fetchep()` function will also be released. Trying to use a fetch pointer once it has been released or its origin has been released will result in undefined behavior.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Note: The external entry point name for `fetchep()` is `__ftchep()`, **NOT** `__fetchep()`.

Examples

These examples and diagram demonstrate the program flow of a call to `fetch()` and subsequent calls to `fetchep()`.

```
/* The module that calls fetch()    */
#include <stdlib.h>
typedef int (*FUNC_T)();

int main(void) {
    FUNC_T (*myfunc)();
    FUNC_T myfunc1;
    FUNC_T myfunc2;
    FUNC_T myfunc3;

    myfunc = (FUNC_T (*)())fetch("MYMOD");
    myfunc1 = myfunc(0);
    myfunc2 = myfunc(1);
    myfunc3 = myfunc(2);
}
```

```
/*
   The following code is the fetched module.
   Please see fetch() for information on how to compile and link the
   above.
*/

/* inside MYMOD */
#include <stdlib.h>
typedef int (*FUNC_T)();
int k; /* global variable to share within MYMOD */
#pragma linkage(x, fetchable)
FUNC_T x(int a)
{
```

```

switch(a)
{
  case 0:
    return (FUNC_T)fetchep((void(*)())func1);
  case 1:
    return (FUNC_T)fetchep((void(*)())func2);
  case 2:
    return (FUNC_T)fetchep((void(*)())func3);
}
}

int func1(int a, int b)
{
  k = 6;
  ...
}

int func2(int a, int b)
{
  k = 4;
  ...
}

int func3(int a, int b)
{
  k = 5;
  ...
}

```

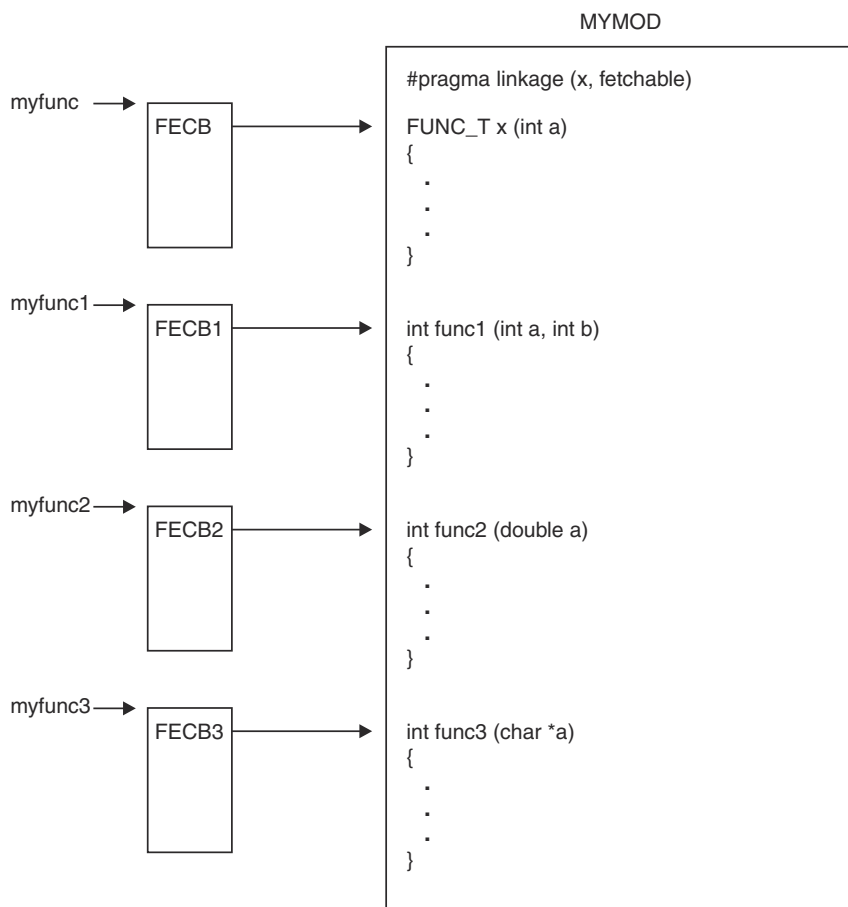


Figure 3. Program Flow of `fetchep()`

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“fetch\(\) — Get a load module” on page 516](#)
- [“release\(\) — Delete a load module” on page 1424](#)

fetetestexcept() – Test the floating-point status flags

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int fetetestexcept(int excepts);
```

General description

fetetestexcept() determines which of a specified subset of floating-point exception flags are currently set. *excepts* specifies the floating-point status flags to be queried.

Note: The following table shows the viable formats for these functions. See “IEEE binary floating-point” on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------------|-----|------|
| fetetestexcept | | X |

Returned value

If successful, fetetestexcept() returns the value of the bitwise OR for the floating-point exception macros corresponding to the currently set floating-point exceptions included in *excepts*.

feupdateenv() – Save the currently raised floating-point exceptions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <fenv.h>

int feupdateenv(const fenv_t *envp);
```

General description

feupdateenv() saves the currently raised floating-point exceptions in its automatic storage, installs the floating-point environment represented by the object pointed to by *envp*, and then raises the saved floating-point exceptions. *envp* should point to an object set by feholdexcept() or fegetenv(), or equal a floating-point environment macro.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|-------------|-----|------|
| feupdateenv | | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. If the hardware has the Decimal Floating-Point Facility installed, this function can update the decimal floating-point rounding mode.
3. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, feupdateenv() returns 0 if the settings have been restored.

If unsuccessful, feupdateenv() returns -1 and sets one of the following errno values:

Error Code

Description

EINVAL

The rounding mode specified is not a valid Decimal Floating Point rounding mode.

EMVSERR

The function was unable to set the specified rounding mode due to an internal error.

Related information

- [“fenv.h – Floating-point environment”](#) on page 23
- [“fegetenv\(\) – Store the current floating-point environment”](#) on page 507
- [“fesetenv\(\) – Set the floating-point environment”](#) on page 514
- [“feholdexcept\(\) – Save the current floating-point environment”](#) on page 509

fflush() – Write buffer to file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

int fflush(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fflush_unlocked(FILE *stream);
```

General description

Flushes the stream pointed to by *stream*. If *stream* is NULL, it flushes all open streams.

The `fflush()` function is affected by the `ungetc()` and `ungetwc()` functions. Calling these functions causes `fflush()` to back up the file position when characters are pushed back. For details, see the `ungetc()` and `ungetwc()` functions respectively. If desired, the `_EDC_COMPAT` environment variable can be set at open time such that `fflush()` discards any pushed-back characters and leaves the file position where it was when the first `ungetc()` or `ungetwc()` function call was issued.

If `fflush()` is used after `ungetwc()` has pushed a wide char on a text stream, the position will be backed up by one wide character from the position the file was at when the `ungetwc()` was issued. For a wide-oriented binary stream, the position will be backed up based on the number of bytes used to represent the wide char in the `ungetc` buffer. For this reason, attempting to use `ungetwc()` on a character when the destination is a binary wide-oriented stream that was never read in the first place results in undefined behavior for `fflush()`. Note that the `_EDC_COMPAT` environment variable also changes the behavior of `fflush()` after `ungetwc()`, and will cause any wide char pushed-back to be discarded and the position left at the point where the `ungetwc()` was issued. For details on the `_EDC_COMPAT` environment variable, see the “Environment Variables” in [z/OS XL C/C++ Programming Guide](#).

If `fflush()` fails, the position is left at the point in the file where the first `ungetc()` or `ungetwc()` function call was issued. All pushed-back characters are discarded.

Note: The system automatically flushes buffers when you close the stream or when a program ends normally without closing the stream.

The buffering mode and the file type can have an effect on when output data is flushed. For more information, see “Buffering of C Streams” in [z/OS XL C/C++ Programming Guide](#).

stream remains open after the `fflush()` call. Because a read operation cannot immediately follow or precede a write operation, the `fflush()` function can be used to allow exchange between these two modes. The `fflush()` function can also be used to refresh the buffer when working with a reader and a simultaneous writer/updater.

`fflush_unlocked()` is functionally equivalent to `fflush()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

The `fflush()` function has no effect for files opened with `type=blocked`.

Returned value

If successful in flushing the buffer, `fflush()` returns 0.

If unsuccessful, `fflush()` returns EOF. When flushing all open files, a failure to flush any of the files causes EOF to be returned. However, flushing will continue on any other open files that can be flushed successfully.

Example

CELEBF15

```
/* CELEBF15

   This example flushes a stream buffer.
   It tests for the returned value of 0 to see if the flushing was
   successful.

   */
#include <stdio.h>

int retval;
int main(void)
{
    FILE *stream;
    stream = fopen("myfile.dat", "w");

    retval=fflush(stream);
    printf("return value=%i",retval);
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“setbuf\(\) — Control buffering” on page 1518](#)
- [“setvbuf\(\) — Control buffering” on page 1589](#)
- [“ungetc\(\) — Push character onto input stream” on page 1941](#)
- [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#)

ffs() — Find first set bit in an integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <strings.h>

int ffs(int i);
```

General description

The `ffs()` function finds the first bit set (beginning with the least significant bit) and returns the index of that bit. Bits are numbered starting at one (the least significant bit).

Returned value

If successful, `ffs()` returns the index of the first bit set.

If *i* is 0, `ffs()` returns 0.

There are no `errno` values defined.

Related information

- [“strings.h — String operations” on page 67](#)

fgetc() — Read a character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

int fgetc(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fgetc_unlocked(FILE *stream);
```

General description

Reads a single-byte unsigned character from the input stream pointed to by *stream* at the current position, and increases the associated file pointer so that it points to the next character.

The `fgetc()` function is not supported for files opened with `type=record` or `type=blocked`.

`fgetc()` has the same restriction as any read operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fgetc_unlocked()` is functionally equivalent to `fgetc()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fgetc()` returns the character read as an integer.

If unsuccessful, `fgetc()` returns EOF to indicate an error or an EOF condition. Use `feof()` or `ferror()` to determine whether the EOF value indicates an error or the end of the file.

Note: EOF is only reached when an attempt is made to read “past” the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Example

CELEBF16

```
/* CELEBF16
```

```
This example gathers a line of input from a stream.
It tests to see if the file can be opened.
If the file cannot be opened &error. is called.

*/
#include <stdio.h>
#define MAX_LEN 80

int main(void)
{
    FILE *stream;
    char buffer[MAX_LEN + 1];
    int i, ch;

    if ((stream = fopen("myfile.dat","r")) != NULL) {
        for (i = 0; (i < (sizeof(buffer)-1) &&
            ((ch = fgetc(stream)) != EOF) && (ch != '\n')); i++)
            printf("character is %d\n",ch);
            buffer[i] = ch;

        buffer[i] = '\0';

        if (fclose(stream))
            perror("fclose error");
    }
    else
        perror("fopen error");
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“feof\(\) — Test end of file \(EOF\) indicator” on page 510](#)
- [“ferror\(\) — Test for read and write errors” on page 512](#)
- [“fgetwc\(\) — Get next wide character” on page 538](#)
- [“fputc\(\) — Write a character” on page 606](#)
- [“getc\(\), getchar\(\) — Read a character” on page 689](#)

fgetpos() — Get file position

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

int fgetpos(FILE * __restrict__stream, fpos_t * __restrict__pos);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fgetpos_unlocked(FILE * __restrict__stream, fpos_t * __restrict__pos);
```


General description

The `fgetpos()` function stores the current value of the file pointer associated with *stream* into the object pointed to by *pos*. The value pointed to by *pos* can be used later in a call to `fsetpos()` to reposition the stream pointed to by *stream*.

Both the `fgetpos()` and `fsetpos()` function save state information for wide-oriented files. The value stored in *pos* is unspecified, and it is usable only by `fsetpos()`.

The position returned by the `fgetpos()` function is affected by the `ungetc()` and `ungetwc()` functions. Each call to these functions causes the file position indicator to be backed up from the position where the `ungetc()` or `ungetwc()` function was issued. For details on how the `ungetc()` function affects the `fgetpos()` function behavior, see [“ungetc\(\) — Push character onto input stream” on page 1941](#). For details on how the `ungetwc()` function affects the `fgetpos()` function behavior for a wide-oriented stream, see [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#).

Multivolume data sets performance: Using the `fgetpos()` and `fsetpos()` functions generally results in better repositioning performance compared to the `ftell()` and `fseek()` functions when working with multivolume data sets.

Large file support for MVS data sets, VSAM data sets, and z/OS UNIX files: The `fgetpos()` function implicitly supports operating on large files. Defining the `_LARGE_FILES` feature test macro is not required to use this function on large files.

Usage notes

1. The `_EDC_COMPAT` environment variable can be set at open time such that the `fgetpos()` function will ignore any pushed-back characters. For further details on `_EDC_COMPAT`, see the environment variables topic in [z/OS XL C/C++ Programming Guide](#).
2. The `fgetpos_unlocked()` function is functionally equivalent to the `fgetpos()` function with the exception that it is not threadsafe. The `fgetpos()` function can safely be used in a multithreaded application if, and only if, it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` functions.

Returned value

If successful, the `fgetpos()` function returns 0.

If unsuccessful, the `fgetpos()` function returns nonzero and sets `errno` to nonzero.

Special behavior for XPG4.2: The `fgetpos()` function returns -1 and sets `errno` to `ESPIPE` if the underlying file type for the stream is a PIPE or a socket.

Example

CELEBF17

```
/* CELEBF17

   This example opens the file myfile.dat for reading.
   The current file pointer position is stored into the variable pos.

*/
#include <stdio.h>

int main(void)
{
    FILE *stream;
    int retcode;
    fpos_t pos;

    stream = fopen("myfile.dat", "rb");

    /* The value returned by fgetpos can be used by fsetpos()
       to set the file pointer if 'retcode' is 0 */
    if ((retcode = fgetpos(stream, &pos)) == 0)
```

```

    printf("Current position of file pointer found\n");
    fclose(stream);
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fseek\(\) — Change file position” on page 638](#)
- [“fsetpos\(\) — Set file position” on page 647](#)
- [“ftell\(\) — Get current file position” on page 657](#)
- [“ungetc\(\) — Push character onto input stream” on page 1941](#)
- [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#)

fgets() — Read a string from a stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```

#include <stdio.h>

char *fgets(char * __restrict__string, int n, FILE * __restrict__stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

char *fgets_unlocked(char * __restrict__string, int n, FILE * __restrict__stream);

```

General description

Reads bytes from a stream pointed to by *stream* into an array pointed to by *string*, starting at the position indicated by the file position indicator. Reading continues until the number of characters read is equal to *n*-1, or until a newline character (`\n`), or until the end of the stream, whichever comes first. The `fgets()` function stores the result in *string* and adds a NULL character (`\0`) to the end of the string. The *string* includes the newline character, if read.

The `fgets()` function is not supported for files opened with `type=record` or `type=blocked`.

`fgets()` has the same restriction as any read operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fgets_unlocked()` is functionally equivalent to `fgets()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fgets()` returns a pointer to the *string* buffer.

If unsuccessful, `fgets()` returns NULL to indicate failure.

Note: When the `O_NONBLOCK` flag is set for the file descriptor’s underlying stream and the thread would be delayed in the `fgets()` operation, then `fgets()` will set `errno` to `EAGAIN`. In the case of a FIFO stream, if some data has been read into the string buffer, `fgets()` will return a pointer to the string buffer to indicate the partial read.

If *n* is less than or equal to 0, it indicates a domain error; `errno` is set to `EDOM` to indicate the cause of the failure.

When *n* equals 1, it indicates a valid result. It means that the string buffer has only room for the NULL terminator; nothing is physically read from the file. (Such an operation is still considered a read operation, so it cannot immediately follow a write operation unless there is an intervening flush or reposition operation first.)

If *n* is greater than 1, `fgets()` will only fail if an I/O error occurs or if EOF is reached, and no data is read from the file.

The `ferror()` and `feof()` functions are used to distinguish between a read error and an EOF. Note that EOF is only reached when an attempt is made to read “past” the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

If EOF is reached after data has already been read into the string buffer, `fgets()` returns a pointer to the string buffer to indicate success. A subsequent call would result in NULL being returned since EOF would be reached without any data being read.

Example

CELEBF18

```
/* CELEBF18

   This example gets a line of input from a data stream.
   It reads no more than MAX_LEN - 1 characters, or up
   to a new-line character, from the stream.

*/
#include <stdio.h>
#define MAX_LEN 100

int main(void)
{
    FILE *stream;
    char line[MAX_LEN], *result;

    stream = fopen("myfile.dat", "r");

    if ((result = fgets(line, MAX_LEN, stream)) != NULL)
        printf("The string is %s\n", result);

    if (fclose(stream))
        printf("fclose error\n");
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“feof\(\) — Test end of file \(EOF\) indicator” on page 510](#)
- [“ferror\(\) — Test for read and write errors” on page 512](#)
- [“fgetc\(\) — Read a character” on page 533](#)
- [“fgetws\(\) — Get a wide-character string” on page 539](#)
- [“fputs\(\) — Write a string” on page 608](#)

- “[gets\(\)](#) — Read a string” on page 770
- “[puts\(\)](#) — Write a string” on page 1357

fgetwc() — Get next wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment XPG4 XPG4.2C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <wchar.h>

wint_t fgetwc(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t fgetwc_unlocked(FILE *stream);
```

General description

Obtains the next multibyte character from the input stream pointed to by *stream*, converts it to a wide character, and advances the associated file position indicator for the stream (if defined).

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Using non-wide-character functions with `fgetwc()` results in undefined behavior. This happens because `fgetwc()` processes a whole multibyte character and does not expect to be “within” such a character. In addition, `fgetwc()` expects state information to be set already. Because functions like `fgetc()` and `fputc()` do not obey such rules, their results fail to meet the assumptions made by `fgetwc()`.

`fgetwc()` has the same restriction as any read operation for read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fgetwc_unlocked()` is functionally equivalent to `fgetwc()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fgetwc()` returns the next wide character that corresponds to the multibyte character from the input stream pointed to by *stream*.

If the stream is at EOF, the EOF indicator for the stream is set and `fgetwc()` returns WEOF.

If a *read* error occurs, the error indicator for the stream is set and `fgetwc()` returns WEOF. If an *encoding* error occurs (an error converting the multibyte character into a wide character), the value of the macro EILSEQ (illegal sequence) is stored in `errno` and WEOF is returned.

The `ferror()` and `feof()` functions are used to distinguish between a read error and an EOF. Note that EOF is only reached when an attempt is made to read “past” the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Example

CELEBF19

```
/* CELEBF19
*/

#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>
#include <errno.h>

int main(void)
{
    FILE    *stream;
    wint_t   wc;

    if ((stream = fopen("myfile.dat", "r")) == NULL) {
        printf("Unable to open file\n");
        exit(1);
    }

    errno = 0;
    while ((wc = fgetwc(stream)) != WEOF)
        printf("wc=0x%X\n", wc);

    if (errno == EILSEQ) {
        printf("An invalid wide character was encountered.\n");
        exit(1);
    }

    fclose(stream);
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fgetc\(\) — Read a character” on page 533](#)
- [“fgetws\(\) — Get a wide-character string” on page 539](#)
- [“fputwc\(\) — Output a wide-character” on page 609](#)

fgetws() — Get a wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <wchar.h>

wchar_t *fgetws(wchar_t * __restrict__ wcs, int n, FILE * __restrict__ stream);
```

```
#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wchar_t *fgetws_unlocked(wchar_t * __restrict __wcs,
                        int n, FILE * __restrict __stream);
```

General description

Reads at most one less than the number of the wide characters specified by *n*, from the stream pointed to by *stream*, into the array pointed to by *wcs*. No additional wide characters are read after a newline wide character (which is retained) or after the EOF. A NULL wide character is written immediately after the last wide character read into the array.

The `fgetws()` function advances the file position unless there is an error, when the file position is undefined.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Using non-wide-character functions with `fgetws()` results in undefined behavior. This happens because `fgetws()` processes a whole multibyte character and does not expect to be “within” such a character. In addition, `fgetws()` expects state information to be set already. Because functions like `fgetc()` and `fputc()` do not obey such rules, their results fail to meet the assumptions made by `fgetws()`.

`fgetws()` has the same restriction as any read operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fgetws_unlocked()` is functionally equivalent to `fgetws()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fgetws()` returns the new value of *wcs*.

If EOF is encountered and no wide characters have been read into the array, the contents of the array remain unchanged and `fgetws()` returns a NULL pointer.

If a read error or an encoding error occurs during the operation, the array contents are indeterminate and `fgetws()` returns a NULL pointer. An *encoding* error is one that occurs when a wide character is converted to a multibyte character. If it occurs, `errno` is set to `EILSEQ` and `fgetws()` returns NULL.

If *n* is less than or equal to 0, it indicates a domain error; `errno` is set to `EDOM` to indicate the cause of the failure.

When *n* equals 1, it indicates a valid result. It means that the string buffer has only room for the NULL terminator; nothing is physically read from the file. (Such an operation is still considered a read operation, so it cannot immediately follow a write operation unless there is an intervening flush or reposition operation first.)

If *n* is greater than 1, `fgetws()` will only fail if an I/O error occurs or if EOF is reached, and no data is read from the file. To find out which error has occurred, use either the `feof()` or the `ferror()` function. If EOF is reached after data has already been read into the string buffer, `fgetws()` returns a pointer to the string buffer to indicate success. A subsequent call would result in NULL being returned because EOF would be reached without any data being read.

The `ferror()` and `feof()` functions are used to distinguish between a read error and an EOF. Note that EOF is only reached when an attempt is made to read “past” the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Example

CELEBF20

```

/* CELEBF20
*/

#include <errno.h>
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>

int main(void)
{
    FILE    *stream;
    wchar_t  wcs[100];
    wchar_t  *ptr;

    if ((stream = fopen("myfile.dat", "r")) == NULL) {
        printf("Unable to open file\n");
        exit(1);
    }

    errno = 0;
    ptr = fgetws(wcs, 100, stream);

    if (ptr == NULL) {
        if (errno == EILSEQ) {
            printf("An invalid wide character was encountered.\n");
            exit(1);
        }
        else if (feof(stream))
            printf("end of file reached\n");
        else
            perror("read error");
    }

    printf("wcs=\"%ls\"\n", wcs);

    fclose(stream);
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fgets\(\) — Read a string from a stream” on page 536](#)
- [“fgetwc\(\) — Get next wide character” on page 538](#)
- [“fputws\(\) — Output a wide-character string” on page 611](#)

fileno() — Get the file descriptor from an open stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1a XPG4 XPG4.2 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```

#define _POSIX_SOURCE
#include <stdio.h>

```

```
int fileno(const FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fileno_unlocked(const FILE *stream);
```

General description

Returns the file descriptor number associated with a specified IBM z/OS C++ I/O stream. The argument *stream* points to a FILE structure controlling a IBM z/OS C++ I/O stream.

The unistd.h header file defines the following macros, which are constants that map to the file descriptors of the standard streams:

STDIN_FILENO

Standard input, `stdin` (value 0)

STDOUT_FILENO

Standard output, `stdout` (value 1)

STDERR_FILENO

Standard error, `stderr` (value 2)

Note that `stdin`, `stdout`, and `stderr` are macros, not constants.

`fileno_unlocked()` is functionally equivalent to `fileno()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fileno()` returns the file descriptor number associated with an open HFS stream (that is, one opened with `fopen()` or `freopen()`). MVS data sets are not supported, so `fileno()` of an MVS data set returns -1.

If unsuccessful, `fileno()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

One of the following error conditions exists:

- *stream* points to a closed stream
- *stream* is an incorrect *stream* pointer
- *stream* points to a stream associated with an MVS data set.

Example

CELEBF21

```
/* CELEBF21

   This example illustrates one use of fileno().

*/
#define _POSIX_SOURCE
#include <errno.h>
#include <stdio.h>

main() {
    FILE *stream;
    char hfs_file[] = ".hfs_file", mvs_ds[] = "//mvs.ds";

    printf("fileno(stdin) = %d\n", fileno(stdin));

    if ((stream = fopen(hfs_file, "w")) == NULL)
```



```

    perror("fopen() error for HFS file");
else {
    printf("fileno() of the HFS file is %d\n", fileno(stream));
    fclose(stream);
    remove(hfs_file);
}

if ((stream = fopen(mvs_ds, "w")) == NULL)
    perror("fopen() error for MVS data set");
else {
    errno = 0;
    printf("fileno() returned %d for MVS data set,\n",fileno(stream));
    printf("  errno=%s\n", strerror(errno));
    fclose(stream);
    remove(mvs_ds);
}
}

```

Output

```

fileno(stdin) = 0
fileno() of the HFS file is 3
fileno() returned -1 for the MVS data set,
errno=Bad file descriptor

```

Related information

- The “Standard Streams” chapter in [z/OS XL C/C++ Programming Guide](#)
- “[stdio.h — Standard input and output](#)” on page 63
- “[fdopen\(\) — Associate a stream with an open file descriptor](#)” on page 500
- “[fopen\(\) — Open a file](#)” on page 571
- “[freopen\(\) — Redirect an open file](#)” on page 622
- “[open\(\) — Open a file](#)” on page 1157

finite() — Determine the infinity classification of a floating-point number

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | OS/390 V2R6 |

Format

```

#define _AIX_COMPATIBILITY
#include <math.h>

int finite(x)
double x;

```

General description

The `finite()` function determines the infinity classification of floating-point number `x`.

Note: This function works in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See “[IEEE binary floating-point](#)” on page 97 for more information about IEEE Binary Floating-Point.

Returned value

finite() returns nonzero if the x parameter is a finite number, that is, if x is not +-, INF, NaNQ, or NaNS.

finite() does not return errors or set bits in the floating-point exception status, even if a parameter is a NaNs.

Special behavior for hex: finite() always returns 1 when it is called from HFP mode.

Related information

- IEEE Standard for Binary Floating-Point Arithmetic (ANSI/IEEE Standards 754-1985 and 854-1987)
- [“math.h — Floating-point math functions” on page 40](#)

__flbf() — Determine if a stream is line buffered

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | None |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

int __flbf(FILE *stream);
```

General description

The __flbf() function determines if the specified stream is line buffered.

Returned value

The __flbf() function returns nonzero if the stream is line buffered. Otherwise, the __flbf() function returns 0. If an error has occurred, __flbf() returns 0 and sets errno to nonzero.

An application wishing to check for error situations should set errno to 0, then call __flbf(), and then check errno. If errno is nonzero, assume that an error has occurred.

Error Code
Description

EBADF
The stream specified by *stream* is not valid.

Example

CELEBF84

```
/* CELEBF84
   This example flushes all the line-buffered files.
*/

#include <stdio.h>
#include <stdio_ext.h>
#include <string.h>

#define BUF_SIZE 128

int main(void)
```

```

{
    char lbuf[BUF_SIZE]; /* line buffer */
    char fbuf[BUF_SIZE]; /* full buffer */
    char *tagstr = "This file was modified!";
    FILE *lfp;
    FILE *ffp;

    lfp = fopen("newlfile.dat", "a+");
    if(lfp == NULL){
        perror("Open file failed!\n");
        return -1;
    }
    if(setvbuf(lfp, lbuf, _IOLBF, sizeof(lbuf)) != 0){ /* set lbuf to line-buffered */
        perror("Format line-buffered failed!\n");
        fclose(lfp);
        return -1;
    }

    if (__flbf(lfp)) printf("newlfile.dat is line-buffered\n");
    else printf("newlfile.dat is not line-buffered\n");

    if(fwrite(lfp, strlen(tagstr), 1, lfp) != 1){ /* write tag string to line buffer*/
        perror("Write line buffer failed!\n");
        fclose(lfp);
        return -1;
    }
    printf("Write to the line buffered file succeeded\n");

    ffp = fopen("newffile.dat", "a+");
    if(ffp == NULL){
        perror("Open file failed!\n");
        fclose(lfp);
        return -1;
    }
    if(setvbuf(ffp, fbuf, _IOFBF, sizeof(fbuf)) != 0){ /* set fbuf to full-buffered */
        perror("Format full-buffered failed!\n");
        fclose(ffp);
        return -1;
    }

    if (__flbf(ffp)) printf("newffile.dat is line-buffered\n");
    else printf("newffile.dat is not line-buffered\n");

    if(fwrite(tagstr, strlen(tagstr), 1, ffp) != 1){ /* write tag string to full buffer */
        perror("Write full buffer failed!\n");
        fclose(lfp);
        fclose(ffp);
        return -1;
    }
    printf("Write to the full buffered file succeeded\n");
    _flushlbf(); /* flush line buffered files */
    printf("Only line buffered files are flushed...\n");
    fclose(lfp);
    fclose(ffp);
    return 0;
}

```

Output

```

newlfile.dat is line-buffered
Write to the line buffered file succeeded
newffile.dat is not line-buffered
Write to the full buffered file succeeded
Only line buffered files are flushed...

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“setbuf\(\) — Control buffering” on page 1518](#)
- [“setvbuf\(\) — Control buffering” on page 1589](#)

fldata() – Retrieve file information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>

int fldata(FILE *file, char *filename, fldata_t *info);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fldata_unlocked(FILE *file, char *filename, fldata_t *info);
```

General description

Retrieves information about an open stream pointed to by *file*. It returns the file name in the buffer that is pointed by *filename* and other information in the structure that is pointed by *info*. The file name buffer and other information structure are user provided. The file name returned in *filename* is the name specified in `fopen()` or `freopen()`. If the file is opened with a *ddname* (for example, `fopen("DD:A", "w")`), then the *filename* field will contain the *ddname* used to open the file, prefixed with `dd:`. If the file is a DASD data set or a memory file, the field `__dsname` contains the *dsname*. If the file is a z/OS UNIX file, the field `__dsname` contains the path name. For all other files, it is NULL.

After a failure, the contents of the information structure are indeterminate.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

For full details about *filename* considerations, see one of the “Opening Files” sections in [z/OS XL C/C++ Programming Guide](#).

If *fldata* is the first reference to a standard stream, a call to the `fldata()` function opens the stream.

See [Table 23 on page 547](#).

Notes:

- A file name of NULL indicates that no file name will be returned.
- `FILENAME_MAX` is recommended for the size of the file name buffer.

The table "Elements Returned in `fldata_t` Data Structure" describes the fields in the `fldata_t` data structure. For further details, see [z/OS XL C/C++ Programming Guide](#).

`fldata_unlocked()` is functionally equivalent to `fldata()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Special behavior for POSIX C: Under z/OS UNIX services, if there had been an exec to an application that invokes `fldata()`, the standard streams are opened at the time of the exec. Thus `fldata()` does not attempt to open them again.

Returned value

If successful, `fldata()` returns 0.

If unsuccessful, `fldata()` returns nonzero.

Table 23. Elements Returned in `fldata_t` Data Structure

| Element | Data Type | General Description |
|------------------------------|----------------|---|
| <code>__recfmF:1</code> | unsigned int | Indicates whether it has fixed-length records. |
| <code>__recfmV:1</code> | unsigned int | Indicates whether it has variable-length records. |
| <code>__recfmU:1</code> | unsigned int | Indicates whether it has undefined-length records. |
| <code>__recfmS:1</code> | unsigned int | Indicates whether it has either standard (if fixed-length) or spanned (if variable-length) records. |
| <code>__recfmBlk:1</code> | unsigned int | Indicates whether it has blocked records. |
| <code>__recfmASA:1</code> | unsigned int | Indicates whether it has ASA print-control characters. |
| <code>__recfmM:1</code> | unsigned int | Indicates whether it has machine print-control codes. |
| <code>__dsorgPO:1</code> | unsigned int | Indicates whether it is a partitioned data set. |
| <code>__dsorgPDSmem:1</code> | unsigned int | Indicates whether a file is a member. |
| <code>__dsorgPDSdir:1</code> | unsigned int | Indicates whether a file is a PDS or PDSE directory. |
| <code>__dsorgPS:1</code> | unsigned int | Indicates whether it is a sequential data set. |
| <code>__dsorgConcat:1</code> | unsigned int | Indicates whether it is a sequentially concatenated file. |
| <code>__dsorgMem:1</code> | unsigned int | Indicates whether it is a memory file. |
| <code>__dsorgHiper:1</code> | unsigned int | Indicates whether it is a memory file in hiperspace. |
| <code>__dsorgTemp:1</code> | unsigned int | Indicates whether it is a temporary file created by <code>tmpfile()</code> . |
| <code>__dsorgVSAM:1</code> | unsigned int | Indicates whether it is a VSAM file. |
| <code>__dsorgHFS:</code> | unsigned int | Indicates whether it is a z/OS UNIX file. |
| <code>__openmode:2</code> | unsigned int | Values are <code>__TEXT</code> , <code>__BINARY</code> , <code>__RECORD</code> , <code>__BLOCKED</code> . |
| <code>__modeflag:4</code> | unsigned int | Values are <code>__APPEND</code> , <code>__READ</code> , <code>__UPDATE</code> , <code>__WRITE</code> . These macros can be added together to determine the value; for example, a file opened with mode <code>a+</code> will have the value <code>__APPEND + __UPDATE</code> . |
| <code>__dsorgPDSE:1</code> | unsigned int | Indicates whether a file is a PDSE. |
| <code>__vsamRLS:3</code> | unsigned int | Returned values are <code>__NORLS</code> , <code>__RLS</code> , <code>__TVS</code> . |
| <code>__recfmB:1</code> | unsigned int | Indicates whether it was allocated with blocked records |
| <code>__reserve2:3</code> | unsigned int | Reserved bits. |
| <code>__device</code> | char | Returned values are <code>__DISK</code> , <code>__TERMINAL</code> , <code>__PRINTER</code> , <code>__TAPE</code> , <code>__TDQ</code> , <code>__DUMMY</code> , <code>__OTHER</code> , <code>__MEMORY</code> , <code>__MSGFILE</code> , <code>__HFS</code> , <code>__HIPERSPACE</code> , <code>__MSGRTN</code> . |
| <code>__blksize</code> | unsigned long | Total block size of the file, including all control information needed in the block. |
| <code>__maxreclen</code> | unsigned long | Maximum length of the data in the record, including ASA control characters, if present. |
| <code>__vsamtype</code> | unsigned short | Returned values are <code>__NOTVSAM</code> , <code>__ESDS</code> , <code>__KSDS</code> , <code>__RRDS</code> , <code>__ESDS_PATH</code> , <code>__KSDS_PATH</code> . Note: Valid only if <code>__dsorgVSAM</code> is set. |

Table 23. Elements Returned in `fldata_t` Data Structure (continued)

| Element | Data Type | General Description |
|-------------------------------|---------------|--|
| <code>__vsamkeylen</code> | unsigned long | Length of VSAM key (if any). Note: Valid only if <code>__dsorgVSAM</code> is set. |
| <code>__vsamRKP</code> | unsigned long | Key position. Note: Valid only if <code>__dsorgVSAM</code> is set. |
| <code>__access_method</code> | uint8_t | Identifies the access method used for the data set. Values include: <code>__AM_UNSPEC</code> <code>__AM_BSAM</code> <code>__AM_QSAM</code> Note: Valid only if <code>__dsorgPS</code> or <code>__dsorgPO</code> is set. |
| <code>__noseek_to_seek</code> | uint8_t | Identifies the reason noseek was changed to seek. Values include: <code>__AM_BSAM_NOSWITCH</code> <code>__AM_BSAM_UPDATE</code> <code>__AM_BSAM_BSAMWRITE</code> <code>__AM_BSAM_FBS_APPEND</code> <code>__AM_BSAM_LRECLX</code> <code>__AM_BSAM_PARTITIONED_DIRECTORY</code> <code>__AM_BSAM_PARTITIONED_INDIRECT</code> Note: Valid only if <code>__dsorgPS</code> or <code>__dsorgPO</code> is set. |
| <code>__dsname</code> | char * | The contents of this field is determined by the following: <ul style="list-style-type: none"> • If the file is a DASD data set, memory file, or a z/OS UNIX file, then <code>__dsname</code> contains the real file name of file opened by <code>ddname</code> • If you open by <code>ddname</code>, and the <code>ddname</code> is a concatenation of PDS or PDSE data sets, then <code>__dsname</code> contains the data set name of the first PDS or PDSE. This is because you are only opening the directory of the first PDS or PDSE. • If you open by <code>ddname(member)</code> and the <code>ddname</code> is a concatenation of PDS or PDSE data sets, then <code>__dsname</code> contains the data set name of the first PDS or PDSE containing the member. Otherwise this field is NULL. The char * <code>__dsname</code> field is allocated internally by the library functions and must be saved before the next call to the <code>fldata()</code> function. |
| <code>__reserve4</code> | unsigned long | Reserved. |

Note: The numeric values for the macro names can be found in `stdio.h`. The meaning of the `__noseek_to_seek` values are described in topic about using the `__amrc` structure in [z/OS XL C/C++ Programming Guide](#).

Example

```
#include <stdio.h>

int main(void)
{
    FILE *stream;
    char filename[100];
    fldata_t fileinfo;
    int rc;

    stream = fopen("myfile.dat","rb+");
    :
    rc = fldata(stream, filename, &fileinfo);
    if (rc != 0)
        printf("fldata failed\n");
    else
        printf("filename is %s\n",filename);
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“freopen\(\) — Redirect an open file” on page 622](#)

flocate() — Locate a VSAM record

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>

int flocate(FILE *stream, const void *key, size_t key_len, int options);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int flocate_unlocked(FILE *stream, const void *key, size_t key_len, int options);
```

General description

Moves the VSAM file position indicator associated with the stream pointed to by *stream*, according to the rest of the arguments specified.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

key points to a key used for positioning.

key_len specifies the length of the search key. The *key_len* argument value must always be nonzero, except for `__KEY_FIRST` and `__KEY_LAST`.

KSDS, KSDS PATH, and ESDS PATH

The *key* can point to a field of any storage type except `register`. Typically it points to a character string whose length is *key_len*. The *key_len* must be less than or equal to the key length of the data

set. If *key_len* is the same as the file's key length, a full key search is automatically used; otherwise, a generic search is used. A generic key search is one in which the search key is a leading portion of the key field. The record positioned to is the first of the records having the same generic key.

ESDS

The *key* points to a relative byte address that may be stored as 4 or 8 byte value. *key_len* is either 4 or 8.

RRDS

The *key* points to a relative record number stored as an unsigned `long int`. *key_len* is either 4 or 8.

options specifies the position options described in [Table 24 on page 550](#).

Table 24. Position Options Parameter for flocate()

| | |
|---------------------|--|
| __KEY_FIRST | Positions to the first record in the file. Subsequent reads are in the forward direction. <i>key</i> and <i>key_len</i> are ignored. |
| __KEY_LAST | Positions to the last record in the file. Subsequent reads are in backward order. <i>key</i> and <i>key_len</i> are ignored. Only applies to VSAM files opened in record mode. |
| __KEY_EQ | Positions to the first record with the specified key. Subsequent reads are in the forward direction. |
| __KEY_EQ_BWD | Positions to the first record with the specified key. Subsequent reads are in backward order. Using this option requires a full key search. <i>key_len</i> must be equal to the key length as defined for the data set. Only applies to VSAM files opened in record mode. |
| __KEY_GE | Positions to the first record with a key greater than or equal to the specified key. |
| __RBA_EQ | Positions to the record with the specified RBA. Subsequent reads are in the forward direction. You cannot use <code>__RBA_EQ</code> with an alternative index path. Using this option with RRDS is <i>not</i> recommended. The underlying VSAM utilities do not support seeking to an RBA in an RRDS file. The <code>flocate()</code> function attempts to convert the RBA to a Relative Record Number by dividing the value by the LRECL of the file and using the equivalent <code>__KEY_EQ</code> . Using this option with KSDS is <i>not</i> recommended because the RBA of a given record may change over time, because of inserts, deletions, or updates of other records. |
| __RBA_EQ_BWD | Positions to the record with the specified RBA. Subsequent reads are in backward order. You cannot use <code>__RBA_EQ_BWD</code> with an alternative index path. Using this option with RRDS is not recommended. The underlying VSAM utilities do not support seeking to an RBA in an RRDS file. The <code>flocate()</code> function attempts to convert the RBA to a Relative Record Number by dividing the value by the LRECL of the file and using the equivalent <code>__KEY_EQ_BWD</code> . Using this option with KSDS is <i>not</i> recommended because the RBA of a given record may change over time, because of inserts, deletions, or updates of other records. Only applies to VSAM files opened in record mode. |

Table 24. Position Options Parameter for *flocate()* (continued)

| | |
|--------------------|---|
| _KEY_EQ_BWD | Positions to the first record with the specified key. Subsequent reads are in backward order. Using this option requires a full key search. <i>key_len</i> must be set equal to the key length as defined for the data set. Only applies to VSAM files opened in record mode. |
|--------------------|---|

Notes:

1. When you are trying to use *flocate()* in a path to a nonunique key, the resulting position will be at the first physical record of the duplicate key set.
2. *flocate()* releases all record locking.
3. Writes to VSAM data sets are not affected by preceding calls to *flocate()*.
4. If a record was not found, you must successfully relocate to another position before reading or writing (using the *flocate()* function). The exception to this is that a write that follows a failed *flocate()* will succeed if the file was opened for initial loading, but no records have been written to it yet.

flocate_unlocked() is functionally equivalent to *flocate()* with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the *flockfile()* or *ftrylockfile()* function.

Considerations for VSAM extended addressability data sets: *flocate()* accepts key lengths of 4 or 8 when relative byte address (RBA) values are used for positioning. A key length of 8 is required only when the working with a VSAM extended addressability data set, because when the address grows past the 4GB boundary, the key needs to be large enough to hold the value.

When using the value 4GB-1 as the key to *flocate()*, the key length must be 8 and the data type used must be 8 bytes in size (for example, X' 00000000FFFFFFFF') . If the key length is 4, *flocate()* treats the key as -1(EOF).

Returned value

If successful, *flocate()* returns 0.

If a record was not found or the position is beyond the EOF, *flocate()* returns EOF.

Example

```
#include <stdio.h>

int main(void)
{
    FILE *stream;
    int    vsam_rc;
    char *key = "RECORD 27";

    stream = fopen("DD:MYCLUS", "rb+", type=record);
    vsam_rc = flocate(stream, key, 9, _KEY_EQ);
    ...
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fdelrec\(\) — Delete a VSAM record” on page 496](#)
- [“fgetpos\(\) — Get file position” on page 534](#)
- [“fseek\(\) — Change file position” on page 638](#)

- [“fsetpos\(\) — Set file position” on page 647](#)
- [“ftell\(\) — Get current file position” on page 657](#)
- [“fupdate\(\) — Update a VSAM record” on page 669](#)
- [Using threads with MVS files in z/OS XL C/C++ Programming Guide](#)
- [Performing VSAM I/O operations in z/OS XL C/C++ Programming Guide](#)

flock()— Apply or remove an advisory lock on an open file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.4 | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/file.h>

int flock(int fd, int operation);
```

General description

`flock()` applies or removes an advisory lock on the open file specified by `fd`. The argument `operation` is one of the following:

- `LOCK_SH` Place a shared lock. More than one process might hold a shared lock for a given file at a given time.
- `LOCK_EX` Place an exclusive lock. Only one process might hold an exclusive lock for a given file at a given time.
- `LOCK_UN` Remove an existing lock that is held by this process.

A call to `flock()` might block if an incompatible lock is held by another process. To make a nonblocking request, include `LOCK_NB` (by ORing) with any of the previous operations.

A single file might not simultaneously have both shared and exclusive locks.

Locks that are created by `flock()` are associated with an open file description. This means that duplicate file descriptors (created by, for example, `fork()` or `dup()`) refer to the same lock, and this lock might be modified or released by using any of these file descriptors. Furthermore, the lock is released either by an explicit `LOCK_UN` operation on any of these duplicate file descriptors, or when all such file descriptors are closed.

If a process uses `open()` (or similar) to obtain more than one file descriptor for the same file, these file descriptors are treated independently by `flock()`. An attempt to lock the file by using one of these file descriptors might be denied by a lock that the calling process places via another file descriptor.

A process might hold only one type of lock (shared or exclusive) on a file. Subsequent `flock()` calls on an locked file convert an existing lock to the new lock mode.

Locks that are created by `flock()` are preserved across an `execve()` call.

A shared or exclusive lock can be placed on a file regardless of the mode in which the file is opened.

Returned value

If successful, `flock()` returns 0.

If unsuccessful, `flock()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EBADF

fd is not an open file descriptor.

EINTR

While waiting to acquire a lock, the call is interrupted by delivery of a signal that is caught by a handler.

EINVAL

operation is invalid.

ENOLCK

The kernel runs out of memory for allocating lock records.

EWOULDBLOCK

The file is locked and the LOCK_NB flag is selected.

Related information

- [“sys/file.h — File manipulation constants” on page 68](#)
- [“close\(\) — Close a file” on page 293](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“execve\(\) — Run a new program by replacing the current process image](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“open\(\) — Open a file” on page 1157](#)

flockfile()— stdio locking

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R8 |

Format

```
#define _UNIX03_SOURCE
#include <stdio.h>

void flockfile(FILE *file);
```

General description

This function provides explicit application-level locking of stdio (FILE*) objects. The flockfile() family of the functions can be used by a thread to delineate a sequence of I/O statements that are executed as a unit.

The flockfile() function acquires ownership of a (FILE*) object for the thread, waiting if necessary, and increases the internal lock count. If the thread has previously been granted ownership, the internal lock count is increased.

The internal lock count allows matching calls to flockfile() (or successful calls to ftrylockfile()) and funlockfile() to be nested.

z/OS Consideration: The flockfile() family of functions acts upon FILE * objects. It is possible to have the same physical file represented by multiple FILE * objects that are not recognized as being equivalent. For

example, `fopen()` opens a file and `open()` opens the same file, and then `fdopen()` creates a `FILE *` object. In this case, locking the first `FILE *` does not prevent the second `FILE *` from also being locked and used.

Returned value

None.

Notes:

1. Because the `flockfile()` function returns void, no error information can be returned.
2. It is the application's responsibility to prevent deadlock (or looping). For example, deadlock (or looping) may occur if a (`FILE *`) object is closed, or a thread is terminated, before relinquishing all locked (`FILE *`) objects.

Related information

- [“ftrylockfile\(\) — stdio locking” on page 665](#)
- [“funlockfile\(\) — stdio unlocking” on page 668](#)

floor(), floorf(), floorl() — Round down to integral value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double floor(double x);
float floor(float x);           /* C++ only */
long double floor(long double x); /* C++ only */
float floorf(float x);
long double floorl(long double x);
```

General description

Calculates the largest integer that is less than or equal to x .

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

Returns the calculated integral value expressed as a double, float, or long double value. The result cannot have a range error.

Example

CELEBF24

```

/* CELEBF24

   This example assigns y the value of the largest integer that is less
   than or equal to 2.8, and it assigns z the value of the largest integer
   that is less than or equal to -2.8.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double y, z;

    y = floor(2.8);
    z = floor(-2.8);

    printf("floor( 2.8 ) = %f\n", y);
    printf("floor( -2.8 ) = %f\n", z);
}

```

Output

```

floor( 2.8 ) = 2.000000
floor( -2.8 ) = -3.000000

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceil\(\), ceilf\(\), ceill\(\) — Round up to integral value” on page 249](#)
- [“fmod\(\), fmodf\(\), fmodl\(\) — Calculate floating-point remainder” on page 565](#)

floor32(), floor64(), floor128() — Round down to integral value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 floor32(_Decimal32 x);
_Decimal64 floor64(_Decimal64 x);
_Decimal128 floor128(_Decimal128 x);
_Decimal32 floor(_Decimal32 x); /* C++ only */
_Decimal64 floor(_Decimal64 x); /* C++ only */
_Decimal128 floor(_Decimal128 x); /* C++ only */

```

General description

Calculates the largest integer that is less than or equal to *x*.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

Returns the calculated integral value expressed as a _Decimal32, _Decimal64, or _Decimal128 value. The result cannot have a range error.

Example

```
/* CELEBF78

This example illustrates the floord64() function.

This example assigns y the value of the largest integer that is less
than or equal to 2.8, and it assigns z the value of the largest
integer that is less than or equal to -2.8.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 y, z;

    y = floord64(+2.8DD);
    z = floord64(-2.8DD);

    printf("floord64(+2.8) = %Df\n", y);
    printf("floord64(-2.8) = %Df\n", z);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceild32\(\), ceild64\(\), ceild128\(\) — Round up to integral value” on page 250](#)
- [“floor\(\), floorf\(\), floorl\(\) — Round down to integral value” on page 554](#)

_flushlbf() — Flush all open line-buffered files

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | None |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

void _flushlbf(void);

#define _OPEN_SYS_UNLOCKED 1
#include <stdio.h>
#include <stdio_ext.h>

void _flushlbf_unlocked(void);
```

General description

The `_flushlbf()` function flushes all open line-buffered streams.

The `_flushlbf()` function is affected by the `ungetc()` and `ungetwc()` functions. Calling this function causes `_flushlbf()` to back up the file position when characters are pushed back. For details, see [“ungetc\(\) — Push character onto input stream” on page 1941](#) and [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#). If needed, the `_EDC_COMPAT` environment variable can be set at open time such that `_flushlbf()` discards any pushed-back characters and leaves the file position where it was when the first `ungetc()` or `ungetwc()` function call was issued.

If the `_flushlbf()` function is used after the `ungetwc()` function pushed a wide char on a text stream, the position will be backed up by one wide character from the position of the file when the `ungetwc()` function was issued. For a wide-oriented binary stream, the position will be backed up based on the number of bytes that are used to represent the wide char in the `ungetc` buffer. For this reason, attempting to use `ungetwc()` on a character when the destination is a binary wide-oriented stream that was never read in the first place results in undefined behavior for `_flushlbf()`. Note that the `_EDC_COMPAT` environment variable also changes the behavior of `_flushlbf()` after `ungetwc()`, and will cause any wide char pushed-back to be discarded and the position left at the point where the `ungetwc()` was issued. For details about the `_EDC_COMPAT` environment variable, see *Environment Variables in z/OS XL C/C++ Programming Guide*.

If `_flushlbf()` fails, the position is left at the point in the file where the first `ungetc()` or `ungetwc()` function call was issued. All pushed-back characters are discarded.

Note:

1. The system automatically flushes buffers when you close the stream or when a program ends normally without closing the stream.
2. The `_flushlbf()` function has no effect on line-buffered text files, because the compiler writes all records to the system as they are completed. All incomplete new records remain in the buffer.

The buffering mode and the file type can have an effect on when output data is flushed. For more information, see *Buffering of C Streams in z/OS XL C/C++ Programming Guide*.

All streams remain open after the `_flushlbf()` call. Because a read operation cannot immediately follow or precede a write operation, the `_flushlbf()` function can be used to allow exchange between these two modes. The `_flushlbf()` function can also be used to refresh the buffer when working with a reader and a simultaneous writer or updater.

The `_flushlbf_unlocked()` function is equivalent to the `_flushlbf()` function with the exception that it is not thread-safe. This function can be safely used in a multithreaded application whether the user has locked all open line-buffered files or not.

When flushing all open line-buffered files, a failure to flush any of the files will leave it unchanged. However, flushing will continue on any other open line-buffered files that can be flushed successfully.

Returned value

The `_flushlbf()` function returns no values.

Example

CELEBF84

```
/* CELEBF84
   This example flushes all the line-buffered files.
*/

#include <stdio.h>
#include <stdio_ext.h>
#include <string.h>

#define BUF_SIZE 128
```

```

int main(void)
{
    char lbuf[BUF_SIZE]; /* line buffer */
    char fbuf[BUF_SIZE]; /* full buffer */
    char *tagstr = "This file was modified!";
    FILE *lfp;
    FILE *ffp;

    lfp = fopen("newlfile.dat", "a+");
    if(lfp == NULL){
        perror("Open file failed!\n");
        return -1;
    }
    if(setvbuf(lfp, lbuf, _IOLBF, sizeof(lbuf)) != 0){ /* set lbuf to line-buffered */
        perror("Format line-buffered failed!\n");
        fclose(lfp);
        return -1;
    }

    if (__flbf(lfp)) printf("newlfile.dat is line-buffered\n");
    else printf("newlfile.dat is not line-buffered\n");

    if(fwrite(lfp, strlen(tagstr), 1, lfp) != 1){ /* write tag string to line buffer*/
        perror("Write line buffer failed!\n");
        fclose(lfp);
        return -1;
    }
    printf("Write to the line buffered file succeeded\n");

    ffp = fopen("newffile.dat", "a+");
    if(ffp == NULL){
        perror("Open file failed!\n");
        fclose(lfp);
        return -1;
    }
    if(setvbuf(ffp, fbuf, _IOFBF, sizeof(fbuf)) != 0){ /* set fbuf to full-buffered */
        perror("Format full-buffered failed!\n");
        fclose(ffp);
        return -1;
    }

    if (__flbf(ffp)) printf("newffile.dat is line-buffered\n");
    else printf("newffile.dat is not line-buffered\n");

    if(fwrite(tagstr, strlen(tagstr), 1, ffp) != 1){ /* write tag string to full buffer */
        perror("Write full buffer failed!\n");
        fclose(lfp);
        fclose(ffp);
        return -1;
    }
    printf("Write to the full buffered file succeeded\n");
    _flushlbf(); /* flush line buffered files */
    printf("Only line buffered files are flushed...\n");
    fclose(lfp);
    fclose(ffp);
    return 0;
}

```

Output

```

newlfile.dat is line-buffered
Write to the line buffered file succeeded
newffile.dat is not line-buffered
Write to the full buffered file succeeded
Only line buffered files are flushed...

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“setbuf\(\) — Control buffering” on page 1518](#)
- [“setvbuf\(\) — Control buffering” on page 1589](#)
- [“ungetc\(\) — Push character onto input stream” on page 1941](#)
- [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#)

fma(), fmaf(), fmal() – Multiply then add

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double fma(double x, double y, double z);
float fmaf(float x, float y, float z);
long double fmal(long double x, long double y, long double z);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float fma(float x, float y, float z);
long double fma(long double x, long double y, long double z);
```

General description

The fma() family of functions compute $(x * y) + z$, rounded as one ternary operation: they compute the value to infinite precision and round once to the resulting format according to the rounding mode characterized by the value of FLT_ROUNDS.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| fma | X | X |
| fmaf | X | X |
| fmal | X | X |

Restriction: The fmaf() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

If successful, they return the rounded value of $(x * y) + z$ as one ternary operation.

Related information

- [“math.h — Floating-point math functions”](#) on page 40

fmad32(), fmad64(), fmad128() – Multiply then add

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 fmad32(_Decimal32 x, _Decimal32 y, _Decimal32 z);
_Decimal64 fmad64(_Decimal64 x, _Decimal64 y, _Decimal64 z);
_Decimal128 fmad128(_Decimal128 x, _Decimal128 y, _Decimal128 z);

_Decimal32 fma(_Decimal32 x, _Decimal32 y, _Decimal32 z);    /* C++ only */
_Decimal64 fma(_Decimal64 x, _Decimal64 y, _Decimal64 z);    /* C++ only */
_Decimal128 fma(_Decimal128 x, _Decimal128 y, _Decimal128 z); /* C++ only */
```

General description

The fma() family of functions compute $(x * y) + z$ rounded as one ternary operation: they compute the value to infinite precision and round once to the resulting format according to the current rounding mode.

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) IEEE Decimal Floating-Point for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, they return the rounded value of $(x * y) + z$ as one ternary operation.

Example

```
/* CELEBF82

   This example illustrates the fmad64() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

void main(void)
{
    _Decimal64 w, x, y, z;

    x = 2.5DD;
    y = 6.7DD;
    z = 1.0DD;
    w = fmad64(x,y,z);

    printf("fmad64( %Df, %Df, %Df ) = %Df\n", x, y, z, w);
}
```

Related information

- [“math.h – Floating-point math functions” on page 40](#)

fmax(), fmaxf(), fmaxl() – Calculate the maximum numeric value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double fmax(double x, double y);
float fmaxf(float x, float y);
long double fmaxl(long double x, long double y);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float fmax(float x, float y);
long double fmax(long double x, long double y);
```

General description

The fmax() family of functions determine the maximum numeric value of their arguments. NaN arguments are treated as missing data. If one argument is a NaN and the other numeric, then the numeric value will be chosen.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| fmax | X | X |
| fmaxf | X | X |
| fmaxl | X | X |

Restriction: The fmaxf() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

If successful, they return the maximum numeric value of their arguments.

Related information

- [“math.h – Floating-point math functions”](#) on page 40
- [“fdim\(\), fdimf\(\), fdiml\(\) – Calculate the positive difference”](#) on page 498
- [“fmin\(\), fminf\(\), fminl\(\) – Calculate the minimum numeric value”](#) on page 563

fmaxd32(), fmaxd64(), fmaxd128() – Calculate the maximum numeric value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 fmaxd32(_Decimal32 x, _Decimal32 y);
_Decimal64 fmaxd64(_Decimal64 x, _Decimal64 y);
_Decimal128 fmaxd128(_Decimal128 x, _Decimal128 y);

_Decimal32 fmax(_Decimal32 x, _Decimal32 y);    /* C++ only */
_Decimal64 fmax(_Decimal64 x, _Decimal64 y);    /* C++ only */
_Decimal128 fmax(_Decimal128 x, _Decimal128 y); /* C++ only */
```

General description

The fmax() family of functions determine the maximum numeric value of their arguments. NaN arguments are treated as missing data. If one argument is a NaN and the other numeric, then the numeric value will be chosen.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, they return the maximum numeric value of their arguments.

Example

```
/* CELEBF79

   This example illustrates the fmaxd128() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x = 3.5DL, y = 4.0DL, z;

    z = fmaxd128(x, y);

    printf("The maximum number between %DDf and %DDf is %DDf\n", x, y, z);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)

- [“fdim32\(\), fdim64\(\), fdim128\(\) — Calculate the positive difference” on page 499](#)
- [“fmax\(\), fmaxf\(\), fmaxl\(\) — Calculate the maximum numeric value” on page 561](#)
- [“fmin32\(\), fmin64\(\), fmin128\(\) — Calculate the minimum numeric value” on page 564](#)

fmin(), fminf(), fminl() — Calculate the minimum numeric value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double fmin(double x, double y);
float fminf(float x, float y);
long double fminl(long double x, long double y);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float fmin(float x, float y);
long double fmin(long double x, long double y);
```

General description

The `fmin()` family of functions determine the minimum numeric value of their arguments. NaN arguments are treated as missing data. If one argument is a NaN and the other numeric, then the numeric value will be chosen.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|--------------------|-----|------|
| <code>fmin</code> | X | X |
| <code>fminf</code> | X | X |
| <code>fminl</code> | X | X |

Restriction: The `fminf()` function does not support the `_FP_MODE_VARIABLE` feature test macro.

Returned value

If successful, they return the minimum numeric value of their arguments.

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“fdim\(\), fdimf\(\), fdiml\(\) — Calculate the positive difference” on page 498](#)
- [“fmax\(\), fmaxf\(\), fmaxl\(\) — Calculate the maximum numeric value” on page 561](#)

fmind32(), fmind64(), fmind128() – Calculate the minimum numeric value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 fmind32(_Decimal32 x, _Decimal32 y);
_Decimal64 fmind64(_Decimal64 x, _Decimal64 y);
_Decimal128 fmind128(_Decimal128 x, _Decimal128 y);

_Decimal32 fmin(_Decimal32 x, _Decimal32 y); /* C++ only */
_Decimal64 fmin(_Decimal64 x, _Decimal64 y); /* C++ only */
_Decimal128 fmin(_Decimal128 x, _Decimal128 y); /* C++ only */
```

General description

The `fmin()` family of functions determine the minimum numeric value of their arguments. NaN arguments are treated as missing data. If one argument is a NaN and the other numeric, then the numeric value will be chosen.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, they return the minimum numeric value of their arguments.

Example

```
/* CELEBF70
   This example illustrates the fmind32() function
*/
```

Related information

- [“math.h – Floating-point math functions” on page 40](#)
- [“fdimd32\(\), fdimd64\(\), fdimd128\(\) – Calculate the positive difference” on page 499](#)
- [“fmaxd32\(\), fmaxd64\(\), fmaxd128\(\) – Calculate the maximum numeric value” on page 562](#)
- [“fmin\(\), fminf\(\), fminl\(\) – Calculate the minimum numeric value” on page 563](#)

fmod(), fmodf(), fmodl() – Calculate floating-point remainder

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double fmod(double x, double y);
float fmodf(float x, float y);      /* C++ only */
long double fmod(long double x, long double y); /* C++ only */
float fmodf(float x, float y);
long double fmodl(long double x, long double y);
```

General description

Calculates the floating-point remainder of x/y . The absolute value of the result is always less than the absolute value of y . The result will have the same sign as x .

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Restriction: The `fmodf()` function does not support the `_FP_MODE_VARIABLE` feature test macro.

Returned value

If y is 0, or the result would overflow, then the function returns 0. `Errno` remains unchanged.

Special behavior for IEEE

If successful, the function returns the floating-point remainder of x/y .

If y is 0, the function sets `errno` to `EDOM` and returns `NaNQ`. No other errors will occur.

Example

CELEBF25

```
/* CELEBF25

   This example computes z as the remainder of x/y; here x/y is -3 with a
   remainder of -1.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y, z;

    x = -10.0;
    y = 3.0;
    z = fmod(x,y);      /* z = -1.0 */
```

```
printf("fmod( %f, %f) = %lf\n", x, y, z);
}
```

Output

```
fmod( -10.000000, 3.000000) = -1.000000
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“modf\(\), modff\(\), modfl\(\) — Extract fractional and integral parts of floating-point value” on page 1092](#)

fmodd32(), fmodd64(), fmodd128() — Calculate floating-point remainder

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 fmodd32(_Decimal32 x, _Decimal32 y);
_Decimal64 fmodd64(_Decimal64 x, _Decimal64 y);
_Decimal128 fmodd128(_Decimal128 x, _Decimal128 y);

_Decimal32 fmod(_Decimal32 x, _Decimal32 y);    /* C++ only */
_Decimal64 fmod(_Decimal64 x, _Decimal64 y);    /* C++ only */
_Decimal128 fmod(_Decimal128 x, _Decimal128 y); /* C++ only */
```

General description

Calculates the floating-point remainder of x/y . The absolute value of the result is always less than the absolute value of y . The result will have the same sign as x .

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#)IEEE Decimal Floating-Point for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, the function returns the floating-point remainder of x/y .
If y is 0, the function sets `errno` to `EDOM` and returns `NaNQ`. No other errors will occur.

Example

```
/* CELEBF83
   This example illustrates the fmodd32() function.
*/
#define __STDC_WANT_DEC_FP__
```



```
#include <math.h>
#include <stdio.h>

void main(void)
{
    _Decimal32 x, y, z;

    x = -10.0DF;
    y = 3.0DF;
    z = fmodd32(x, y);

    printf("fmodd32( %Hf, %Hf ) = %Hf\n", x, y, z);
}
```

Related information

- “[math.h — Floating-point math functions](#)” on page 40
- “[modfd32\(\), modfd64\(\), modfd128\(\) — Extract fractional and integral parts of decimal floating-point value](#)” on page 1093

fmtmsg() — Display a message in the specified format

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <fmtmsg.h>

int fmtmsg(long classification, const char *label, int severity,
           const char *text, const char *action, const char *tag);
```

General description

The `fmtmsg()` function can be used to display messages in a specified format instead of the traditional `printf()` function.

Based on a message's classification component, `fmtmsg()` writes a formatted message either to standard error, to the console, or to both.

A formatted message consists of up to five components as defined below. The component classification is not part of a message displayed to the user, but defines the source of the message and directs the display of the formatted message.

classification

Contains identifiers from the following groups of major classifications and subclassifications. Any one identifier from a subclass may be used in combination with a single identifier from a different subclass. Two or more identifiers from the same subclass should not be used together, with the exception of identifiers from the display subclass. (Both display subclass identifiers may be used so that messages can be displayed to both standard error and the system console).

Major Classifications

Identifies the source of the condition. Identifiers are: **MM_HARD** (hardware), **MM_SOFT** (software), and **MM_FIRM** (firmware).

Message Source Subclassifications

Identifies the type of software in which the problem is detected. Identifiers are: **MM_APPL** (application), **MM_UTIL** (utility), and **MM_OPSYS** (operating system).

Display Subclassifications

Indicates where the message is to be displayed. Identifiers are: **MM_PRINT** to display the message on the standard error stream, **MM_CONSOLE** to display the message on the system console. One or both identifiers may be used.

Status Subclassifications

Indicates whether the application will recover from the condition. Identifiers are: **MM_RECOVER** (recoverable) and **MM_NRECOV** (non-recoverable).

An additional identifier, **MM_NULLMC**, indicates that no classification component is supplied for the message.

label

Identifies the source of the message. The format is two fields separated by a colon. The first field is up to 10 bytes, the second is up to 14 bytes. The constant **__MM_MXLABELLN** defines the maximum length of *label*.

severity

Indicates the seriousness of the condition. Identifiers for the levels of severity are:

MM_HALT

indicates that the application has encountered a severe fault and is halting. Produces the string "HALT".

MM_ERROR

indicates that the application has detected a fault. Produces the string "ERROR".

MM_WARNING

indicates a condition that is out of the ordinary, that might be a problem, and should be watched. Produces the string "WARNING".

MM_INFO

provides information about a condition that is not in error. Produces the string "INFO".

MM_NOSEV

indicates that no severity level is supplied for the message.

Other

provides an unknown severity. Produce the string "SV=n", where n is the *severity* value specified.

text

Describes the error condition that produced the message. The character string is not limited to a specific size. If the character string is empty, then the text produced is unspecified.

action

Describes the first step to be taken in the error-recovery process. The `fmtmsg()` function precedes the action string with the prefix: "TO FIX:". The action string is not limited to a specific size.

tag

An identifier that references on-line documentation for the message. Suggested usage is that tag includes the label and a unique identifying number. A sample tag is "XSI:cat:146". The constant **__MM_MXTAGLN** defines the maximum length of *tag*.

The MSGVERB environment variable (for message verbosity) tells `fmtmsg()` which message components it is to select when writing messages to standard error. The value of MSGVERB is a colon-separated list of optional keywords. Valid keywords are: label, severity, text, action, and tag. If MSGVERB contains a keyword for a component and the component's value is not the component's NULL value, `fmtmsg()` includes that component in the message when writing the message to standard error. If MSGVERB does not include a keyword for a message component, that component is not included in the display of the message. The keywords may appear in any order. If MSGVERB is not defined, if its value is the NULL string, if its value is not of the correct format, or if it contains keywords other than the valid ones listed above, `fmtmsg()` selects all components.

MSGVERB affects only which components are selected for display to standard error. All message components are included in console messages.

Returned value

fmtmsg() returns one of the following values:

Value

Description

MM_OK

The function succeeded.

MM_NOCON

The function was unable to generate a console message, but otherwise succeeded.

MM_NOMSG

The function was unable to generate a message on standard error, but otherwise succeeded.

MM_NOTOK

The function failed completely.

Examples

The following is an example of fmtmsg():

```
fmtmsg(MM_PRINT, "XSI:cat", MM_ERROR, "illegal option",
"refer to cat in user's reference manual", "XSI:cat:001")

    produces a complete message in the specified message format:

XSI:cat: ERROR: illegal option
TO FIX: refer to cat in user's reference manual XSI:cat:001
```

The following is another example when the environment variable MSGVERB is set.

```
export MSGVERB=severity:text:action

fmtmsg(MM_PRINT, "XSI:cat", MM_ERROR, "illegal option",
"refer to cat in user's reference manual", "XSI:cat:001")

    produces a complete message in the specified message format:

ERROR: illegal option
TO FIX: refer to cat in user's reference manual
```

Related information

- [“fmtmsg.h — Message display structures” on page 27](#)
- [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data” on page 593](#)

fnmatch() — Match file name or path name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <fnmatch.h>

int fnmatch(const char *pattern, const char *string, int flags);
```

General description

The `fnmatch()` function matches patterns as described in the **XCU** specification, **Section 2.13.1, Patterns Matching a Single Character**, and **Section 2.13.2, Patterns Matching Multiple Characters**. It checks the string specified by the *string* argument to see if it matches the pattern specified by the *pattern* argument.

The *flags* argument modifies the interpretation of *pattern* and *string*. It is the bitwise inclusive-OR of zero or more of the flags defined in the header `<fnmatch.h>`. If the `FNM_PATHNAME` flag is set in *flags*, then a slash character in *string* will be explicitly matched by a slash in *pattern*; it will not be matched by either the asterisk or question-mark special characters, nor by a bracket expression. If `FNM_PATHNAME` is set and either of these characters would match a slash, the function returns `FNM_ESLASH`. If the `FNM_PATHNAME` flag is not set, the slash character is treated as an ordinary character.

If `FNM_NOESCAPE` is not set in *flags*, a backslash character (`\`) in *pattern* followed by any other character will match that second character in *string*. In particular, `\\` will match a backslash in *string*. If `FNM_NOESCAPE` is set, a backslash character will be treated as an ordinary character.

If `FNM_PERIOD` is set in *flags*, then a leading period in *string* will match a period in *pattern*; as described by rule 2 in the **XCU** specification, **Section 2.13.3, Patterns Used for Filename Expansion**, where the location of “leading” is indicated by the value of `FNM_PATHNAME`:

- If `FNM_PATHNAME` is set, a period is “leading” if it is the first character in *string* or if it immediately follows a slash.
- If `FNM_PATHNAME` is not set, a period is “leading” only if it is the first character of *string*.

If `FNM_PERIOD` is not set, then no special restrictions are placed on matching a period. If `FNM_PERIOD` is set, and a pattern wildcard would match a leading period as defined by the above rules, then the function returns `FNM_EPERIOD`.

Returned value

If *string* matches the pattern specified by *pattern*, `fnmatch()` returns 0.

If there is no match, `fnmatch()` returns `FNM_NOMATCH`, which is defined in the header `<fnmatch.h>`.

If an error occurs, `fnmatch()` returns another nonzero value. See the discussion above for the various possible nonzero returns.

Related information

- [“fnmatch.h — Filename matching types” on page 27](#)
- [“glob\(\) — Generate path names matching a pattern” on page 808](#)
- [“wordexp\(\) — Perform shell word expansions” on page 2067](#)

fopen() — Open a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

FILE *fopen(const char *__restrict__filename, const char *__restrict__mode);
```

General description

The `fopen()` function opens the file specified by *filename* and associates a stream with it. The *mode* variable is a character string specifying the type of access requested for the file. The *mode* variable contains one positional parameter followed by optional keyword parameters. The positional parameters are described in [Table 25 on page 572](#) and [Table 27 on page 573](#).

The positional parameters must be passed as lowercase characters.

The keyword parameters can be passed in mixed case. They must be separated by commas. Only one instance of a keyword can be specified.

The file name passed to `fopen()` often determines the type of file that is opened. A set of file-naming rules exist, which allow you to create an application that references both MVS and z/OS UNIX files specifically. For details on how `fopen()` determines the type of file from the *filename* and *mode* strings, see the topics about opening files in [z/OS XL C/C++ Programming Guide](#).

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Named pipes in multithreaded environment: Do not use `fopen()` to open named pipes in multithreaded environment. If used, a deadlock will occur. See [z/OS XL C/C++ Programming Guide](#) for a detailed explanation.

File mode

Restriction: When running with `POSIX(OFF)` and specifying a mode parameter that includes `t`, for example, `rt`, `rt+`, `r+t`, `wt`, `wt+`, `w+t`, `at`, `at+` or `a+t`, the `fopen()` request will fail with a message indicating a non-valid mode was specified.

Positional parameter points to a string that begins with one of the following sequences. To support extended file modes, additional characters can be included either as a last character or as a character between the characters in any of the two-character strings.

Table 25. Values for positional parameter under file mode

| File mode | General description |
|------------|---|
| r | Open a text file for reading. (The file must exist.) |
| w | Open a text file for writing. If the w mode is specified for a ddname that has DISP=MOD, the behavior is the same as if a had been specified. Otherwise, if the file already exists, its contents are destroyed. |
| a | Open a text file in append mode for writing at the end of the file. fopen() creates the file if it does not exist. |
| r+ | Open a text file for both reading and writing. (The file must exist.) |
| w+ | Open a text file for both reading and writing. If the w+ mode is specified for a ddname that has DISP=MOD, the behavior is the same as if a+ had been specified. Otherwise, if the file already exists, its contents are destroyed. |
| a+ | Open a text file in append mode for reading or updating at the end of the file. fopen() creates the file if it does not exist. |
| rb | Open a binary file for reading. (The file must exist.) |
| wb | Open an empty binary file for writing. If the wb mode is specified for a ddname that has DISP=MOD, the behavior is the same as if ab had been specified. Otherwise, if the file already exists, its contents are destroyed. |
| ab | Open a binary file in append mode for writing at the end of the file. fopen() creates the file if it does not exist. |
| rt | Open a text file for reading. (The file must exist.) |
| wt | Open a text file for writing. If the file already exists, its contents are destroyed. |
| at | Open a text file in append mode for writing at the end of the file. fopen() creates the file if it does not exist. |
| r+b or rb+ | Open a binary file for both reading and writing. (The file must exist.) |
| w+b or wb+ | Open an empty binary file for both reading and writing. If the w+b (or wb+) mode is specified for a ddname that has DISP=MOD, the behavior is the same as if ab+ had been specified. Otherwise, if the file already exists, its contents are destroyed. |
| a+b or ab+ | Open a binary file in append mode for reading or updating at the end of the file. fopen() creates the file if it does not exist. |
| r+t or rt+ | Open a text file for both reading and writing. (The file must exist.) |
| w+t or wt+ | Open a text file for both reading and writing. If the file already exists, its contents are destroyed. |
| a+t or at+ | Open a text file in append mode for reading or updating at the end of the file. fopen() creates the file if it does not exist. |

Table 26. Values for positional parameter under extended file mode

| Extended file mode | General description |
|--------------------|--|
| e | Open the z/OS UNIX system file with the O_CLOEXEC flag. This flag is ignored for fdopen(). This flag is ignored if the file not a z/OS UNIX system file. |
| x | Open the z/OS UNIX system file exclusively. If the file already exists, fopen() fails, and sets errno to EEXIST. This flag is ignored for fdopen(). This flag is ignored if the file is not a z/OS UNIX system file. |



Attention: Use the `w`, `w+`, `wb`, `w+b`, and `wb+` parameters with care; data in existing files of the same name will be lost.

Text files contain printable characters and control characters organized into lines. Each line ends with a newline character. The system may insert or convert control characters in an output text stream. For example, `\r` written to an MVS DASD text file will be treated as if `\n` (newline) was written.

Note: When compared, data output to a text stream may not be equal to data input from the same text stream.

Binary files contain a series of characters. For binary files, the system does not translate control characters on input or output. Under IBM z/OS C/C++, some types of files are always treated as binary files, even when opened in text mode.

In such cases, a control character is written to the file as binary data. On input, the control character will be read back as it was written. See the topic about the byte stream model in [z/OS XL C/C++ Programming Guide](#) for more information.

IBM z/OS C/C++ has *Record I/O* and *Blocked I/O* file extensions. These files are binary in nature—no data interpretation—and require additional qualifiers: `type=record` and `type=blocked`. See the topics about writing to record I/O files and writing to blocked I/O files in [z/OS XL C/C++ Programming Guide](#) for more information.

When you open a file with `a`, `a+`, `ab`, `a+b`, or `ab+` mode, all write operations take place at the end of the file. Although you can reposition the file pointer using `fseek()`, `fsetpos()`, or `rewind()`, the write functions move the file pointer back to the end of the file before they carry out any output operation. This action prevents you from overwriting existing data.

When you specify the update mode (using `+` in the second or third position), you can both read from and write to the file. However, when switching between reading and writing, you must include an intervening positioning function such as `fseek()`, `fsetpos()`, `rewind()`, or `fflush()`. Output may immediately follow input if the EOF was detected.

Table 27. Keyword Parameters for File Mode

| Parameter | Description |
|----------------------------|--|
| <code>abend=value</code> | Controls whether the runtime library should attempt to recover from an abend issued during OS I/O operations against the stream being opened. The <i>value</i> can be abend or recover . See z/OS XL C/C++ Programming Guide for more information. |
| <code>acc=value</code> | Indicator of the direction of the access of the VSAM data set. The <i>value</i> can be fwd or bwd . |
| <code>acc=bwd</code> | Sets the file position indicator to the last record. The access direction may be changed by a call to <code>flocate()</code> . |
| <code>asis</code> | Indicates that the file name is not to be converted to uppercase but used as is. This option is the default under POSIX. It is also the default for z/OS UNIX file names (see z/OS XL C/C++ Programming Guide for more information). |
| <code>blksize=value</code> | Specifies the maximum length, in bytes, of a physical block of records. To check whether your <code>blksize</code> parameter is valid and is within its limits, see the appropriate topic in z/OS XL C/C++ Programming Guide for the type of file you are opening. |
| <code>byteseek</code> | Indicator to allow byte seeks for a binary file. For more information, see the <code>ftell()</code> and <code>fseek()</code> functions. |

Table 27. Keyword Parameters for File Mode (continued)

| Parameter | Description |
|------------------|---|
| lrec1=value | Specifies the length, in bytes, for fixed-length records and the maximum length for variable-length records. To check whether your lrec1 parameter is valid and is within its limits, see the appropriate topic in <i>z/OS XL C/C++ Programming Guide</i> for the type of file you are opening. |
| noseek | Indicates that the stream may not use any of the reposition functions. This may improve performance. |
| password=xxxxxxx | Specifies the password for a VSAM data set. |
| recfm=A | ASA print-control characters |
| recfm=F | Fixed-length, unblocked |
| recfm=FA | Fixed-length, ASA print-control characters |
| recfm=FB | Fixed-length, blocked |
| recfm=FM | Fixed-length, machine print-control codes |
| recfm=FS | Fixed-length, unblocked, standard |
| recfm=FBA | Fixed-length, blocked, ASA print-control characters |
| recfm=FBM | Fixed-length, blocked, machine print-control codes |
| recfm=FBS | Fixed-length, unblocked, standard ASA print-control characters |
| recfm=FSA | Fixed-length, unblocked, standard, ASA print-control characters |
| recfm=FSM | Fixed-length, unblocked, standard, machine print-control codes |
| recfm=FBSA | Fixed-length, blocked, standard, ASA print-control characters |
| recfm=FBSM | Fixed-length, blocked, standard, machine print-control codes |
| recfm=U | Undefined-length |
| recfm=UA | Undefined-length, ASA print control characters |
| recfm=UM | Undefined-length, machine print control codes |
| recfm=V | Variable, unblocked |
| recfm=VA | Variable, ASA print-control characters |
| recfm=VB | Variable, blocked |
| recfm=VM | Variable, machine print-control codes |
| recfm=VS | Variable, unblocked, spanned |
| recfm=VBA | Variable, blocked, ASA print-control characters |
| recfm=VBM | Variable, blocked, machine print-control codes |
| recfm=VBS | Variable, blocked, spanned |
| recfm=VSA | Variable, unblocked, spanned, ASA print-control characters |
| recfm=VSM | Variable, unblocked, spanned, machine print-control codes |
| recfm=VBSA | Variable, blocked, spanned, ASA print-control characters |
| recfm=VBSM | Variable, blocked, spanned, machine print-control codes |

Table 27. Keyword Parameters for File Mode (continued)

| Parameter | Description |
|-------------------------|---|
| recfm=* | Existing file attributes are used if file is opened in write mode. Note: Using recfm=* is only valid for existing DASD data sets. It is ignored in all other cases. |
| recfm=+ | Identical to recfm=* with the following exceptions: <ul style="list-style-type: none"> • If there is no record format for the existing DASD data set, defaults are assigned as if the data set did not exist. • When append mode is used, the fopen() fails. See z/OS XL C/C++ Programming Guide for more information about fopen() default attributes. |
| samethread | This parameter specifies that I/O operations against the stream are restricted to the thread in which the stream was opened. The library will not lock the stream in a multithread environment. Use of this keyword can improve performance when the stream does not need to be accessed on different threads. |
| space | Space attributes for MVS data sets. Within the parameter, you cannot have any imbedded blanks. Where: <ul style="list-style-type: none"> u unit type of space requested p primary amount of space requested s secondary amount of space requested d number of directory space requested See the topic about fopen() and freopen() parameters in z/OS XL C/C++ Programming Guide for more information about the syntax of this parameter. |
| type=blocked | This parameter specifies that the file is to be opened for sequential blocked I/O. The file must be opened as a binary file; otherwise, fopen() fails. Read and write operations are done with the fread() and fwrite() functions. |
| type=memory | This parameter identifies this file as a memory file that is accessible only from C programs. |
| type=memory(hiperspace) | If you are using MVS/ESA, you can specify the HIPERSPACE suboption to open a hiperspace memory file. Restriction: For AMODE 64 applications, type=memory(hiperspace) is treated as type=memory. |
| type=record | This parameter specifies that the file is to be opened for sequential record I/O. The file must be opened as a binary file; otherwise, fopen() fails. Read and write operations are done with the fread() and fwrite() functions. This is the default fopen() mode for accessing VSAM clusters. |

Returned value

If successful, `fopen()` returns a pointer to the object controlling the associated stream.

If unsuccessful, `fopen()` returns a NULL pointer.

`fopen()` generally fails if parameters are mismatched.

Special behavior for large files: The following is a possible value of `errno`:

Error Code

Description

EEXIST

The named file refers to a symbolic link, or a file or directory already exists with the mentioned pathname.

EOVERFLOW

The named file is a regular file and the size of the file cannot be represented correctly in an object of type `off_t`.

Example

CELEBF26

```
/* CELEBF26

   This example attempts to open two files for reading, myfile.dat
   and myfile2.dat.

*/
#include <stdio.h>

int main(void)
{
    FILE *stream;

    /* The following call opens a text file for reading */
    if ((stream = fopen("myfile.dat", "r")) == NULL)
        printf("Could not open data file for reading\n");

    /* The following call opens:
       the file myfile2.dat,
       a binary file for reading and writing,
       whose record length is 80 bytes,
       and maximum length of a physical block is 240 bytes,
       fixed-length, blocked record format
       for sequential record I/O.
    */

    if ( (stream = fopen("myfile2.dat", "rb+", lrecl=80,\
        blksize=240, recfm=fb, type=record)) == NULL )
        printf("Could not open data file for read update\n");
}
```

Related information

- See the topics about dealing with I/O in [z/OS XL C/C++ Programming Guide](#).
- “[stdio.h — Standard input and output](#)” on page 63
- “[fclose\(\) — Close file](#)” on page 482
- “[fldata\(\) — Retrieve file information](#)” on page 546
- “[freopen\(\) — Redirect an open file](#)” on page 622
- “[open\(\) — Open a file](#)” on page 1157
- [Binary streams](#) in *z/OS C/C++ Runtime Library Programming Guide*

fork() — Create a new process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/types.h>
#include <unistd.h>

pid_t fork(void);
```

Note: Although POSIX.1 does not require that the `<sys/types.h>` include file be included, XPG4 has it as an optional header. Therefore, it is recommended that you include it for portability.

General description

Creates a new process. The new process (the *child process*) is an exact duplicate of the process that calls `fork()` (the *parent process*), except for the following:

- The child process has a unique process ID (PID) that does not match any active process group ID.
- The child has a different parent process ID, that is, the process ID of the process that called `fork()`.
- The child has its own copy of the parent's file descriptors. Each file descriptor in the child refers to the same open file description as the corresponding file descriptor in the parent.
- The child has its own copy of the parent's open directory streams. Each child's open directory stream can share directory stream positioning with the corresponding parent's directory stream.
- The following elements in the `tms` structure are set to 0 in the child:

```
tms_utime
tms_stime
tms_cutime
tms_cstime
```

For more information about these elements, see [“times\(\) — Get process and child process times” on page 1867](#).

- The child does not inherit any file locks previously set by the parent.
- The child process has no alarms set (similar to the results of a call to `alarm()` with an argument value of 0).
- The child has no pending signals.
- The child process has only a single thread. That thread is a copy of the thread in the parent that called `fork()`. The child process has a different thread ID. If the parent process was multithreaded (invoked `pthread_create()` at least once), the child process can only safely invoke async-signal-safe functions before it invokes an `exec()` family function. (This restriction also applies to any process created as the result of the child invoking `fork()` before it invokes an `exec()` family function because the child process is still considered multithreaded.) The child process does not inherit pthread attributes or pthread security environment. See [Table 28 on page 578](#) for a list of async-signal-safe functions.

In all other respects, the child is identical to the parent. Because the child is a duplicate, it contains the same call to `fork()` that was in the parent. Execution begins with this `fork()` call, which returns a value of 0; the child then proceeds with normal execution.

The child address space inherits the following address space attributes of the parent address space:

- Region size
- Time limit

If the parent process is multithreaded, it is the responsibility of the application to ensure that the application data is in a consistent state when the `fork()` occurs. For example, mutexes that are used to serialize updates to application data may need to be locked before the `fork()` and unlocked afterwards.

For more information on `fork()`, refer to [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

You can use MVS memory files from a z/OS UNIX program. However, use of the `fork()` function from the program removes access from a hiperspace memory file for the child process. Use of an `exec` function from the program clears a memory file when the process address space is cleared.

The child process that results from a `fork()` in a multithreaded environment can only invoke async-signal-safe functions.

An async-signal-safe function is defined as a function that may be invoked, without restriction, from signal-catching functions. All supported async-signal-safe functions are listed in [Table 28 on page 578](#).

Table 28. Async-signal-safe library functions

| | | | |
|----------------------|----------------------------|----------------------------|----------------------------|
| abort() | <code>fpathconf()</code> | <code>raise()</code> | <code>sigpending()</code> |
| accept() | <code>fstat()</code> | <code>read()</code> | <code>sigprocmask()</code> |
| access() | <code>fsync()</code> | <code>readlink()</code> | <code>sigqueue()</code> |
| aio_error() | <code>ftruncate()</code> | <code>recv()</code> | <code>sigset()</code> |
| aio_return() | <code>getegid()</code> | <code>recvfrom()</code> | <code>sigsuspend()</code> |
| aio_suspend() | <code>geteuid()</code> | <code>recvmsg()</code> | <code>socket()</code> |
| alarm() | <code>getgid()</code> | <code>rename()</code> | <code>socketpair()</code> |
| bind() | <code>getgroups()</code> | <code>rmdir()</code> | <code>stat()</code> |
| cfgetispeed() | <code>getpeername()</code> | <code>select()</code> | <code>symlink()</code> |
| cfgetospeed() | <code>getpgrp()</code> | <code>send()</code> | <code>sysconf()</code> |
| cfsetispeed() | <code>getpid()</code> | <code>sendmsg()</code> | <code>tcdrain()</code> |
| cfsetospeed() | <code>getppid()</code> | <code>sendto()</code> | <code>tcflow()</code> |
| chdir() | <code>getsockname()</code> | <code>setgid()</code> | <code>tcflush()</code> |
| chmod() | <code>getsockopt()</code> | <code>setpgid()</code> | <code>tcgetattr()</code> |
| chown() | <code>getuid()</code> | <code>setsid()</code> | <code>tcgetpgrp()</code> |
| close() | <code>kill()</code> | <code>setsockopt()</code> | <code>tcsendbreak()</code> |
| connect() | <code>link()</code> | <code>setuid()</code> | <code>tcsetattr()</code> |
| creat() | <code>listen()</code> | <code>shutdown()</code> | <code>tcsetpgrp()</code> |
| dup() | <code>lseek()</code> | <code>sigaction()</code> | <code>time()</code> |
| dup2() | <code>lstat()</code> | <code>sigaddset()</code> | <code>times()</code> |
| execle() | <code>mkdir()</code> | <code>sigdelset()</code> | <code>umask()</code> |
| execve() | <code>mkfifo()</code> | <code>sigemptyset()</code> | <code>uname()</code> |

Table 28. Async-signal-safe library functions (continued)

| | | | |
|-----------------|------------|---------------|-----------|
| _Exit() | open() | sigfillset() | unlink() |
| _exit() | pathconf() | sigismember() | utime() |
| fchmod() | pause() | sleep() | wait() |
| fchown() | pipe() | signal() | waitpid() |
| fcntl() | poll() | sigpause() | write() |
| fork() | | | |

Interoperability restriction: For POSIX resources, fork() behaves as just described. But in general, MVS resources that existed in the parent do *not* exist in the child. This is true for open streams in MVS data sets and assembler-accessed MVS facilities, such as STIMERS. In addition, MVS allocations (through JCL, SVC99, or ALLOCATE) are not passed to the child process.

Special behavior for z/OS UNIX Services:

1. A prior loaded copy of an HFS program in the same address space is reused under the same circumstances that apply to the reuse of a prior loaded MVS unauthorized program from an unauthorized library by the MVS XCTL service with the following exceptions:
 - If the calling process is in Ptrace debug mode, a prior loaded copy is not reused.
 - If the calling process is not in Ptrace debug mode, but the only prior loaded usable copy found of the HFS program is in storage modifiable by the caller, the prior copy is not reused.
2. If the specified file name represents an external link or a sticky bit file, the program is loaded from the caller's MVS load library search order. For an external link, the external name is only used if the name is eight characters or less, otherwise the caller receives an error from the loadhfs service. For a sticky bit program, the file name is used if it is eight characters or less. Otherwise, the program is loaded from the HFS.
3. If the calling task is in a WLM enclave, the resulting task in the new process image is joined to the same WLM enclave. This allows WLM to manage the old and new process images as one 'business unit of work' entity for system accounting and management purposes.

Returned value

If successful, fork() returns 0 to the child process and the process ID of the newly created child to the parent process.

If unsuccessful, fork() fails to create a child process, returns -1 to the parent, and sets errno to one of the following values:

Error Code Description

EAGAIN

There are insufficient resources to create another process, or the process has already reached the maximum number of processes you can run.

ELEMSGERR

Language Environment message file not available.

ELEMULTITHREAD

Application contains a language that does not support fork() in a multithreaded environment, or the multithreaded fork() is being attempted while running in a Language Environment preinitialization (CEEPIPI) environment.

ELENOFORK

Application contains a language that does not support fork().

ENOMEM

The process requires more space than is available.

Example

CELEBF27

```

/* CELEBF27

   This example creates a new child process.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>
#include <stdlib.h>
#include <sys/wait.h>

main() {
    pid_t pid;
    int status;

    if ((pid = fork()) < 0)
        perror("fork() error");
    else if (pid == 0) {
        puts("This is the child.");
        printf("Child's pid is %d and my parent's is %d\n",
            (int) getpid(), (int) getppid());
        exit(42);
    }
    else {
        puts("This is the parent.");
        printf("Parent's pid is %d and my child's is %d\n",
            (int) getpid(), (int) pid);
        puts("I'm waiting for my child to complete.");
        if (wait(&status) == -1)
            perror("wait() error");
        else if (WIFEXITED(status))
            printf("The child exited with status of %d\n",
                WEXITSTATUS(status));
        else
            puts("The child did not exit successfully");
    }
}

```

Output

```

This is the parent.
This is the child.
Child's pid is 1114120 and my parent's is 2293766
Parent's pid is 2293766 and my child's is 1114120
I'm waiting for my child to complete.
The child exited with status of 42

```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“exec functions” on page 442](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getrlimit\(\) — Get current or maximum resource consumption” on page 767](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“nice\(\) — Change priority of a process” on page 1150](#)
- [“putenv\(\) — Change or add an environment variable” on page 1354](#)
- [“semop\(\) — Semaphore operations” on page 1488](#)
- [“shmat\(\) — Shared memory attach operation” on page 1593](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)

- [“times\(\) — Get process and child process times” on page 1867](#)
- [“ulimit\(\) — Get or set process file size limits” on page 1924](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)

fortrc() — Return FORTRAN return code

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <stdlib.h>

int fortrc(void);
```

External entry point: @@FORTRC, __fortrc

General description

Restriction: This function is not supported in AMODE 64.

The `fortrc()` function returns the value specified on the FORTRAN RETURN statement issued by the last FORTRAN routine called from the C program.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The FORTRAN routine called must be identified to C as a FORTRAN routine using the following preprocessor directive:

```
#pragma linkage(identifier,FORTRAN,RETURNCODE)
```

The function `fortrc()` should be called immediately after a call to the FORTRAN routine *identifier* or else results are unpredictable.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)

fp_clr_flag() — Reset floating-point exception status flag

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | OS/390 V2R6 |

Format

```
#include <float.h>
#include <fpxcp.h>

void fp_clr_flag(mask)
fpflag_t mask;
```

General description

The fp_clr_flag() function resets the exception status flags defined by the mask parameter to 0 (false). The remaining flags in the exception status remain unchanged.

Note: This function works only in IEEE Binary Floating-Point. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

The **fpxcp.h** file defines the following names for the flags indicating floating-point exception status:

- FP_INVALID**
Invalid operation summary
- FP_OVERFLOW**
Overflow
- FP_UNDERFLOW**
Underflow
- FP_DIV_BY_ZERO**
Division by 0
- FP_INEXACT**
Inexact result

Users can reset multiple exception flags using the fp_clr_flag() function by OR-ing the names of individual flags. For example, the following resets both the overflow and inexact flags.

```
fp_clr_flag(FP_OVERFLOW | FP_INEXACT)
```

Returned value

fp_clr_flag() returns no values.

Related information

- [“float.h — ISO C/C++ constants for floating-point data types”](#) on page 24
- [“fpxcp.h — Floating-point exception interfaces”](#) on page 27
- [“fp_raise_xcp\(\) — Raise a floating-point exception”](#) on page 582
- [“fp_read_flag\(\) — Return the current floating-point exception status”](#) on page 584
- [“__isBFP\(\) — Determine application floating-point format”](#) on page 905

fp_raise_xcp() — Raise a floating-point exception

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | OS/390 V2R6 |

Format

```
#include <fpxcp.h>

int fp_raise_xcp(mask)
fpflag_t mask;
```


General description

The `fp_raise_xcp()` function causes floating-point exceptions defined by the *mask* parameter to be raised immediately.

If the exceptions defined by the *mask* parameter are enabled and the program is running in serial mode, the signal for floating-point exceptions, SIGFPE, is raised.

Note: This function works only in IEEE Binary Floating-Point. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

The **fpxcp.h** file defines the following names for the flags indicating floating-point exception status:

FP_INVALID

Invalid operation summary

FP_OVERFLOW

Overflow

FP_UNDERFLOW

Underflow

FP_DIV_BY_ZERO

Division by 0

FP_INEXACT

Inexact result

Users can cause multiple exceptions using `fp_raise_xcp()` by OR-ing the names of individual flags. For example, the following causes both overflow and division by 0 exceptions to occur.

```
fp_raise_xcp(FP_OVERFLOW | FP_DIV_BY_ZERO)
```

If more than one exception is included in the mask variable, the exceptions are raised in the following order:

1. Non-valid operation
2. Division by zero
3. Underflow
4. Overflow
5. Inexact result

Thus, if the user exception handler does not disable further exceptions, one call to the `fp_raise_xcp()` function can cause the exception handler to be entered many times.

Returned value

If successful, `fp_raise_xcp()` returns 0.

If unsuccessful, `fp_raise_xcp()` returns nonzero.

Related information

- [“fp_xcp.h — Floating-point exception interfaces”](#) on page 27
- [“fp_clr_flag\(\) — Reset floating-point exception status flag”](#) on page 581
- [“fp_read_flag\(\) — Return the current floating-point exception status”](#) on page 584
- [“__isBFP\(\) — Determine application floating-point format”](#) on page 905

fp_read_flag() — Return the current floating-point exception status

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | OS/390 V2R6 |

Format

```
#include <float.h>
#include <fpxcp.h>

fpflag_t fp_read_flag()
```

General description

The `fp_read_flag()` function returns the current floating-point exception status.

These functions aid in determining both when an exception has occurred and the exception type. These functions can be called explicitly around blocks of code that may cause a floating-point exception.

According to the IEEE Standard for Binary Floating-Point Arithmetic, the following types of floating-point operations must be signaled when detected in a floating-point operation:

- Non-valid operation
- Division by zero
- Overflow
- Underflow
- Inexact

A non-valid operation occurs when the result cannot be represented (for example, a square root operation on a number less than 0).

The IEEE Standard for Binary Floating-Point Arithmetic states: “For each type of exception, the implementation shall provide a status flag that shall be set on any occurrence of the corresponding exception when no corresponding trap occurs. It shall be reset only at the user's request. The user shall be able to test and to alter the status flags individually, and should further be able to save and restore all five at one time.”

Floating-point operations can set flags in the floating-point exception status but cannot clear them. Users can clear a flag in the floating-point exception status using an explicit software action such as the `fp_clr_flag (0)` subroutine.

Note: This function works only in IEEE Binary Floating-Point. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

The **fpxcp.h** file defines the following names for the flags indicating floating-point exception status:

FP_INVALID

non-valid operation summary

FP_OVERFLOW

Overflow

FP_UNDERFLOW

Underflow

FP_DIV_BY_ZERO

Division by 0

FP_INEXACT

Inexact result

Returned value

fp_read_flag() returns the current floating-point exception status. The flags in the returned exception status can be tested using the flag definitions above. You can test individual flags or sets of flags.

Related information

- IEEE Standard for Binary Floating-Point Arithmetic (ANSI/IEEE Standards 754-1985 and 854-1987)
- [“float.h — ISO C/C++ constants for floating-point data types” on page 24](#)
- [“fp_xcp.h — Floating-point exception interfaces” on page 27](#)
- [“fp_clr_flag\(\) — Reset floating-point exception status flag” on page 581](#)
- [“fp_raise_xcp\(\) — Raise a floating-point exception” on page 582](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)

fp_read_rnd() — Determine rounding mode

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | OS/390 V2R6 |

Format

```
#define _AIX_COMPATIBILITY 1
#include <float.h>

fprnd_t fp_read_rnd(void);
```

General description

For an application running in binary floating-point mode, the fp_read_rnd() function returns the current rounding mode indicated by the rounding mode field of the floating-point control (FPC) register. For an application running in hexadecimal floating-point mode, fp_read_rnd() returns 0.

Note: This function will not return or update decimal floating-point rounding mode bits.

Returned value

For an application running in IEEE Binary Floating-Point mode, fp_read_rnd() returns the following:

Value**Rounding Mode****_FP_RND_RZ**

Round toward 0

_FP_RND_RN

Round to nearest

_FP_RND_RP

Round toward +infinity

_FP_RND_RM

Round toward -infinity

For an application running in hexadecimal floating-point mode, fp_read_rnd() returns 0.

Related information

- [“float.h — ISO C/C++ constants for floating-point data types” on page 24](#)
- [“fp_swap_rnd\(\) — Swap rounding mode” on page 586](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)

fp_swap_rnd() — Swap rounding mode

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | OS/390 V2R6 |

Format

```
#define _AIX_COMPATIBILITY 1
#include <float.h>

fpnd_t fp_swap_rnd(RoundMode)
fpnd_t RoundMode
```

General description

For an application running in IEEE Binary Floating-Point mode, the fp_swap_rnd() function returns the current rounding mode specified by the rounding mode field of the floating-point control (FPC) register and sets the rounding mode field in the FPC register based on the value of *RoundMode* as follows:

Value

Rounding Mode

_FP_RND_RZ

Round toward 0

_FP_RND_RN

Round to nearest

_FP_RND_RP

Round toward +infinity

_FP_RND_RM

Round toward -infinity

Notes:

1. When processing IEEE Binary Floating-Point values, the z/OS C/C++ runtime library math functions require IEEE rounding mode of round to nearest. The z/OS C/C++ runtime library takes care of setting round to nearest rounding mode while executing math functions and restoring application rounding mode before returning to the caller.
2. This function will not return or update decimal floating-point rounding mode bits.

Returned value

For an application running in hexadecimal floating-point mode, fp_swap_rnd() returns 0.

For an application running in IEEE Binary Floating-Point mode, fp_swap_rnd() returns the previous (changed from) rounding mode as follows:

Value**Rounding Mode****_FP_RND_RZ**

Round toward 0

_FP_RND_RN

Round to nearest

_FP_RND_RP

Round toward +infinity

_FP_RND_RM

Round toward -infinity

Related information

- [“float.h — ISO C/C++ constants for floating-point data types”](#) on page 24
- [“fp_read_rnd\(\) — Determine rounding mode”](#) on page 585
- [“__isBFP\(\) — Determine application floating-point format”](#) on page 905

fpathconf() — Determine configurable path name variables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

long fpathconf(int fildes, int varcode);
```

General description

Determines the value of a configuration variable (*varcode*) associated with a particular file descriptor (*fildes*).

fpathconf() works exactly like pathconf(), except that it takes a file descriptor as an argument rather than taking a path name.

The *varcode* argument can be any one of a set of symbols defined in the unistd.h header file. Each symbol stands for a configuration variable. These are the possible symbols:

_PC_LINK_MAX

Represents **LINK_MAX**, the maximum number of links the file can have. If *pathname* is a directory, fpathconf() returns the maximum number of links that can be established to the directory itself.

_PC_MAX_CANON

Represents **MAX_CANON**, the maximum number of bytes in a terminal canonical input line. *pathname* must refer to a character special file for a terminal.

_PC_MAX_INPUT

Represents **MAX_INPUT**, the minimum number of bytes for which space will be available in a terminal input queue. This input space is the maximum number of bytes that a portable application will

allow an end user to enter before the application actually reads the input. *pathname* must refer to a character special file for a terminal.

_PC_NAME_MAX

Represents **NAME_MAX**, the maximum number of characters in a file name (not including any terminating NULL character if the file name is stored as a string). This limit refers only to the file name itself, that is, the last component of the file's path name. `fpathconf()` returns the maximum length of file names.

_PC_PATH_MAX

Represents **PATH_MAX**, the maximum number of characters in a complete path name (not including any terminating NULL if the path name is stored as a string). `fpathconf()` returns the maximum length of a relative path name.

_PC_PIPE_BUF

Represents **PIPE_BUF**, the maximum number of bytes that can be written to a pipe as one unit. If more than this number of bytes is written to a pipe, the operation can take more than one physical write operation and can require more than one physical read operation to read the data on the other end of the pipe. If *pathname* is a FIFO special file, `fpathconf()` returns the value for the file itself. If *pathname* is a directory, `fpathconf()` returns the value for any FIFOs that exist or can be created under the directory. If *pathname* is any other kind of file, an `errno` of `EINVAL` (see description below) will be returned.

_PC_CHOWN_RESTRICTED

Represents `_POSIX_CHOWN_RESTRICTED` defined in the `unistd.h` header file. This symbol indicates that the use of `chown()` is restricted; see the callable service `chown()` for more details. If *pathname* is a directory, `fpathconf()` returns the value for any kind of file under the directory, but not for subdirectories of the directory.

_PC_NO_TRUNC

Represents `_POSIX_NO_TRUNC` defined in the `unistd.h` header file. This symbol indicates that an error should be generated if a file name is longer than **NAME_MAX**. If *pathname* refers to a directory, the value returned by `fpathconf()` applies to all files under that directory.

_PC_VDISABLE

Represents `_POSIX_VDISABLE` defined in the `unistd.h` header file. This symbol indicates that terminal special characters can be disabled using this character value, if it is defined. See the callable service `tcsetattr()` for details. *pathname* must refer to a character special file for a terminal.

_PC_ACL

Returns 1 if an access control mechanism is supported by the security product for the file identified by the file descriptor.

_PC_ACL_ENTRIES_MAX

Returns the maximum number of ACL entries in an ACL for the file or directory identified by the file descriptor.

Returned value

If a particular variable has no limit, `fpathconf()` returns -1 but does not change `errno`.

If successful, `fpathconf()` returns the value of the variable requested in *varcode*.

If unsuccessful, `fpathconf()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

fd is not a valid open file descriptor.

EINVAL

varcode is not a valid variable code, or the given variable cannot be associated with the specified file.

- If *varcode* refers to **MAX_CANON**, **MAX_INPUT**, or `_POSIX_VDISABLE`, and *pathname* does not refer to a character special file, `fpathconf()` returns -1 and sets `errno` to `EINVAL`.

- If *varcode* refers to **NAME_MAX**, **PATH_MAX**, or **POSIX_NO_TRUNC**, and *pathname* does not refer to a directory, `fpathconf()` returns the requested information.
- If *varcode* refers to **PC_PIPE_BUF** and *pathname* refers to a pipe or a FIFO, the value returned applies to the referenced object itself. If *pathname* refers to a directory, the value returned applies to any FIFOs that exist or can be created within the directory. If *pathname* refers to any other type of file, the function sets `errno` to `EINVAL`.

Example

CELEBF29

```

/* CELEBF29

   This example uses fpathconf() with __PC_NAME_MAX to determine the value
   of the NAME_MAX configuration variable.

*/
#define _POSIX_SOURCE
#include <errno.h>
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    long result;
    char fn[]="temp.file";
    int fd;

    if ((fd = creat(fn, S_IRUSR)) < 0)
        perror("creat() error");
    else {
        errno = 0;
        puts("examining NAME_MAX limit for current working directory's");
        puts("filesystem:");
        if ((result = fpathconf(fd, _PC_NAME_MAX)) == -1)
            if (errno == 0)
                puts("There is no limit to NAME_MAX.");
            else
                perror("fpathconf() error");
        else
            printf("NAME_MAX is %ld\n", result);
        close(fd);
        unlink(fn);
    }
}

```

Output

```

examining NAME_MAX limit for current working directory's
file system:
NAME_MAX is 255

```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pathconf\(\) — Determine configurable path name variables” on page 1179](#)

fpclassify() – Classifies an argument value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int fpclassify (real-floating x);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int fpclassify([real-floating|decimal-floating] x);

#define _TR1_C99
#include <math.h>

int fpclassify(real-floating x);
```

General description

This macro or function template classifies its argument value as NaN, infinite, normal, subnormal or zero based on the type of its argument. If the argument is represented in a format wider than its semantic type, then it is converted to its semantic type and then it is classified.

| Function | Hex | IEEE |
|------------|-----|------|
| fpclassify | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

fpclassify() returns:

- FP_NAN if the argument is Not-a-Number.
- FP_INFINITE if the argument is plus or minus infinity.
- FP_ZERO if the argument is of value zero.
- FP_SUBNORMAL if the argument is too small to be represented in the normal format.
- FP_NORMAL if none of the above.

Special behavior in hex:

- FP_ZERO if the argument is of value zero.
- FP_NORMAL if the argument is a normalized number.

- FP_SUBNORMAL if the argument is an unnormalized number.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

__fpending() — Retrieve number of bytes pending for write

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

size_t __fpending(FILE *stream);

#define _OPEN_SYS_UNLOCKED 1
#include <stdio.h>
#include <stdio_ext.h>

size_t __fpending_unlocked(FILE *stream);
```

General description

The `__fpending()` function retrieves the number of bytes pending to be written in the output buffer associated with the specified binary stream. When the stream is opened for text processing, the `__fpending()` function retrieves the number of characters pending to be written.

The `__fpending_unlocked()` function is equivalent to the `__fpending()` function with the exception that it is not thread-safe. This function can be safely used in a multithreaded application if it is called while the invoking thread owns the (FILE *) object, such as after a successful call to either the `flockfile()` or `ftrylockfile()` function.

The `__fpending()` function cannot be used on buffers in read mode or opened read-only.

Usage notes

1. If `__fpending()` is called when the stream is currently reading, `__fpending()` returns 0 and sets `errno` to a nonzero value.
2. If `__fpending()` is called on a data set opened `type=record`, `__fpending()` returns 0 and sets `errno` to a nonzero value.
3. For text data sets, any newline characters representing record boundaries written to the buffer will be included in the returned value.

Returned value

The `__fpending()` functions return the number of bytes or characters pending to be written in the current buffer, depending on the type of stream. Otherwise, the `__fpending()` functions return 0. If an error has occurred, `__fpending()` functions return 0 and set `errno` to nonzero.

When the stream is wide-oriented text, the `__fpending()` functions return a value measured in wide characters.

An application wishing to check for error situations should set `errno` to 0, then call `__fpending()`, and then check `errno`. If `errno` is nonzero, assume that an error has occurred.

Error Code

Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF89

```
/* CELEBF89

   This example writes and reads data to a file while querying the
   stream for information about data in the I/O buffer.

*/

#include <stdio.h>
#include <stdio_ext.h>

void main() {
    FILE *f;
    char filename[FILENAME_MAX] = "myfile.dat";
    char data[128] = "There are 34 bytes in this buffer\n";
    int datalen = strlen(data);
    size_t n = 0;

    f = fopen(filename, "wb+");
    if (f == NULL) {
        perror("fopen() failed\n");
        return;
    }

    if (__fwritable(f)) printf("Writing is allowed on the open stream\n");
    if (__freadable(f)) printf("Reading is allowed on the open stream\n");

    n = fputs(data, f);
    if (n == EOF) {
        perror("fputs() failed\n");
        return;
    }

    n = __fpending(f);
    printf("There are %d bytes in the buffer pending to be written\n", n);

    if (__fwriting(f)) printf("The last operation on the stream was a write\n");

    rewind(f);

    n = fgetc(f);

    n = __freadahead(f);
    printf("There are %d bytes remaining to be read from the buffer\n", n);

    if (__freading(f)) printf("The last operation on the stream was a read\n");

    return;
}
```

Output

```
Writing is allowed on the open stream
Reading is allowed on the open stream
There are 34 bytes in the buffer pending to be written
The last operation on the stream was a write
There are 33 bytes remaining to be read from the buffer
The last operation on the stream was a read
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“__freadahead\(\) — Retrieve number of bytes remaining in input buffer” on page 616](#)

fprintf(), printf(), sprintf() – Format and write data

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C/C++ DFP ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | z/OS V1.8 |

Format

```
#include <stdio.h>

int fprintf(FILE *__restrict__stream, const char *__restrict__format-string, ...);
int printf(const char *__restrict__format-string, ...);
int sprintf(char *__restrict__buffer, const char *__restrict__format-string, ...);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fprintf_unlocked(FILE *__restrict__stream,
                    const char *__restrict__format-string, ...);
int printf_unlocked(const char *__restrict__format-string, ...);
```

General description

These three related functions are referred to as the fprintf family.

The fprintf() function formats and writes output to a *stream*. It converts each entry in the *argument list*, if any, and writes to the stream according to the corresponding format specification in the *format-string*. The fprintf() function cannot be used with a file that is opened using type=record or type=blocked.

The printf() function formats and writes output to the standard output stream stdout. printf() cannot be used if stdout has been reopened using type=record or type=blocked.

The sprintf() function formats and stores a series of characters and values in the array pointed to by *buffer*. Any *argument-list* is converted and put out according to the corresponding format specification in the *format-string*. If the strings pointed to by *buffer* and *format* overlap, behavior is undefined.

fprintf() and printf() have the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

The *format-string* consists of ordinary characters, escape sequences, and conversion specifications. The ordinary characters are copied in order of their appearance. Conversion specifications, beginning with a percent sign (%) or the sequence (%n\$) where n is a decimal integer in the range [1,NL_ARGMAX], determine the output format for any *argument-list* following the *format-string*. The *format-string* can contain multibyte characters beginning and ending in the initial shift state. When the *format-string* includes the use of the optional prefix *ll* to indicate the size expected is a long long datatype then the corresponding value in the argument list should be a long long datatype if correct output is expected.

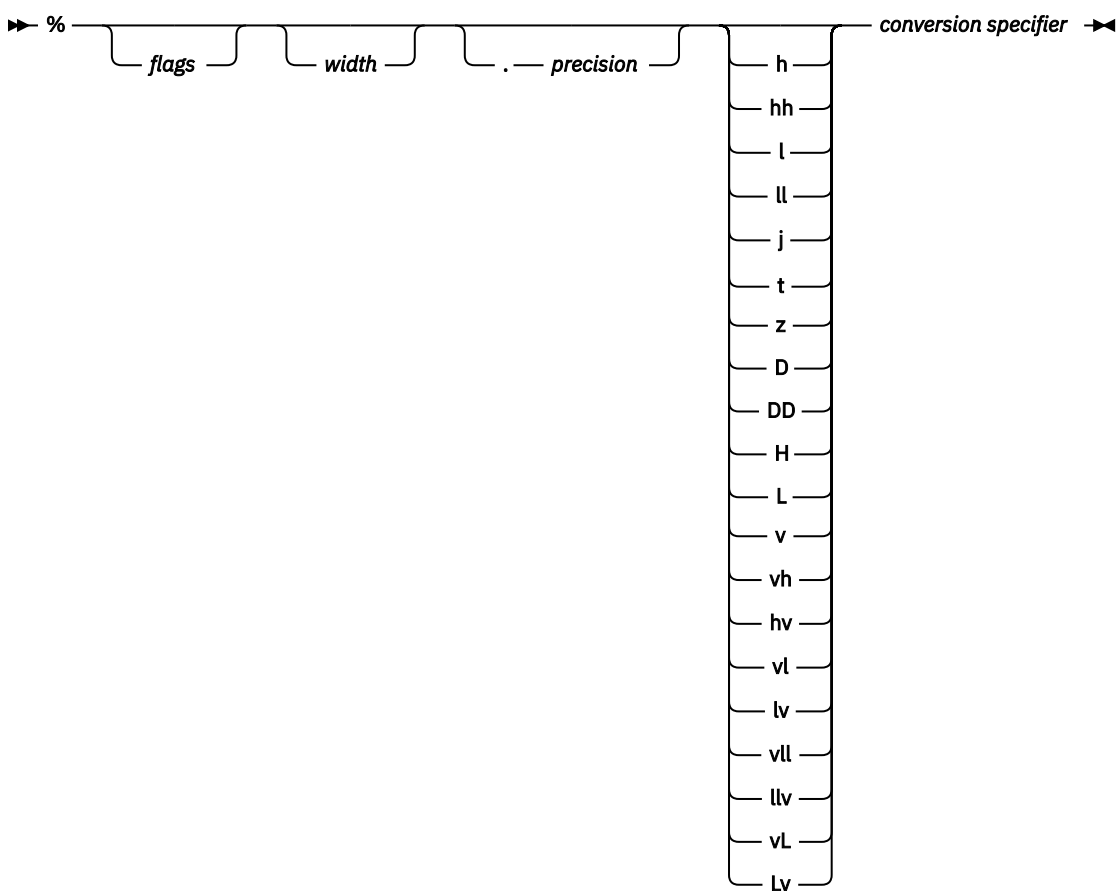
fprintf_unlocked() is functionally equivalent to fprintf() with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking

thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

printf_unlocked() is functionally equivalent to printf() with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

The *format-string* is read from left to right. When the first format specification is found, the value of the first *argument* after the *format-string* is converted and output according to the format specification. The second format specification causes the second *argument* after the *format-string* to be converted and output, and so on through the end of the *format-string*. If there are more arguments than there are format specifications, the extra arguments are evaluated and ignored. The results are undefined if there are not enough arguments for all the format specifications. The format specification is illustrated below.

Format Specification for fprintf(), printf(), and sprintf()



Each field of the format specification is a single character or number signifying a particular format option. The *type* character, which appears after the last optional format field, determines whether the associated argument is interpreted as a character, a string, a number, or pointer. The simplest format specification contains only the percent sign and a *type* character (for example, `%s`).

Percent sign: If a percent sign (`%`) is followed by a character that has no meaning as a format field, the character is simply copied to stdout. For example, to print a percent sign character, use `%%`.

Flag characters: The *flag* characters in Table 29 on page 595 are used for the justification of output and printing of thousands' grouping characters, signs, blanks, decimal-points, octal and hexadecimal prefixes, the semantics for `wchar_t` precision unit and the separator for vector data type output

conversion. Notice that more than one *flag* can appear in a format specification. This is an optional field.

Table 29. Flag Characters for fprintf Family

| Flag | Meaning | Default |
|--------------------|---|---|
| ' | Added for XPG4: The integer portion of the result of a decimal conversion(%i,%d,%u,%f,%g or %G) will be formatted with the thousands' grouping characters. | No grouping. |
| - | Left-justify the result within the field width. | Right-justify. |
| + | Prefix the output value with a sign (+ or -) if the output value is of a signed type. | Sign appears only for negative signed values (-). |
| <i>blank</i> (' ') | Prefix the output value with a blank if the output value is signed and positive. The + flag overrides the <i>blank</i> flag if both appear, and a positive signed value will be output with a sign. | No blank. |
| # | When used with the o, x, or X formats, the # flag prefixes any nonzero output value with 0, 0x, or 0X, respectively. For o conversion, it increases the precision, if and only if necessary, to force the first digit of the result to be a zero (if the value and precision are both 0, a single 0 will be printed) | No prefix. |
| | When used with the f, e, or E formats, the # flag forces the output value to contain a decimal-point in all cases. The decimal-point is sensitive to the LC_NUMERIC category of the same current locale. | Decimal-point appears only if digits follow it. |
| | When used with the g or G formats, the # flag forces the output value to contain a decimal-point in all cases and prevents the truncation of trailing zeros. | Decimal-point appears only if digits follow it; trailing zeros are truncated. |
| | When used with the lS or S format, the # flag causes precision to be measured in wide characters. | Precision indicates the maximum number of bytes to be output. |
| 0 | When used with the d, i, o, u, x, X, e, E, f, g, or G formats, the 0 flag causes leading 0's to pad the output to the field width. The 0 flag is ignored if <i>precision</i> is specified for an integer or if the - flag is specified. | Space padding. |
| , ; : _ | Indicates the separator character between each two components in the vector data type conversion. Only one separator character can be specified. | The default value for the separator character is a space (' '), unless the c format is being used. For the c format, there is no separator at all if no separator character is specified. |

The code point for the # character varies between the EBCDIC encoded character sets. The definition of the # character is based on the current LC_SYNTAX category. The default C locale expects the # character to use the code point for encoded character set IBM-1047.

When the LC_SYNTAX category is set using setlocale(), the format strings passed to the printf() functions must use the same encoded character set as is specified for the LC_SYNTAX category.

The # flag should not be used with c, lc, C, d, i, u, s, or p conversion specifier.

Output width: The *width* argument is a nonnegative decimal integer controlling the minimum number of characters printed. If the number of characters in the output value is less than the specified *width*, blanks are added on the left or the right (depending on whether the – flag is specified) until the minimum width is reached.

The width never causes a value to be truncated; if the number of characters in the output value is greater than the specified *width*, or *width* is not given, all characters of the value are output (subject to the *precision* specification).

The *width* specification can be an asterisk (*); if it is, an argument from the argument list supplies the value. The *width* argument must precede the value being formatted in the argument list. This is an optional field.

If *format-string* contains the %n\$ form of conversion specification, *width* can be indicated by the sequence *m\$, where m is a decimal integer in the range [1,NL_ARGMAX] giving the position of an integer argument in the argument list containing the field width.

Output precision: The *precision* argument is a nonnegative decimal integer preceded by a period. It specifies the number of characters to be output, or the number of decimal places. Unlike the *width* specification, the *precision* can cause truncation of the output value or rounding of a floating-point value.

Be aware that the rounding of floating-point values may not always occur as expected based on the decimal value of the number. This is because the internal binary representation cannot always be an exact representation of the decimal value, so the rounding may occur on an inexact value. This is true of both OS/390 hexadecimal and IEEE 754 binary floating-point formats.

The *precision* argument can be an asterisk (*); if it is, an argument from the argument list supplies the value. The *precision* argument must precede the value being formatted in the argument list. The *precision* field is optional.

If *format-string* contains the %n\$ form of conversion specification, *precision* can be indicated by the sequence *m\$, where m is a decimal integer in the range [1,NL_ARGMAX] giving the position of an integer argument in the argument list containing the field precision.

The interpretation of the *precision* value and the default when the *precision* is omitted depend upon the *type*, as shown in Table 30 on page 596.

Table 30. Precision Argument in fprintf Family

| Type | Meaning | Default |
|----------------------------|--|---|
| d i o u x X | <i>precision</i> specifies the minimum number of digits to be output. If the number of digits in the argument is less than <i>precision</i> , the output value is padded on the left with zeros. The value is not truncated when the number of digits exceeds <i>precision</i> . | Default <i>precision</i> is 1. If <i>precision</i> is 0, or if the period (.) appears without a number following it, the <i>precision</i> is set to 0. When <i>precision</i> is 0, conversion of the value zero results in no characters. |
| e E f F | <i>precision</i> specifies the number of digits to be output after the decimal-point. The last digit output is rounded. The decimal-point is sensitive to the LC_NUMERIC category of the current locale. | Default <i>precision</i> is 6. If <i>precision</i> is 0 or the period appears without a number following it, no decimal-point is output. |

Table 30. Precision Argument in fprintf Family (continued)

| Type | Meaning | Default |
|---------|---|--|
| a A | For non decimal floating-point numbers, <i>precision</i> specifies the number of hexadecimal digits to be output after the decimal-point character. For decimal floating-point numbers, precision determines the style of formatting to be used. | For non decimal floating-point numbers, default <i>precision</i> is 6. If <i>precision</i> is 0, no decimal-point is output. For decimal floating-point numbers, precision is determined by the quantum of the decimal floating-point number. Refer to Table 31 on page 598 for more details. |
| g G | <i>precision</i> specifies the maximum number of significant digits output. | All significant digits are output. |
| c | No effect. | The character is output. |
| C lc | No effect. | The wide character is output. |
| s | <i>precision</i> specifies the maximum number of characters to be output. Characters in excess of <i>precision</i> are not output. | Characters are output until a NULL character is encountered. |
| S ls | <i>precision</i> specifies the maximum number of bytes to be output. Bytes in excess of <i>precision</i> are not output; however, multibyte integrity is always preserved. | wchar_t characters are output until a NULL character is encountered. |
| m lm | <i>precision</i> specifies the maximum number of characters to be output. Characters in excess of precision are not output. | Characters are output until a NULL character is encountered. |

Optional prefix: The optional prefix characters used to indicate the size of the argument expected or size of a single component in a vector data type output conversion are explained:

Prefix

Meaning

h

Specifies that the d, i, o, u, x, or X conversion specifier applies to a short or unsigned short argument (the argument will have been promoted according to the integer promotions, but its value shall be converted to short or unsigned short before printing); or that a following n conversion specifier applies to a pointer to a short argument.

hh

Specifies that the d, i, o, u, x, or X conversion specifier applies to a signed char or unsigned char argument (the argument will have been promoted according to the integer promotions, but its value shall be converted to signed char or unsigned char before printing); or that a following n conversion specifier applies to a pointer to a signed char argument.

l

(ell) Specifies that the d, i, o, u, x, or X conversion specifier applies to a long or unsigned long argument; that a following n conversion specifier applies to a pointer to a long argument; that the c conversion specifier applies to a wint_t argument; that the s conversion specifier applies to a pointer to a wchar_t argument. It has no effect on the a, A, e, E, f, F, g, G, or m conversion specifier.

- ll**
(ell-ell) Specifies that the d, i, o, u, x, or X conversion specifier applies to a long long or unsigned long long argument; or that the n conversion specifier applies to a pointer to a long long argument.
- j**
Specifies that the d, i, o, u, x, or X conversion specifier applies to an intmax_t or uintmax_t argument; or that the n conversion specifier applies to a pointer to an intmax_t argument.
- t**
Specifies that the d, i, o, u, x, or X conversion specifier applies to a ptrdiff_t or the corresponding unsigned type argument; or that the n conversion specifier applies to a pointer to a ptrdiff_t argument.
- z**
Specifies that the d, i, o, u, x, or X conversion specifier applies to a size_t or the corresponding signed integer type argument; or that the n conversion specifier applies to a pointer to a signed integer type corresponding to a size_t argument.
- D**
Specifies that the a, A, e, E, f, F, g, or G conversion specifier applies to an _Decimal64 argument.
- DD**
Specifies that the a, A, e, E, f, F, g, or G conversion specifier applies to an _Decimal128 argument.
- H**
Specifies that the a, A, e, E, f, F, g, or G conversion specifier applies to an _Decimal32 argument.
- L**
Specifies that the a, A, e, E, f, F, g, or G conversion specifier applies to a long double argument.
- v**
Specifies that a following c, d, i, u, o, x, or X conversion specifier applies to a vector signed char, vector unsigned char, or vector bool char parameter. It consumes one argument and interprets the data as a series of sixteen 1-byte components.
- vh, hv**
Specifies that a following d, i, u, o, x, or X conversion specifier applies to a vector signed short, vector unsigned short, or vector bool short parameter. It consumes one argument and interprets the data as a series of eight 2-byte integer components.
- vl, lv**
Specifies that a following d, i, u, o, x, or X conversion specifier applies to a vector signed int, vector unsigned int, or vector bool int parameter. It consumes one argument and interprets the data as a series of four 4-byte integer components.
- vll, llv**
Specifies that a following d, i, u, o, x, or X conversion specifier applies to a vector signed long long, vector unsigned long long, or vector bool long long parameter. It consumes one argument and interprets the data as a series of two 8-byte integer components.
- vL, Lv**
specifies that a following a, A, e, E, f, F, g, or G conversion specifier applies to a vector double parameter. It consumes one argument and interprets the data as a series of two 8-byte floating point components.

Conversion specifier: [Table 31 on page 598](#) explains the meaning of the type characters used in the precision argument.

Table 31. Type Characters and their Meanings

| Conversion specifier | Argument | Output Format |
|----------------------|----------|---|
| d, i | Integer | Signed decimal integer. |
| u | Integer | Unsigned decimal integer. |
| o | Integer | Unsigned octal integer. |
| x | Integer | Unsigned hexadecimal integer, using abcdef. |
| X | Integer | Unsigned hexadecimal integer, using ABCDEF. |

Table 31. Type Characters and their Meanings (continued)

| Conversion specifier | Argument | Output Format |
|----------------------|-----------------------------|---|
| f, F | Double | Signed value having the form [-]ddd.dddd, where dddd is one or more decimal digits. The number of digits before the decimal-point depends on the magnitude of the number. The number of digits after the decimal-point is equal to the requested precision. The decimal-point is sensitive to the LC_NUMERIC category of the current locale. |
| e | Double | Signed value having the form [-]d.dddd[sign]ddd, where d is a single-decimal digit, dddd is one or more decimal digits, ddd is 2 or more decimal digits, and sign is + or -. A double argument representing an infinity or NaN is converted in the style of an f or F conversion specifier. |
| E | Double | Identical to the e format, except that E introduces the exponent, not e. |
| g | Double | Signed value output in f or e format. The e format is used only when the exponent of the value is less than -4 or greater than or equal to precision. Trailing zeros are truncated, and the decimal-point appears only if one or more digits follow it. A double argument representing an infinity or NaN is converted in the style of an f or F conversion specifier. |
| G | Double | Identical to the g format, except that E introduces the exponent (where appropriate), not e. |
| D(n,p) | Decimal type argument. | Fixed-point value consisting of a series of one or more decimal digits possibly containing a decimal-point. |
| c C or lc | Character Wide Character | Single character. The argument of wchar_t type is converted to an array of bytes representing a multibyte character as if by call to wctomb(). |
| s S or ls | String Wide String | Characters output up to the first NULL character (\0) or until precision is reached. The argument is a pointer to an array of wchar_t type. Wide characters from the array are converted to multibyte characters up to and including a terminating NULL wide character. Conversion takes place as if by a call to wcstombs(), with the conversion state described by the mbstate_t object initialized to 0. The result written out will not include the terminating NULL character. If precision is not specified, the array contains a NULL wide character. If precision is specified, it sets the maximum number of characters written, including shift sequences. A partial multibyte character cannot be written. |
| n | Pointer to integer | Number of characters successfully output so far to the stream or buffer; this value is stored in the integer whose address is given as the argument. |
| p | Pointer | Pointer to void converted to a sequence of printable characters. Refer to the individual system reference guides for the specific format. |

Table 31. Type Characters and their Meanings (continued)

| Conversion specifier | Argument | Output Format |
|----------------------|---|---|
| a, A | Double _Decimal32 _Decimal64 _Decimal128 | <p>A double argument representing a floating-point number is converted to the "[<i>-</i>]0x.hhhhp±d" format, where there is one hexadecimal digit (non-zero when the argument is a normalized floating-point number; otherwise unspecified) before the decimal-point character and the number of hexadecimal digits after it is equal to <i>precision</i>. If <i>precision</i> is missing and FLT_RADIX is a power of 2, then the precision will be sufficient for an exact representation of the value. If <i>precision</i> is missing and FLT_RADIX is not a power of 2, then the precision will be sufficient to distinguish values of type double, except that trailing zeros may be omitted. If <i>precision</i> is zero and the "#" flag is not specified, no decimal-point will appear. The letters "abcdef" are used for the a conversion and the letters "ABCDEF" for the A conversion. The A conversion specifier produces a number with letters "X" and "P" instead of letters "x" and "p". The exponent always contains at least one digit, and only as many more digits as necessary to represent the decimal exponent of 2. If the value is zero, the exponent is zero.</p> <p>A double argument representing an infinity or NaN is converted in the style of an f or F conversion specifier.</p> <p>If <i>precision</i> is zero, results can be different for Hexadecimal floating point format and IEEE floating point format. For Hexadecimal floating point, a decimal point will not appear in the output. For IEEE floating point, a decimal point will appear.</p> <p>If an H, D, or DD modifier is present and <i>precision</i> is missing, then for a decimal floating type argument, either the f or e style formatting is used based on the following criteria:</p> <ul style="list-style-type: none"> f style formatting is used when the quantum is less than or equal to 0 but greater than or equal to $-(n+5)$. The quantum of a number can be determined by calling the quantexp() functions. The number of digits (n) in the digit-sequence includes trailing zeros only and ignores the decimal point. For example: <ul style="list-style-type: none"> 0.000005 contains 1 digit in the digit sequence, n = 1. 0.0000050 contains 2 digits in the digit sequence, n = 2. 12.30 contains 4 digits in the digit sequence, n = 4. <i>precision</i> is equal to -quantum. e style formatting is used when the quantum does not satisfy the f style criteria. <i>precision</i> is equal to n-1, except if the argument is equal to 0 then the digit-sequence in the exponent-part is equal to the quantum. For example: <ul style="list-style-type: none"> 0.0000000 produces 0e-07. -1870 produces -1.87e+03. <p>If <i>precision</i> is present and at least as large as the precision of the decimal floating type, the conversion is as if the precision were missing. If the precision is present and less than the precision of the decimal floating type, the input is first rounded according to the current rounding direction to the number of digits specified by the precision. The result is then converted as if <i>precision</i> were missing.</p> <p>The "quantum" when referring to a finite decimal floating-point number is defined as the "magnitude of a value of one in the rightmost digit position of the significand". For example, pennies and dollars can be represented respectively as $1 * 10$ with a quantum of -2 and 0, or, $1 * 10^{-2}$ and $1 * 10^0$. For more information on the term quantum, see <i>z/Architecture Principles of Operation</i>.</p> |
| m | No argument is required. | Characters of <code>strerror</code> (<code>errno</code>) output up to the NULL character (<code>\0</code>) or until <i>precision</i> is reached. If <i>precision</i> is specified, it sets the maximum number of characters written. |

Special behavior for XPG4:

- If the `%n$` conversion specification is found, the value of the *nth argument* after the *format-string* is converted and output according to the conversion specification. Numbered arguments in the argument list can be referenced from *format-string* as many times as required.
- The *format-string* can contain either form of the conversion specification, that is, % or `%n$` but the two forms cannot be mixed within a single *format-string* except that %% can be mixed with the `%n$` form. When numbered conversion specifications are used, specifying the 'nth' argument requires that the first to (n-1)th arguments are specified in the *format-string*.

Floating-point and the fprintf family of formatted output functions: The fprintf family functions match a, A, e, E, f, F, g, or G conversion specifiers to floating-point arguments for which they produce floating-point number substrings in the output stream. The fprintf family functions have been extended to determine the floating-point format, hexadecimal floating-point or IEEE Binary Floating-Point, of types a, A, e, E, f, F, g, or G by using `__isBFP()`.

The fprintf family functions convert IEEE Binary Floating-Point infinity and NaN argument values to special infinity and NaN floating-point number output sequences.

- The special output sequence for infinity values is a plus or minus sign, then the character sequence INF followed by a white space character (space, tab, or newline), a NULL character (`\0`) or EOF.

- The special output sequence for NaN values is a plus or minus sign, then the character sequence NANS for a signalling NaN or NANQ for a quiet NaN, then a NaN ordinal sequence, and then a white space character (space, tab, or newline), a NULL character (`\0`) or EOF.

For binary floating point NaNs: A NaN ordinal sequence is a left-parenthesis character, "(", followed by a digit sequence representing an integer n , where $1 \leq n \leq \text{INT_MAX}-1$, followed by a right-parenthesis character, ")". The integer value, n , is determined by the fraction bits of the NaN argument value as follows:

1. For a signalling NaN value, NaN fraction bits are reversed (left to right) to produce bits (right to left) of an even integer value, $2*n$. Then formatted output functions produce a (signalling) NaN ordinal sequence corresponding to the integer value n .
2. For a quiet NaN value, NaN fraction bits are reversed (left to right) to produce bits (right to left) of an odd integer value, $2*n-1$. Then formatted output functions produce a (quiet) NaN ordinal sequence corresponding to the integer value n .

For decimal floating point NaNs: A NaN ordinal sequence is a left parenthesis character, "(", followed by a decimal digit sequence of up to 6 digits for a `_Decimal32` output number, up to 15 digits for a `_Decimal64` output value, or up to 33 digits for a `_Decimal128` output value, followed by a right parenthesis, ")". If the NaN ordinal sequence is omitted, NaN ordinal sequence "(0)" is assumed. If the NaN ordinal sequence is shorter than 6, 15, or 33 digits, it will be padded on the left with "0" digits so that the length becomes 6, 15, or 33 digits for `_Decimal32`, `_Decimal64`, and `_Decimal128` values respectively.

For decimal floating point numbers, the digits are not reversed, and both odd or even NaN ordinal sequences can be specified for either a Quiet NaN or Signalling NaN.

The C99 standard does not distinguish between the quiet NaN and signaling NaN values. An argument representing a NaN (Not a Number) is to be displayed as `[-]nan` or `[-]nan(n-char-sequence)`; where the implementation decides the representation. For the A, E, F, and G conversion specifiers, NaN values are displayed as the uppercase versions of the aforementioned character string representations. To get this behavior set the environment variable `_EDC_C99_NAN` to YES.

Some compatibility with NaN sequences output by AIX® formatted output functions can be achieved by setting a new environment variable, `_AIX_NAN_COMPATIBILITY`, which z/OS formatted output functions recognize, to one of the following (string) values:

Value

Output function

1

Formatted output functions which produce special NaN output sequences omit the NaN ordinal output sequence (1). This results in output NaN sequences of plus or minus sign followed by NANS or NANQ instead of plus or minus sign followed by NANS(1) or NANQ(1). All other NaN ordinal sequences are explicitly output.

ALL

Formatted output functions which produce special NaN output sequences omit the NaN ordinal output sequence for all NaN values. This results in output NaN sequences of plus or minus sign followed by NANS or NANQ instead of plus or minus sign followed by NANS(n) or NANQ(n) for all NaN values.

Note: `_AIX_NAN_COMPATIBILITY` does not affect the formatting of DFP NAN values. It affects only the formatting of BFP NAN values.

Vector types and the fprintf family of formatted output functions: The fprintf family functions support character, integer, and floating-point vector data types in the output conversion specification. The vector value is displayed in the following general form:

```
Value1Cvalue2C...CValueN
```

where C is a separator character optionally defined in flag characters, and there can be 2, 4, 8, or 16 output values depending on the optional prefix v, vh, hv, vl, lv, vll, llv, vL, or Lv. Each value is formatted according to the conversion specifier.

The sprintf() function is available to C applications in a stand-alone System Programming C (SPC) Environment.

Usage notes

1. [Hexadecimal floating point representation](#) normalizes differently than [IEEE floating point representation](#). [Hexadecimal floating point representation](#) produces output in 0x0.hhhhhp+/-dd format, not in the 0x1.hhhhhp+/-dd format.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, fprintf(), printf(), and sprintf() return the number of characters output. The ending NULL character is not counted.

If unsuccessful, they return a negative value.

Example

CELEBF30

```
/* CELEBF30

   This example prints data using &printf. in a variety of
   formats.

*/
#include <stdio.h>

int main(void)
{
    char ch = 'h', *string = "computer";
    int count = 234, hex = 0x10, oct = 010, dec = 10;
    double fp = 251.7366;
    unsigned int a = 12;
    float b = 123.45;
    int c;
    void *d = "a";

    printf("the unsigned int is %u\n\n",a);

    printf("the float number is %g, and %G\n\n",b,b);

    printf("RAY%\n\n",&c);

    printf("last line prints %d characters\n\n",c);

    printf("Address of d is %p\n\n",d);

    printf("%d  %d  %06d  %X  %x  %o\n\n",
        count, count, count, count, count, count);

    printf("1234567890123\n4567890123456789\n\n", &count);

    printf("Value of count should be 13; count = %d\n\n", count);

    printf("%10c%5c\n\n", ch, ch);

    printf("%25s\n%25.4s\n\n", string, string);

    printf("%f  %.2f  %e  %E\n\n", fp, fp, fp, fp);

    printf("%i  %i  %i\n\n", hex, oct, dec);
}
```

Output

```

the unsigned int is 12
the float number is 123.45 and 123.45
RAY
last line prints 3 characters
Address of d is DD72F9
234  +234  000234  EA  ea  352
12345678901234567890123456789
Value of count should be 13; count = 13
      h      h
      computer
      comp
251.736600    251.74    2.517366e+02    2.517366E+02
16    8    10

```

CELEBF31

```

/* CELEBF31
   The following example illustrates the use of printf() to print
   fixed-point decimal data types.
   This example works under C only, not C++.
*/
#include <stdio.h>
#include <decimal.h>

decimal(10,2) pd01 = -12.34d;
decimal(12,4) pd02 = 12345678.9876d;
decimal(31,10) pd03 = 123456789013579246801.9876543210d;

int main(void) {
    printf("pd01 %D(10,2)      = %D(10,2)\n", pd01);
    printf("pd02 %D( 12 , 4 ) = %D( 12 , 4 )\n", pd02);

    printf("pd01 %%010.2D(10,2) = %%010.2D(10,2)\n", pd01);
    printf("pd02 %%20.2D(12,4)  = %%20.2D(12,4)\n", pd02);
    printf("\n Give strange result if the specified size is wrong!\n");
    printf("pd03 %D(15,3)       = %D(15,3)\n\n", pd03);
}

```

Output

```

pd01 %D(10,2)      = -12.34
pd02 %D( 12 , 4 ) = 12345678.9876
pd01 %%010.2D(10,2) = -000012.34
pd02 %%20.2D(12,4)  =          12345678.98

Give strange result if the specified size is wrong!
pd03 %D(15,3)       = -123456789013.579

```

CELEBF32

```

/* CELEBF32
   This example illustrates the use of sprintf() to format and print
   various data.
*/
#include <stdio.h>

char buffer[200];
int i, j;
double fp;
char *s = "baltimore";
char c;

int main(void)
{
    c = 'l';

```

```

i = 35;
fp = 1.7320508;

/* Format and print various data */
j = sprintf(buffer, "%s\n", s);
j += sprintf(buffer+j, "%c\n", c);
j += sprintf(buffer+j, "%d\n", i);
j += sprintf(buffer+j, "%f\n", fp);
printf("string:\n%s\ncharacter count = %d\n", buffer, j);
}

```

Output

```

string:
Baltimore
1
35
1.732051

character count = 24

```

CELEBF90

```

/* CELEBF90
   The following example illustrates the use of printf() to print
   vector data types.
*/
#include <stdio.h>

vector signed char s8 =
    {'a','b',' ','d','e','f','g','h',
     'i','j','k','l','m','!','o','p'};
vector unsigned short u16 = {1,2,3,4,5,6,7,8};
vector signed int s32 = {1, 2, 3, 99};
vector unsigned long long u64 = {1, 2};
vector double d64 = {0.1, 1.2};

int main(void)
{
    printf("s8 = %vc\n", s8);
    printf("s8 = %,vc\n", s8);
    printf("u16 = %vhu\n", u16);
    printf("s32 = %,2lvd\n", s32);
    printf("u64 = %vllu\n", u64);
    printf("d64 = %vLf\n", d64);
}

```

Output

```

s8 = ab defghijklm!op
s8 = a,b, ,d,e,f,g,h,i,j,k,l,m,!,o,p
u16 = 1 2 3 4 5 6 7 8
s32 = 1, 2, 3,99
u64 = 1 2
d64 = 0.100000 1.200000

```

Related information

- See the topic about internationalization of locales and characters sets in [z/OS XL C/C++ Programming Guide](#)
- See the topic about system programming C (SPC) facilities in [z/OS XL C/C++ Programming Guide](#)
- [“locale.h — Locale settings” on page 36](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“localeconv\(\) — Query numeric conventions” on page 988](#)
- [“setlocale\(\) — Set locale” on page 1547](#)

- “`wcrtomb()` — Convert a wide character to a multibyte character” on page 1988

__fpurge() — Discard pending data in a stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | None |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

void __fpurge(FILE *stream);

#define _OPEN_SYS_UNLOCKED 1
#include <stdio.h>
#include <stdio_ext.h>

void __fpurge_unlocked(FILE *stream);
```

General description

The `_fpurge()` function requests that any pending data in the stream be discarded.

After a call to `__fpurge()`, if stream is currently reading, any data that has been read from the system but not yet presented to the application will be discarded. Similarly, any data that has been pushed back into the stream with `ungetc()` will also be discarded.

After a call to `__fpurge()`, if stream is currently writing, any data that the application has requested to be written, but has not yet been flushed to an output device will be discarded. Any data that is written to the buffer after a call to `__fpurge()` is destined to be written out, to the block where the discarded data was originally intended to be placed, either explicitly via `fflush()` or implicitly once the buffer is full.

The `__fpurge_unlocked()` function is equivalent to the `__fpurge()` function with the exception that it is not thread-safe. This function can be safely used in a multithreaded application if it is called while the invoking thread owns the (FILE *) object, such as after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Usage note

The `__fpurge()` function is allowed to be called on UNIX files only. Calling this function on any other type of file will not cause pending data in the buffer to be discarded. The function will return and result in `errno` being set to a nonzero value.

Returned value

The `_fpurge()` function returns no values.

An application wishing to check for error situations should set `errno` to 0, then call `__fpurge()`, and then check `errno`. If `errno` is nonzero, assume that an error has occurred.

Error Code

Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF86

```
/* CELEBF86

   This example purges pending data in the I/O buffer.
*/

#include <stdio.h>
#include <errno.h>
#include <stdio_ext.h>

void main(int argc, char** argv){
    char *bufflush="data will be written into file";
    char *bufpurge="data will be not written into file";
    FILE *fp=fopen("./myfile", "a");
    if(NULL==fp){
        perror("failed to open file\n");
        exit(0);
    }
    fwrite(bufflush, strlen(bufflush), 1, fp);
    fflush(fp);
    fwrite(bufpurge, strlen(bufpurge), 1, fp);
    errno=0;
    __fpurge(fp);
    if(errno!=0)
        perror("call __fpurge() failed\n");
    fclose(fp);
}
```

Output

The file "myfile" contains the text - data will be written into file

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“_flushlbf\(\) — Flush all open line-buffered files” on page 556](#)
- [“fflush\(\) — Write buffer to file” on page 530](#)
- [“ungetc\(\) — Push character onto input stream” on page 1941](#)
- [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#)

fputc() — Write a character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language environment | both | |

Format

```
#include <stdio.h>
```



```
int fputc(int c, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fputc_unlocked(int c, FILE *stream);
```

General description

Converts *c* to an unsigned `char` and then writes *c* to the output stream pointed to by *stream* at the current position and advances the file position appropriately. The `fputc()` function is identical to *putc* but is always a function, because it is not available as a macro.

If the stream is opened with one of the append modes, the character is appended to the end of the stream regardless of the current file position.

The `fputc()` function is not supported for files opened with `type=record` or `type=blocked`.

`fputc()` has the same restriction as any write operation for a read immediately following a write, or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fputc_unlocked()` is functionally equivalent to `fputc()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fputc()` returns the character written.

If unsuccessful, `fputc()` returns EOF.

Example

CELEBF34

```
/* CELEBF34

   This example writes the contents of buffer to a file called
   myfile.dat.
   Because the output occurs as a side effect within the second
   expression of the for statement, the statement body is null.

*/
#include <stdio.h>
#define NUM_ALPHA 26

int main(void)
{
    FILE * stream;
    int i;
    int ch;

    char buffer[NUM_ALPHA + 1] = "abcdefghijklmnopqrstuvwxyz";

    if (( stream = fopen("myfile.dat", "w")) != NULL )
    {
        /* Put buffer into file */
        for ( i = 0; ( i < sizeof(buffer) ) &&
              ((ch = fputc( buffer[i], stream)) != EOF ); ++i );
        fclose( stream );
    }
    else
        printf( "Error opening myfile.dat\n" );
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fgetc\(\) — Read a character” on page 533](#)
- [“putc\(\), putchar\(\) — Write a character” on page 1352](#)

fputs() — Write a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language environment | both | |

Format

```
#include <stdio.h>

int fputs(const char * __restrict__string, FILE * __restrict__stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fputs_unlocked(const char * __restrict__string, FILE * __restrict__stream);
```

General description

Writes the string pointed to by *string* to the output stream pointed to by *stream*. It does not write the terminating `\0` at the end of the string.

For a text file, truncation may occur if the record is too long. *Truncation* means that excess characters are discarded after the record is full, up to a control character that ends the line (`\n`). Characters after the `\n` start at the next record. For more information, see the section on “Truncation” in [z/OS XL C/C++ Programming Guide](#).

`fputs()` is not supported for files opened with `type=record` or `type=blocked`.

`fputs()` has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fputs_unlocked()` is functionally equivalent to `fputs()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fputs()` returns the number of bytes written.

If unsuccessful, `fputs()` returns EOF.

Example

CELEBF35

```

/* CELEBF35

   This example writes a string to a stream.

   */
#include <stdio.h>
#define NUM_ALPHA 26

int main(void)
{
    FILE * stream;
    int num;

    /* Do not forget that the '\0' char occupies one character */
    static char buffer[NUM_ALPHA + 1] = "abcdefghijklmnopqrstuvwxyz";

    if ((stream = fopen("myfile.dat", "w")) != NULL )
    {
        /* Put buffer into file */
        if ( (num = fputs( buffer, stream )) != EOF )
        {
            /* Note that fputs() does not copy the \0 character */
            printf( "Total number of characters written to file = %i\n", num );
            fclose( stream );
        }
        else /* fputs failed */
            printf( "fputs failed" );
    }
    else
        printf( "Error opening myfile.dat" );
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fgets\(\) — Read a string from a stream” on page 536](#)
- [“gets\(\) — Read a string” on page 770](#)
- [“puts\(\) — Write a string” on page 1357](#)

fputwc() — Output a wide-character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 Language Environment | both | |

Format

Non-XPG4:

```

#include <stdio.h>
#include <wchar.h>

wint_t fputwc(wchar_t wc, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t fputwc_unlocked(wchar_t wc, FILE *stream);

```

XPG4:

```
#define _XOPEN_SOURCE
#include <stdio.h>
#include <wchar.h>

wint_t fputwc(wint_t wc, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t fputwc_unlocked(wchar_t wc, FILE *stream);
```

XPG4 and MSE:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <stdio.h>
#include <wchar.h>

wint_t fputwc(wchar_t wc, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t fputwc_unlocked(wchar_t wc, FILE *stream);
```

General description

Converts the wide character specified by *wc* to a multibyte character and writes it to the output stream pointed to by *stream*, at the position indicated by the associated file position indicator for the stream (if defined), and advances the indicator appropriately. If the file cannot support positioning requests or if the stream was opened with append mode, the character is appended to the output stream.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. Using non-wide-character functions with `fputwc()` results in undefined behavior.

`fputwc()` has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fputwc_unlocked()` is functionally equivalent to `fputwc()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then the compiler assumes that your program is using the XPG4 variety of the `fputwc()` function, unless you also define the `_MSE_PROTOS` feature test macro. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

The prototype for the XPG4 variety of the `fputwc()` function is:

```
wint_t fputwc(wint_t wc, FILE *stream);
```

The difference between this variety and the MSE variety of the `fputwc()` function is that the first parameter has type `wint_t` rather than type `wchar_t`.

Returned value

If successful, `fputwc()` returns the wide character written.

If a write error occurs, the error indicator for the stream is set and WEOF is returned. If an encoding error occurs during conversion from wide character to a multibyte character, the value of the macro `EILSEQ` is stored in `errno` and WEOF is returned.

Example

CELEBF36

```

/* CELEBF36
*/

#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>
#include <errno.h>

int main(void)
{
    FILE    *stream;
    wchar_t *wcs = L"This test string should not cause a WEOF condition";
    int      i;
    int      rc;

    if ((stream = fopen("myfile.dat", "w")) == NULL) {
        printf("Unable to open file.\n");
        exit(1);
    }

    for (i=0; wcs[i] != L'\0'; i++) {
        errno = 0;
        if ((rc = fputwc(wcs[i], stream)) == WEOF) {
            printf("Unable to fputwc() the wide character.\n");
            printf("wcs[%d] = 0x%lx\n", i, wcs[i]);
            if (errno == EILSEQ)
                printf("An invalid wide character was encountered.\n");
            exit(1);
        }
    }

    fclose(stream);
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)

fputws() — Output a wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```

#include <wchar.h>

int fputws(const wchar_t * __restrict__wcs, FILE * __restrict__stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

int fputws_unlocked(const wchar_t * __restrict__wcs, FILE * __restrict__stream);

```

General description

Converts the wide-character string pointed to by *wcs* to a multibyte character string and writes it to the stream pointed to by *stream*, as a multibyte character string. The terminating NULL byte is not written.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. Using non-wide-character functions with `fputws()` results in undefined behavior.

`fputws()` has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fputws_unlocked()` is functionally equivalent to `fputws()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fputws()` returns a nonnegative value.

If a *stream* error occurs, `fputws()` returns -1 and the error indicator for the stream is set.

If an *encoding* error occurs, `fputws()` returns -1 and the value of the macro `EILSEQ` is stored in `errno`. An encoding error is one that occurs when converting a wide character to a multibyte character.

Example

CELEBF37

```
/* CELEBF37 */
#include <errno.h>
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>

int main(void)
{
    FILE    *stream;
    wchar_t *wcs = L"This test string should not return -1";
    int      rc;

    if ((stream = fopen("myfile.dat", "w")) == NULL) {
        printf("Unable to open file.\n");
        exit(1);
    }

    errno = 0;
    rc = fputws(wcs, stream);

    if (rc == EOF) {
        printf("Unable to complete fputws() function.\n");
        if (errno == EILSEQ)
            printf("An invalid wide character was encountered.\n");
        exit(1);
    }

    fclose(stream);
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)

fread() – Read items

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language environment | both | |

Format

```
#include <stdio.h>

size_t fread(void * __restrict__buffer, size_t size, size_t count, FILE * __restrict__stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

size_t fread_unlocked(void * __restrict__buffer, size_t size,
                      size_t count, FILE * __restrict__stream);
```

General description

Reads up to *count* items of *size* length from the input stream pointed to by *stream* and stores them in the given *buffer*. The file position indicator advances by the number of bytes read.

If there is an error during the read operation, the file position indicator is undefined. If a partial element is read, the element's value is undefined.

When you are using `fread()` for record I/O, set *size* to 1 and *count* to the maximum expected length of the record, to obtain the number of bytes. Only one record is read, regardless of *count*, when using record I/O.

When you are using `fread()` for blocked I/O, set *size* to 1 and *count* to the maximum expected length of the block, to obtain the number of bytes. Only one block is read, regardless of *count*, when using blocked I/O.

`fread()` has the same restriction as any read operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fread_unlocked()` is functionally equivalent to `fread()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftwlockfile()` function.

Returned value

`fread()` returns the number of complete items successfully read.

If *size* or *count* is 0, `fread()` returns 0, and the contents of the array and the state of the stream remain unchanged. For record I/O and blocked I/O, it is possible that the number of complete items can be less than *count*. However, this result does not necessarily indicate that an error has occurred.

If the Physical File System does not support simple reads from directories, `fread()` will return 0 if it is used for a directory. Users should use `Opendir()` and `readdir()` instead.

The `ferror()` and `feof()` functions are used to distinguish between a read error and an EOF. Note that EOF is only reached when an attempt is made to read “past” the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Example

CELEBF38

```
/* CELEBF38

This example attempts to read NUM_ALPHA characters from the
file myfile.dat.
If there are any errors with either &fread. or &fopen., a
message is printed.

*/
#include <stdio.h>
#define NUM_ALPHA 26

int main(void)
{
    FILE * stream;
    int num;          /* number of characters read from stream */

    /* Do not forget that the '\0' char occupies one character too! */
    char buffer[NUM_ALPHA + 1];
    buffer[NUM_ALPHA] = '\0';

    if (( stream = fopen("myfile.dat", "r")) != NULL )
    {
        num = fread( buffer, sizeof( char ), NUM_ALPHA, stream );
        if (num == NUM_ALPHA) { /* fread success */
            printf( "Number of characters read = %i\n", num );
            printf( "buffer = %s\n", buffer );
            fclose( stream );
        }
        else { /* fread failed */
            if ( ferror(stream) ) /* possibility 1 */
                printf( "Error reading myfile.dat" );
            else if ( feof(stream) ) /* possibility 2 */
                printf( "EOF found\n" );
            printf( "Number of characters read %d\n", num );
            printf( "buffer = %.*s\n", num, buffer );
        }
    }
    else
        printf( "Error opening myfile.dat" );
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“freopen\(\) — Redirect an open file” on page 622](#)
- [“fwrite\(\) — Write items” on page 678](#)

__freadable() — Determine if a stream is open for reading

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

int __freadable(FILE *stream);
```

General description

The `__freadable()` function determines if the specified stream has been opened for reading.

Returned value

The `__freadable()` function returns nonzero if the stream is opened for reading. Otherwise, the `__freadable()` function returns 0. If an error has occurred, `__freadable()` function returns 0 and sets `errno` to nonzero.

An application wishing to check for error situations should set `errno` to 0, then call `__freadable()`, and then check `errno`. If `errno` is nonzero, assume that an error has occurred.

Error Code Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF89

```
/* CELEBF89

   This example writes and reads data to a file while querying the
   stream for information about data in the I/O buffer.

*/

#include <stdio.h>
#include <stdio_ext.h>

void main() {
    FILE *f;
    char filename[FILENAME_MAX] = "myfile.dat";
    char data[128] = "There are 34 bytes in this buffer\n";
    int datalen = strlen(data);
    size_t n = 0;

    f = fopen(filename, "wb+");
    if (f == NULL) {
        perror("fopen() failed\n");
        return;
    }

    if (__fwritable(f)) printf("Writing is allowed on the open stream\n");
    if (__freadable(f)) printf("Reading is allowed on the open stream\n");

    n = fputs(data, f);
    if (n == EOF) {
        perror("fputs() failed\n");
        return;
    }

    n = __fpending(f);
    printf("There are %d bytes in the buffer pending to be written\n", n);

    if (__fwriting(f)) printf("The last operation on the stream was a write\n");

    rewind(f);

    n = fgetc(f);

    n = __freadahead(f);
    printf("There are %d bytes remaining to be read from the buffer\n", n);
```

```
    if (__freading(f)) printf("The last operation on the stream was a read\n");
    return;
}
```

Output

```
Writing is allowed on the open stream
Reading is allowed on the open stream
There are 34 bytes in the buffer pending to be written
The last operation on the stream was a write
There are 33 bytes remaining to be read from the buffer
The last operation on the stream was a read
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“freopen\(\) — Redirect an open file” on page 622](#)
- [“__freading\(\) — Determine if last operation on stream is a read operation” on page 618](#)
- [“__fwritable\(\) — Determine if a stream is open for writing” on page 676](#)
- [“__fwriting\(\) — Determine if last operation on stream is a write operation” on page 679](#)

__freadahead() — Retrieve number of bytes remaining in input buffer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

size_t __freadahead(FILE *stream);

#define _OPEN_SYS_UNLOCKED 1
#include <stdio.h>
#include <stdio_ext.h>

size_t __freadahead_unlocked(FILE *stream);
```

General description

The `__freadahead()` function retrieves the number of bytes remaining to be read in the input buffer that is associated with the specified binary stream. When the stream is opened for text processing, `__fpending` retrieves the number of characters pending to be written.

The `__freadahead_unlocked()` function is equivalent to the `__freadahead()` function with the exception that it is not thread-safe. This function can be safely used in a multithreaded application if it is called while the invoking thread owns the (FILE *) object, such as after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Usage notes

1. If `__freadahead()` is called when the stream is currently writing, `__freadahead()` returns 0 and sets `errno` to a nonzero value.
2. If `__freadahead()` is called on a data set opened `type=record`, `__freadahead()` returns 0 and sets `errno` to a nonzero value.
3. For text data sets, any newline characters representing record boundaries will be included in the returned value.

Returned value

The `__freadahead()` functions return the number of bytes or characters remaining to be read in the current buffer, depending on the type of stream. Otherwise, the `__freadahead()` functions return 0. If an error has occurred, `__freadahead()` functions return 0 and set `errno` to nonzero.

When the stream is wide-oriented text, the `__freadahead()` function returns a value measured in wide characters.

An application wishing to check for error situations should set `errno` to 0, then call `__freadahead()`, and then check `errno`. If `errno` is nonzero, assume that an error has occurred.

Error Code

Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF89

```
/* CELEBF89

   This example writes and reads data to a file while querying the
   stream for information about data in the I/O buffer.

*/

#include <stdio.h>
#include <stdio_ext.h>

void main() {
    FILE *f;
    char filename[FILENAME_MAX] = "myfile.dat";
    char data[128] = "There are 34 bytes in this buffer\n";
    int datalen = strlen(data);
    size_t n = 0;

    f = fopen(filename, "wb+");
    if (f == NULL) {
        perror("fopen() failed\n");
        return;
    }

    if (__fwritable(f)) printf("Writing is allowed on the open stream\n");
    if (__freadable(f)) printf("Reading is allowed on the open stream\n");

    n = fputs(data, f);
    if (n == EOF) {
        perror("fputs() failed\n");
        return;
    }

    n = __fpending(f);
    printf("There are %d bytes in the buffer pending to be written\n", n);

    if (__fwriting(f)) printf("The last operation on the stream was a write\n");

    rewind(f);

    n = fgetc(f);
```

```
n = __freadahead(f);
printf("There are %d bytes remaining to be read from the buffer\n", n);

if (__freading(f)) printf("The last operation on the stream was a read\n");

return;
}
```

Output

```
Writing is allowed on the open stream
Reading is allowed on the open stream
There are 34 bytes in the buffer pending to be written
The last operation on the stream was a write
There are 33 bytes remaining to be read from the buffer
The last operation on the stream was a read
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“__fpending\(\) — Retrieve number of bytes pending for write” on page 591](#)

__freading() — Determine if last operation on stream is a read operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

int __freading(FILE *stream);

#define _OPEN_SYS_UNLOCKED 1
#include <stdio.h>
#include <stdio_ext.h>

int __freading_unlocked(FILE *stream);
```

General description

The `__freading()` function determines if the last operation on the specified stream is a read operation or if the specified stream is open for read-only.

The `__freading_unlocked()` function is equivalent to the `__freading()` function with the exception that it is not thread-safe. This function can be safely used in a multithreaded application if it is called while the invoking thread owns the (FILE *) object, such as after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

The `__freading()` functions return nonzero when the last operation is a read operation or the stream is open for read-only. Otherwise, the `__freading()` functions return 0. If an error has occurred, `__freading()` functions return 0 and set `errno` to nonzero.

An application wishing to check for error situations should set `errno` to 0, then call `__freading()`, and then check `errno`. If `errno` is nonzero, assume that an error has occurred.

Error Code Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF89

```
/* CELEBF89

   This example writes and reads data to a file while querying the
   stream for information about data in the I/O buffer.

*/

#include <stdio.h>
#include <stdio_ext.h>

void main() {
    FILE *f;
    char filename[FILENAME_MAX] = "myfile.dat";
    char data[128] = "There are 34 bytes in this buffer\n";
    int datalen = strlen(data);
    size_t n = 0;

    f = fopen(filename, "wb+");
    if (f == NULL) {
        perror("fopen() failed\n");
        return;
    }

    if (__fwritable(f)) printf("Writing is allowed on the open stream\n");
    if (__freadable(f)) printf("Reading is allowed on the open stream\n");

    n = fputs(data, f);
    if (n == EOF) {
        perror("fputs() failed\n");
        return;
    }

    n = __fpending(f);
    printf("There are %d bytes in the buffer pending to be written\n", n);

    if (__fwriting(f)) printf("The last operation on the stream was a write\n");

    rewind(f);

    n = fgetc(f);

    n = __freadahead(f);
    printf("There are %d bytes remaining to be read from the buffer\n", n);

    if (__freading(f)) printf("The last operation on the stream was a read\n");

    return;
}
```

Output

```
Writing is allowed on the open stream
Reading is allowed on the open stream
There are 34 bytes in the buffer pending to be written
The last operation on the stream was a write
There are 33 bytes remaining to be read from the buffer
The last operation on the stream was a read
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)

- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“freopen\(\) — Redirect an open file” on page 622](#)
- [“__freadable\(\) — Determine if a stream is open for reading” on page 614](#)
- [“__fwritable\(\) — Determine if a stream is open for writing” on page 676](#)
- [“__fwriting\(\) — Determine if last operation on stream is a write operation” on page 679](#)

free() — Free a block of storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

void free(void *ptr);
```

General description

Frees a block of storage pointed to by *ptr*. The *ptr* variable points to a block previously reserved with a call to `aligned_alloc()`, `calloc()`, `malloc()`, `posix_memalign()`, `realloc()`, or `strdup()`. The number of bytes freed is the number of bytes specified when you reserved (or reallocated, in the case of `realloc()`), the block of storage. If *ptr* is NULL, `free()` simply returns without freeing anything. Since *ptr* is passed by value `free()` will not set *ptr* to NULL after freeing the memory to which it points.

This function is also available to C applications in a stand-alone System Programming C (SPC) Environment.

Note: Attempting to free a block of storage not allocated with `aligned_alloc()`, `calloc()`, `malloc()`, `posix_memalign()`, `realloc()`, `strdup()`, or previously freed storage, can affect the subsequent reserving of storage and lead to an abend.

Special behavior for C++: Under C++, you cannot use `free()` with an item that was allocated using the C++ `new` keyword.

Returned value

`free()` returns no values.

Example

```
/* This example illustrates the use of calloc() to allocate storage for x
   array elements and then calls free() to free them.
   */
#include <stdio.h>
#include <stdlib.h>
```

```

int main(void)
{
    long * array;      /* start of the array */
    long * index;      /* index variable */
    int i;             /* index variable */
    int num;           /* number of entries of the array */

    printf( "Enter the size of the array\n" );
    scanf( "%i", &num );

    /* allocate num entries */
    if ( (index = array = (long *)calloc( num, sizeof( long ))) != NULL )
    {
        : /* do something with the array */
        free( array ); /* deallocates array */
    }
    else
    { /* Out of storage */
        printf( "Error: out of storage\n" );
        abort();
    }
}

```

Related information

- “Using the System Programming C Facilities” in *z/OS XL C/C++ Programming Guide*
- “spc.h — System library functions and storage allocation” on page 59
- “stdlib.h — Standard library functions” on page 65
- “aligned_alloc() — Allocating aligned memory blocks” on page 157
- “calloc() — Reserve and initialize storage” on page 232
- “malloc() — Reserve storage block” on page 1035
- “posix_memalign() — Reserve aligned storage block” on page 1201
- “realloc() — Change reserved storage block size” on page 1395

freeaddrinfo() — Free addrinfo storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R4 |

Format

```

#define _OPEN_SYS_SOCKET_IPV6
#include <sys/socket.h>
#include <netdb.h>

void *freeaddrinfo(struct addrinfo *ai);

```

SUSV3

```

#define _POSIX_C_SOURCE 200112L
#include <sys/socket.h>
#include <netdb.h>

void *freeaddrinfo(struct addrinfo *ai);

```

General description

The `freeaddrinfo()` function frees one or more `addrinfo` structures returned by `getaddrinfo()`, along with any additional storage associated with those structures. If the `ai_next` field of the structure is not null, the entire list of structures is freed.

Returned value

No return value is defined.

Related information

- [“connect\(\) — Connect a socket” on page 312](#)
- [“gai_strerror\(\) — Address and name information error description” on page 683](#)
- [“getaddrinfo\(\) — Get address information” on page 685](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“netdb.h — Network database operations” on page 45](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)

freopen() — Redirect an open file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

FILE *freopen(const char *__restrict__ filename, const char *__restrict__ mode,
              FILE *__restrict__ stream);
```

General description

Closes the file currently associated with *stream* and pointed to by *stream*, opens the file specified by the *filename*, and then associates the stream with it.

The `freopen()` function opens the new file with the type of access requested by the *mode* argument. The *mode* argument is used as in the `fopen()` function. See [“fopen\(\) — Open a file” on page 571](#) for a description of the *mode* parameter.

You can also use the `freopen()` function to redirect the standard stream files `stdin`, `stdout`, and `stderr` to files that you specify. The file pointer input to the `freopen()` function must point to a valid open file. If the file pointer has been closed, the behavior is undefined.

You could use the following `freopen()` call to redirect `stdout` to a memory file `a.b`:

```
freopen("a.b", "wb, type=memory", stdout);
```


If *filename* is an empty string, `freopen()` closes the file and reuses the original file name. For details on how the file name and open mode is interpreted, see [z/OS XL C/C++ Programming Guide](#).

A standard stream can be opened by default to a type of file not available to a general `fopen()`. This is true for standard streams under CICS, and also true for the default `stderr`, when running a non-POSIX Language Environment application.

The following statement uses `freopen()` to have `stdin` use binary mode instead of text mode:

```
fp = freopen("", "rb", stdin);
```

You can use the same empty string method to change the mode from binary back to text. This method is not allowed for:

- The default CICS data queues used by the standard streams under CICS
- The Language Environment Message File (MSGFILE), which is the default for `stderr`
- z/OS UNIX files.
- -CELQPIPI MSGRTN file, which is the default for `stderr` if MSGRTN service routine is specified.

Note: Using the empty string method is included in the SAA C definition, but not in the ISO C standard.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `freopen()` returns the value of *stream*, the same value that was passed to it, and clears both the error and EOF indicators associated with the stream.

A failed attempt to close the original file is ignored.

If an error occurs in reopening the requested file, `freopen()` closes the original file, and returns a NULL pointer value.

Special behavior for large z/OS UNIX files: The following is the possible value of `errno`:

Error Code

Description

EOVERFLOW

The named file is a regular file and the size of the file cannot be represented correctly in an object of type `off_t`.

Example

This example illustrates the IBM z/OS C extension that allows you to change characteristics of a file by reopening it.

```
#include <stdio.h>

int main(void)
{
    FILE *stream, *stream2;

    stream = fopen("myfile.dat", "r");
    stream2 = freopen("", "w+", stream);
}
```

This example closes the `stream` data stream and reassigns its stream pointer:

```
#include <stdio.h>
```

frexp, frexpf, frexpl

```
int main(void)
{
    FILE *stream, *stream2;

    stream = fopen("myfile.dat", "r");
    stream2 = freopen("myfile2.dat", "w+", stream);
}
```

Note: stream and stream2 will have the same value.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fclose\(\) — Close file” on page 482](#)
- [“fopen\(\) — Open a file” on page 571](#)

frexp(), frexpf(), frexpl() — Extract mantissa and exponent of the floating-point value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double frexp(double x, int *expptr);
float frexp(float x, int *expptr);          /* C++ only */
long double frexp(long double x, int *expptr); /* C++ only */
float frexpf(float x, int *expptr);
long double frexpl(long double x, int *expptr);
```

General description

Breaks down the floating-point value *x* into a component *m* for the normalized fraction component and another term *n* for the exponent, such that the absolute value of *m* is greater than or equal to 0.5 and less than 1.0 or equal to 0, and $x = m * 2^n$. The function stores the integer exponent *n* at the location to which *exp ptr* points.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Restriction: The frexpf() and frexpl() functions do not support the _FP_MODE_VARIABLE feature test macro.

Returned value

Returns the normalized fraction *m*. If *x* is 0, the function returns 0 for both the fraction and exponent. The fraction has the same sign as the argument *x*. The result of the function cannot have a range error.

Example

CELEBF41

```

/* CELEBF41

   This example decomposes the floating-point value of x, 16.4, into its
   normalized fraction 0.5125, and its exponent 5.
   It stores the mantissa in y and the exponent in n.

*/

#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, m;
    int n;

    x = 16.4;
    m = frexp(x, &n);

    printf("The fraction is %lf and the exponent is %d\n", m, n);
}

```

Output

```
The mantissa is 0.512500 and the exponent is 5
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ldexp\(\), ldexpf\(\), ldexpl\(\) — Multiply by a power of two” on page 940](#)
- [“modf\(\), modff\(\), modfl\(\) — Extract fractional and integral parts of floating-point value” on page 1092](#)

frexpd32(), frexpd64(), frexpd128() — Extract mantissa and exponent of the decimal floating-point value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 frexpd32(_Decimal32 x, int *expptr);
_Decimal64 frexpd64(_Decimal64 x, int *expptr);
_Decimal128 frexpd128(_Decimal128 x, int *expptr);

_Decimal32 frexp(_Decimal32 x, int *expptr); /* C++ only */
_Decimal64 frexp(_Decimal64 x, int *expptr); /* C++ only */
_Decimal128 frexp(_Decimal128 x, int *expptr); /* C++ only */

```

General description

Breaks down the decimal floating-point value x into a component m for the normalized fraction component and another term n for the exponent, such that the absolute value of m is greater than or

equal to 0.1 and less than 1.0 or equal to 0, and $x = m * 10^n$. The function stores the integer exponent n at the location to which *exp_ptr* points.

Notes:

- 1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
- 2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

Returns the normalized fraction m . If x is 0, the function returns 0 for both the fraction and exponent. The fraction has the same sign as the argument x . The result of the function cannot have a range error.

Example

```
/* CELEBF81
   This example illustrates the frexpd64() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 x, m;
    int n;

    x = 164.5DD;
    m = frexpd64(x, &n);

    printf("The fraction of %Df is %Df and the exponent is %d\n",
           x, m, n);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“frexp\(\), frexpf\(\), frexpl\(\) — Extract mantissa and exponent of the floating-point value” on page 624](#)
- [“ilogbd32\(\), ilogbd64\(\), ilogbd128\(\) — Integer unbiased exponent” on page 835](#)
- [“ldexpd32\(\), ldexpd64\(\), ldexpd128\(\) — Multiply by a power of ten” on page 941](#)

fscanf(), scanf(), sscanf() — Read and format data

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 C/C++ DFP Language environment | both | z/OS V1R8 |

Format

```
#include <stdio.h>

int fscanf(FILE *__restrict__stream, const char *__restrict__format-string, ...);
int scanf(const char *__restrict__format-string, ...);
int sscanf(const char *__restrict__buffer, const char *__restrict__format, ...);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fscanf_unlocked(FILE *__restrict__stream,
                    const char *__restrict__format-string, ...);
int scanf_unlocked(const char *__restrict__format-string, ...);
```

General description

These three related functions are referred to as the `fscanf` family.

Reads data from the current position of the specified *stream* into the locations given by the entries in the argument list, if any. The argument list, if it exists, follows the format string. The `fscanf()` function cannot be used for a file opened with `type=record` or `type=blocked`.

The `scanf()` function reads data from the standard input stream `stdin` into the locations given by each entry in the argument list. The argument list, if it exists, follows the format string. *scanf()* cannot be used if `stdin` has been reopened as a `type=record` or `type=blocked` file.

The `sscanf()` function reads data from *buffer* into the locations given by *argument-list*. Reaching the end of the string pointed to by *buffer* is equivalent to `fscanf()` reaching EOF. If the strings pointed to by *buffer* and *format* overlap, behavior is undefined.

`fscanf()` and `scanf()` have the same restriction as any read operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

For all three functions, each entry in the argument list must be a pointer to a variable of a type that matches the corresponding conversion specification in *format-string*. If the types do not match, the results are undefined.

For all three functions, the *format-string* controls the interpretation of the argument list. The *format-string* can contain multibyte characters beginning and ending in the initial shift state.

The format string pointed to by *format-string* can contain one or more of the following:

- White space characters, as specified by `isspace()`, such as blanks and newline characters. A white space character causes `fscanf()`, `scanf()`, and `sscanf()` to read, but not to store, all consecutive white space characters in the input up to the next character that is not white space. One white space character in *format-string* matches any combination of white space characters in the input.
- Characters that are not white space, except for the percent sign character (%). A non-white space character causes `fscanf()`, `scanf()`, and `sscanf()` to read, but not to store, a matching non-white space character. If the next character in the input stream does not match, the function ends.
- Conversion specifications which are introduced by the percent sign (%) or the sequence (%n\$) where *n* is a decimal integer in the range [1, `NL_ARGMAX`]. A conversion specification causes `fscanf()`, `scanf()`, and `sscanf()` to read and convert characters in the input into values of a conversion specifier. The value is assigned to an argument in the argument list.

All three functions read *format-string* from left to right. Characters outside of conversion specifications are expected to match the sequence of characters in the input stream; the matched characters in the input stream are scanned but not stored. If a character in the input stream conflicts with *format-string*, the function ends, terminating with a “matching” failure. The conflicting character is left in the input stream as if it had not been read.

When the first conversion specification is found, the value of the first *input field* is converted according to the conversion specification and stored in the location specified by the first entry in the argument list. The

second conversion specification converts the second input field and stores it in the second entry in the argument list, and so on through the end of *format-string*.

fscanf_unlocked() is functionally equivalent to fscanf() with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

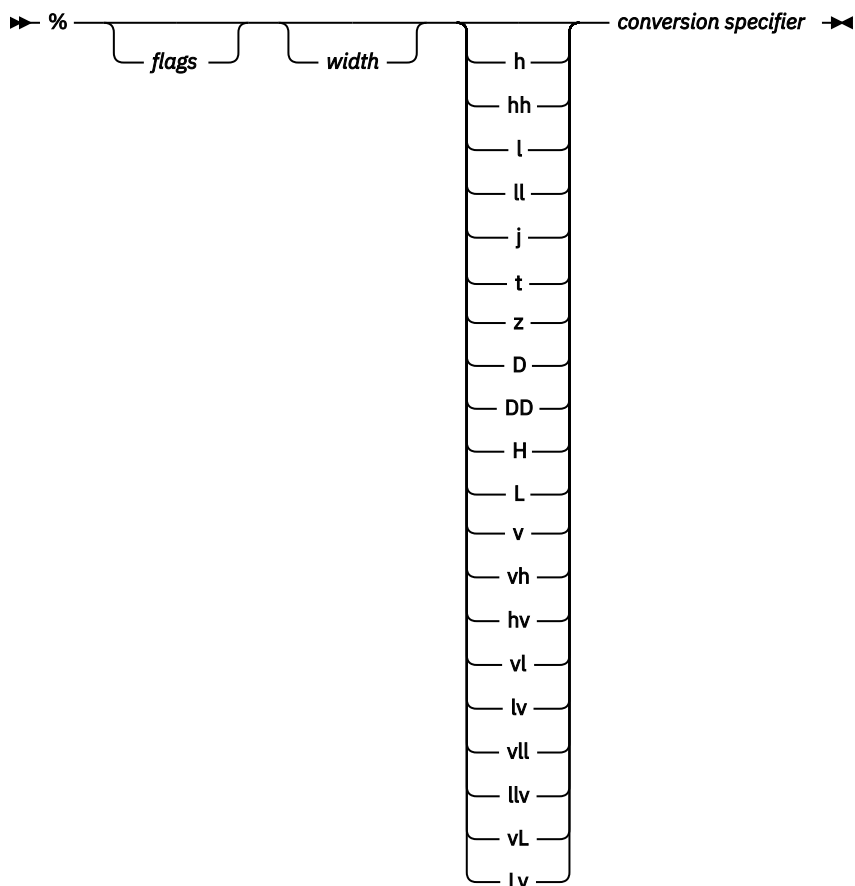
scanf_unlocked() is functionally equivalent to scanf() with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

An *input field* is defined as:

- All characters until a white space character (space, tab, or newline) is encountered
- All characters until a character is encountered that cannot be converted according to the conversion specification
- All characters until the field *width* is reached.

If there are too many arguments for the conversion specifications, the extra arguments are evaluated but otherwise ignored. The results are undefined if there are not enough arguments for the conversion specifications.

Syntax of Conversion Specification for fscanf(), scanf(), and sscanf()



Each field of the conversion specification is a single character or a number signifying a particular format option. The *conversion specifier*, which appears after the last optional format field, determines whether the input field is interpreted as a character, a string, or a number. The simplest conversion specification contains only the percent sign and a *conversion specifier* (for example, %s).

Each field of the format specification is discussed in detail below.

Other than conversion specifiers, you should avoid using the percent sign (%), except to specify the percent sign: %%. Currently, the percent sign is treated as the start of a conversion specifier. Any unrecognized specifier is treated as an ordinary sequence of characters. If, in the future, the compiler permits a new conversion specifier, it could match a section of your format string, be interpreted incorrectly, and result in undefined behavior. See [Table 33 on page 630](#) for a list of conversion specifiers.

Flag characters: The *flag* characters in [Table 32 on page 629](#) are used for assignment-suppressing and separator for vector type input conversion. Notice that more than one *flag* can appear in a format specification. This is an optional field.

Table 32. Flag Characters for fscanf Family

| Flag | Meaning | Default |
|---------|--|---|
| * | Suppresses assignment of the next input field, which is interpreted as a field of the specified conversion specifier. The field is scanned but not stored. | |
| , ; : _ | Indicates the separator character between each two components in the vector data type conversion. Only one separator character can be specified. | The default value for the separator character is a space (' '), unless the c format is being used. For the c format, there is no separator at all if no separator character is specified. |

width is a positive decimal integer controlling the maximum number of characters to be read. No more than *width* characters are converted and stored at the corresponding *argument*.

Fewer than *width* characters are read if a white space character (space, tab, or newline), or a character that cannot be converted according to the given format occurs before *width* is reached.

Optional prefix: The optional prefix characters used to indicate the size of the argument expected or size of a single value in a vector data type input conversion are explained:

Prefix

Meaning

h

Specifies that the d, i, o, u, x, X, or n conversion specifier applies to an argument with type pointer to short or unsigned short.

hh

Specifies that the d, i, o, u, x, X, or n conversion specifier applies to an argument with type pointer to signed char or unsigned char.

l

(ell) Specifies that the d, i, o, u, x, X, or n conversion specifier applies to an argument with type pointer to long or unsigned long; the following a, A, e, E, f, F, g, or G conversion specifier applies to an argument with type pointer to double; and the following c, s, or [conversion specifier applies to an argument with type pointer to wchar_t.

ll

(ell-ell) Specifies that the d, i, o, u, x, X, or n conversion specifier applies to an argument with type pointer to long long or unsigned long long.

j

Specifies that the d, i, o, u, x, X, or n conversion specifier applies to an argument with type pointer to intmax_t or uintmax_t.

- t**
Specifies that the d, i, o, u, x, X, or n conversion specifier applies to an argument with type pointer to ptrdiff_t or the corresponding unsigned type.
- z**
Specifies that the d, i, o, u, x, X, or n conversion specifier applies to an argument with type pointer to size_t or the corresponding signed integer type.
- D**
Specifies that the e, E, f, F, g, or G conversion specifier applies to an argument with type pointer to _Decimal64 float.
- DD**
Specifies that the e, E, f, F, g, or G conversion specifier applies to an argument with type pointer to _Decimal128 float.
- H**
Specifies that the e, E, f, F, g, or G conversion specifier applies to an argument with type pointer to _Decimal32 float.
- L**
Specifies that the a, A, e, E, f, F, g, or G conversion specifier applies to an argument with type pointer to long double.
- v**
Specifies that a following c, d, i, u, o, x, or X conversion specifier applies to an argument with type pointer to vector signed char, vector unsigned char, or vector bool char.
- vh, hv**
Specifies that a following d, i, u, o, x, or X conversion specifier applies to an argument with type pointer to vector signed short, vector unsigned short, or vector bool short.
- vl, lv**
Specifies that a following d, i, u, o, x, or X conversion specifier applies to an argument with type pointer to vector signed int, vector unsigned int, or vector bool int.
- vll, llv**
Specifies that a following d, i, u, o, x, or X conversion specifier applies to an argument with type pointer to vector signed long long, vector unsigned long long, or vector bool long long.
- vL, Lv**
Specifies that a following a, A, e, E, f, F, g, or G conversion specifier applies to an argument with type pointer to vector double.

Conversion specifier: [Table 33 on page 630](#) explains the valid conversion specifiers and their meanings are in.

| Table 33. Conversion Specifiers in fscanf Family | | |
|--|--|-------------------------|
| Conversion Specifier | Type of Input Expected | Type of Argument |
| d | Decimal integer | Pointer to int |
| o | Octal integer | Pointer to unsigned int |
| x X | Hexadecimal integer | Pointer to unsigned int |
| i | Decimal, hexadecimal, or octal integer | Pointer to int |
| u | Unsigned decimal integer | Pointer to unsigned int |

Table 33. Conversion Specifiers in fscanf Family (continued)

| Conversion Specifier | Type of Input Expected | Type of Argument |
|----------------------------|--|--|
| e E f F g G | Floating-point value consisting of an optional sign (+ or -); a series of one or more decimal digits possibly containing a decimal-point; and an optional exponent (e or E) followed by a possibly signed integer value | Pointer to <code>float</code> |
| a A | Matches an optionally signed floating-point number, infinity, or NaN, whose format is the same as expected for the subject sequence of <code>strtod()</code> . In the absence of a size modifier, the application shall ensure that the corresponding argument is a pointer to <code>float</code> . | Pointer to <code>float</code> |
| D(n,p) | Fixed-point value consisting of an optional sign (+ or -); a series of one or more decimal digits possibly containing a decimal-point. | Pointer to decimal |
| c | Sequence of one or more characters as specified by field width; white space characters that are ordinarily skipped are read when <code>%c</code> is specified. No terminating null is added. | Pointer to <code>char</code> large enough for input field. |
| C or lc | <p>The input is a sequence of one or more multibyte characters as specified by the field width, beginning in the initial shift state. Each multibyte character in the sequence is converted to a wide character as if by a call to the <code>mbrtowc()</code> function. The conversion state described by the <code>mbstate_t</code> object is initialized to zero before the first multibyte character is converted.</p> <p>The corresponding argument is a pointer to the initial element of an array of <code>wchar_t</code> large enough to accept the resulting sequence of wide characters. No NULL wide character is added.</p> | C or lc uses a pointer to <code>wchar_t</code> . |
| s | Like c, a sequence of bytes of type <code>char</code> (signed or unsigned), except that white space characters are not allowed, and a terminating null is always added. | Pointer to character array large enough for input field, plus a terminating NULL character (<code>\0</code>) that is automatically appended. |
| S or ls | <p>A sequence of multibyte characters that begins and ends in the initial shift state. Each multibyte character in the sequence is converted to a wide character as if by a call to the <code>mbrtowc()</code> function, with the conversion state described by the <code>mbstate_t</code> object initialized to zero before the first multibyte character is converted.</p> <p>The corresponding argument is a pointer to the initial array of <code>wchar_t</code> large enough to accept the sequence and the terminating NULL wide character, which is added automatically.</p> | S or ls uses a pointer to <code>wchar_t</code> string. |

Table 33. Conversion Specifiers in fscanf Family (continued)

| Conversion Specifier | Type of Input Expected | Type of Argument |
|----------------------|---|--|
| n | No input read from <i>stream</i> or buffer. | Pointer to <code>int</code> , into which is stored the number of characters successfully read from the <i>stream</i> or buffer up to that point in the call to either <code>fscanf()</code> or to <code>scanf()</code> . |
| p | Pointer to void converted to series of characters. For the specific format of the input, see the individual system reference guides. | Pointer to void. |
| [| <p>A non-empty sequence of bytes to be matched against a set of expected bytes (the <i>scanset</i>), which form the conversion specification. White space characters that are ordinarily skipped are read when <code>%[</code> is specified.</p> <p>Consider the following situations:</p> <p><code>[^bytes]</code>. In this case, the <i>scanset</i> contains all bytes that do not appear between the circumflex and the right square bracket.</p> <p><code>[]abc] or [^]abc.]</code> In both these cases the right square bracket is included in the <i>scanset</i> (in the first case: <code>]abc</code> and in the second case, <i>not</i> <code>]abc</code>)</p> <p><code>[a–z]</code> In EBCDIC The – is in the <i>scanset</i>, the characters <code>b</code> through <code>y</code> are <i>not</i> in the <i>scanset</i>; in ASCII The – is <i>not</i> in the <i>scanset</i>, the characters <code>b</code> through <code>y</code> are.</p> <p>The code point for the square brackets (<code>[</code> and <code>]</code>) and the caret (<code>^</code>) vary among the EBCDIC encoded character sets. The default C locale expects these characters to use the code points for encoded character set Latin-1 / Open Systems 1047. Conversion proceeds one byte at a time: there is no conversion to wide characters.</p> | Pointer to the initial byte of an array of <code>char</code> , signed <code>char</code> , or unsigned <code>char</code> large enough to accept the sequence and a terminating byte, which will be added automatically. |
| l[| If an <code>l</code> length modifier is present, input is a sequence of multibyte characters that begins and ends in the initial shift state. Each multibyte character in the sequence is converted to a wide character as if by a call to the <code>mbrtowc()</code> function, with the conversion state described by the <code>mbstate_t</code> object initialized to zero before the first multibyte character is converted. The corresponding argument is a pointer to the initial array of <code>wchar_t</code> large enough to accept the sequence and the terminating NULL wide character, which is added automatically. | <code>l[</code> uses a pointer to <code>wchar_t</code> string |

When the `LC_SYNTAX` category is set using `setlocale()`, the format strings passed to the `fscanf()`, `scanf()`, or `sscanf()` functions must use the same encoded character set as is specified for the `LC_SYNTAX` category.

To read strings not delimited by space characters, substitute a set of characters in square brackets (`[]`) for the `s` (string) conversion specifier. The corresponding input field is read up to the first character that does

not appear in the bracketed character set. If the first character in the set is a logical not (\neg), the effect is reversed: the input field is read up to the first character that does appear in the rest of the character set.

To store a string without storing an ending NULL character ($\backslash 0$), use the specification $\%ac$, where a is a decimal integer. In this instance, the c conversion specifier means that the argument is a pointer to a character array. The next a characters are read from the input stream into the specified location, and no NULL character is added.

The input for a $\%x$ conversion specifier is interpreted as a hexadecimal number.

All three functions, `fscanf()`, `scanf()`, and `sscanf()` scan each input field character by character. It might stop reading a particular input field either before it reaches a space character, when the specified *width* is reached, or when the next character cannot be converted as specified. When a conflict occurs between the specification and the input character, the next input field begins at the first unread character. The conflicting character, if there is one, is considered unread and is the first character of the next input field or the first character in subsequent read operations on the input stream.

Special behavior for XPG4.2:

- When the $\%n\$$ conversion specification is found, the value of the *input field* is converted according to the conversion specification and stored in the location specified by the n th argument in the argument list. Numbered arguments in the argument list can only be referenced once from *format-string*.
- The *format-string* can contain either form of the conversion specification, that is, $\%$ or $\%n\$$ but the two forms cannot be mixed within a single *format-string* except that $\%\%$ or $\%\%$ can be mixed with the $\%n\$$ form.

Floating-point and the fscanf family of formatted input functions: The `fscanf` family functions match e , E , f , F , g or G conversion specifiers to floating-point number substrings in the input stream. The `fscanf` family functions convert each input substring matched by an e , E , f , F , g or G conversion specifier to a float, double or long double value depending on a size modifier preceding the e , E , f , F , g or G conversion specifier.

The floating-point value produced is hexadecimal floating-point or IEEE Binary Floating-Point format depending on the floating-point mode of the thread invoking the `fscanf` family function. The `fscanf` family functions use `__isBFP()` to determine the floating-point mode of invoking threads.

Many IBM z/OS C/C++ formatted input functions, including the `fscanf` family, recognize special infinity and NaN floating-point number input sequences when the invoking thread is in IEEE Binary Floating-Point mode as determined by `__isBFP()`.

- The special sequence for infinity input is an optional plus or minus sign, then the character sequence INF, where the individual characters may be uppercase or lowercase, and then a white space character (space, tab, or newline), a NULL character ($\backslash 0$) or EOF.
- The special sequence for NaN input is an optional plus or minus sign, then the character sequence NANS for a signalling NaN or NANQ for a quiet NaN, where the individual characters may be uppercase or lowercase, then an optional NaN ordinal sequence, and then a white space character (space, tab, or newline), a NULL character ($\backslash 0$) or EOF.

For binary floating point NaNs: A NaN ordinal sequence is a left-parenthesis character, "(", followed by a digit sequence representing an integer n , where $1 \leq n \leq \text{INT_MAX}-1$, followed by a right-parenthesis character, ")". If the NaN ordinal sequence is omitted, NaN ordinal sequence (1) is assumed. The integer value, n , corresponding to a NaN ordinal sequence determines what IEEE Binary Floating-Point NaN fraction bits are produced by formatted input functions.

For a signalling NaN, these functions produce NaN fraction bits (left to right) by reversing the bits (right to left) of the even integer value $2*n$.

For a quiet NaN they produce NaN fraction bits (left to right) by reversing the bits (right to left) of the odd integer value $2*n-1$.

For decimal floating point NaNs: A NaN ordinal sequence is a left parenthesis character, "(", followed by a decimal digit sequence of up to 6 digits for a `_Decimal32` output number, up to 15 digits for a `_Decimal64` output value, or up to 33 digits for a `_Decimal128` output value, followed by a right

parenthesis, ")". If the NaN ordinal sequence is omitted, NaN ordinal sequence "(0)" is assumed. If the NaN ordinal sequence is shorter than 6, 15, or 33 digits, it will be padded on the left with "0" digits so that the length becomes 6, 15, or, 33 digits for `_Decimal32`, `_Decimal64`, and `_Decimal128` values respectively.

For decimal floating point numbers, the digits are not reversed, and both odd or even NaN ordinal sequences can be specified for either a Quiet NAN or Signalling NAN.

Vector types and the fscanf family of formatted input functions: The fscanf family functions support character, integer, and floating-point vector data types in the input conversion specification. The vector value to be scanned is in the following general form:

```
Value1Cvalue2C...CValueN
```

where C is a separator character optionally defined in flag characters, and there can be 2, 4, 8, or 16 components depending on the optional prefix v, vh, hv, vl, lv, vll, llv, vL, or Lv. Each value is scanned according to the conversion specifier. If the conversion fails in the middle of a vector value, the successful elements will be saved to the vector argument and the other elements in the vector argument will remain unchanged.

Usage note

To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

All three functions, `fscanf()`, `scanf()`, and `sscanf()` return the number of input items that were successfully matched and assigned. The returned value does not include conversions that were performed but not assigned (for example, suppressed assignments). The functions return EOF if there is an input failure before any conversion, or if EOF is reached before any conversion. Thus a returned value of 0 means that no fields were assigned: there was a matching failure before any conversion. Also, if there is an input failure, then the file error indicator is set, which is not the case for a matching failure.

The `ferror()` and `feof()` functions are used to distinguish between a read error and an EOF. Note that EOF is only reached when an attempt is made to read “past” the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Examples

CELEBF42

```
/* CELEBF42

   This example scans various types of data
*/
#include <stdio.h>

int main(void)
{
    int i;
    float fp;
    char c, s[81];

    printf("Enter an integer, a real number, a character "
           "and a string : \n");
    if (scanf("%d %f %c %s", &i, &fp, &c, s) != 4)
        printf("Not all of the fields were assigned\n");
    else
    {
        printf("integer = %d\n", i);
        printf("real number = %f\n", fp);
        printf("character = %c\n", c);
        printf("string = %s\n", s);
    }
}
```

Output

If input is: 12 2.5 a yes, then output would be:

```
Enter an integer, a real number, a character and a string:
integer = 12
real number = 2.500000
character = a
string = yes
```

CELEBF43

```
/* CELEBF43
   This example converts a hexadecimal integer to a decimal integer.
   The while loop ends if the input value is not a hexadecimal integer.
*/
#include <stdio.h>

int main(void)
{
    int number;

    printf("Enter a hexadecimal number or anything else to quit:\n");
    while (scanf("%x",&number))
    {
        printf("Hexadecimal Number = %x\n",number);
        printf("Decimal Number      = %d\n",number);
    }
}
```

Output

If input is: 0x231 0xf5e 0x1 q, then output would be:

```
Enter a hexadecimal number or anything else to quit:
Hexadecimal Number = 231
Decimal Number     = 561
Hexadecimal Number = f5e
Decimal Number     = 3934
Hexadecimal Number = 1
Decimal Number     = 1
```

CELEBF44

```
/* CELEBF44
   The next example illustrates the use of scanf() to input fixed-point
   decimal data types. This example works under C only, not C++.
*/
#include <stdio.h>
#include <decimal.h>

decimal(15,4) pd01;
decimal(10,2) pd02;
decimal(5,5) pd03;

int main(void) {
    printf("\nFirst time :-----\n");
    printf("Enter three fixed-point decimal number\n");
    printf("  (15,4) (10,2) (5,5)\n");
    if (scanf("%D(15,4) %D(10,2) %D(5,5)", &pd01, &pd02, &pd03) != 3) {
        printf("Error found in scanf\n");
    } else {
        printf("pd01 = %D(15,4)\n", pd01);
        printf("pd02 = %D(10,2)\n", pd02);
        printf("pd03 = %D(5,5)\n", pd03);
    }
    printf("\nSecond time :-----\n");
    printf("Enter three fixed-point decimal number\n");
    printf("  (15,4) (10,2) (5,5)\n");
    if (scanf("%D(15,4) %D(10,2) %D(5,5)", &pd01, &pd02, &pd03) != 3) {
        printf("Error found in scanf\n");
    } else {
        printf("pd01 = %D(15,4)\n", pd01);
        printf("pd02 = %D(10,2)\n", pd02);
        printf("pd03 = %D(5,5)\n", pd03);
    }
}
```

```
    return(0);
}
```

Output

```
First time :-----
Enter three fixed-point decimal number
(15,4) (10,2) (5,5)
12345678901.2345 -987.6 .24680
pd01 = 12345678901.2345
pd02 = -987.60
pd03 = 0.24680

Second time :-----
Enter three fixed-point decimal number
(15,4) (10,2) (5,5)
123456789013579.24680 123.4567890 987
pd01 = 12345678901.3579
pd02 = 123.45
pd03 = 0.98700
```

CELEBF46

```
/* CELEBF46
   The next example opens the file myfile.dat for reading and then scans
   this file for a string, a long integer value, a character, and a
   floating-point value.
*/
#include <stdio.h>
#define MAX_LEN 80

int main(void)
{
    FILE *stream;
    long l;
    float fp;
    char s[MAX_LEN + 1];
    char c;

    stream = fopen("myfile.dat", "r");

    /* Put in various data. */
    fscanf(stream, "%s", &s[0]);
    fscanf(stream, "%ld", &l);
    fscanf(stream, "%c", &c);
    fscanf(stream, "%f", &fp);

    printf("string = %s\n", s);
    printf("long double = %ld\n", l);
    printf("char = %c\n", c);
    printf("float = %f\n", fp);
}
```

Output

If myfile.dat contains abcdefghijklmnopqrstuvwxyz 343.2, then the expected output is:

```
string = abcdefghijklmnopqrstuvwxyz
long double = 343
char = .
float = 2.000000
```

CELEBS32

```
/* CELEBS32
   This example uses sscanf() to read various data from the string
   tokenstring, and then displays the data.
*/
#include <stdio.h>
#define SIZE 81

int main(void)
{
    char *tokenstring = "15 12 14";
    int i;
    float fp;
    char s[SIZE];
```

```

char c;

/* Input various data */
printf("No. of conversions=%d\n",
       sscanf(tokenstring, "%s %c%d%f", s, &c, &i, &fp));

/* If there were no space between %s and %c,
/* sscanf would read the first character following */
/* the string, which is a blank space. */

/* Display the data */
printf("string = %s\n", s);
printf("character = %c\n", c);
printf("integer = %d\n", i);
printf("floating-point number = %f\n", fp);
}

```

Output

You would see this output from example CELEBS32.

```

No. of conversions = 4
string = 15
character = 1
integer = 2
floating-point number = 14.000000

```

CELEBF91

```

/* CELEBF91
The following example illustrates the use of sscanf()
to input vector data types.
*/
#include <stdio.h>

int main (void)
{
    vector signed char s8;
    vector unsigned short u16;
    vector signed int s32;
    vector unsigned long long u64;
    vector double d64;

    sscanf("ab defghijklm,op", "%vc", &s8);
    printf("s8 = %vc\n", s8);

    sscanf("a,b, ,d,e,f,g,h,i,j,k,l,m,! ,o,p", "%,vc", &s8);
    printf("s8 = %,vc\n", s8);

    sscanf("1 2 3 4 5 6 7 8", "%vhu", &u16);
    printf("u16 = %vhu\n", u16);

    Sscanf(" 1, 2, 3,99", "%,2lvd", &s32);
    printf("s32 = %,2lvd\n", s32);

    sscanf("1 2", "%vllu", &u64);
    printf("u64 = %vllu\n", u64);

    sscanf("0.1 1.2", "%vLf\n", &d64);
    printf("d64 = %vLf\n", d64);
}

```

Output

```

s8 = ab defghijklm!op
s8 = a,b, ,d,e,f,g,h,i,j,k,l,m,! ,o,p
u16 = 1 2 3 4 5 6 7 8
s32 = 1, 2, 3,99
u64 = 1 2
d64 = 0.100000 1.200000

```

Related information

- See the topic about internationalization of locales and character sets in [z/OS XL C/C++ Programming Guide](#).

- [“locale.h — Locale settings” on page 36](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data” on page 593](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“setlocale\(\) — Set locale” on page 1547](#)

fseek() — Change file position

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

int fseek(FILE *stream, long int offset, int origin);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fseek_unlocked(FILE *stream, long int offset, int origin);
```

General description

The `fseek()` function changes the current file position associated with *stream* to a new location within the file. The next operation on the stream takes place at the new location. On a stream opened for update, the next operation can be either a reading or a writing operation.

The *origin* must be one of the following constants defined in `stdio.h`:

Origin

Definition

SEEK_SET

Beginning of file

SEEK_CUR

Current position of file pointer

SEEK_END

End of file

If successful, the `fseek()` function clears the EOF indicator, even when *origin* is `SEEK_END`, and cancels the effect of any preceding `ungetc()` or `ungetwc()` function on the same stream.

If the call to the `fseek()` function or the `fsetpos()` function is not valid, the call is treated as a flush and the `ungetc` characters are discarded.

Behavior for binary streams: ISO C/C++ states that binary streams use relative byte offsets for both the `ftell()` and `fseek()` functions. Under IBM z/OS C/C++, this is true except for record-oriented files that have

variable length records. For these types of files, the default behavior is to use encoded offsets for the `ftell()` function and the `fseek()` function using an origin of `SEEK_SET`.

Encoded offsets restrict you to seeking only to those positions that are recorded by a previous `ftell()` function call or to position 0. If you want to use relative-byte offsets for these types of files, you can either open the file with the `BYTESEEK` `fopen()` function option or set the `_EDC_BYTE_SEEK` environment variable before opening.

With relative-byte offsets, you can calculate your own offsets. If the offset exceeds the EOF, your file is extended with NULLs, except for z/OS UNIX files, for which the file is only extended with NULLs if you subsequently write new data. This is true also under POSIX, using z/OS UNIX files, where the file is only extended with NULLs if you subsequently write new data.

Attempting to reposition to before the start of the file causes the `fseek()` function to fail.

Regardless of whether encoded or relative offsets are returned by the `ftell()` function, you can specify relative offsets when using `SEEK_CUR` and `SEEK_END`.

If the new position is before the start of the file, the `fseek()` function fails. If the relative offset is positioned beyond the EOF, the file is padded with NULLs, except in the case of POSIX, using z/OS UNIX files, where padding does not occur until a subsequent write of new data.

Behavior for text streams: For text streams, the `ftell()` function returns an encoded offset. When seeking with an origin of `SEEK_SET`, you are restricted to seeking only to 0 or to positions returned by a previous `ftell()` function call.

Attempting to calculate your own position is not supported, and might result in a non-valid position and the failure of the `fseek()` function.

When you are using `SEEK_CUR` or `SEEK_END`, the offset is a relative byte offset. Attempting to seek to before the start of the file or past the EOF results in failure.

Behavior for record I/O: For files opened for record I/O using the `type=record` open mode parameter, the `ftell()` function returns the relative record number. For the origins of `SEEK_SET`, `SEEK_CUR`, and `SEEK_END`, the offset is a relative record number.

Attempting to seek to before the first record or past the EOF results in failure.

Behavior for blocked I/O: For files opened for blocked I/O using the `type=blocked` open mode parameter, the `ftell()` function returns the relative block number. For the origins of `SEEK_SET`, `SEEK_CUR`, and `SEEK_END`, the offset is a relative block number.

Attempting to seek to before the first block or past the EOF results in failure.

Behavior for wide-oriented streams: All of the above restrictions apply for wide-oriented streams of any type.

Multivolume data sets performance: Using the `fgetpos()` and `fsetpos()` functions generally results in better repositioning performance compared to the `ftell()` and `fseek()` functions when working with multivolume data sets.

Large file support for MVS data sets, VSAM data sets, and z/OS UNIX files: For AMODE 31 C/C++ applications, the `fseek()` function accepts a signed 4-byte offset and therefore cannot be used to directly or relatively position to offsets beyond 2 GB - 1. To avoid repositioning limitations, AMODE 31 C/C++ applications should define the `_LARGE_FILES` feature test macro before any headers are included and replace the `fseek()` function with the `fseeko()` function. For AMODE 64 C/C++ applications, there are no restrictions on using the `fseek()` function with large files. The AMODE 64 version automatically accepts a signed 8-byte offset.

Usage notes

1. Repositioning within a wide-oriented file and performing updates is strongly discouraged because it is not possible to predict if your update will overwrite part of a multibyte string or character, thereby invalidating subsequent data. For example, you could inadvertently add data that overwrites a

shift-out. The following data expects the shift-out to be there, so is not valid if it is treated as if in the initial shift state. Repositioning to the end of the file and adding new data is safe.

2. If you specify SEEK_CUR, any characters pushed back by the `ungetc()` or `ungetwc()` functions will have backed up the current position of the file pointer—which is the starting point of the seek. The seek will discard any pushed-back characters before repositioning, but the starting point will still be affected. For more information about calling the `fseek()` function after an `ungetc()` or `ungetwc()` function call, see [“ungetc\(\) — Push character onto input stream” on page 1941](#) and [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#).
3. The `_EDC_COMPAT` environment variable causes `fseek()` to ignore the effects of the `ungetc()` or `ungetwc()` functions. For more details, see the topic about environment variables in [z/OS XL C/C++ Programming Guide](#).
4. The `fseek_unlocked()` function is functionally equivalent to the `fseek()` function with the exception that it is not threadsafe. The `fseek()` function can safely be used in a multithreaded application if, and only if, it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful in moving the pointer, the `fseek()` function returns 0.

If unsuccessful, or on devices that cannot seek, such as terminals and printers, the `fseek()` function returns nonzero.

Special behavior for XPG4.2: If unsuccessful, the `fseek()` function returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EOVERFLOW

The resulting file offset would be a value which cannot be represented correctly in an object of type `long`.

Note: Environment variable `_EDC_EOVERFLOW` can be used to control behavior of the `fseek()` function with respect to detecting an EOVERFLOW condition for z/OS UNIX files. By default, the `fseek()` function will continue to be able to position beyond a location that the `ftell()` function can return. When `_EDC_EOVERFLOW` is set to YES, the `fseek()` function will check if the new position can be returned by the `ftell()` function.

ESPIPE

The underlying file type for the stream is a PIPE or a socket.

Example

```
/* This example opens a file myfile.dat for reading.
   After performing input operations (not shown), it moves the file
   pointer to the beginning of the file.
*/
#include <stdio.h>

int main(void)
{
    FILE *stream;
    int result;

    if (stream = fopen("myfile.dat", "r"))
    { /* successful */

        if (fseek(stream, 0L, SEEK_SET)); /* moves pointer to */
                                         /* the beginning of the file */
        { /* if not equal to 0
            then error ... */
        }
        else {
            /* fseek() successful */
        }
    }
}
```

```
}
}
```

Related information

- For information about wide-oriented streams, see [z/OS XL C/C++ Programming Guide](#).
- For information about BYTESEEK or _EDC_BYTE_SEEK, see [z/OS XL C/C++ Programming Guide](#).
- For additional usage information about the fseek() function with respect to MVS data sets, VSAM data sets, or z/OS UNIX files, see [z/OS XL C/C++ Programming Guide](#).
- [“stdio.h — Standard input and output” on page 63](#)
- [“fseeko\(\) — Change file position” on page 641](#)
- [“ftell\(\) — Get current file position” on page 657](#)
- [“ungetc\(\) — Push character onto input stream” on page 1941](#)
- [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#)

fseeko() — Change file position

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 Language Environment | both | OS/390 V2R10 |

Format

```
#define _XOPEN_SOURCE 500
#include <stdio.h>

int fseeko(FILE *stream, off_t offset, int origin);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fseeko_unlocked(FILE *stream, off_t offset, int origin);
```

General description

The fseeko() function changes the current file position associated with *stream* to a new location within the file. The next operation on the stream takes place at the new location. On a stream opened for update, the next operation can be either a reading or a writing operation.

The *origin* must be one of the following constants defined in stdio.h:

Origin

Definition

SEEK_SET

Beginning of file

SEEK_CUR

Current position of file pointer

SEEK_END

End of file

If successful, the fseeko() function clears the EOF indicator, even when the origin is SEEK_END, and cancels the effect of any preceding ungetc() or ungetwc() function on the same stream.

If the call to the `fseeko()` function or the `fsetpos()` function is not valid, the call is treated as a flush and the ungetc characters are discarded.

Behavior for binary streams: ISO C/C++ states that binary streams use relative byte offsets for both the `ftello()` and `fseeko()` functions. Under IBM z/OS C/C++, this is true except for record-oriented files that have variable length records. For these types of files, the default behavior is to use encoded offsets for the `ftello()` function and the `fseeko()` function using an origin of `SEEK_SET`.

Encoded offsets restrict you to seeking only to those positions that are recorded by a previous `ftello()` function call or to position 0. If you want to use relative-byte offsets for these types of files, you can either open the file with the `BYTESEEK` `fopen()` function option or set the `_EDC_BYTE_SEEK` environment variable before opening.

With relative-byte offsets, you can calculate your own offsets. If the offset exceeds the EOF, your file is extended with NULLs, except for z/OS UNIX files, for which the file is only extended with NULLs if you subsequently write new data. This is true also under POSIX, using z/OS UNIX files, where the file is only extended with NULLs if you subsequently write new data.

Attempting to reposition to before the start of the file causes the `fseeko()` function to fail.

Regardless of whether encoded or relative offsets are returned by the `ftello()` function, you can specify relative offsets when using `SEEK_CUR` and `SEEK_END`.

If the new position is before the start of the file, the `fseeko()` function fails. If the relative offset is positioned beyond the EOF, the file is padded with NULLs, except in the case of POSIX, using z/OS UNIX files, where padding does not occur until a subsequent write of new data.

Behavior for text streams: For text streams, the `ftello()` function returns an encoded offset. When seeking with an origin of `SEEK_SET`, you are restricted to seeking only to 0 or to positions returned by a previous `ftello()` function call.

Attempting to calculate your own position is not supported, and might result in a non-valid position and the failure of the `fseeko()` function.

When you are using `SEEK_CUR` or `SEEK_END`, the offset is a relative byte offset. Attempting to seek to before the start of the file or past the EOF results in failure.

Behavior for record I/O: For files opened for record I/O using the `type=record` open mode parameter, the `ftello()` function returns the relative record number. For the origins of `SEEK_SET`, `SEEK_CUR`, and `SEEK_END`, the offset is a relative record number.

Attempting to seek to before the first record or past the EOF results in failure.

Behavior for blocked I/O: For files opened for blocked I/O using the `type=blocked` open mode parameter, the `ftello()` function returns the relative block number. For the origins of `SEEK_SET`, `SEEK_CUR`, and `SEEK_END`, the offset is a relative block number.

Attempting to seek to before the first block or past the EOF results in failure.

Behavior for wide-oriented streams: All of the above restrictions apply for wide-oriented streams of any type.

Multivolume data sets performance: Using the `fgetpos()` and `fsetpos()` functions generally results in better repositioning performance compared to the `ftello()` and `fseeko()` functions when working with multivolume data sets.

Large file support for MVS data sets, VSAM data sets, and z/OS UNIX files: For AMODE 31 C/C++ applications, the `fseeko()` function accepts a signed 4-byte offset and therefore cannot be used to directly or relatively position to offsets beyond 2 GB - 1. To avoid repositioning limitations, AMODE 31 C/C++ applications should define the `_LARGE_FILES` feature test macro before any headers are included. For AMODE 64 C/C++ applications, there are no restrictions on using the `fseeko()` function with large files. The AMODE 64 version automatically accepts a signed 8-byte offset.

Usage notes

1. Repositioning within a wide-oriented file and performing updates is strongly discouraged because it is not possible to predict if your update will overwrite part of a multibyte string or character, thereby invalidating subsequent data. For example, you could inadvertently add data that overwrites a shift-out. The following data expects the shift-out to be there, so is not valid if it is treated as if in the initial shift state. Repositioning to the end of the file and adding new data is safe.
2. If you specify `SEEK_CUR`, any characters pushed back by the `ungetc()` or `ungetwc()` functions will have backed up the current position of the file pointer—which is the starting point of the seek. The seek will discard any pushed-back characters before repositioning, but the starting point will still be affected. For more information about calling the `fseeko()` function after an `ungetc()` or `ungetwc()` function call, see [“ungetc\(\) — Push character onto input stream” on page 1941](#) and [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#).
3. The `_EDC_COMPAT` environment variable causes `fseeko()` to ignore the effects of the `ungetc()` or `ungetwc()` functions. For more details, see the topic about environment variables in [z/OS XL C/C++ Programming Guide](#).
4. The `fseeko_unlocked()` function is functionally equivalent to the `fseeko()` function with the exception that it is not threadsafe. The `fseek()` function can safely be used in a multithreaded application if, and only if, it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `fseeko()` returns 0, which means it successfully moved the pointer.

If unsuccessful, `fseeko()` returns nonzero and sets `errno` to one of the following values.

On devices that cannot seek, such as terminals and printers, the `fseeko()` function returns nonzero.

Error Code

Description

EBADF

The file descriptor underlying stream is not an open file descriptor.

EOVERFLOW

The current file offset cannot be represented correctly in an object of type `off_t`.

ESPIPE

The file descriptor underlying stream is associated with a pipe or FIFO.

Example

```
/* This example opens a file myfile.dat for reading.
   After performing input operations (not shown), it moves the file
   pointer to the beginning of the file.
*/
#define _XOPEN_SOURCE 500
#define _LARGE_FILES 1
#include <stdio.h>

int main(void)
{
    FILE *stream;
    int result;

    if (stream = fopen("/myfile.dat", "r"))
    { /* successful */

        if (fseeko(stream, 0LL, SEEK_SET)); /* moves pointer to */
                                           /* the beginning of the file */
        { /* if not equal to 0
            then error ... */
        }
    }
    else {
        /* fseeko() successful */
    }
}
```

```
}  
}
```

Related information

- For information about wide-oriented streams, see [z/OS XL C/C++ Programming Guide](#).
- For information about BYTESEEK or _EDC_BYTE_SEEK, see [z/OS XL C/C++ Programming Guide](#).
- For additional usage information about the fseeko() function with respect to MVS data sets, VSAM data sets, or z/OS UNIX files, see [z/OS XL C/C++ Programming Guide](#).
- “stdio.h — Standard input and output” on page 63
- “fseek() — Change file position” on page 638
- “ftello() — Get current file position” on page 659
- “ungetc() — Push character onto input stream” on page 1941
- “ungetwc() — Push a wide character onto a stream” on page 1943

__fseterr() — Set stream in error

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>  
#include <stdio_ext.h>  
  
void __fseterr(FILE *stream);
```

General description

The __fseterr() function sets the specified stream in error.

Returned value

The __fseterr() function returns no values.

An application wishing to check for error situations should set errno to 0, then call __fseterr(), and then check errno. If errno is nonzero, assume that an error has occurred.

Error Code

Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF88

```
/* CELEBF88  
  
   This example sets a stream in error.  
  
*/  
  
#include <stdio.h>
```

```
#include <stdio_ext.h>

void main() {
    FILE *f;
    char filename[FILENAME_MAX] = "myfile.dat";

    f = fopen(filename, "wb");
    if (f == NULL) {
        perror("fopen failed\n");
        return;
    }

    if (ferror(f)) printf("The error indicator is set for the open stream\n");
    else printf("The error indicator is not set for the open stream\n");

    __fseterr(f);

    if (ferror(f)) printf("The error indicator is set for the open stream\n");
    else printf("The error indicator is not set for the open stream\n");

    return;
}
```

Output

```
The error indicator is not set for the open stream
The error indicator is set for the open stream
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“clearerr\(\) — Reset error and end of file \(EOF\)” on page 285](#)
- [“ferror\(\) — Test for read and write errors” on page 512](#)

__fsetlocking() — Set locking type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | None |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

int __fsetlocking(FILE *stream, int type);
```

General description

The `__fsetlocking()` function allows the type of locking on an open stream to be controlled or queried by the application.

If `type` is `FSETLOCKING_INTERNAL`, subsequent stdio functions perform implicit locking around every operation on the given stream. This is the default system behavior.

If `type` is `FSETLOCKING_BYCALLER`, subsequent stdio functions assume that the caller is responsible for maintaining the integrity of the stream in the face of access by multiple threads. If only one thread is accessing the stream, nothing further needs to be done. If multiple threads are accessing the stream, you can use the `flockfile()`, `funlockfile()`, and `ftrylockfile()` functions to provide the appropriate serialization.

If *type* is FSETLOCKING_QUERY, the __fsetlocking() function returns the current locking type of the stream without changing it.

Usage notes

1. The _fsetlocking() function acts upon FILE* objects. It is possible to have the same physical file represented by multiple FILE* objects that are not recognized as being equivalent. For example, fopen() opens a file in thread A and sets the locking type as FSETLOCKING_INTERNAL. Then fopen() opens the same file in another thread B and sets the locking type as FSETLOCKING_BYCALLER. If both threads begin to write to their FILE* objects, the results are unpredictable.
2. The __fsetlocking() function impacts the behavior of all other stream operation functions. Using __fsetlocking() to modify the locking type while any of these stream operation functions are executing might produce undesirable behaviors, including hang conditions. You must make sure that __fsetlocking() is used only when no other functions are acting upon the stream.

Returned value

The __fsetlocking() function returns the locking type in effect before the call to __fsetlocking().

The __fsetlocking() function returns -1 if the stream or the locking type is not valid and sets errno to nonzero.

Error Code

Description

EBADF

The stream specified by *stream* is not valid.

EINVAL

The locking type is not valid.

Example

CELEBF85

```
/* CELEBF85

   This example sets LOCKING_TYPE as locking type to a stream.

   It checks that the fopen() function is successful and that
   locking type is setted to the stream and queried from the stream.

*/

#include <stdio.h>
#include <stdio_ext.h>

int main(void)
{
    FILE *stream;
    int locktype;
    int nwrite;
    int buflen;
    char buf[5]="1234";

    if((stream = fopen("myfile.dat", "w+b")) != NULL )
    {
        locktype = __fsetlocking(stream,FSETLOCKING_BYCALLER);
        locktype = __fsetlocking(stream,FSETLOCKING_QUERY);
        if(locktype == FSETLOCKING_BYCALLER){
            printf("__fsetlocking succeeds! \n\
            Lock type is FSETLOCKING_BYCALLER\n");
        }
        buflen = strlen(buf);
        flockfile(stream);
        nwrite = fwrite(buf, 1, buflen, stream);
        if(nwrite < buflen){
            printf("fwrite did not return expected number of bytes\n");
        }
        funlockfile(stream);
    }
}
```



```

    }
    return(0);
}

```

Output

```
__fsetlocking succeeds! Lock type is FSETLOCKING_BYCALLER
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“ftrylockfile\(\) — stdio locking” on page 665](#)
- [“flockfile\(\) — stdio locking” on page 553](#)
- [“funlockfile\(\) — stdio unlocking” on page 668](#)

fsetpos() — Set file position

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```

#include <stdio.h>

int fsetpos(FILE *stream, const fpos_t *pos);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int fsetpos_unlocked(FILE *stream, const fpos_t *pos);

```

General description

The `fsetpos()` function moves the file position associated with *stream* to a new location within the file according to the value of the object pointed to by *pos*. The value of *pos* must be obtained by a call to the `fgetpos()` function. If successful, the `fsetpos()` function clears the EOF indicator, and cancels the effect of any previous `ungetc()` or `ungetwc()` function on the same stream.

If the call to the `fsetpos()` function is not valid, the call is treated as a flush, and the `ungetc` characters are discarded.

The `fsetpos()` function handles the double-byte character set (DBCS) state information for wide-oriented files. An `fsetpos()` function call to a position that no longer exists results in an error.

For text streams, the DBCS shift state is recalculated from the start of the record, which has a performance implication. The `fsetpos()` function repositions to the start of a multibyte character.

For binary streams, the DBCS shift state is set to the state saved by the `fsetpos()` function. If the record has been updated in the meantime, the shift state might be incorrect.

After the `fsetpos()` function call, the next operation on a stream in update mode can be an input or output operation.

Multivolume data sets performance: Using the `fgetpos()` and `fsetpos()` functions generally results in better repositioning performance compared to the `ftell()` and `fseek()` functions when working with multivolume data sets.

Large file support for MVS data sets, VSAM data sets, and z/OS UNIX files: The `fsetpos()` function implicitly supports operating on large files. Defining the `_LARGE_FILES` feature test macro is not required to use this function on large files.

Usage notes

1. Repositioning within a wide-oriented file and performing updates is strongly discouraged because it is not possible to predict if the update will overwrite part of a multibyte string or character, thereby invalidating subsequent data. For example, you could inadvertently add data that overwrites a shift-out. The following data expects the shift-out to be there, so is not valid if it is treated as if in the initial shift state. Repositioning to the end of the file and adding new data is safe. For information about wide-oriented streams, see *z/OS XL C/C++ Programming Guide*.
2. The `fsetpos_unlocked()` function is functionally equivalent to the `fsetpos()` function with the exception that it is not threadsafe. The `fsetpos()` function can safely be used in a multithreaded application if, and only if, it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful in changing the current position of the file, the `fsetpos()` function returns 0.

If unsuccessful, the `fsetpos()` function returns nonzero and sets `errno`.

Special behavior for XPG4.2: If unsuccessful, the `fsetpos()` function returns -1 and sets `errno` to one of the following values:

Error Code

Description

ESPIPE

The underlying file type for the stream is a PIPE or a socket.

Example

```
/* This example opens a file called myfile.dat for reading.
   After performing input operations (not shown), it moves the file
   pointer to the beginning of the file and rereads the first byte.
*/
#include <stdio.h>

int main(void)
{
    FILE *stream;
    int retcode;
    fpos_t pos, pos1, pos2, pos3;
    char ptr[20]; /* existing file 'myfile.dat' has 20 byte records */

    /* Open file, get position of file pointer, and read first record */

    stream = fopen("myfile.dat", "rb");
    fgetpos(stream, &pos);
    pos1 = pos;
    if (!fread(ptr, sizeof(ptr), 1, stream))
        printf("fread error\n");

    /* Perform a number of read operations. The value of 'pos'
       changes if 'pos' is passed to fgetpos() */

    :

    /* Re-set pointer to start of file and re-read first record */
```

```
fsetpos(stream,&pos1);
if (!fread(ptr,sizeof(ptr),1,stream))
    printf("fread error\n");

fclose(stream);
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fgetpos\(\) — Get file position” on page 534](#)
- [“ftell\(\) — Get current file position” on page 657](#)
- [“rewind\(\) — Set file position to beginning of file” on page 1449](#)
- [“ungetc\(\) — Push character onto input stream” on page 1941](#)
- [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#)

fstat(), fstat64() — Get status information about a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

fstat:

```
#define _POSIX_SOURCE
#include <sys/stat.h>

int fstat(int fildes, struct stat *info);
```

fstat64:

```
#define _LARGE_TIME_API
#define _POSIX_SOURCE
#include <sys/stat.h>

int fstat64 (int fildes, struct stat64 *info);
```

Compile requirement: Use of the fstat64() function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

Gets status information about the file specified by the open file descriptor *fil*des and stores it in the area of memory indicated by the *info* argument. The status information is returned in a stat or stat64 structure, as defined in the sys/stat.h header file. The elements of this structure are described in [“stat\(\), stat64\(\) — Get file information” on page 1706](#).

The fstat64() function behaves exactly like fstat() except fstat64() uses structure stat64 instead of struct stat to support time beyond 03:14:07 UTC on January 19, 2038.

Note: Environment variable _EDC_EOVERFLOW can be used to control behavior of fstat() with respect to detecting an EOVERFLOW condition for z/OS UNIX files. By default, fstat() does not set

EOVERFLOW when the file size cannot be represented correctly in structure pointed to by info. When `_EDC_EOVERFLOW` is set to YES, `fstat()` will check for an overflow condition.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `fstat()` returns 0.

If unsuccessful, `fstat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

fildev is not a valid open file descriptor.

EINVAL

info contains a NULL.

EIO

Added for XPG4.2: An I/O error occurred while reading from the file system.

EOVERFLOW

The file size in bytes or the number of blocks allocated to the file or the file serial number cannot be represented correctly in the structure pointed to by info.

Note: The `fstat()` function might fail with error code EOVERFLOW if large file support is not enabled. The environment variable `_EDC_EOVERFLOW` controls this behavior. If `_EDC_EOVERFLOW` is set to YES the new behavior will take place. The default for `_EDC_EOVERFLOW` is NO.

Example

CELEBF47 This example gets status information for the file called `temp.file`.

```
/* CELEBF47 */
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>
#include <time.h>

main() {
    char fn[]="temp.file";
    struct stat info;
    int fd;

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        if (fstat(fd, &info) != 0)
            perror("fstat() error");
        else {
            puts("fstat() returned:");
            printf("  inode:   %d\n", (int) info.st_ino);
            printf(" dev id:  %d\n", (int) info.st_dev);
            printf("   mode:  %08x\n", info.st_mode);
            printf("  links:  %d\n", info.st_nlink);
            printf("   uid:   %d\n", (int) info.st_uid);
            printf("   gid:   %d\n", (int) info.st_gid);
            printf("created:  %s", ctime(&info.st_createtime));
        }
        close(fd);
    }
}
```

```
        unlink(fn);
    }
}
```

Output

fstat() returned the following output:

```
inode:    3057
dev id:   1
mode:    03000080
links:    1
uid:     25
gid:     500
created:  Fri Jun 16 16:03:16 2006
```

Related information

- [“sys/stat.h – z/OS UNIX files and access” on page 70](#)
- [“sys/types.h – typedef symbols and structures” on page 71](#)
- [“fcntl\(\) – Control open file descriptors” on page 483](#)
- [“lstat\(\), lstat64\(\) – Get status of file or symbolic link” on page 1025](#)
- [“open\(\) – Open a file” on page 1157](#)
- [“stat\(\), stat64\(\) – Get file information” on page 1706](#)

fstatat(), fstatat64() – Get file status information relative to a directory file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

fstatat:

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>
#include <sys/stat.h>

int fstatat(int dirfd, const char *pathname, struct stat *statbuf, int flags);
```

fstatat64:

```
#define _LARGE_TIME_API
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>

int fstatat64(int dirfd, const char *pathname, struct stat64 *statbuf, int flags);
```

Compile requirement: Use of the fstatat64() function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

fstatat() is equivalent to stat() except for the following differences.

- If the *pathname* is relative, it is interpreted relative to the directory referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by *stat()* for a relative *pathname*).
- If *pathname* is relative and *dirfd* is the special value *AT_FDCWD*, *pathname* is interpreted relative to the current working directory of the calling process.

If *pathname* is absolute, *dirfd* is ignored.

The *flags* argument is a bit mask consisting of zero or the following flag:

AT_SYMLINK_NOFOLLOW

If *pathname* is a symbolic link, the status of the symbolic link is returned.

Note: Environment variable *_EDC_EOVERFLOW* can be used to control behavior of *fstatat()* regarding detecting an *EOverflow* condition for z/OS UNIX files. By default, *fstatat()* does not set *EOverflow* when the file size cannot be represented correctly in the structure that is pointed to by *statbuf*. When *_EDC_EOVERFLOW* is set to YES, *fstatat()* checks for an overflow condition.

Large file support for z/OS UNIX files: *fstatat64()* automatically supports large z/OS UNIX files for both *AMODE 31* and *AMODE 64 C/C++* applications, which means the *_LARGE_FILES* feature test macro does not need to be defined. However, *fstatat()* automatically supports large z/OS UNIX files for *AMODE 64 C/C++* applications only. *AMODE 31 C/C++* applications must be compiled with the [long long data type support](#) enabled and define the *_LARGE_FILES* feature test macro before any headers are included to enable *fstatat()* to operate on z/OS UNIX files that are larger than 2 GB. File size and offset fields are enlarged to 63 bits. Therefore, any other function operating on the file is required to define the *_LARGE_FILES* feature test macro.

Returned value

If successful, *fstatat()* and *fstatat64()* return 0.

If unsuccessful, *fstatat()* and *fstatat64()* return -1 and sets *errno* to one of the following values:

Error Code

Description

EACCES

The process does not have search permission on some component of the *pathname* prefix.

EBADF

The file descriptor that is specified for *dirfd* is incorrect.

EINVAL

pathname is a NULL pointer, *statbuf* is a NULL pointer, an invalid flag was specified in *flags*, or *dot(.)* or *dot-dot(. .)* is specified in the *pathname*.

ELOOP

A loop exists in symbolic links that are encountered during resolution of the *pathname* argument. This error is returned if more than *POSIX_SYMLINK_LOOP* (defined in the *limits.h* header file) symbolic links are encountered during resolution of the *pathname* argument.

ENAMETOOLONG

pathname is longer than *PATH_MAX* characters, or some component of *pathname* is longer than *NAME_MAX* characters while *_POSIX_NO_TRUNC* is in effect. For symbolic links, the length of the path name string that is substituted for a symbolic link exceeds *PATH_MAX*. The *PATH_MAX* and *NAME_MAX* values can be determined with *pathconf()*.

ENOENT

There is no file that is named *pathname*, or *pathname* is an empty string.

ENOTDIR

A component of the *pathname* prefix names an existing file that is not a directory or a symbolic link to a directory, or the *pathname* argument contains at least one non-*<slash>* character and ends with one or more trailing *<slash>* characters and the last *pathname* component names an existing file that is not a directory or a symbolic link to a directory.

EOVERFLOW

The file size in bytes or the number of blocks that are allocated to the file or the file serial number cannot be represented correctly in the structure that is pointed to by *statbuf*.

Note: The `fstatat()` function might fail with error code `EOVERFLOW` if large file support is not enabled. The environment variable `_EDC_EOVERFLOW` controls this behavior. If `_EDC_EOVERFLOW` is set to `YES`, the new behavior takes place. The default for `_EDC_EOVERFLOW` is `NO`.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“mknod\(\) — Make a directory or file” on page 1078](#)
- [“fstat\(\), fstat64\(\) — Get status information about a file” on page 649](#)
- [“lstat\(\), lstat64\(\) — Get status of file or symbolic link” on page 1025](#)

fstatfs() — Get file system statistics

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/statfs.h>

int fstatfs(int fd, struct statfs *buf);
```

General description

The `fstatfs()` system call returns information about a mounted file system. *fd* is a descriptor refer to an open file. *buf* is a pointer to a structure of `statfs` as defined in the `sys/statfs.h` header file.

Returned value

If successful, `fstatfs()` returns 0.

If unsuccessful, `fstatfs()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EBADF**

The *fd* argument is not a valid file descriptor.

EINTR

A signal is caught during the function execution.

EIO

An I/O error occurs while reading the file system.

EINVAL

A parameter is specified incorrectly.

ERANGE

The result is too large to fit in the available buffer space.

Related information

- [“sys/statvfs.h — File system status” on page 71](#)

fstatvfs() — Get file system information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/statvfs.h>

int fstatvfs(int fildev, struct statvfs *fsinfo);
```

General description

The `fstatvfs()` function obtains information about the file system containing the file referenced by *fildev* and stores it in the area of memory pointed to by the *fsinfo* argument.

The information is returned in a `statvfs` structure, as defined in the `sys/statvfs.h` header file. The elements of this structure are described in [“statvfs\(\) — Get file system information” on page 1712](#). If `fstatvfs()` successfully determines this information, it stores it in the area indicated by the *fsinfo* argument. The size of the buffer determines how much information is stored; data that exceeds the size of the buffer is truncated.

Returned value

If successful, `fstatvfs()` returns 0.

If unsuccessful, `fstatvfs()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

fildev is not a valid open file descriptor.

EINTR

A signal was caught during the execution of the function.

EIO

An I/O error has occurred while reading the file system.

Example

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/statvfs.h>
#include <stdio.h>

main()
{
    char fn[]="temp.file";
    int fd;
    struct statvfs buf;

    if ((fd = creat(fn,S_IWUSR)) < 0)
        perror("creat() error");
```



```

else {
    if (fstatvfs(fd, &buf) == -1)
        perror("fstatvfs() error");
    else {
        printf("each block is %d bytes big\n", buf.f_frsize);
        printf("there are %d blocks available\n", buf.f_bavail);
        printf("out of a total of %d in bytes,\n", buf.f_blocks);
        printf("that's %.0f bytes free out of a total of %.0f\n",
            ((double)buf.f_bavail * buf.f_frsize),
            ((double)buf.f_blocks * buf.f_frsize));
    }
    close(fd);
    unlink(fn);
}
}

```

Output

```

each block is 4096 bytes big
there are 2089 blocks available
out of a total of 2400 in bytes,
that's 8556544 bytes free out of a total of 9830400

```

Related information

- [“sys/statvfs.h — File system status” on page 71](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“mknod\(\) — Make a directory or file” on page 1078](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“time\(\),time64\(\) — Determine current UTC time” on page 1865](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)
- [“utime\(\), utime64\(\) — Set file access and modification times” on page 1952](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

fsync() — Write changes to direct-access storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX1_SOURCE 2
#include <unistd.h>

int fsync(int fildes);
```

General description

Transfers all data for the file indicated by the open file descriptor *fil*des to the storage device associated with *fil*des. fsync() does not return until the transfer has completed, or until an error is detected.

Returned value

If successful, fsync() returns 0.

If unsuccessful, fsync() returns -1 and sets errno to one of the following values:

Error Code

Description

EBADF

*fil*des is not a valid open file descriptor.

EINVAL

The file is not a regular file.

Example

CELEBF48

```
/* CELEBF48 */
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>
#include <stdlib.h>

#define mega_string_len 250000

main() {
    char *mega_string;
    int fd, ret;
    char fn[]="fsync.file";

    if ((mega_string = (char*) malloc(mega_string_len)) == NULL)
        perror("malloc() error");
    else if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        memset(mega_string, 's', mega_string_len);
        if ((ret = write(fd, mega_string, mega_string_len)) == -1)
            perror("write() error");
        else {
            printf("write() wrote %d bytes\n", ret);
            if (fsync(fd) != 0)
                perror("fsync() error");
            else if ((ret = write(fd, mega_string, mega_string_len)) == -1)
                perror("write() error");
            else
                printf("write() wrote %d bytes\n", ret);
        }
        close(fd);
        unlink(fn);
    }
}
```

Output

```
write() wrote 250000 bytes
write() wrote 250000 bytes
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

ftell() — Get current file position

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

long int ftell(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

long int ftell_unlocked(FILE *stream);
```

General description

The `ftell()` function obtains the current value of the file position indicator for the stream pointed to by *stream*.

Behavior for binary streams: ISO C/C++ states that the `ftell()` function returns relative byte offsets from the beginning of the file for binary files. Under IBM z/OS C/C++, this is true except for record-oriented files that have variable length records. For these types of files, the `ftell()` function returns an encoded offset.

If you want to use relative-byte offsets for these types of files, you can either open the file with the `BYTESEEK` `fopen()` function option or set the `_EDC_BYTE_SEEK` environment variable before opening.

Behavior for text streams: The `ftell()` function returns an encoded offset for text streams.

Behavior for record I/O: For files opened for record I/O using the `type=record` open mode parameter, the `ftell()` function returns the relative record offset of the current file position from the beginning of the file. All offset values are given in terms of records.

Behavior for blocked I/O: For files opened for blocked I/O using the `type=blocked` open mode parameter, the `ftell()` function returns the relative block offset of the current file position from the beginning of the file. All offset values are given in terms of blocks.

Multivolume data sets performance: Using the `fgetpos()` and `fsetpos()` functions generally results in better repositioning performance compared to the `ftell()` and `fseek()` functions when working with multivolume data sets.

Large file support for MVS data sets, VSAM data sets, and z/OS UNIX files: For AMODE 31 C/C++ applications, the `ftell()` function accepts a signed 4-byte offset and therefore cannot be used to directly or relatively position to offsets beyond 2 GB - 1. To avoid repositioning limitations, AMODE 31 C/C++ applications should define the `_LARGE_FILES` feature test macro before any headers are included and replace the `ftell()` function with the `ftello()` function. For AMODE 64 C/C++ applications, there are no restrictions on using the `ftell()` function with large files. The AMODE 64 version automatically accepts a signed 8-byte offset.

Usage note

The `ftell_unlocked()` function is functionally equivalent to the `ftell()` function with the exception that it is not threadsafe. The `ftell()` function can safely be used in a multithreaded application if, and only if, it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, the `ftell()` function returns the calculated value.

If unsuccessful, the `ftell()` function returns -1 and sets `errno` to a positive value.

Special behavior for XPG4.2: If unsuccessful, the `ftell()` function returns -1 and sets `errno` to one of the following values:

Error Code

Description

EOverflow

For `ftell()`, the current file offset cannot be represented correctly in an object of type `long`.

Note: Environment variable `_EDC_EOverflow` can be used to control behavior of the `ftell()` function with respect to detecting an `EOverflow` condition for z/OS UNIX files. By default, the `ftell()` function will not set `EOverflow` when the file offset cannot be represented correctly. When `_EDC_EOverflow` is set to YES, the `ftell()` function will check for an overflow condition.

ESPIPE

The underlying file type for the stream is a PIPE or a socket.

Example

```
/* This example opens the file myfile.dat for reading.
   The current file pointer position is stored in the variable pos.
*/
#include <stdio.h>

int main(void)
{
    FILE *stream;
    long int pos;

    stream = fopen("myfile.dat", "rb");

    /* The value returned by ftell can be used by fseek()
       to set the file pointer if 'pos' is not -1          */

    if ((pos = ftell(stream)) != EOF)
        printf("Current position of file pointer found\n");
    fclose(stream);
}
```

Related information

- For information about `BYTESEEK` or `_EDC_BYTE_SEEK`, see [z/OS XL C/C++ Programming Guide](#).
- For information about calling the `ftell()` function after an `ungetc()` or `ungetwc()` function call, see [“ungetc\(\) — Push character onto input stream”](#) on page 1941 and [“ungetwc\(\) — Push a wide character onto a stream”](#) on page 1943.
- For additional usage information about the `ftell()` function with respect to MVS data sets, VSAM data sets, or z/OS UNIX files, see [z/OS XL C/C++ Programming Guide](#).
- [“stdio.h — Standard input and output”](#) on page 63
- [“fgetpos\(\) — Get file position”](#) on page 534
- [“fopen\(\) — Open a file”](#) on page 571
- [“fseek\(\) — Change file position”](#) on page 638
- [“fsetpos\(\) — Set file position”](#) on page 647
- [“ftello\(\) — Get current file position”](#) on page 659

ftello() — Get current file position

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 Language Environment | both | OS/390 V2R10 |

Format

```
#define _XOPEN_SOURCE 500
#include <stdio.h>

off_t ftello(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

off_t ftello_unlocked(FILE *stream);
```

General description

The `ftello()` function obtains the current value of the file position indicator for the stream pointed to by *stream*.

Behavior for binary streams: ISO C/C++ states that the `ftello()` function returns relative byte offsets from the beginning of the file for binary files. Under IBM z/OS C/C++, this is true except for record-oriented files that have variable length records. For these types of files, the `ftello()` function returns an encoded offset.

If you want to use relative-byte offsets for these types of files, you can either open the file with the `BYTESEEK` `fopen()` function option or set the `_EDC_BYTE_SEEK` environment variable before opening.

Behavior for text streams: The `ftello()` function returns an encoded offset for text streams.

Behavior for record I/O: For files opened for record I/O using the `type=record` open mode parameter, the `ftello()` function returns the relative record offset of the current file position from the beginning of the file. All offset values are given in terms of records.

Behavior for blocked I/O: For files opened for blocked I/O using the type=blocked open mode parameter, the ftello() function returns the relative block offset of the current file position from the beginning of the file. All offset values are given in terms of blocks.

Multivolume data sets performance: Using the fgetpos() and fsetpos() functions generally results in better repositioning performance compared to the ftello() and fseeko() functions when working with multivolume data sets.

Large file support for MVS data sets, VSAM data sets, and z/OS UNIX files: For AMODE 31 C/C++ applications, the ftello() function accepts a signed 4-byte offset and therefore cannot be used to directly or relatively position to offsets beyond 2 GB - 1. To avoid repositioning limitations, AMODE 31 C/C++ applications should define the _LARGE_FILES feature test macro before any headers are included. For AMODE 64 C/C++ applications, there are no restrictions on using the ftello() function with large files. The AMODE 64 version automatically accepts a signed 8-byte offset.

Usage notes

1. The ftello_unlocked() function is functionally equivalent to the ftello() function with the exception that it is not threadsafe. The ftello() function can safely be used in a multithreaded application if, and only if, it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

Returned value

If successful, the ftello() function returns the calculated value.

If unsuccessful, the ftello() function returns (off_t)-1 and sets errno to one of the following values:

Error Code

Description

EBADF

The file descriptor underlying stream is not an open file descriptor.

E_OVERFLOW

The current file offset cannot be represented correctly in an object of type off_t.

ESPIPE

The file descriptor underlying stream is associated with a pipe or FIFO.

Example

```
/* This example opens the file myfile.dat for reading.
   The current file pointer position is stored in the variable
   pos.
*/
#define _XOPEN_SOURCE 500
#define _LARGE_FILES 1
#include <stdio.h>

int main(void)
{
    FILE *stream;
    off_t pos;

    stream = fopen("/myfile.dat", "rb");

    /* The value returned by ftello() can be used by fseeko()
       to set the file pointer if 'pos' is not -1 */

    if ((pos = ftello(stream)) != -1LL)
        printf("Current position of file pointer found\n");
    fclose(stream);
}
```

Related information

- For information about `BYTESEEK` or `_EDC_BYTE_SEEK`, see [z/OS XL C/C++ Programming Guide](#).
- For information about calling the `ftello()` function after an `ungetc()` or `ungetwc()` function call, see [“ungetc\(\) — Push character onto input stream” on page 1941](#) and [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#).
- For additional usage information about the `ftello()` function with respect to MVS data sets, VSAM data sets, or z/OS UNIX files, see [z/OS XL C/C++ Programming Guide](#).
- [“stdio.h — Standard input and output” on page 63](#)
- [“fgetpos\(\) — Get file position” on page 534](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“fseek\(\) — Change file position” on page 638](#)
- [“fsetpos\(\) — Set file position” on page 647](#)
- [“ftell\(\) — Get current file position” on page 657](#)
- [“ungetc\(\) — Push character onto input stream” on page 1941](#)
- [“ungetwc\(\) — Push a wide character onto a stream” on page 1943](#)

ftime(), ftime64() — Set the date and time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

ftime:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/timeb.h>

int ftime(struct timeb *tp);
```

ftime64:

```
#define _LARGE_TIME_API
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/timeb.h>

int ftime64(struct timeb64 *tp);
```

Compile requirement: Use of the `ftime64()` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The `ftime()` function sets the `time` and `millitm` members of the `timeb` structure pointed to by `tp` to contain seconds and milliseconds, respectively, of the current time in seconds since 00:00:00 Coordinated Universal Time (UTC), January 1, 1970.

Note: The `ftime()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `time()` function is preferred for portability.

The `ftime64()` function behaves exactly like `ftime()` except `ftime64()` supports time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, `ftime()` returns 0.

If overflow occurs¹, `ftime()` returns -1.

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“sys/timex.h — Date and time” on page 71](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“time\(\), time64\(\) — Determine current UTC time” on page 1865](#)

ftok() — Generate an interprocess communication (IPC) key

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/ipc.h>

key_t ftok(const char *path, int id);
```

General description

The `ftok()` function returns a key based on *path* and *id* that is usable in subsequent calls to `msgget()`, `semget()`, and `shmget()`. The *path* argument must be the path name of an existing file that the process is able to `stat()`.

The `ftok()` function returns the same key value for all paths that name the same file, when called with the same *id* value. If a different *id* value is given, or a different file is given, a different key is returned. Only the low-order 8-bits of *id* are significant, and must be nonzero.

Note: The `ftok()` function does not guarantee unique key generation. The key is created by combining the given *id* byte, the lower 16 bits of the inode number, and the lower 8 bits of the device number into a 32-bit result. The occurrence of key duplication is very rare.

Returned value

If successful, `ftok()` returns a key.

If unsuccessful, `ftok()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Search permission is denied for a component of the path prefix.

¹ Overflow occurs when the current time in seconds since 00:00:00 UTC, January 1, 1970 exceeds the capacity of the *time* member of the `timeb` structure pointed to by *tp*. The *time* member is type `time_t`.

EINVAL

The low-order 8-bits of *id* are zero.

ELOOP

Too many symbolic links were encountered in resolving path.

ENAMETOOLONG

One of the following error conditions exists:

- The length of the *path* argument exceeds **PATH_MAX** or a path name component is longer than **NAME_MAX**.
- The path name resolution of a symbolic link produced an intermediate result whose length exceeds **PATH_MAX**.

ENOENT

A component of *path* does not name an existing file or *path* is an empty string.

ENOTDIR

A component of the path prefix is not a directory.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“msgget\(\) — Get message queue” on page 1112](#)
- [“semget\(\) — Get a set of semaphores” on page 1486](#)
- [“shmget\(\) — Get a shared memory segment” on page 1597](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)

ftruncate() — Truncate a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1a XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX1_SOURCE 2
#include <unistd.h>

int ftruncate(int fil-des, off_t length);
```

General description

The `ftruncate()` function truncates the file indicated by the open file descriptor *fil-des* to the indicated *length*. *fil-des* must be a regular file that is open for writing. If the file size exceeds *length*, any extra data is discarded. If the file size is smaller than *length*, bytes between the old and new lengths are read as zeros. A change to the size of the file has no impact on the file offset.

Special behavior for XPG4.2: If the `ftruncate()` function would cause the file size to exceed the soft file size limit for the process, `ftruncate()` will fail and a SIGXFSZ signal will be generated for the process.

If successful, the `ftruncate()` function marks the `st_ctime` and `st_mtime` fields of the file.

If unsuccessful, the `ftruncate()` function leaves the file unchanged.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, the `ftruncate()` function returns 0.

If unsuccessful, the `ftruncate()` function returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

filides is not a valid open file descriptor.

EFBIG

The length argument was greater than the maximum file size.

EINTR

Added for XPG4.2: A signal was caught during execution.

EINVAL

filides does not refer to a regular file, it is opened read-only, or the length specified is incorrect.

EIO

Added for XPG4.2: An I/O error occurred while reading from or writing to a file system.

EROFS

The file resides on a read-only file system.

Example

CELEBF49

```
/* CELEBF49 */
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>
#include <stdlib.h>

#define string_len 1000

main() {
    char *mega_string;
    int fd, ret;
    char fn[]="write.file";
    struct stat st;

    if ((mega_string = (char*) malloc(string_len)) == NULL)
        perror("malloc() error");
    else if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        memset(mega_string, '0', string_len);
        if ((ret = write(fd, mega_string, string_len)) == -1)
            perror("write() error");
        else {
            printf("write() wrote %d bytes\n", ret);
            fstat(fd, &st);
            printf("the file has %ld bytes\n", (long) st.st_size);
            if (ftruncate(fd, 1) != 0)
                perror("ftruncate() error");
            else {
                fstat(fd, &st);
                printf("the file has %ld bytes\n", (long) st.st_size);
            }
        }
    }
}
```

```

    }
    }
    close(fd);
    unlink(fn);
}

```

Output

```

write() wrote 1000 bytes
the file has 1000 bytes
the file has 1 bytes

```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“truncate\(\) — Truncate a file to a specified length” on page 1901](#)

ftrylockfile() — stdio locking

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R8 |

Format

```

#define _UNIX03_SOURCE
#include <stdio.h>

int ftrylockfile(FILE *file);

```

General description

This function provides explicit application-level locking of stdio (FILE*) objects. The flockfile() family of functions can be used by a thread to delineate a sequence of I/O statements that are executed as a unit.

If the (**FILE***) object specified by the ftrylockfile() function is available, ownership is granted to the thread for the (FILE*) object and the internal lock count is increased. If the thread has previously been granted ownership, the internal lock count is increased. If another thread has been granted ownership, ftrylockfile() does not grant ownership to the calling thread and returns a non-zero value. ftrylockfile() is a non-blocking version of flockfile().

The internal lock count allows matching calls to flockfile() (or successful calls to ftrylockfile()) and funlockfile() to be nested.

z/OS consideration: The flockfile() family of functions acts upon FILE * objects. It is possible to have the same physical file represented by multiple FILE * objects that are not recognized as being equivalent. For example, fopen() opens a file and open() opens the same file, and then fdopen() creates a FILE * object. In this case, locking the first FILE * does not prevent the second FILE * from also being locked and used.

Returned value

The ftrylockfile() function returns zero for success and non-zero to indicate that the lock cannot be acquired.

Error Code
Definition

EBADF

The input (**FILE ***) object is not valid.

EBUSY

The input (**FILE ***) object is locked by another thread.

Note: It is the application’s responsibility to prevent deadlock (or looping). For example, deadlock (or looping) may occur if a (FILE *) object is closed, or a thread is terminated, before relinquishing all locked (FILE *) objects.

Related information

- “[flockfile\(\)— stdio locking](#)” on page 553
- “[funlockfile\(\) — stdio unlocking](#)” on page 668

ftw(), ftw64() – Traverse a file tree

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

ftw:

```
#define _XOPEN_SOURCE
#include <ftw.h>

int ftw(const char *path,
        int (*fn)(const char *, const struct stat *, int),
        int ndirs);
```

ftw64:

```
#define _LARGE_TIME_API
#define _XOPEN_SOURCE
#include <ftw.h>

int ftw64(const char *path,
           int (*fn)(const char *, const struct stat64 *, int),
           int ndirs);
```

Compile requirement: Use of the ftw64() function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The ftw() function recursively descends the directory hierarchy rooted in *path*. For each object in the hierarchy, ftw() calls the function pointed to by *fn*, passing it a pointer to a NULL-terminated string containing the name of the object, a pointer to a *stat* structure containing information about the object, and an integer. Possible values of the integer, defined in the <ftw.h> header, are:

FTW_D
for a directory

FTW_DNR

for a directory that cannot be read

FTW_F

for a file

FTW_SL

for a symbolic link

FTW_NS

for an object other than a symbolic link on which `stat()` could not be successfully executed. If the object is a symbolic link, and `stat()` failed, it is unspecified whether `ftw()` passes `FTW_SL` or `FTW_NS` to the user-supplied function.

If the integer is `FTW_DNR`, descendants of that directory will not be processed. If the integer is `FTW_NS`, the `stat` structure will contain undefined values. An example of an object that would cause `FTW_NS` to be passed to the function pointed to by *fn* would be a file in a directory with read but without execute (search) permission.

The `ftw()` function visits a directory before visiting any of its descendants.

The `ftw()` function uses at most one file descriptor for each level in the tree.

The argument *ndirs* should be in the range of 1 to `OPEN_MAX`.

The tree traversal continues until the tree is exhausted, an invocation of *fn* returns a nonzero value, or some other error, other than `[EACCES]`, is detected within `ftw()`.

The *ndirs* argument specifies the maximum number of directory streams or file descriptors or both available for use by `ftw()` while traversing the tree. When `ftw()` returns it closes any directory streams and file descriptors it uses not counting any opened by the application-supplied *fn* function.

The `ftw64()` function behaves exactly like `ftw()` except `ftw64()` uses structure `stat64` instead of struct `stat` to support time beyond 03:14:07 UTC on January 19, 2038.

Large file support for z/OS UNIX files: `ftw64()` automatically supports large z/OS UNIX files for both `AMODE 31` and `AMODE 64` C/C++ applications, which means there is no need for `_LARGE_FILES` feature test macro to be defined. As for `ftw()`, the automatic support is only for `AMODE 64` C/C++ applications. `AMODE 31` C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable `ftw()` to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If the tree is exhausted, `ftw()` returns 0. If the function pointed to by *fn* returns a nonzero value, `ftw()` stops its tree traversal and returns whatever value was returned by the function pointed to by *fn()*.

If `ftw()` detects an error, it returns -1 and sets `errno` to one of the following values. All other `errno`s returned by `ftw()` are unchanged.

Error Code**Description****EACCES**

Search permission is denied for any component of *path* or read permission is denied for *path*.

EINVAL

The value of the *ndirs* argument is not valid.

ELOOP

Too many symbolic links were encountered.

ENAMETOOLONG

One of the following error conditions exists:

- Path name resolution of a symbolic link produced an intermediate result whose length exceeds PATH_MAX.
- The length of *path* exceeds PATH_MAX, or a path name component is longer than PATH_MAX.

ENOENT

A component of *path* does not name an existing file or *path* is an empty string.

ENOTDIR

A component of *path* is not a directory.

Related information

- [“ftw.h — File tree traversal constants” on page 27](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“lstat\(\), lstat64\(\) — Get status of file or symbolic link” on page 1025](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“nftw\(\), nftw64\(\) — Traverse a file tree” on page 1147](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)

funlockfile() — stdio unlocking

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R8 |

Format

```
#define _UNIX03_SOURCE
#include <stdio.h>

void funlockfile(FILE *file);
```

General description

This function provides explicit application-level unlocking of stdio (FILE*) objects. The flockfile() family of functions can be used by a thread to delineate a sequence of I/O statements that are executed as a unit.

The funlockfile() function reduces the internal lock count. When the count is reduced to zero, the funlockfile() function relinquishes the ownership granted to the thread, of a (FILE *) object. If a call to funlockfile() is made by a thread which has not been granted ownership of a (FILE *) object, the call is ignored and the lock count is not reduced.

The internal lock count allows matching calls to flockfile() (or successful calls to ftrylockfile()) and funlockfile() to be nested.

z/OS consideration: The flockfile() family of functions acts upon FILE * objects. It is possible to have the same physical file represented by multiple FILE * objects that are not recognized as being equivalent. For example, fopen() opens a file and open() opens the same file, and then fdopen() creates a FILE * object. In this case, locking the first FILE * does not prevent the second FILE * from also being locked and used.

Returned value

None.

Notes:

1. Because the `funlockfile()` function returns void, no error information can be returned. If an invalid (FILE *) object is input, it will be ignored.
2. It is the application's responsibility to prevent deadlock (or looping). For example, deadlock (or looping) may occur if a (FILE *) object is closed, or a thread is terminated, before relinquishing all locked (FILE *) objects.

Related information

- [“flockfile\(\)— stdio locking” on page 553](#)
- [“ftrylockfile\(\) — stdio locking” on page 665](#)

fupdate() — Update a VSAM record

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>

size_t fupdate(const void *buffer, size_t size, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

size_t fupdate_unlocked(const void *buffer, size_t size, FILE *stream);
```

General description

Replaces the last record read from the VSAM cluster pointed to by *stream*, with the contents of *buffer* for a length of *size*. See “Performing VSAM I/O Operations” in [z/OS XL C/C++ Programming Guide](#) for details.

The `fupdate()` function can be used *only* with a VSAM data set opened in update mode (`rb+ / r+b`, `ab+ / a+b`, or `wb+ / w+b`) with the `type=record` option.

The `fupdate()` function can only be used after an `fread()` call has been performed and before any other operation on that file pointer. For example, if you need to acquire the file position using `ftell()` or `fgetpos()`, you can do it either before the `fread()` or after the `fupdate()`. An `fread()` after an `fupdate()` retrieves the next updated record.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

`fupdate_unlocked()` is functionally equivalent to `fupdate()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

KSDS or KSDS PATH: The size of the record can be changed by a call to `fupdate()`. If the size is greater than the existing record size but less than or equal to the maximum record length of the file, a call to `fupdate()` will lengthen the record up to the maximum record length of the file. If the size is greater than the maximum record length of the file, the record is truncated and `errno` is set. If the size is less than or

equal to the existing record length, all size bytes of the record are written, and no padding or overlaying occurs. The records will be shortened and not partially updated.

ESDS, ESDS PATH, or RRDS: The size of a record cannot be changed by a call to `fupdate()`. If you call `fupdate()` with *size* smaller than the size of the existing record, *size* bytes of the record are updated; the remaining bytes are unchanged, and the record length remains unchanged.

The key of reference (the prime key if opened as a cluster, the alternative index key if opened as a path) cannot be changed by an update. If a data set is opened as a path, the prime key cannot be changed by an update. For RRDS files, the `buffer` must be an RRDS record structure, which includes an `rrds_key`.

Returned value

If successful, `fupdate()` returns the size of the updated record.

If the update operation is not successful, `fupdate()` returns 0.

Example

CELEBF50

```
/* CELEBF50 */
#include <stdio.h>

int main(void)
{
    FILE *stream;
    struct record { char name[20];
                   char address[40];
                   int age;
                   } buffer;
    int vsam_rc, numread;

    stream = fopen("DD:MYCLUS", "rb+", type=record");
    numread = fread(&buffer, 1, sizeof(buffer), stream);
    /* ... Update fields in the record ... */
    vsam_rc = fupdate(&buffer, sizeof(buffer), stream);
}
```

Related information

- “Performing VSAM I/O Operations” in [z/OS XL C/C++ Programming Guide](#)
- “`stdio.h` — Standard input and output” on page 63
- “`fdelrec()` — Delete a VSAM record” on page 496
- “`flocate()` — Locate a VSAM record” on page 549

futimes() — Change file access and modification times

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE 1

#include <sys/time.h>

int futimes(int fd, const struct timeval times[2]);
```


General description

The `futimes()` function changes the access and modification times of a file that is pointed to by the `fd` argument to the value of the `times` argument. `futimes()` behaves the same as `utimes()`, except that `futimes()` uses a file descriptor `fd` to specify the file whose timestamps are to be changed while `utimes()` uses a path name to specify the file.

The `times` argument is an array of two `timeval` structures. The first array member represents the date and time of the last access, and the second member represents the date and time of the last modification. The times in the `timeval` structure are measured in seconds and microseconds since the Epoch, but the actual times that are stored with the file are rounded to the nearest second. The `timeval` members are:

tv_sec

Seconds since 1 January 1970 (Coordinated Universal Time)

tv_usec

Microseconds

If the `times` argument is a NULL pointer, the access and modification times of the file are set to the current time.

Returned value

If successful, `futimes()` returns 0.

If unsuccessful, `futimes()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have search permission on some components of the `path` prefix; or all of the following are true:

- `times` is NULL.
- The effective user ID of the process does not match the owner of the file.
- The process does not have write permission on the file.

EBADF

The `fd` argument is not a valid file descriptor.

EPERM

`times` is not NULL. The effective user ID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.

EROFS

The file is on a read-only file system.

Related information

- [“sys/time.h — Time types” on page 71](#)
- [“utime\(\), utime64\(\) — Set file access and modification times” on page 1952](#)
- [“utimes\(\), utimes64\(\) — Set file access and modification times” on page 1956](#)
- [“lutimes\(\) — Change file access and modification times” on page 1031](#)

futimesat() — Change timestamps of a file relative to a directory file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <fcntl.h> /* Definition of AT_* constants */
#include <sys/time.h>

int futimesat(int dirfd, const char *pathname, const struct timeval times[2]);
```

General description

`futimesat()` operates in the same way as `utimes()` except for the following differences.

- If *pathname* is relative, it is interpreted relative to the directory referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by `utimes()` for a relative *pathname*).
- If *pathname* is relative and *dirfd* is the special value `AT_FDCWD`, *pathname* is interpreted relative to the current working directory of the calling process (like `utimes()`).
- If *pathname* is absolute, *dirfd* is ignored.

Returned value

If successful, `futimesat()` returns 0.

If unsuccessful, `futimesat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have appropriate permissions. Possible reasons include:

- The process attempts to set access time or modification time to current time (*times* is NULL), but the effective UID of the process does not match the file's owner.
- The process does not have write permission on the file.
- The process does not have appropriate privileges.

EBADF

pathname is relative but *dirfd* is not `AT_FDCWD` or a valid file descriptor, or *dirfd* is not a valid file descriptor.

EBUSY

The file is open by a remote NFS client with a share reservation that conflicts with the requested operation.

EINVAL

- Invalid value in *flags*.
- *pathname* is NULL, *dirfd* is not `AT_FDCWD`, and *flags* contains `AT_SYMLINK_NOFOLLOW`.
- Invalid value in one of the *tv_nsec* fields (value outside range 0 to 999,999,999, and not `UTIME_NOW` or `UTIME_OMIT`); or an invalid value in one of the *tv_sec* fields.

ELOOP

A loop exists in symbolic links. This error is issued if more than POSIX_SYMLOOP symbolic links are detected in the resolution of *pathname*.

EMVSERR

An MVS environmental error is detected.

ENAMETOOLONG

pathname is longer than PATH_MAX characters, or some component of *pathname* is longer than NAME_MAX characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the *pathname* string that is substituted for a symbolic link exceeds PATH_MAX.

ENOENT

There is no file that is named *pathname*, or the *pathname* argument is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EPERM

times is not NULL. The effective user ID of the calling process does not match the owner of the file. The calling process does not have appropriate privileges.

EROFS

pathname is on a read-only file system.

Related information

- [“futimes\(\) — Change file access and modification times” on page 670](#)
- [“openat\(\) — Open a file relative to a directory file descriptor” on page 1162](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“utimes\(\), utimes64\(\) — Set file access and modification times” on page 1956](#)
- [“utimensat\(\) — Change file timestamps with nanosecond precision” on page 1954](#)

fwide() — Set stream orientation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment ISO/ANSI C++ C99 Single UNIX Specification, Version 3 Language Environment | both | z/OS V1R7 |

Format

```
#define _MSE_PROTOS
#include <stdio.h>
#include <wchar.h>

int fwide(FILE *stream, int mode);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

int fwide_unlocked(FILE *stream, int mode);
```

General description

fwide() determines the orientation of the stream pointed to by *stream*. If *mode* is greater than 0, the function attempts to make the stream wide-oriented. If *mode* is less than 0, the function attempts to

make the stream byte-oriented. Otherwise, *mode* is 0 and the function does not alter the orientation of the stream, rather the function returns the current orientation of the stream.

If the orientation of the stream has already been determined, `fwide()` will not change it.

Streams opened as `type=record` or `type=blocked` do not have orientation.

VSAM data sets and CICS transient data queues do not have orientation. Use of `fwide()` against streams referring to VSAM data sets or CICS transient data queues will be unsuccessful.

An application wishing to check for error situations should set `errno` to 0, then call `fwide()`, then check `errno`. If `errno` is non-zero assume an error has occurred.

`fwide_unlocked()` is functionally equivalent to `fwide()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Special considerations for C++: The interaction of `fwide()` and a C++ I/O stream is undefined.

Usage notes

1. The runtime library does not prevent using byte-oriented I/O functions on a wide-oriented stream, using wide-oriented I/O functions on a byte-oriented stream, or any other mixed orientation usage. The behavior of an application doing so is undefined. As a result, the orientation of a stream reported by `fwide()` might not be consistent with the I/O functions that are being used. The stream orientation first set using `fwide()` itself, or through the first I/O operation on the stream is what will be returned. For example, if `fwide()` is used to set the orientation as byte-oriented, but only wide-oriented I/O functions are used on the stream, the orientation of the stream remains byte-oriented even though no mixing of I/O functions has occurred.

Returned value

If successful, `fwide()` returns a value greater than 0 if the stream has wide-orientation after the call. It returns a value less than 0 if the stream has byte-orientation, or 0 if the stream has no orientation after the call.

When unsuccessful, `fwide()` returns 0 and sets `errno` to one of the following:

EBADF – The stream specified by `stream` was not valid.

EINVAL – The stream specified by `stream` was opened as `type=record` or `type=blocked`, or the stream refers to a VSAM data set or CICS transient data queue.

Related information

- [“stdio.h – Standard input and output” on page 63](#)
- [“wchar.h – ISO/C Multibyte Support extensions” on page 79](#)

fwprintf(), swprintf(), wprintf() – Format and write wide characters

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

Non-XPG4:

```
#include <wchar.h>

int fwprintf(FILE * __restrict__ stream, const wchar_t * __restrict__ format, ...);
int swprintf(wchar_t * __restrict__ wcs, size_t n, const wchar_t * __restrict__ format, ...);
int wprintf(const wchar_t * __restrict__ format, ...);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

int fwprintf_unlocked(FILE * __restrict__ stream, const wchar_t * __restrict__ format, ...);
int wprintf_unlocked(const wchar_t * __restrict__ format, ...);
```

XPG4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

int fwprintf(FILE * __restrict__ stream, const wchar_t * __restrict__ format, ...);
int swprintf(wchar_t * __restrict__ wcs, size_t n, const wchar_t * __restrict__ format, ...);
int wprintf(const wchar_t * __restrict__ format, ...);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

int fwprintf_unlocked(FILE * __restrict__ stream, const wchar_t * __restrict__ format, ...);
int wprintf_unlocked(const wchar_t * __restrict__ format, ...);
```

General description

The `fwprintf()`, `swprintf()` and `wprintf()` functions are equivalent to `fprintf()`, `sprintf()` and `printf()`, respectively, except for the following:

- For `swprintf()`, the argument `wcs` specifies an array of type `wchar_t` into which the generated output is to be written, rather than an array of type `char`.
- The argument `format` specifies an array of type `wchar_t` that describes how subsequent arguments are converted for output, rather than an array of type `char`.
- `%c` without an `l` prefix means an `int` arg is to be converted to `wchar_t`, as if `mbtowc()` were called, and then written.
- `%c` with `l` prefix means a `wint_t` is converted to `wchar_t` and then written.
- `%s` without an `l` prefix means a character array containing a multibyte character sequence is to be converted to an array of `wchar_t` and then written. The conversion will take place as if `mbrtowc()` were called repeatedly.
- `%s` with `l` prefix means an array of `wchar_t` will be written. The array is written up to but not including the terminating NULL character, unless the precision specifies a shorter output.

For `swprintf()`, a NULL wide character is written at the end of the wide characters written; the NULL wide character is not counted as part of the returned sum. If copying takes place between objects that overlap, the behavior is undefined.

`fwprintf_unlocked()` family is functionally equivalent to `fwprintf()` family with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `fwprintf()`, `swprintf()` or `wprintf()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Note: The `fwprintf()` and `wprintf()` functions have a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support” on page 2123](#) for details.

Returned value

If successful, `fwprintf()`, `wprintf()`, and `swprintf()` return the number of wide characters written, not counting the terminating NULL wide character.

If unsuccessful, a negative value is returned.

If *n* or more wide characters were requested to be written, `swprintf()` returns a negative value and sets `errno` to indicate the error.

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data” on page 593](#)
- [“vfwprintf\(\), vswprintf\(\), vwprintf\(\) — Format and write wide characters of a STDARG argument list” on page 1970](#)

__fwritable() — Determine if a stream is open for writing

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>
#include <stdio_ext.h>

int __fwritable(FILE *stream);
```

General description

The `__fwritable()` function determines if the specified stream has been opened for writing.

Returned value

The `__fwritable()` function returns nonzero if the stream is opened for writing. Otherwise, the `__fwritable()` function returns 0. If an error has occurred, `__fwritable()` returns 0 and sets `errno` to nonzero.

An application wishing to check for error situations should set `errno` to 0, then call `__fwritable()`, and then check `errno`. If `errno` is nonzero, assume that an error has occurred.

Error Code

Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF89

```
/* CELEBF89

   This example writes and reads data to a file while querying the
   stream for information about data in the I/O buffer.

*/

#include <stdio.h>
```

```
#include <stdio_ext.h>

void main() {
    FILE *f;
    char filename[FILENAME_MAX] = "myfile.dat";
    char data[128] = "There are 34 bytes in this buffer\n";
    int datalen = strlen(data);
    size_t n = 0;

    f = fopen(filename, "wb+");
    if (f == NULL) {
        perror("fopen() failed\n");
        return;
    }

    if (__fwritable(f)) printf("Writing is allowed on the open stream\n");
    if (__freadable(f)) printf("Reading is allowed on the open stream\n");

    n = fputs(data, f);
    if (n == EOF) {
        perror("fputs() failed\n");
        return;
    }

    n = __fpending(f);
    printf("There are %d bytes in the buffer pending to be written\n", n);

    if (__fwriting(f)) printf("The last operation on the stream was a write\n");

    rewind(f);

    n = fgetc(f);

    n = __freadahead(f);
    printf("There are %d bytes remaining to be read from the buffer\n", n);

    if (__freading(f)) printf("The last operation on the stream was a read\n");

    return;
}
```

Output

```
Writing is allowed on the open stream
Reading is allowed on the open stream
There are 34 bytes in the buffer pending to be written
The last operation on the stream was a write
There are 33 bytes remaining to be read from the buffer
The last operation on the stream was a read
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“freopen\(\) — Redirect an open file” on page 622](#)
- [“__freadable\(\) — Determine if a stream is open for reading” on page 614](#)
- [“__freading\(\) — Determine if last operation on stream is a read operation” on page 618](#)
- [“__fwriting\(\) — Determine if last operation on stream is a write operation” on page 679](#)

fwrite() – Write items

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

size_t fwrite(const void * __restrict__buffer, size_t size, size_t count, FILE * __restrict__stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

size_t fwrite_unlocked(const void * __restrict__buffer, size_t size,
                      size_t count, FILE * __restrict__stream);
```

General description

Writes up to *count* items of size *size* from the location pointed to by *buffer* to the stream pointed to by *stream*.

When you are using `fwrite()` for record I/O output, set *size* to 1 and *count* to the length of the record to be written. You can only write one record at a time when you are using record I/O. Any string longer than the record length is truncated at the record length. A flush or reposition is required before a subsequent read.

When you are using `fwrite()` for blocked I/O output, set *size* to 1 and *count* to the length of the block to be written. You can only write one block at a time when you are using blocked I/O. Any string longer than the block length is truncated at the block length.

Because `fwrite()` may buffer output before writing it out to the stream, data from prior `fwrite()` calls may be lost where a subsequent call to `fwrite()` causes a failure when the buffer is written to the stream.

`fwrite()` has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`fwrite_unlocked()` is functionally equivalent to `fwrite()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

`fwrite()` returns the number of items that were successfully written.

This number can be smaller than *count* only if a write error occurred.

Example

CELEBF51

```

/* CELEBF51

   This example writes NUM long integers to a stream in binary
   format.
   It checks that the &fopen. function is successful and that
   100 items are written to the stream.

*/
#include <stdio.h>
#define NUM 100

int main(void)
{
    FILE *stream;
    long list[NUM];
    int numwritten, number;

    if((stream = fopen("myfile.dat", "w+b")) != NULL )
    {
        for (number = 0; number < NUM; ++number)
            list[number] = number;
        numwritten = fwrite(list, sizeof(long), NUM, stream);
        printf("number of long characters written is %d\n",numwritten);
    }
    else
        printf("fopen error\n");
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“freopen\(\) — Redirect an open file” on page 622](#)
- [“fread\(\) — Read items” on page 613](#)

__fwriting() — Determine if last operation on stream is a write operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```

#include <stdio.h>
#include <stdio_ext.h>

int __fwriting(FILE *stream);

#define _OPEN_SYS_UNLOCKED 1
#include <stdio.h>
#include <stdio_ext.h>

int __fwriting_unlocked(FILE *stream);

```

General description

The `__fwriting()` function determines if the last operation on the specified stream is a write operation or if the specified stream is open for write-only or append-only.

The `__fwrite_unlocked()` function is equivalent to the `__fwriting()` function with the exception that it is not thread-safe. This function can be safely used in a multithreaded application if it is called while the invoking thread owns the (FILE *) object, such as after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

The `__fwriting()` functions return nonzero when the last operation was a write operation or the stream is open for write-only or append-only. Otherwise, the `__fwriting()` function returns 0. If an error has occurred, the `__fwriting()` functions return 0 and set `errno` to nonzero.

An application wishing to check for error situations should set `errno` to 0, then call `__fwriting()`, and then check `errno`. If `errno` is nonzero, assume that an error has occurred.

Error Code

Description

EBADF

The stream specified by *stream* is not valid.

Example

CELEBF89

```
/* CELEBF89

   This example writes and reads data to a file while querying the
   stream for information about data in the I/O buffer.

*/

#include <stdio.h>
#include <stdio_ext.h>

void main() {
    FILE *f;
    char filename[FILENAME_MAX] = "myfile.dat";
    char data[128] = "There are 34 bytes in this buffer\n";
    int datalen = strlen(data);
    size_t n = 0;

    f = fopen(filename, "wb+");
    if (f == NULL) {
        perror("fopen() failed\n");
        return;
    }

    if (__fwritable(f)) printf("Writing is allowed on the open stream\n");
    if (__freadable(f)) printf("Reading is allowed on the open stream\n");

    n = fputs(data, f);
    if (n == EOF) {
        perror("fputs() failed\n");
        return;
    }

    n = __fpending(f);
    printf("There are %d bytes in the buffer pending to be written\n", n);

    if (__fwriting(f)) printf("The last operation on the stream was a write\n");

    rewind(f);

    n = fgetc(f);

    n = __freadahead(f);
    printf("There are %d bytes remaining to be read from the buffer\n", n);

    if (__freading(f)) printf("The last operation on the stream was a read\n");

    return;
}
```

Output

```
Writing is allowed on the open stream
Reading is allowed on the open stream
There are 34 bytes in the buffer pending to be written
The last operation on the stream was a write
There are 33 bytes remaining to be read from the buffer
The last operation on the stream was a read
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdio_ext.h — stdio extensions” on page 65](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“freopen\(\) — Redirect an open file” on page 622](#)
- [“__freadable\(\) — Determine if a stream is open for reading” on page 614](#)
- [“__freading\(\) — Determine if last operation on stream is a read operation” on page 618](#)
- [“__fwritable\(\) — Determine if a stream is open for writing” on page 676](#)

fwscanf(), swscanf(), wscanf() — Convert formatted wide-character input

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment ISO/ANSI C++ C99 Single UNIX Specification, Version 3 Language Environment | both | z/OS V1R7 |

Format

Non-XP4:

```
#define _MSE_PROTOS
#include <stdio.h>
#include <wchar.h>

int fwscanf(FILE *__restrict__ stream,
            const wchar_t *__restrict__ format, ... );

int swscanf(const wchar_t *__restrict__ wcs,
            const wchar_t *__restrict__ format, ... );

int wscanf(const wchar_t *__restrict__ format, ... );

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

int fwscanf_unlocked(FILE *__restrict__ stream,
                    const wchar_t *__restrict__ format, ... );
int wscanf_unlocked(const wchar_t *__restrict__ format, ... );
```

XP4 and swscanf():

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

int swscanf(const wchar_t *wcs, const wchar_t *format, ... );
```

General description

The `fwscanf()`, `swscanf()`, and `wscanf()` functions are equivalent to `fscanf()`, `scanf()`, and `sscanf()` respectively, except for the following:

- The argument *wcs* specifies an array of type `wchar_t` from which the input is to be obtained, rather than an array of type `char`.
- The *format* argument specifies an array of type `wchar_t` that describes the admissible input sequences and how they are to be converted for assignment, rather than an array of type `char`.
- `%c` with no *l* prefix means one or more (depending on precision) `wchar_t` is converted to multibyte characters and copied to the character array pointed to by the corresponding argument.
- `%c` with the *l* prefix means one or more (depending on precision) `wchar_t` is copied to the array of `wchar_t` pointed to by the corresponding argument.
- `%s` with no *l* prefix means a sequence of non-white `wchar_t` will be converted and copied, including the terminating NULL character, to the character array pointed to by the corresponding argument.
- `%s` with the *l* prefix means an array of `wchar_t` will be copied, including the terminating NULL wide-character, to the array of `wchar_t` pointed to by the corresponding argument.
- `%[` with no *l* prefix means a sequence of non-white `wchar_t` will be converted and copied, including the terminating NULL character, to the character array pointed to by the corresponding argument.
- `%[` with the *l* prefix means an array of `wchar_t` will be copied, including the terminating NULL wide-character, to the array of `wchar_t` pointed to by the corresponding argument.

Note: Reaching the end of a wide-character string is equivalent to reaching the end of a `char` string for the `fscanf()` and `scanf()` functions. If copying takes place between objects that overlap, the behavior is undefined.

`fwscanf_unlocked()` family is functionally equivalent to `fwscanf()` family with the exception that they are not thread-safe. These functions can safely be used in a multithreaded application if and only if they are called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Special behavior for XPG4 and `swscanf()`: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `swscanf()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

If successful, they either return the number of input items assigned, which can be fewer than provided for, or 0 in the event of an early matching failure. If an input failure occurs before any conversion, EOF is returned.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)

gai_strerror() — Address and name information error description

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R4 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netdb.h>

char *gai_strerror(int ecode);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <netdb.h>
const char *gai_strerror(int ecode);
```

General description

The `gai_strerror()` function returns a pointer to a text string describing the error value returned by a failure return from either the `getaddrinfo()` or `getnameinfo()` function. If the *ecode* is not one of the `EAI_XXX` values from the `<netdb.h>` header, then `gai_strerror()` returns a pointer to a string indicating an unknown error.

Subsequent calls to `gai_strerror()` will overwrite the buffer containing the text string.

Returned value

When successful, `gai_strerror()` returns a pointer to a string describing the error. Upon failure, `gai_strerror()` will return `NULL` and set `errno` to one of the following:

Error Code

Description

ENOMEM

Insufficient memory to allocate buffer for text string describing the error.

Related information

- [“getaddrinfo\(\) — Get address information” on page 685](#)
- [“getnameinfo\(\) — Get name information” on page 739](#)
- [“netdb.h — Network database operations” on page 45](#)

gamma() — Calculate gamma function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| SAA XPG4 XPG4.2 | both | |

Format

SAA:

```
#include <math.h>

double gamma(double x);
```

This function must be used with the [runtime library extensions](#) or under the [SAA based language constructs](#).

General description

gamma() provides the same function as lgamma(), including the use of *signgam*. Use of lgamma() instead of gamma() is suggested by XPG4.2.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use lgamma() instead of gamma().

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“lgamma\(\), lgammaf\(\), lgammal\(\) — Log gamma function” on page 968](#)
- [“__signgam\(\) — Return signgam reference” on page 1640](#)

gcv() — Convert double to string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

char *gcv(double x, int ndigit, char *buf);
```

General description

The gcv() function converts double floating-point argument values to floating-point output strings. The gcv() function has been extended to determine the floating-point format (hexadecimal floating-point or IEEE Binary Floating-Point) of double argument values by using `__isBFP()`.

IBM z/OS C/C++ formatted output functions, including the gcv() function, convert IEEE Binary Floating-Point infinity and NaN argument values to special infinity and NaN floating-point number output sequences. See [“fprintf Family of Formatted Output Functions” on fprintf\(\), printf\(\), sprintf\(\) — Format and write data](#) for a description of the special infinity and NaN output sequences.

The `gcvt()` function converts *x* to a NULL-terminated string (similar to the `%g` format of “[fprintf\(\), printf\(\), sprintf\(\) — Format and write data](#)” on page 593) in the array pointed to by *buf* and returns *buf*. It produces *ndigit* significant digits (limited to an unspecified value determined by the precision of a double) in `%f` if possible, or `%e` (scientific notation) otherwise. A minus sign is included in the returned string if *value* is less than 0. A radix character is included in the returned string if *value* is not a whole number. Trailing zeros are suppressed where *value* is not a whole number. The radix character is determined by the current locale. If “[setlocale\(\) — Set locale](#)” on page 1547 has not been called successfully, the default locale, “POSIX”, is used. The default locale specifies a period (.) as the radix character. The `LC_NUMERIC` category determines the value of the radix character within the current locale.

Note: This function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `sprintf()` function is preferred for portability.

Returned value

If successful, `gcvt()` returns the character equivalent of *x* as specified above.

If unsuccessful, `gcvt()` returns NULL.

Related information

- “[stdlib.h — Standard library functions](#)” on page 65
- “[ecvt\(\) — Convert double to string](#)” on page 417
- “[fcvt\(\) — Convert double to string](#)” on page 493
- “[__isBFP\(\) — Determine application floating-point format](#)” on page 905

getaddrinfo() — Get address information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC2553 | both | z/OS V1R4 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <sys/socket.h>
#include <netdb.h>

int getaddrinfo(const char *nodename,
                const char *servname,
                const struct addrinfo *hints,
                struct addrinfo **res);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <sys/socket.h>
#include <netdb.h>
int getaddrinfo(const char *__restrict__ nodename,
                const char *__restrict__ servname,
                const struct addrinfo *__restrict__ hints,
                struct addrinfo **__restrict__ res);
```

General description

The `getaddrinfo()` function translates the name of a service location (for example, a host name) and/or service name and returns a set of socket addresses and associated information to be used in creating a socket with which to address the specified service.

The *nodename* and *servname* arguments are either pointers to null-terminated strings or null pointers. One or both of these two arguments must be specified as a non-null pointer.

The format of a valid name depends on the protocol family or families. If a specific family is not given and the name could be interpreted as valid within multiple supported families, the function attempts to resolve the name in all supported families. When no errors are detected, all successful results will be returned.

If the *nodename* argument is not null, it can be a descriptive name or it can be an address string. If the specified address family is AF_INET, AF_INET6, or AF_UNSPEC, valid descriptive names include host names. If the specified address family is AF_INET or AF_UNSPEC, address strings using standard dot notation as specified in `inet_addr()` are valid. If the specified address family is AF_INET6 or AF_UNSPEC, standard IPv6 text forms described in `inet_pton()` are valid. In addition, scope information can be appended to the descriptive name or the address string using the format *nodename%scope* information. Scope information can be either an interface name or the numeric representation of an interface index suitable for use on this system.

If *nodename* is not null, the requested service location is named by *nodename*; otherwise, the requested service location is local to the caller.

If *servname* is null, the call returns network-level addresses for the specified *nodename*. If *servname* is not null, it is a null-terminated character string identifying the requested service. This can be either a descriptive name or a numeric representation suitable for use with the address family or families. If the specified address family is AF_INET, AF_INET6, or AF_UNSPEC, the service can be specified as a string specifying a decimal port number.

If the argument *hints* is not null, it refers to a structure containing input values that may direct the operation by providing options and by limiting the returned information to a specific socket type, address family and/or protocol. In the hints structure every member other than *ai_flags*, *ai_family*, *ai_socktype*, and *ai_protocol* must be zero or a null pointer. A value of AF_UNSPEC for *ai_family* means that the caller will accept any protocol family. A value of zero for *ai_socktype* means that the caller will accept any socket type. A value of zero for *ai_protocol* means that the caller will accept any protocol. If *hints* is a null pointer, the behavior must be as if it referred to a structure containing the value zero for the *ai_flags*, *ai_socktype*, and *ai_protocol* fields, and AF_UNSPEC for the *ai_family* field.

The *ai_flags* member to which the hints argument points can be set to 0 or be the bitwise inclusive OR of one or more of the following values:

- AI_PASSIVE
- AI_CANONNAME
- AI_NUMERICHOST
- AI_NUMERICSERV
- AI_V4MAPPED
- AI_ALL
- AI_ADDRCONFIG
- AI_EXTFLAGS

If the AI_PASSIVE bit is set in the *ai_flags* member of the hints structure, then the caller plans to use the returned socket address structure in a call to `bind()`. In this case, if the *nodename* argument is a null pointer, then the IP address portion of the socket address structure will be set to INADDR_ANY for an IPv4 address or IN6ADDR_ANY_INIT for an IPv6 address. If the AI_PASSIVE bit is not set in the *ai_flags* member of the hints structure, then the returned socket address structure will be ready for a call to `connect()` (for a connection-oriented protocol) or either `connect()`, `sendto()`, or `sendmsg()` (for a connectionless protocol). In this case, if the *nodename* argument is a null pointer, then the IP address portion of the socket address structure will be set to the loopback address.

If the AI_CANONNAME bit is set in the *ai_flags* member of the hints structure, then upon successful return the *ai_canonname* member of the first `addrinfo` structure in the linked list will point to a null-terminated string containing the canonical name of the specified *nodename*.

If the `AI_NUMERICHOST` bit is set in the `ai_flags` member of the hints structure, then a non-null `nodename` string must be a numeric host address string. Otherwise an error code of `EAI_NONAME` is returned. This flag prevents any type of name resolution service (for example, the DNS) from being called.

If the `AI_NUMERICSERV` flag is specified then a non-null `servname` string must be a numeric port string. Otherwise an error code `EAI_NONAME` is returned. This flag prevents any type of name resolution service (for example, NIS+ from being invoked).

If the `AI_V4MAPPED` flag is specified with the `ai_family` field using the value of `AF_INET6` or `AF_UNSPEC`, then the caller will accept IPv4-mapped IPv6 addresses.

- If the `ai_family` field is `AF_INET6`, a query for IPv4 addresses is made if the `AI_ALL` flag is specified or if no IPv6 addresses are found. Any IPv4 addresses that are found are returned as IPv4-mapped IPv6 addresses.
- If the `ai_family` field is `AF_UNSPEC`, queries are made for both IPv6 and IPv4 addresses. If IPv4 addresses are found and IPv6 is supported, the IPv4 addresses are returned as IPv4-mapped IPv6 addresses.
- Otherwise, the `AI_V4MAPPED` flag is ignored.

If the `ai_family` field has a value of `AF_INET6` and `AI_ALL` is set, the `AI_V4MAPPED` flag must also be set to indicate that the caller will accept all addresses (IPv6 and IPv4-mapped IPv6 addresses). If the `ai_family` field has a value of `AF_UNSPEC`, `AI_ALL` is accepted but has no impact on the processing. Whether `AI_ALL` is specified or not, the caller accepts IPv6 addresses and either IPv4 or IPv4-mapped IPv6 addresses. A query is first made for IPv6 addresses and if successful, the IPv6 addresses are returned. Another query is then made for IPv4 addresses, and any found are returned as IPv4 addresses (if `AI_V4MAPPED` was not set or the system does not support IPv6) or as IPv4-mapped IPv6 addresses (if `AI_V4MAPPED` was set and the system supports IPv6). Otherwise, the `AI_ALL` flag is ignored.

If the `AI_ADDRCONFIG` flag is specified then a query for IPv6 address records should occur only if the node has at least one IPv6 source address configured. A query for IPv4 address records will always occur, whether or not any IPv4 addresses are configured. The loopback address is not considered for this case as valid as a configured sources address.

If the `AI_EXTFLAGS` flag is specified then `getaddrinfo()` will look for the values stored in the extended flags field called `ai_eflags` in the `addrinfo` structure. The flags stored in the `ai_eflags` field are only meaningful if the `AI_EXTFLAGS` flag is set in the `ai_flags` field of the `addrinfo` data structure. By default, `AI_EXTFLAGS` is not set in the `ai_flags` field. If `AI_EXTFLAGS` is set in the `ai_flags` field, and the `ai_eflags` extended flags field is 0 (zero) or undefined, then `AI_EXTFLAGS` is ignored. The `ai_eflags` field can be set to any of the following:

- `IPV6_PREFER_SRC_HOME` - prefer home address as source
- `IPV6_PREFER_SRC_COA` - prefer care-of address as source
- `IPV6_PREFER_SRC_TMP` - prefer temporary address as source
- `IPV6_PREFER_SRC_PUBLIC` - prefer public address as source
- `IPV6_PREFER_SRC_CGA` - prefer CGA address as source
- `IPV6_PREFER_SRC_NONCGA` - prefer a non-CGA address as source

These flags can be combined into a flag set to express complex address preferences, but some can result in a contradictory flag set. For example, the following flags are mutually exclusive:

- `IPV6_PREFER_SRC_HOME` and `IPV6_PREFER_SRC_COA`
- `IPV6_PREFER_SRC_TMP` and `IPV6_PREFER_SRC_PUBLIC`
- `IPV6_PREFER_SRC_CGA` and `IPV6_PREFER_SRC_NONCGA`

All of the information returned by `getaddrinfo()` is dynamically allocated: the `addrinfo` structures, and the socket address structures and canonical node name strings pointed to by the `addrinfo` structures. To return this information to the system the function `freeaddrinfo()` is called.

Usage notes

1. If the caller handles only TCP and not UDP, for example, then the *ai_protocol* member of the hints structure should be set to IPPROTO_TCP when getaddrinfo() is called.
2. If the caller handles only IPV4 and not IPv6, then the *ai_family* member of the hints structure should be set to AF_INET when getaddrinfo() is called.
3. Scope information is only pertinent to IPv6 link-local addresses. It is ignored for resolved IPv4 addresses and IPv6 addresses that are not link-local addresses.

Returned value

When successful, getaddrinfo() returns 0 and a pointer to a linked list of one or more addrinfo structures through the res argument. The caller can process each addrinfo structure in this list by following the ai_next pointer, until a null pointer is encountered. In each returned addrinfo structure the three members *ai_family*, *ai_socktype*, and *ai_protocol* are the corresponding arguments for a call to the socket() function. In each addrinfo structure the *ai_addr* member points to a filled-in socket address structure whose length is specified by the *ai_addrlen* member. Upon failure, getaddrinfo() returns a non-zero error code. The error codes are as follows:

Error Code

Description

EAI_AGAIN

The name specified by the Node_Name or Service_Name parameter could not be resolved within the configured time interval, or the resolver address space has not been started. The request can be retried later.

EAI_BADEXTFLAGS

The extended flags parameter had an incorrect setting.

EAI_BADFLAGS

The flags parameter had an incorrect setting.

EAI_FAIL

An unrecoverable error occurred.

EAI_FAMILY

The family parameter had an incorrect setting.

EAI_MEMORY

A memory allocation failure occurred during an attempt to acquire an Addr_Info structure.

EAI_NONAME

One of the following conditions occurred:

1. The name does not resolve for the specified parameters. At least one of the Name or Service operands must be specified.
2. The request name parameter is valid, but it does not have a record at the name server.

EAI_SERVICE

The service that was passed was not recognized for the specified socket type.

EAI_SOCKTYPE

The intended socket type was not recognized.

EAI_SYSTEM

A system error occurred.

For more information about the above return codes, see [z/OS Communications Server: IP and SNA Codes](#).

Related information

- “netdb.h — Network database operations” on page 45
- “sys/socket.h — Sockets definitions” on page 70

- “freeaddrinfo() — Free addrinfo storage” on page 621
- “gai_strerror() — Address and name information error description” on page 683
- “getnameinfo() — Get name information” on page 739

getc(), getchar() — Read a character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

int getc(FILE *stream);
int getchar(void);
```

General description

Reads a single character from the current *stream* position and advances the *stream* position to the next character. The `getchar()` function is identical to `getc(stdin)`.

The `getc()` and `fgetc()` functions are identical. However, `getc()` and `getchar()` are provided in a highly efficient macro form. For performance purposes, it is recommended that the macro forms be used rather than the functional forms or `fgetc()`. By default, `stdio.h` provides the macro versions of these functions.

However, to get the functional forms, do one or more of the following:

- For C only: do *not* include `stdio.h`.
- Specify `#undef`, for example, `#undef getc`
- Surround the call statement by parentheses, for example, `(getc)`

`getc()` and `getchar()` are not supported for files opened with `type=record` or `type=blocked`.

`getc()` and `getchar()` have the same restriction as any read operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

If the application is not multithreaded, then setting the `_ALL_SOURCE_NO_THREADS` feature test macro may improve performance of the application, because it allows use of the inline version of this function.

Special behavior for POSIX: In a multithreaded C application that uses `POSIX(ON)`, in the presence of the feature test macro, `_OPEN_THREADS`, these macros are in an `#undef` status because they are not thread-safe.

Note: Because the `getc()` macro reevaluates its input argument more than once, you should never pass a stream argument that is an expression with side effects.

Returned value

`getc()` and `getchar()` return the character read.

A returned value of EOF indicates either an error or an EOF condition. If a read error occurs, the error indicator is set. If an EOF is encountered, the EOF indicator is set.

Use `ferror()` or `feof()` to determine whether an error or an EOF condition occurred. Note that EOF is only reached when an attempt is made to read past the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Example

CELEBG02

```

/* CELEBG02

   This example gets a line of input from the stdin stream.
   You can also use getc(stdin) instead of &getchar. in the for
   statement to get a line of input from stdin.

*/
#include <stdio.h>

#define LINE 80

int main(void)
{
    char buffer[LINE+1];
    int i;
    int ch;

    printf( "Please enter string\n" );

    /* Keep reading until either:
       1. the length of LINE is exceeded or
       2. the input character is EOF or
       3. the input character is a new-line character
    */
    for ( i = 0; ( i < LINE ) && (( ch = getchar()) != EOF) &&
          ( ch != '\n' ); ++i )
        buffer[i] = ch;

    buffer[i] = '\0'; /* a string should always end with '\0' ! */
    printf( "The string is %s\n", buffer );
}

```

Output

```

Please enter string
hello world
The string is hello world

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fgetc\(\) — Read a character” on page 533](#)
- [“gets\(\) — Read a string” on page 770](#)
- [“putc\(\), putchar\(\) — Write a character” on page 1352](#)
- [“ungetc\(\) — Push character onto input stream” on page 1941](#)

getc_unlocked(), getchar_unlocked(), putc_unlocked(), putchar_unlocked() — Stdio with explicit client locking

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R8 |

Format

```
#define _UNIX03_SOURCE
#include <stdio.h>

int getc_unlocked(FILE *stream);
int getchar_unlocked(void);
int putc_unlocked(int c, FILE *stream);
int putchar_unlocked(int c);
```

General description

Versions of the functions `getc()`, `getchar()`, `putc()`, and `putchar()` respectively named `getc_unlocked()`, `getchar_unlocked()`, `putc_unlocked()`, and `putchar_unlocked()` are functionally equivalent to the original versions, with the exception that they are not thread-safe. These functions may safely be used in a multi-threaded program if and only if they are called while the invoking thread owns the (FILE*) object, as is the case after a successful call to the `flockfile()` or `ftrylockfile()` functions.

`getc_unlocked`, `getchar_unlocked`, `putc_unlocked`, `putchar_unlocked` are provided in a highly efficient macro form. For performance purposes, it is recommended that the macro forms be used rather than the functional forms. By default, `stdio.h` provides the macro versions of these functions.

However, to get the functional forms, do one or more of the following:

- Surround the call statement by parentheses, for example, `(getc_unlocked)`
- Specify `#undef`, for example, `#undef getc_unlocked`
- For C only: do *not* include `stdio.h`.

`getc_unlocked`, `getchar_unlocked`, `putc_unlocked`, `putchar_unlocked` are not supported for files that are opened with `type=record` or `type=blocked`.

`getc_unlocked`, `getchar_unlocked`, `putc_unlocked`, `putchar_unlocked` have the same restrictions as any read or write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

Note: Because the macro forms of these functions reevaluate their input arguments more than once, you must not pass an argument that is an expression with side effects.

Returned value

See [“getc\(\), getchar\(\) — Read a character”](#) on page 689 and [“putc\(\), putchar\(\) — Write a character”](#) on page 1352.

Related information

getclientid() – Get the identifier for the calling application

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>
#include <sys/types.h>

int getclientid(int domain, struct clientid *clientid);
```

General description

The getclientid() function call returns the identifier by which the calling application is known to the TCP/IP address space. The *clientid* can be used in the givesocket() and takesocket() calls. However, this function is supplied for use by existing programs that depend on the address space name returned. Even for these programs it is recommended that the name be saved for its later use and the __getclientid() function be issued to reconstruct the clientid structure for use by givesocket() and takesocket().

Parameter

Description

domain

The address domain requested.

clientid

The pointer to a *clientid* structure to be filled.

The clientid structure is filled in by the call and returned as follows:

The clientid structure:

```
struct clientid {
    int domain;
    union {
        char name[8];
        struct {
            int NameUpper;
            pid_t pid;
        } c_pid;
    } c_name;
    char subtaskname[8];

    struct {
        char type;
        union {
            char specific[19];
            struct {
                char unused[3];
                int SockToken;
            } c_close;
        } c_func;
    } c_reserved;
};
```

Element

Description

domain

The input *domain* value returned in the domain field of the clientid structure.

c_name.name

The application program's address space name, left-justified and padded with blanks.

subtaskname

The calling program's task identifier.

c_reserved

Specifies binary zeros.

Returned value

If successful, `getclientid()` returns 0.

If unsuccessful, `getclientid()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EFAULT**

Using the *clientid* parameter as specified would result in an attempt to access storage outside the caller's address space, or storage not modifiable by the caller.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“__getclientid\(\) — Get the PID identifier for the calling application” on page 693](#)

__getclientid() — Get the PID identifier for the calling application

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>
#include <sys/types.h>

int __getclientid(int domain, struct clientid *clientid);
```

General description

The `__getclientid()` function call returns the process identifier (PID) by which the calling application is known to the TCP/IP address space. The *clientid* is used in the `givesocket()` and `takesocket()` calls. Use the `__getclientid()` function call to transfer sockets between the caller and the selected application. The `__getclientid()` function provides improved performance and integrity over the `getclientid()` function for applications that use the output of `__getclientid()` as input *clientids* for `givesocket()` and `takesocket()`.

Parameter**Description****domain**

The address domain requested.

clientid

The pointer to a *clientid* structure to be filled.

The *clientid* structure:

```
struct clientid {
    int domain;
    union {
```

```

    char name[8];
    struct {
        int NameUpper;
        pid_t pid;
    } c_pid;
} c_name;
char subtaskname[8];

struct {
    char type;
    union {
        char specific[19];
        struct {
            char unused[3];
            int SocketToken;
        } c_close;
    } c_func;
} c_reserved;
};

```

Element Description

domain

The input *domain* value returned in the domain field of the clientid structure.

c_pid.pid

Is the label in the *clientid* structure that is filled in by the function call to the PID of the requester (caller of `__getclientid()`). It should be left as set because it is used by the `takesocket()` and `givesocket()` functions.

subtaskname

Blanks

c_reserved

Binary zeros

Returned value

If successful, `__getclientid()` returns 0.

If unsuccessful, `__getclientid()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EFAULT

Using the *clientid* parameter as specified would result in an attempt to access storage outside the caller's address space, or storage not modifiable by the caller.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“getclientid\(\) — Get the identifier for the calling application” on page 692](#)
- [“givesocket\(\) — Make the specified socket available” on page 805](#)
- [“takesocket\(\) — Acquire a socket from another program” on page 1806](#)

getcontext() — Get user context

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ucontext.h>

int getcontext(ucontext_t *ucp);
```

General description

The `getcontext()` function initializes the structure pointed to by `ucp` to the current user context of the calling process. The **`ucontext_t`** type that `ucp` points to defines the user context and includes the contents of the calling process's machine registers, the signal mask, and the current execution stack. A subsequent call to `setcontext()` restores the saved context and returns control to a point in the program corresponding to the `getcontext()` call. Execution resumes as if the `getcontext()` call had just returned. The return value from `getcontext()` is the same regardless of whether the return is from the initial invocation or using a call to `setcontext()`.

The context created by `getcontext()` may be modified by the `makecontext()` function. Refer to `makecontext` for details.

`getcontext()` is similar in some respects to `sigsetjmp()` (and `setjmp()` and `_setjmp()`). The `getcontext()`–`setcontext()` pair, the `sigsetjmp()`–`siglongjmp()` pair, the `setjmp()`–`longjmp()` pair, and the `_setjmp()`–`_longjmp()` pair cannot be intermixed. A context saved by `getcontext()` should be restored only by `setcontext()`.

Note: Some compatibility exists with `siglongjmp()`, so it is possible to use `siglongjmp()` from a signal handler to restore a context created with `getcontext()`, but it is not recommended.

Portable applications should not modify or access the **`uc_mcontext`** member of **`ucontext_t`**. A portable application cannot assume that context includes any process-wide static data, possibly including `errno`. Users manipulating contexts should take care to handle these explicitly when required.

This function is supported only in a POSIX program.

The **`<ucontext.h>`** header file defines the **`ucontext_t`** type as a structure that includes the following members:

| | | |
|-------------------------|--------------------------|--|
| <code>mcontext_t</code> | <code>uc_mcontext</code> | A machine-specific representation of the saved context. |
| <code>ucontext_t</code> | <code>*uc_link</code> | Pointer to the context that will be resumed when this context returns. |
| <code>sigset_t</code> | <code>uc_sigmask</code> | The set of signals that are blocked when this context is active. |
| <code>stack_t</code> | <code>uc_stack</code> | The stack used by this context. |

Special behavior for C++: If `getcontext()` and `setcontext()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. The use of `getcontext()` and `setcontext()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Do not issue `getcontext()` in a C++ constructor or destructor, since the saved context would not be usable in a subsequent `setcontext()` or `swapcontext()` after the constructor or destructor returns.

Special behavior for XPLINK-compiled C/C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **jmp_buf**, **sigjmp_buf** or **ucontext_t** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **jmp_buf**, **sigjmp_buf** or **ucontext_t** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **jmp_buf**, **sigjmp_buf** or **ucontext_t** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Language Environment V2R10 and later headers define a shorter **jmp_buf**, **sigjmp_buf** or **ucontext_t** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **jmp_buf**, **sigjmp_buf** or **ucontext_t** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

If successful, `getcontext()` returns 0.

If unsuccessful, `getcontext()` returns -1.

There are no `errno` values defined.

Example

This example saves the context in `main` with the `getcontext()` statement. It then returns to that statement from the function `func` using the `setcontext()` statement. Since `getcontext()` always returns 0 if successful, the program uses the variable `x` to determine if `getcontext()` returns as a result of `setcontext()` or not.

```
/* This example shows the usage of getcontext() and setcontext().    */
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdio.h>
#include <ucontext.h>

void func(void);

int x = 0;
ucontext_t context, *cp = &context;

int main(void) {
    getcontext(cp);
    if (!x) {
        printf("getcontext has been called\n");
        func();
    }
    else {
        printf("setcontext has been called\n");
    }
}

void func(void) {
    x++;
    setcontext(cp);
}
```

Output

```
getcontext has been called
setcontext has been called
```

Related information

- [“ucontext.h — Context related functions” on page 76](#)
- [“makecontext\(\) — Modify user context” on page 1032](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“setjmp\(\) — Preserve stack environment” on page 1542](#)
- [“_setjmp\(\) — Set jump point for a nonlocal goto” on page 1544](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

__get_cpuid() — Retrieves the system CPUID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R10 |

Format

```
#define _OPEN_SYS_EXT 1
#include <sys/ps.h>

int __get_cpuid(char *buff);
```

General description

Retrieves the current CPU ID in the form of a string containing the readable part of the serial number concatenated with the model number. The variable *buff* is a character string of 11 bytes in length. It is a work area to build the unique cpuid.

Returned value

Always returns the serial and model number.

Related information

- [“sys/ps.h — w_getpsent\(\) function and w_psproc structure” on page 70](#)

getcwd() — Get path name of the working directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

char *getcwd(char *buffer, size_t size);
```

General description

Determines the path name of the working directory and stores it in *buffer*.

size

The number of characters in the *buffer* area.

buffer

The name of the buffer that will be used to hold the path name of the working directory. *buffer* must be big enough to hold the working directory name, plus a terminating NULL to mark the end of the name.

Returned value

If successful, `getcwd()` returns a pointer to the buffer.

If unsuccessful, `getcwd()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process did not have read or search permission on some component of the working directory's path name.

EINVAL

size is less than or equal to zero.

EIO

An input/output error occurred.

ENOENT

A component of the working directory's path name does not exist.

ENOTDIR

A directory component of the working directory's path name is not really a directory.

ERANGE

size is greater than 0, but less than the length of the working directory's path name, plus 1 for the terminating NULL.

Example

CELEBG03

```
/* CELEBG03

   This example determines the working directory.

*/
#define _POSIX_SOURCE
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    char cwd[256];

    if (chdir("/tmp") != 0)
        perror("chdir() error");
    else {
        if (getcwd(cwd, sizeof(cwd)) == NULL)
            perror("getcwd() error");
```

```

    else
        printf("current working directory is: %s\n", cwd);
    }
}

```

Output

```
current working directory is: /tmp
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chdir\(\) — Change the working directory” on page 270](#)

getdate(), getdate64() — Convert user format date and time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```

#define _XOPEN_SOURCE_EXTENDED 1
#include <time.h>

struct tm *getdate(const char *string);

extern int getdate_err;

```

```

#define _LARGE_TIME_API
#include <time.h>

struct tm *getdate64(const char *string);

```

General description

The `getdate()` function converts definable date and/or time specifications pointed to by *string* into a `tm` structure. The `tm` structure declaration is in the header `<time.h>`.

Templates are used to parse and interpret the input string. The templates are contained in text files created by the process and identified using the environment variable `DATMSK`. The `DATMSK` variable should be set to indicate the full path name of the file that contains the templates. The first line in the template that matches the input specification is used for the interpretation and conversion into the internal time format.

The following field descriptors are supported:

%%

same as %.

%a

abbreviated weekday name

%A

full weekday name

%b

abbreviated month name

%B

full month name

%c

locale's appropriate date and time representation

%C

Century number [00,99]; leading zeros are permitted but not required. Used in conjunction with %y

%d

day of month (01-31; the leading 0 is optional)

%D

date as %m/%d/%y

%e

same as %d

%h

same as %b

%H

hour (00-23; the leading 0 is optional)

%I

hour (01-12; the leading 0 is optional)

%m

month number (00-11; the leading 0 is optional)

%M

minute (00-59; the leading 0 is optional)

%n

same as \n

%p

locale's equivalent of either AM or PM

%r

locale's 12 hour time representation. In the POSIX locale this is equivalent to %I:%M:%S %p

%R

time as %H:%M

%S

Seconds [00,60]. The range goes to 60 (rather than stopping at 59) to allow positive leap seconds to be expressed. Since leap seconds cannot be predicted by any algorithm, leap second data must come from some external source.

%t

same as \t (tab)

%T

time as %H:%M:%S

%w

weekday number (0-6; 0 indicates Sunday)

%x

locale's date representation. In the POSIX locale this is equivalent to %m/%d/%y.

%X

locale's time representation. In the POSIX locale this is equivalent to %H:%M:%S.

%y

year within century. When a century is not otherwise specified, values in the range 69-99 refer to years in the twentieth century (1969 to 1999 inclusive); values in the range 00-68 refer to years in the twenty-first century (2000 to 2068 inclusive). 31-bit supports values in the range 00-37 and 64-bit supports values in the range 00-68.

%Y

year as ccyy (1969-9999)

31-bit the upper bound for %Y is 2037.

64-bit the upper bound for %Y is 9999.

%Z

time zone name or no characters if no time zone exists. If the time zone supplied for %Z is not the time zone `getdate()` expects, a non-valid input specification error will result. The `getdate()` function calculates an expected time zone based on time and date information supplied to it.

The match between the template and input specification performed by `getdate()` is case insensitive.

The month and weekday names can consist of any combination of uppercase or lowercase letters. The process can request that the input date and time specification be in a specific language by setting the `LC_TIME` category (see `setlocale()`).

Leading 0's are not necessary for the descriptors that allow leading 0's. However, at most two digits are allowed for those descriptors, including leading 0's. Extra white space in either the template file or in *string* is ignored.

The field descriptors %c, %x, and %X will not be supported if they include unsupported field descriptors.

The following rules apply for converting the input specification into a `tm` structure:

- If only weekday is given, today is assumed if the given day is equal to the current day and next week if it is less,
- If only the month is given, the current month is assumed if the given month is equal to the current month and next year if it is less and no year is given (the first day of the month is assumed if no day is given),
- If no hour, minute, and second are given, the current hour, minute and second are assumed,
- If no date is given, today is assumed if the given hour is greater than the current hour and tomorrow is assumed if it is less.

Notes:

1. When converting an input specification into a `tm` structure, the `getdate()` function assumes current time and date values for missing fields as indicated in the previous list. The function treats these values as local time, based on the customization of time zone data.
2. When neither the `TZ` (POSIX) nor `_TZ` (non-POSIX) environment variable is defined, the current locale is interrogated for time zone information. If neither `TZ` nor `_TZ` is defined and `LC_TOD` time zone information is not present in the current locale, a default value is applied to local time. POSIX programs simply default to Coordinated Universal Time (UTC), while non-POSIX programs establish an offset from UTC based on the setting of the system clock. For more information about customizing a time zone to work with local time, see "Customizing a time zone" in [z/OS XL C/C++ Programming Guide](#).

If a field descriptor in the template file is not one of the supported field descriptors, then the following behaviors exist when the descriptor is encountered:

1. In an ASCII application, it is ignored (treated as non-matching) and processing continues to the next template.
2. In an EBCDIC application, it causes the function to return unsuccessful with `getdate_err` being set to the value 8.

The function `getdate64()` will behave exactly like `getdate()` except it will convert definable date or time specifications pointed to by *string* into a `tm` structure of calendar times beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Returned value

If successful, `getdate()` returns a pointer to a `tm` structure.

If unsuccessful, `getdate()` returns a NULL pointer and sets the external variable `getdate_err` to a value indicating the error.

The `tm` structure to which `getdate()` returns a pointer is not shared with any other functions. Also, the `getdate()` function produces a `tm` structure unique to the thread on which it runs.

As is true for all external variables, C/370 allocates storage for the `getdate_err` external variable in writable static storage which is shared among all threads. Thus, `getdate_err` is not intrinsically “thread-safe”.

C/370 allocates storage on a per thread basis for an analog of `getdate_err`. The `__gderr()` function returns a pointer to this storage. It is recommended that multithread applications and applications running from a DLL use the `__gderr()` function rather than `getdate_err` if `getdate()` returns a NULL pointer to determine in a thread-safe manner why `getdate()` was unsuccessful.

The `__gderr()` is defined as follows:

```
#include <time.h>

int *__gderr(void);
```

The `__gderr()` function returns a pointer to the thread-specific value of `getdate_err`. The `getdate64()` function affects the same pointer to the thread-specific value of `getdate_err` as the `getdate()` function does.

The following is a list of `getdate_err` settings and their description:

- 1** The DATEMSK environment variable is NULL or undefined.
- 2** The template file cannot be opened for reading.
- 3** Failed to get file status information.
- 4** The template file is not a regular file.
- 5** An error was encountered while reading the template file.
- 6** Memory allocation failed (not enough memory available).
- 7** No line in the template file matches the input specification.
- 8** Non-valid input specification. For example, February 31; or a time that can not be represented in a `time_t` (representing the time is seconds since Epoch - midnight, January 1, 1970 (UTC)).
- 9** Unable to determine current time.
Note: This value is unique for z/OS UNIX services.

Related information

- [“time.h — Time and date” on page 75](#)

getdtablesize() – Get the file descriptor table size

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int getdtablesize(void);
```

General description

The `getdtablesize()` function is equivalent to `getrlimit()` with the `RLIMIT_NOFILE` option.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use `getrlimit()` instead of `getdtablesize()`.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

`getdtablesize()` returns the current soft limit as if obtained from a call to `getrlimit()`.

There are no `errno` values defined.

Related information

- [“unistd.h – Implementation-specific functions” on page 77](#)
- [“close\(\) – Close a file” on page 293](#)
- [“getrlimit\(\) – Get current or maximum resource consumption” on page 767](#)
- [“open\(\) – Open a file” on page 1157](#)
- [“select\(\), pselect\(\) – Monitor activity on files or sockets and message queues” on page 1472](#)
- [“setrlimit\(\) – Control maximum resource consumption” on page 1568](#)

getegid() – Get the effective group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

gid_t getegid(void);
```

General description

Finds the effective group ID (GID) of the calling process.

Returned value

Returns the effective group ID (GID). It is always successful.

There are no documented errno values.

Example

CELEBG04

```
/* CELEBG04

   This example finds the group ID.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <sys/types.h>
#include <unistd.h>

main() {
    printf("my group id is %d\n", (int) getgid());
}
```

Output

```
my group id is 500
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getgid\(\) — Get the real group ID” on page 709](#)
- [“setegid\(\) — Set the effective group ID” on page 1522](#)
- [“setgid\(\) — Set the group ID” on page 1532](#)

getentropy() — Fill a buffer with random bytes

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <unistd.h>
```

```
int getentropy(void *buffer, size_t length);
```

General description

`getentropy()` function writes `length` bytes of high-quality random data to the buffer that starts at the location that is pointed to by `buffer`. The maximum valid value for the `length` argument is 256.

Returned value

If successful, `getentropy()` returns 0.

If unsuccessful, `getentropy()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EFAULT

Part or all of the buffer that is specified by `buffer` and `length` is not in valid addressable memory.

EIO

`length` is greater than 256.

Related information

- [“getrandom\(\) — Obtain a series of random bytes” on page 766](#)

getenv() — Get value of environment variables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

char *getenv(const char *varname);
```

General description

Searches the table of environment variables for an entry corresponding to `varname` and returns a pointer to a buffer containing the current string value of `varname`.

Special behavior for POSIX: Under POSIX, the value of the `char **environ` pointer is honored and used by `getenv()`. You can declare and use this pointer. Under POSIX(OFF) this is not the case: the table start cannot be modified.

Usage Note

To avoid changing the environment variables or management process, the caller must ensure not to modify or release the buffer that is pointed by the returned pointer.

Returned value

If successful, `getenv()` returns a pointer to a buffer containing the current string value of *varname*. You should copy the string that is returned because a subsequent call to `getenv()` will overwrite it.

If the *varname* is not found, `getenv()` returns a NULL pointer. The returned value is NULL if the given variable is not currently defined.

Example

CELEBG05

```
/* CELEBG05

   In this example, *pathvar points to the value of the PATH
   environment variable.
   In a POSIX environment, this variable would be from the CENV
   group ID.

*/
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    char *pathvar;

    pathvar = getenv("PATH");
    printf("pathvar=%s",pathvar);
}
```

Related information

- “Using Environment Variables” in [z/OS XL C/C++ Programming Guide](#)
- “`stdlib.h` – Standard library functions” on page 65
- “`clearenv()` – Clear environment variables” on page 283
- “`__getenv()` – Get an environment variable” on page 706
- “`setenv()` – Add, delete, and change environment variables” on page 1523
- “`putenv()` – Change or add an environment variable” on page 1354

__getenv() – Get an environment variable

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <stdlib.h>

char *__getenv(const char *varname);
```

General description

`__getenv()` returns a unique character pointer for each environmental variable. For single-threaded applications, this eliminates the need to copy the string returned by previous `__getenv()` calls.

This function should not be used by multithreaded applications. Updates to the environmental variable on another thread may invalidate the address returned by `__getenv()` before the application copies the returned value.

The format of an environment variable is made up of three parts that are combined to form:

name=value

Where:

1. The first part, *name*, is a character string that represents the name of the environment variable. It is this part of the environment variable that `__getenv()` tries to match with *varname*.
2. The second part, `=`, is a separator character (since the equal sign is used as a separator character it cannot appear in the *name*).
3. The third part, *value*, is a NULL-terminated character string that represents the value that the environment variable, *name*, is set to. This is the part of the environment variable that `__getenv()` returns a pointer to.

There are several ways to establish a set of environment variables.

- Set at program initialization time from the Language Environment runtime option ENVAR.
- Set at program initialization time from a data set.
- If the program was invoked with a `system()` call, they can be inherited from the calling enclave.
- In the z/OS UNIX environment they can also be inherited from the parent process if the program was invoked with one of the `exec` functions.
- During the running of a program they can be set with the `setenv()` function or the `putenv()` function.

For a list of the environment variables that z/OS UNIX services support, see the chapter “Using Environment Variables” in *z/OS XL C/C++ Programming Guide*.

Special behavior for POSIX: Under POSIX, the value of the `char **environ` pointer is honored and used by `getenv()`. You can declare and use this pointer. Under POSIX(OFF) this is not the case: the table start cannot be modified.

Note: The `__getenv()` function has a dependency on the level of the Enhanced ASCII Extensions. See “Enhanced ASCII support” on page 2123 for details.

Returned value

If successful, `__getenv()` returns a pointer to the string containing the value of the environment variable specified by *varname*.

If unsuccessful, `__getenv()` returns a NULL pointer. The returned value is NULL if the given variable is not currently defined or if the system does not support environment variables.

Related information

- “Using Environment Variables” in *z/OS XL C/C++ Programming Guide*
- “`stdlib.h` — Standard library functions” on page 65
- “`clearenv()` — Clear environment variables” on page 283
- “`getenv()` — Get value of environment variables” on page 705
- “`putenv()` — Change or add an environment variable” on page 1354
- “`setenv()` — Add, delete, and change environment variables” on page 1523

geteuid() – Get the effective user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

uid_t geteuid(void);
```

General description

Finds the effective user ID (UID) of the calling process.

Returned value

Returns the effective user ID of the calling process. It is always successful.

There are no documented errno values.

Example

CELEBG06

```
/* CELEBG06

   This example returns information for your user ID.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <pwd.h>
#include <unistd.h>

main() {
    struct passwd *p;
    uid_t uid;

    if ((p = getpwuid(uid = geteuid())) == NULL)
        perror("getpwuid() error");
    else {
        puts("getpwuid() returned the following info for your userid:");
        printf(" pw_name  : %s\n",      p->pw_name);
        printf(" pw_uid   : %d\n", (int) p->pw_uid);
        printf(" pw_gid   : %d\n", (int) p->pw_gid);
        printf(" pw_dir   : %s\n",      p->pw_dir);
        printf(" pw_shell : %s\n",      p->pw_shell);
    }
}
```

Output

getpwuid() returns the following information for your user ID:

```
pw_name  : MVSUSR1
pw_uid   : 25
pw_gid   : 500
```

```
pw_dir   : /u/mvsusr1
pw_shell : /bin/sh
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)
- [“seteuid\(\) — Set the effective user ID” on page 1526](#)
- [“setreuid\(\) — Set real and effective user IDs” on page 1566](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)

getgid() — Get the real group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

gid_t getgid(void);
```

General description

Finds the real group ID (GID) of the calling process.

Returned value

Returns the real group ID of the calling process. It is always successful.

There are no documented errno values.

Example

CELEBG07

```
/* CELEBG07

   This example gets the real group ID.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>

main() {
    printf("my group id is %d\n", (int) getgid());
}
```

Output

```
my group id is 500
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getegid\(\) — Get the effective group ID” on page 703](#)
- [“geteuid\(\) — Get the effective user ID” on page 708](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)
- [“setgid\(\) — Set the group ID” on page 1532](#)

getgrent() — Get group database entry

The information for this function is included in [“endgrent\(\) — Group database entry functions” on page 419](#).

getgrgid() — Access the group database by ID**Standards**

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <grp.h>

struct group *getgrgid(gid_t gid);
```

General description

Provides information about the group specified by *gid* and its members.

Returned value

If successful, `getgrgid()` returns a pointer to a group structure containing an entry from the group database with the specified *gid*. The return value may point to static data that is overwritten by each call. This group structure, defined in the `grp.h` header file, contains the following members:

gr_name

The name of the group

gr_gid

The numerical group ID (GID)

gr_mem

A NULL-terminated vector of pointers to the individual member names

If unsuccessful, `getgrgid()` returns a NULL pointer.

There are no documented errno values.

Example

CELEBG08

```
/* CELEBG08

   This example provides the root GID and group name.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <grp.h>
#include <stdio.h>
#include <sys/stat.h> /*FIX: used to be <stat.h>*/

main() {
    struct stat info;
    struct group *grp;

    if (stat("/", &info) < 0)
        perror("stat() error");
    else {
        printf("The root is owned by gid %d\n", info.st_gid);
        if ((grp = getgrgid(info.st_gid)) == NULL)
            perror("getgrgid() error");
        else
            printf("This group name is %s\n", grp->gr_name);
    }
}
```

Output

```
The root is owned by gid 500
This group name is SYS1
```

Related information

- [“grp.h — Access group databases” on page 27](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“endgrent\(\) — Group database entry functions” on page 419](#)
- [“getgrgid_r\(\) — Get group database entry for a group ID” on page 711](#)
- [“getgrnam\(\) — Access the group database by name” on page 713](#)
- [“getgrnam_r\(\) — Search group database for a name” on page 714](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“getlogin_r\(\) — Get login name” on page 734](#)

getgrgid_r() — Get group database entry for a group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 z/OS UNIX | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <sys/types.h>
#include <grp.h>

int getgrgid_r(gid_t gid, struct group *grp, char *buffer,
size_t bufsize, struct group **result);

#define _POSIX_SOURCE
#include <grp.h>

int __getgrgid1(gid_t gid, struct group *grp, char *buffer,
size_t bufsize, struct group **result);
```

General description

The `getgrgid_r()` function updates the group structure pointed to by *grp* and stores a pointer to that structure at the location pointed to by *result*. The structure contains an entry from the group database with a matching *gid*. Storage referenced by the group structure is allocated from the memory provided with the *buffer* parameter, which is *bufsize* bytes in size. A NULL pointer is returned at the location pointed to by *result* on error or if the requested entry is not found.

The `__getgrgid1()` function is identical to `getgrgid_r()` except that it does not return the individual group member names. Element `gr_mem` of the group structure pointed to by *grp* will be set to NULL.

Returned value

If successful, `getgrgid_r()` or `__getgrgid1()` returns 0.

If unsuccessful, `getgrgid_r()` or `__getgrgid1()` returns an error number and sets `errno` to one of the following values:

Error Code

Description

EINVAL

One of the input arguments was not valid. Arguments *grp*, *buffer*, and *result* must not be NULL. Argument *bufsize* must not be 0.

ERANGE

Insufficient storage was supplied in *buffer* and *bufsize* to contain the data to be referenced by the resulting group structure.

EMVSSAFEXTRERR

The system authorization facility (SAF) RACROUTE EXTRACT service had an error.

EMVSSAF2ERR

The SAF Get GMAP service had an error.

Related information

- [“grp.h — Access group databases” on page 27](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“endgrent\(\) — Group database entry functions” on page 419](#)
- [“getgrgid\(\) — Access the group database by ID” on page 710](#)
- [“getgrnam\(\) — Access the group database by name” on page 713](#)
- [“getgrnam_r\(\) — Search group database for a name” on page 714](#)

getgrnam() — Access the group database by name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <grp.h>

struct group *getgrnam(const char *name);
```

General description

Accesses the group structure containing an entry from the group database with the specified *name*.

Returned value

If successful, `getgrnam()` returns a pointer to a group structure. The return value may point to static data that is overwritten by each call.

The group structure, defined in the `grp.h` header file, contains the following members:

gr_name

The name of the group

gr_gid

The numerical group ID (GID)

gr_mem

A NULL-terminated vector of pointers to the individual member names.

If unsuccessful or if the requested entry is not found, `getgrnam()` returns a NULL pointer.

There are no documented `errno` values.

Example

CELEBG09

```
/* CELEBG09

   This example provides the members of a group.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <grp.h>
#include <stdio.h>

main() {
    struct group *grp;
    char  grpname[]="USERS", **curr;

    if ((grp = getgrnam(grpname)) == NULL)
        perror("getgrnam() error");
    else {
        printf("The following are members of group %s:\n", grpname);
        for (curr=grp->gr_mem; (*curr) != NULL; curr++)
            printf("  %s\n", *curr);
    }
}
```

```

    }
}

```

Output

The following are members of group USERS:

```

MVSUSR1
MVSUSR2
MVSUSR3
MVSUSR4
MVSUSR5
MVSUSR6
MVSUSR7
MVSUSR8
MVSUSR9

```

Related information

- [“grp.h — Access group databases” on page 27](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“endgrent\(\) — Group database entry functions” on page 419](#)
- [“getgrgid\(\) — Access the group database by ID” on page 710](#)
- [“getgrgid_r\(\) — Get group database entry for a group ID” on page 711](#)
- [“getgrnam_r\(\) — Search group database for a name” on page 714](#)

getgrnam_r() — Search group database for a name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 z/OS UNIX | both | OS/390 V2R8 |

Format

```

#define _XOPEN_SOURCE 500
#include <sys/types.h>
#include <grp.h>

int getgrnam_r(const char *name, struct group *grp, char *buffer,
size_t bufsize, struct group **result);

#define _POSIX_SOURCE
#include <grp.h>

int __getgrnam1(const char *name, struct group *grp, char *buffer,
size_t bufsize, struct group **result);

```

General description

The `getgrnam_r()` function updates the group structure pointed to by `grp` and stores a pointer to that structure at the location pointed to by `result`. The structure contains an entry from the group database with a matching name. Storage referenced by the group structure is allocated from the memory provided with the `buffer` parameter, which is `bufsize` bytes in size. A NULL pointer is returned at the location pointed to by `result` on error or if the requested entry is not found.

The `__getgrnam1()` function is identical to `getgrnam_r()` except that it does not return the individual group member names. Element `gr_mem` within the group structure pointed to by `grp` will be set to `NULL`.

Returned value

If successful, `getgrnam_r()` or `__getgrnam1()` returns 0.

If unsuccessful, `getgrnam_r()` or `_getgrnam1()` returns an error number and sets `errno` to one of the following values:

Error Code

Description

EINVAL

One of the input arguments was not valid. Arguments *grp*, *buffer*, and *result* must not be `NULL`. Argument *bufsize* must not be 0.

ERANGE

Insufficient storage was supplied in *buffer* and *bufsize* to contain the data to be referenced by the resulting group structure.

EMVSSAFEXTRERR

The system authorization facility (SAF) RACROUTE EXTRACT service had an error.

EMVSSAF2ERR

The SAF Get GMAP service had an error.

Related information

- [“grp.h — Access group databases” on page 27](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“endgrent\(\) — Group database entry functions” on page 419](#)
- [“getgrgid\(\) — Access the group database by ID” on page 710](#)
- [“getgrgid_r\(\) — Get group database entry for a group ID” on page 711](#)
- [“getgrnam\(\) — Access the group database by name” on page 713](#)

getgroups() — Get a list of supplementary group IDs

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int getgroups(int size, gid_t list[]);
```

General description

Stores the supplementary group IDs of the calling process in the *list* array. *size* gives the number of `gid_t` elements that can be stored in the *list* array.

Returned value

If successful, `getgroups()` returns the number of supplementary group IDs that it puts into *list*. This value is always greater than or equal to 1 and less than or equal to the value of **NGROUPS_MAX** (which is defined in the `limits.h` header file).

If *size* is zero, `getgroups()` returns the total number of supplementary group IDs for the process. `getgroups()` does not try to store group IDs in *list*.

If unsuccessful, `getgroups()` returns -1 and sets `errno` to one of the following values.

Error Code

Description

EINVAL

size was not equal to 0 and is less than the total number of supplementary group IDs for the process.
list may or may not contain a subset of the supplementary group IDs for the process.

Example

CELEBG10

```
/* CELEBG10

   This example provides a list of the supplementary group IDs.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <grp.h>
#include <stdio.h>
#include <unistd.h>

#define dim(x) (sizeof(x)/sizeof(x[0]))

main() {
    gid_t gids[500];
    struct group *grp;
    int count, curr;

    if ((count = getgroups(dim(gids), gids)) == -1)
        perror("getgroups() error");
    else {
        puts("The following is the list of my supplementary groups:");
        for (curr=0; curr<count; curr++) {
            if ((grp = getgrgid(gids[curr])) == NULL)
                perror("getgrgid() error");
            else
                printf("  %8s (%d)\n", grp->gr_name, (int) gids[curr]);
        }
    }
}
```

Output

```
The following is the list of my supplementary groups:
  SYS1 (500)
  KINGS (512)
  NOBLES (513)
  KNIGHTS (514)
  WIZARDS (515)
  SCRIBES (516)
  JESTERS (517)
  PEASANTS (518)
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getegid\(\) — Get the effective group ID” on page 703](#)

- “[getgid\(\)](#) — Get the real group ID” on page 709
- “[getgrnam\(\)](#) — Access the group database by name” on page 713
- “[setgid\(\)](#) — Set the group ID” on page 1532

getgroupsbyname() — Get supplementary group IDs by user name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int getgroupsbyname(char username[], int size, gid_t list[]);
```

General description

Stores the supplementary group IDs of the specified *username* in the array, *list*. *size* gives the number of `gid_t` elements that can be stored in the array, *list*.

Returned value

If successful, `getgroupsbyname()` returns the number of supplementary group IDs that it puts into *list*. This value is always greater than or equal to one, and less than or equal to the value of **NGROUPS_MAX**.

If *size* is zero, `getgroupsbyname()` returns the total number of supplementary group IDs for the process. `getgroupsbyname()` does not try to store group IDs in *list*.

If unsuccessful, `getgroupsbyname()` returns -1 and sets `errno` to one of the following values.

Error Code

Description

EINVAL

size was less than or equal to the total number of supplementary group IDs for the process. *list* may or may not contain a subset of the supplementary group IDs for the process.

Example

CELEBG11

```
/* CELEBG11

   This example provides a list of the supplementary group IDs for
   MVSUSR1.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <grp.h>
#include <stdio.h>
#include <unistd.h>

#define dim(x) (sizeof(x)/sizeof(x[0]))

main() {
    gid_t gids[500];
    struct group *grp;
    int count, curr;
    char user[]="MVSUSR1";
```

```
if ((count = getgroupsbyname(user, dim(gids), gids)) == -1)
    perror("getgroups() error");
else {
    printf("The following is the list of %s's supplementary groups:\n",
           user);
    for (curr=0; curr<count; curr++) {
        if ((grp = getgrgid(gids[curr])) == NULL)
            perror("getgrgid() error");
        else
            printf("  %8s (%d)\n", grp->gr_name, (int) gids[curr]);
    }
}
```

Output

```
The following is the list of MVSUSR1's supplementary groups:
  SYS1 (500)
  USERS (523)
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getegid\(\) — Get the effective group ID” on page 703](#)
- [“getgid\(\) — Get the real group ID” on page 709](#)
- [“getgroups\(\) — Get a list of supplementary group IDs” on page 715](#)
- [“setgid\(\) — Set the group ID” on page 1532](#)

gethostbyaddr() — Get a host entry by address

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>
extern int h_errno;

struct hostent *gethostbyaddr(const void *address, size_t len, int type);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct hostent *gethostbyaddr(char *address, int address_len, int domain);
```

General description

The `gethostbyaddr()` call tries to resolve the host address through a name server, if one is present. `gethostbyaddr()` searches the local host tables until a matching host address is found or an EOF marker is reached.

| Parameter | Description |
|-----------|-------------|
|-----------|-------------|

address

The pointer to a structure containing the address of the host. (An unsigned long for AF_INET.)

address_len

The size of *address* in bytes.

domain

The address domain supported (AF_INET).

If you want `gethostbyaddr()` to bypass the name server and instead resolve the host address using the local host tables, you must define the `RESOLVE_VIA_LOOKUP` symbol before including any sockets-related include files in your source program.

You can use the **X_ADDR** environment variable to specify different local host tables and override those supplied by the z/OS global resolver during initialization.

Note: For more information on these local host tables or the environment variables, see [z/OS Communications Server: IP Configuration Guide](#).

The `gethostbyaddr()` call returns a pointer to a `hostent` structure for the host address specified on the call.

`gethostent()`, `gethostbyaddr()`, and `gethostbyname()` all use the same static area to return the `hostent` structure. This static area is only valid until the next one of these functions is called on the same thread.

The **netdb.h** include file defines the `hostent` structure and contains the following elements:

| Element | Description |
|---------|-------------|
|---------|-------------|

h_addr_list

A pointer to a NULL-terminated list of host network addresses.

h_addrtype

The type of address returned; currently, it is always set to AF_INET.

h_aliases

A zero-terminated array of alternative names for the host.

h_length

The length of the address in bytes.

h_name

The official name of the host.

The following function (X/Open sockets only) is defined in **netdb.h** and should be used by multithreaded applications when attempting to reference *h_errno* return on error:

```
int *__h_errno(void);
```

Also use this function when you invoke `gethostbyaddr()` in a DLL.

This function returns a pointer to a thread-specific value for the *h_errno* variable.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Note: The `gethostbyaddr()` and `gethostbyname()` functions have been moved to obsolescence in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `getaddrinfo()` and `getnameinfo()` functions are preferred for portability.

Returned value

The return value points to static data that is overwritten by subsequent calls. A pointer to a `hostent` structure indicates success. A NULL pointer indicates an error or End Of File (EOF).

If unsuccessful in X/Open, `gethostbyaddr()` sets `h_errno` to indicate the error as follows:

Error Code

Description

HOST_NOT_FOUND

No such host is known.

NO_DATA

The server recognized the request and the name but no address is available. Another type of request to the name server might return an answer.

NO_RECOVERY

An unexpected server failure occurred from which there is no recovery.

TRY_AGAIN

A temporary error such as no response from a server, indicating the information is not available now but may be at a later time.

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endhostent\(\) — Close the host information data set” on page 420](#)
- [“gethostbyname\(\) — Get a host entry by name” on page 720](#)
- [“gethostent\(\) — Get the next host entry” on page 722](#)
- [“sethostent\(\) — Open the host information data set” on page 1534](#)

gethostbyname() — Get a host entry by name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>
extern int h_errno;

struct hostent *gethostbyname(const char *name);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct hostent *gethostbyname(char *name);
```

General description

The `gethostbyname()` call tries to resolve the host name through a name server, if one is present. If a name server is not present, `gethostbyname()` searches the local host tables until a matching host name is found or an EOF marker is reached.

Parameter

Description

name

The name of the host.

The `gethostbyname()` call returns a pointer to a `hostent` structure for the host name specified on the call.

`gethostent()`, `gethostbyaddr()`, and `gethostbyname()` all use the same static area to return the `hostent` structure. This static area is only valid until the next one of these functions is called on the same thread.

If you want `gethostbyname()` to bypass the name server and instead resolve the host name using the local host tables, you must define the `RESOLVE_VIA_LOOKUP` symbol before including any sockets-related include files in your source program.

If the name server is not present or the `RESOLVE_VIA_LOOKUP` option is in effect, you can use the **X_SITE** environment variable to specify different local host tables and override those supplied by the z/OS global resolver during initialization.

Note: For more information on these local host tables or the environment variables, see [z/OS Communications Server: IP Configuration Guide](#).

`gethostent()`, `gethostbyaddr()`, and `gethostbyname()` all use the same static area to return the `HOSTENT` structure. This static area is only valid until the next one of these functions is called on the same thread.

The **netdb.h** include file defines the `hostent` structure and contains the following elements:

Element**Description*****h_addr_list***

A pointer to a NULL-terminated list of host network addresses.

h_addrtype

The type of address returned; currently, it is always set to `AF_INET`.

h_aliases

A zero-terminated array of alternative names for the host.

h_length

The length of the address in bytes.

h_name

The official name of the host.

The following function (X/Open sockets only) is defined in **netdb.h** and should be used by multithreaded applications when attempting to reference `h_errno` return on error:

```
int *__h_errno(void);
```

Also use this function when you invoke `gethostbyname()` in a DLL. This function returns a pointer to a thread-specific value for the `h_errno` variable.

Special Behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Note: The `gethostbyaddr()` and `gethostbyname()` functions have been moved to obsolescence in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `getaddrinfo()` and `getnameinfo()` functions are preferred for portability.

Returned value

The return value points to static data that is overwritten by subsequent calls. A pointer to a `hostent` structure indicates success. A NULL pointer indicates an error or End Of File (EOF).

If unsuccessful in X/Open, `gethostbyname()` sets `h_errno` to one of the following values:

Error Code**Description****HOST_NOT_FOUND**

No such host is known.

NO_DATA

The server recognized the request and the name but no address is available. Another type of request to the name server might return an answer.

NO_RECOVERY

An unexpected server failure occurred from which there is no recovery.

TRY_AGAIN

A temporary error such as no response from a server, indicating the information is not available now but may be at a later time.

Related information

- “[netdb.h — Network database operations](#)” on page 45
- “[endhostent\(\) — Close the host information data set](#)” on page 420
- “[gethostbyaddr\(\) — Get a host entry by address](#)” on page 718
- “[gethostent\(\) — Get the next host entry](#)” on page 722
- “[gethostname\(\) — Get the name of the host processor](#)” on page 724
- “[sethostent\(\) — Open the host information data set](#)” on page 1534

gethostent() — Get the next host entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**X/Open:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct hostent *gethostent(void);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct hostent *gethostent(void);
```

General description

The `gethostent()` call reads the next line of the local host tables.

The `gethostent()` call returns a pointer to the next entry in the local host tables. `gethostent()` uses the local host tables to get aliases.

You can use the **X_SITE** environment to specify different local host tables and override those supplied by the z/OS resolver during initialization.

Note: For more information on these local host tables or the environment variables, see [z/OS Communications Server: IP Configuration Guide](#).

gethostent(), gethostbyaddr(), and gethostbyname() all use the same static area to return the hostent structure. This static area is only valid until the next one of these functions is called on the same thread.

The **netdb.h** include file defines the hostent structure and contains the following elements:

Element

Description

h_addrtype

The type of address returned; currently, it is always set to AF_INET.

h_addr

A pointer to the network address of the host.

h_aliases

A zero-terminated array of alternative names for host.

h_length

The length of the address in bytes.

h_name

The official name of the host.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, gethostent() returns a pointer to a hostent structure. The return value points to data that is overwritten by subsequent calls returning the same data structure.

If unsuccessful, gethostent() returns a NULL pointer, indicating an error or End Of File (EOF).

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“gethostbyaddr\(\) — Get a host entry by address” on page 718](#)
- [“gethostbyname\(\) — Get a host entry by name” on page 720](#)
- [“sethostent\(\) — Open the host information data set” on page 1534](#)

gethostid() — Get the unique identifier of the current host

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

long gethostid(void);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <unistd.h>
```

```
int gethostid();
```

General description

The `gethostid()` call gets the unique 32-bit identifier for the current host. This value is the default home Internet address.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Note: `gethostid()` is not supported for callers in an IBM z/OS Container Platform environment.

Returned value

If successful, `gethostid()` returns the 32-bit identifier of the current host, which should be unique across all hosts.

If unsuccessful, `gethostid()` returns -1 and stores the error value in `errno`. For return codes, see [z/OS UNIX System Services Messages and Codes](#).

Error Code

Description

ENOTSUP

`gethostid()` is not supported for callers in an IBM z/OS Container Platform environment.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“gethostname\(\) — Get the name of the host processor” on page 724](#)

gethostname() — Get the name of the host processor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int gethostname(char *name, size_t namelen);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <unistd.h>

int gethostname(char *name, int namelen);
```

General description

The `gethostname()` call returns the name of the host processor that the program is running on. If a UTS namespace is previously created for the caller of the `gethostname()` call, the host name that is

associated with that UTS namespace is returned. Up to *namelen* characters are copied into the name array. The returned name is NULL-terminated unless there is insufficient room in the name array.

Parameter Description

name

The character array to be filled with the host name.

namelen

The length of *name*.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, `gethostname()` returns 0.

If unsuccessful, `gethostname()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EAGAIN

The resource is temporarily unavailable or the caller is not authorized to access the stack.

EMVSERR

An MVS environmental or internal error occurs. Contact IBM support.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“gethostbyname\(\) — Get a host entry by name” on page 720](#)
- [“gethostid\(\) — Get the unique identifier of the current host” on page 723](#)

getibmopt() — Get IBM TCP/IP image

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCKET_EXT
#include <sys/socket.h>

int getibmopt(int cmd, struct ibm_gettcpinfo *bfrp);
```

General description

The `getibmopt()` function call returns -1 with `errno` EOPNOTSUPP to indicate that this function is not currently supported.

Parameter Description

cmd

The value in domain must be `AF_INET`.

bfrp

The pointer to an `ibm_gettcpinfo` structure.

Returned value

`getibmsockopt()` always returns -1, indicating that this function is not currently supported.

Error Code
Description

EOPNOTSUPP
This function is not supported.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

getibmsockopt() — Get IBM specific options associated with a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>

int getibmsockopt(int s, int level, int optname, char *optval, int *optlen);
```

General description

Like `getsockopt()`, the `getibmsockopt()` gets the options associated with a socket in the `AF_INET` or `AF_INET6` domain. Only `SOL_SOCKET` is supported. This call is for options specific to the IBM implementation of sockets. Currently, only the `SOL_SOCKET` level and the socket options `SO_NONBLOCKLOCAL` and `SO_IGNOREINCOMINGPUSH` are supported.

Parameter
Description

- s**
The socket descriptor.
- level**
The level for which the option is set.
- optname**
The name of a specified socket option.
- optval**
The pointer to option data.
- optlen**
The pointer to the length of the option data.

The fields `b_num_UNITSs_sent` and `b_num_UNITSs_received` represent cumulative totals for this socket since the time the application was started.

For `SO_NONBLOCKLOCAL`, `optval` should point to an integer. `getibmsockopt()` returns 0 in `optval` if the socket is in blocking mode, and returns 1 in `optval` if the socket is in nonblocking mode.

For SO_IGNOREINCOMINGPUSH, *optval* should point to an integer. `getibmssockopt()` returns 0 in *optval* if the option is not set, and returns 1 in *optval* if the option is set.

Returned value

If successful, `getibmssockopt()` returns 0.

If unsuccessful, `getibmssockopt()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

The *s* parameter is not a valid socket descriptor.

EFAULT

Using *optval* and *optlen* parameters would result in an attempt to access storage outside the caller's address space.

ENOPROTOPT

The *optname* parameter is unrecognized, or the *level* parameter is not SOL_SOCKET.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“setibmssockopt\(\) — Set IBM specific options associated with a socket” on page 1537](#)

__getipc(), __getipc64()— Query interprocess communications

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

__getipc:

```
#define _XOPEN_SOURCE
#include <sys/__getipc.h>

int __getipc(int token_id, IPCQPROC *bufptr, size_t buflen, int cmd);
```

__getipc64:

```
#define _LARGE_TIME_API
#define _XOPEN_SOURCE
#include <sys/__getipc.h>

int __getipc64(int token_id, IPCQPROC64 *bufptr, size_t buflen, int cmd);
```

General description

The `__getipc()` and `__getipc64()` functions provide means for obtaining information about the status of interprocess communications (IPC) resources, message queues, semaphores, shared memory, and map service memory.

The `__getipc64()` function behaves exactly like `__getipc()` except `__getipc64()` supports time beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

The argument *token_id* is a number that identifies the relative position of an IPC member in the system or specifies a message queue ID, semaphore ID, or shared memory ID. Zero represents the first IPC member ID in the system. On the first call to `__getipc()`, pass the a *token_id* of zero; the function will return the

token that identifies the next IPC resource to which the caller has access. Use this token on the next call to `__getipc()`.

The argument *bufptr* is the address where the data is to be stored.

The argument *buflen* is the length of the buffer.

The argument *cmd* specifies one of the following commands:

IPCQALL

Retrieve the next shared memory, semaphore, or message queue

IPCQMSG

Retrieve the next message member

IPCQSEM

Retrieve the next semaphore member

IPCQSHM

Retrieve the next shared memory member

IPCQMAP

Retrieve the next map service memory currently allocated

IPCQOVER

Overview of system variables. Ignores the value of the first argument *token_id*.

Returned value

If successful, `__getipc()` returns 0.

If unsuccessful, `__getipc()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Operation permission (read) is denied to the calling process for the member ID specified by *token_id*.

EFAULT

The argument *bufptr* contains an non-valid address.

EINVAL

The member ID specified in the argument *token_id* is not valid for the command specified, or the argument *cmd* is not a valid command.

Related information

- [“sys/__getipc.h — Interprocess communication” on page 68](#)
- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“msgctl\(\), msgctl64\(\) — Message control operations” on page 1110](#)
- [“msgget\(\) — Get message queue” on page 1112](#)
- [“msgrcv\(\) — Message receive operation” on page 1115](#)
- [“msgsnd\(\) — Message send operations” on page 1119](#)
- [“msgxrcv\(\), msgxrcv64\(\) — Extended message receive operation” on page 1120](#)
- [“semctl\(\), semctl64\(\) — Semaphore control operations” on page 1482](#)
- [“semget\(\) — Get a set of semaphores” on page 1486](#)
- [“semop\(\) — Semaphore operations” on page 1488](#)
- [“shmat\(\) — Shared memory attach operation” on page 1593](#)
- [“shmctl\(\), shmctl64\(\) — Shared memory control operations” on page 1595](#)
- [“shmdt\(\) — Shared memory detach operation” on page 1596](#)
- [“shmget\(\) — Get a shared memory segment” on page 1597](#)

getipv4sourcefilter() – Get source filter

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3678 | both | z/OS V1.9 |

Format

```
#define _OPEN_SYS_SOCK_EXT3
#include <netinet/in.h>

int getipv4sourcefilter(int s, struct in_addr interface, struct in_addr group,
                       uint32_t *fmode, uint32_t *numsrc, struct in_addr *slist);
```

General description

This function allows applications to get a previously set multicast filtering state for a tuple consisting of socket, interface, and multicast group values.

A multicast filter is described by a filter mode, which is MCAST_INCLUDE or MCAST_EXCLUDE, and a list of source addresses which are filtered.

This function is IPv4-specific, must be used only on AF_INET sockets with an open socket of type SOCK_DGRAM or SOCK_RAW.

If the function is unable to obtain the required storage, control will not return to the caller. Instead the application will terminate due to an out of memory condition (if the reserve stack is available and the caller is not XPLINK), or it will terminate with an abend indicating that storage could not be obtained.

Argument

Description

s

Identifies the socket.

interface

Holds the local IP address of the interface.

group

Holds the IP multicast address of the group.

fmode

Points to an integer that will contain the filter mode on a successful return. The value of this field will be either MCAST_INCLUDE or MCAST_EXCLUDE, which are likewise defined in <netinet/in.h>.

numsrc

It is a pointer that on input, points to the number of source addresses that will fit in the slist array. On return, points to the total number of sources associated with the filter.

slist

Points to buffer into which an array of IP addresses of included or excluded (depending on the filter mode) sources will be written. If numsrc was 0 on input, a NULL pointer may be supplied.

Returned value

If successful, the function returns 0. Otherwise, it returns -1 and sets errno to one of the following values.

errno

Description

EADDRNOTAVAIL

The tuple consisting of socket, interface, and multicast group values does not exist, or the specified interface address is incorrect for this host, or the specified interface address is not multicast capable.

EBADF

s is not a valid socket descriptor.

EINVAL

Interface or group is not a valid IPv4 address, or the socket s has already requested multicast setsockopt options.

EPROTOTYPE

The socket s is not of type SOCK_DGRAM or SOCK_RAW.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“setipv4sourcefilter\(\) — Set source filter” on page 1539](#)

getitimer() — Get value of an interval timer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/time.h>

int getitimer(int which, struct itimerval *value);
```

General description

getitimer() gets the current value of an (previously set) interval timer. An interval timer is a timer which sends a signal after each repetition (interval) of time.

The *which* argument indicates what kind of time is being controlled. Values for *which* are:

ITIMER_REAL

This timer is marking real (clock) time. A SIGALRM signal is generated after each interval of time.

Note: alarm() also sets the real interval timer.

ITIMER_VIRTUAL

This timer is marking process virtual time. Process virtual time is the amount of time spent while executing in the process, and can be thought of as a CPU timer. A SIGVTALRM signal is generated after each interval of time.

ITIMER_PROF

This timer is marking process virtual time plus time spent while the system is running on behalf of the process. A SIGPROF signal is generated after each interval of time.

Note: In a multithreaded environment, each of the above timers is specific to a thread of execution for both the generation of the time interval and the measurement of time. For example, an ITIMER_VIRTUAL timer will mark execution time for just the thread, not the entire process.

The *value* argument is a pointer to a structure containing:

it_interval

timer interval

it_value

current timer value (time remaining)

Each of these fields is a timeval structure, and contains:

tv_sec

seconds since January 1, 1970 (UTC)

tv_usec

microseconds

Returned valueIf successful, `getitimer()` returns 0, and *value* points to the itimerval structure.If unsuccessful, `getitimer()` returns -1 and sets `errno` to one of the following values:**Error Code****Description****EINVAL***which* is not a valid timer type.**Related information**

- [“sys/time.h — Time types” on page 71](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“gettimeofday\(\), gettimeofday64\(\) — Get date and time” on page 790](#)
- [“sleep\(\) — Suspend execution of a thread” on page 1668](#)
- [“setitimer\(\) — Set value of an interval timer” on page 1540](#)
- [“ualarm\(\) — Set the interval timer” on page 1921](#)
- [“usleep\(\) — Suspend execution for an interval” on page 1951](#)

getline() — Read an entire line from a stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L

#include <stdio.h>
ssize_t getline(char **__restrict__ lineptr, size_t *__restrict__ n, FILE *__restrict__ stream);
```

General description

The `getline()` function reads an entire line from *stream*, storing the address of the buffer containing the text into **lineptr*. The buffer is null-terminated and includes the newline character, if one is found.

If **lineptr* is set to NULL and **n* is set 0 before the call, `getline()` allocates a buffer for storing the line. This buffer must be freed by the user program even when `getline()` fails.

Alternatively, before calling `getline()`, `*lineptr` can contain a pointer to a buffer that is allocated by `malloc()`, which is `*n` bytes in size. If the buffer is not large enough to hold the line, `getline()` resizes it with `realloc()`, updating `*lineptr` and `*n` as necessary.

In either case, on a successful call, `*lineptr` and `*n` are updated to reflect the buffer address and allocated size respectively.

Returned value

If successful, `getline()` returns the number of characters that are read, including the newline character, but not including the terminating null byte (`'\0'`). This value can be used to handle embedded null bytes in the line read.

If unsuccessful, `getline()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EINVAL
Invalid arguments. `*lineptr` or `*n` is NULL, or `stream` is not valid.

ENOMEM
Allocation or reallocation of the line buffer fails.

ERECIO
File opened for record I/O. Cannot get single bytes.

EOVERFLOW
Line length is too large, which exceeds the maximum value that the returning type `ssize_t` can represent.

Related information

- [“fopen\(\) — Open a file” on page 571](#)
- [“fclose\(\) — Close file” on page 482](#)

getlogin() — Get the user login name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

_POSIX_SOURCE:

```
#define _POSIX_SOURCE
#include <unistd.h>

char *getlogin(void);
```

_XOPEN_SOURCE:

```
#define _XOPEN_SOURCE
#include <unistd.h>

char *getlogin(void);
```

General description

Finds the name that the login process associated with the current terminal. This string is stored in a static data area and, therefore, may be overwritten with every call to `getlogin()`.

Special behavior for `_POSIX_SOURCE`: If called from a batch program, a TSO command, or a shell command, `getlogin()` returns the MVS user name associated with the program. With z/OS UNIX services, this name is a TSO/E user ID. When `_POSIX_SOURCE` is defined and `_XOPEN_SOURCE` is not defined, then `getlogin()` is the same as `__getlogin1()`.

Special behavior for XPG4.2: You must have a TTY at file descriptor 0, 1, or 2, and the TTY must be recorded in the `/etc/utmpx` database. Someone must have logged in using the TTY. Also, the program must be invoked from a shell session, and file descriptors 0, 1, and 2 are not all redirected.

If `getlogin()` cannot determine the login name, you can call `getuid()` to get the user ID of the process, and then call `getpwuid()` to get a login name associated with that user ID. `getpwuid()` always returns the `passwd` struct for the same user, even if multiple users have the same UID.

Returned value

If successful, `getlogin()` returns a pointer to a string that has the login name for the current terminal.

Special behavior for `_POSIX_SOURCE`: If unsuccessful, `getlogin()` returns the NULL pointer.

There are no documented `errno` values.

Special behavior for XPG4.2: If unsuccessful, `getlogin()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

EMFILE

`OPEN_MAX` file descriptors are currently open in the calling process.

ENFILE

The maximum allowable number of files is currently open in the system.

ENXIO

The calling process has no controlling terminal.

Example

CELEBG12

```
/* CELEBG12

   This example gets the user login name.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <unistd.h>

main() {
    char *user;

    if ((user = __getlogin1()) == NULL)
        perror("__getlogin1() error");
    else printf("__getlogin1() returned %s\n", user);
}
```

Output

```
getlogin() returned MEGA
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getlogin_r\(\) — Get login name” on page 734](#)
- [“__getlogin1\(\) — Get the user login name” on page 735](#)
- [“getpwuid\(\) — Access the user database by user ID” on page 764](#)
- [“getpwuid_r\(\) — Search user database for a user ID” on page 765](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)

getlogin_r() — Get login name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <unistd.h>

int getlogin_r(char *name, size_t namesize);
```

General description

The `getlogin_r()` function puts the name associated by the login activity with the control terminal of the current process in the character array pointed to by *name*. The array is *namesize* characters long and should have space for the name and the terminating NULL character. The maximum size of the login name is **LOGIN_NAME_MAX**.

If `getlogin_r()` is successful, *name* points to the name the user used at login, even if there are several login names with the same user ID.

Returned value

If successful, `getlogin_r()` returns 0.

If unsuccessful, `getlogin_r()` sets `errno` to one of the following values:

Error Code

Description

ERANGE

The value of *namesize* is smaller than the length of the string to be returned including the terminating NULL character.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“__getlogin1\(\) — Get the user login name” on page 735](#)
- [“getpwuid\(\) — Access the user database by user ID” on page 764](#)
- [“getpwuid_r\(\) — Search user database for a user ID” on page 765](#)

- “getuid() — Get the real user ID” on page 792

__getlogin1() — Get the user login name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---------------------------|----------|--------------|
| POSIX.1 XPG4 XPG4.2 | both | |

Format

_POSIX_SOURCE:

```
#define _POSIX_SOURCE
#include <unistd.h>

char *__getlogin1(void);
```

General description

Finds the name that the login process associated with the current terminal. If called from batch, __getlogin1() finds the name associated with the batch program. With z/OS UNIX services, this name is a TSO/E user ID unless the USERIDALISTABLE is in use. If the USERIDALISTABLE is setup and a z/OS UNIX alias name exists for a given MVS(TSO, batch user, etc.) userid, then that will be returned.

If __getlogin1() cannot determine the login name, you can call getuid() to get the user ID of the process, and then call getpwuid() to get a login name associated with that user ID. getpwuid() always returns the passwd struct for the same user, even if multiple users have the same UID.

Returned value

If successful, __getlogin1() returns a pointer to a string that has the login name for the current terminal.

If unsuccessful, __getlogin1() returns the NULL pointer.

There are no documented errno values.

Example

CELEBG12

```
/* CELEBG12

   This example gets the user login name.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <unistd.h>

main() {
    char *user;

    if ((user = __getlogin1()) == NULL)
        perror("__getlogin1() error");
    else printf("__getlogin1() returned %s\n", user);
}
```

Output

```
getlogin() returned MEGA
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“getpwuid\(\) — Access the user database by user ID” on page 764](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)

getmccoll() — Get next collating element from string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <collate.h>

collcl_t getmccoll(char **src);
```

General description

If the object pointed to by *src* is not a NULL pointer, the `getmccoll()` library function determines the longest sequence of bytes in the array pointed to by *src* that constitute a valid multicharacter collating element. It then produces the value of type `collcl_t` corresponding to that collating element. The object pointed to by *src* is assigned the address just past the last byte of the multicharacter collating element processed.

Returned value

If successful, `getmccoll()` returns the value of type `collcl_t` that represents the collating element found. If the object pointed to by *src* is a NULL pointer, or if it points to NULL character, `getmccoll()` returns 0.

Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“cclass\(\) — Return characters in a character class” on page 243](#)
- [“collequiv\(\) — Return a list of equivalent collating elements” on page 300](#)
- [“collorder\(\) — Return list of collating elements” on page 301](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“colltostr\(\) — Return a string for a collating element” on page 304](#)
- [“getwmcoll\(\) — Get next collating element from wide string” on page 803](#)
- [“ismccolcl\(\) — Identify a multicharacter collating element” on page 915](#)
- [“maxcoll\(\) — Return maximum collating element” on page 1043](#)
- [“strtcoll\(\) — Return collating element for string” on page 1757](#)

getmsg(), getpmsg() – Receive next message from a STREAMS file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stropts.h>

int getmsg(int fildes, struct strbuf *ctlptr,
           struct strbuf *dataptr, int *flagsp);
int getpmsg(int fildes, struct strbuf *ctlptr,
            struct strbuf *dataptr, int *bandp, int *flagsp);
```

General description

The `getmsg()` function retrieves the contents of a message located at the head of the STREAM head read queue associated with a STREAMS file and places the contents into one or more buffers. The message contains either a data part, a control part, or both. The data and control parts of the message are placed into separate buffers, as described below. The semantics of each part is defined by the originator of the message.

The `getpmsg()` function does the same thing as `getmsg()`, but provides finer control over the priority of the messages received. Except where noted, all requirements on `getmsg()` also pertain to `getpmsg()`.

The *fildes* argument specifies a file descriptor referencing a STREAMS-based file.

The *ctlptr* and *dataptr* arguments each point to a `strbuf` structure, in which the **buf** member points to a buffer in which the data or control information is to be placed, and the **maxlen** member indicates the maximum number of bytes this buffer can hold. On return, the **len** member contains the number of bytes of data or control information actually received. The **len** member is set to 0 if there is a zero-length control or data part and **len** is set to -1 if no data or control information is present in the message.

When `getmsg()` is called, *flagsp* should point to an integer that indicates the type of message the process is able to receive. This is described further below.

The *ctlptr* argument is used to hold the control part of the message, and *dataptr* is used to hold the data part of the message. If *ctlptr* (or *dataptr*) is a NULL pointer or the **maxlen** member is -1, the control (or data) part of the message is not processed and is left on the STREAM head read queue. If the *ctlptr* (or *dataptr*) is not a NULL pointer, **len** is set to -1. If the **maxlen** member is set to 0 and there is a zero-length control (or data) part, that zero-length part is removed from the read queue and **len** is set to 0. If the **maxlen** member is set to 0 and there are more than 0 bytes of control (or data) information, that information is left on the read queue and **len** is set to 0. If the **maxlen** member in *ctlptr* (or *dataptr*) is less than the control (or data) part of the message, **maxlen** bytes are retrieved. In this case, the remainder of the message is left on the STREAM head read queue and a nonzero return value is provided.

By default, `getmsg()` processes the first available message on the STREAM head read queue. However, a process may choose to retrieve only high-priority messages by setting the integer pointed to by *flagsp* to `RS_HIPRI`. In this case, `getmsg()` and `getpmsg()` will only process the next message if it is a high-priority message. When the integer pointed to by *flagsp* is 0, any message will be retrieved. In this case, on return, the integer pointed to by *flagsp* will be set to `RS_HIPRI` if a high-priority message was retrieved, or 0 otherwise.

For `getpmsg()`, the flags are different. The *flagsp* argument points to a bitmask with the following mutually-exclusive flags defined: `MSG_HIPRI`, `MSG_BAND`, and `MSG_ANY`. Like `getmsg()`, `getpmsg()` processes the first available message on the STREAM head read queue. A process may choose to retrieve

only high-priority messages by setting the integer pointed to by *flagsp* to MSG_HIPRI and the integer pointed to by *bandp* to 0. In this case, getpmsg() will only process the next message if it is a high-priority message. In a similar manner, a process may choose to retrieve a message from a particular priority band by setting the integer pointed to by *flagsp* to MSG_BAND and the integer pointed to by *bandp* to the priority band of interest. In this case, getpmsg() will only process the next message if it is in a priority band equal to, or greater than, the integer pointed to by *bandp*, or if it is a high-priority message. If a process just wants to get the first message off the queue, the integer pointed to by *flagsp* should be set to MSG_ANY and the integer pointed to by *bandp* should be set to 0. On return, if the message retrieved was a high-priority message, the integer pointed to by *flagsp* will be set to MSG_HIPRI and the integer pointed to by *bandp* will be set to 0. Otherwise, the integer pointed to by *flagsp* will be set to MSG_BAND and the integer pointed to by *bandp* will be set to the priority band of the message.

If O_NONBLOCK is not set, getmsg() and getpmsg() will block until a message of the type specified by *flagsp* is available at the front of the STREAM head read queue. If O_NONBLOCK is set and a message of the specified type is not present at the front of the read queue, getmsg() and getpmsg() fail and set errno to EAGAIN.

If a hang-up occurs on the STREAM from which messages are to be retrieved, getmsg() and getpmsg() continue to operate normally, as described above, until the STREAM head read queue is empty. Thereafter, they return 0 in the *len* members of *ctlptr* and *dataptr*.

The following symbolic constants are defined under _XOPEN_SOURCE_EXTENDED 1 in <stropts.h>.

MSG_ANY

Receive any message.

MSG_BAND

Receive message from specified band.

MSG_HIPRI

Send/Receive high priority message.

MORECTL

More control information is left in message.

MOREDATA

More data is left in message.

Returned value

If successful, getmsg() and getpmsg() return a nonnegative value. A value of 0 indicates that a full message was read successfully. A return value of MORECTL indicates that more control information is waiting for retrieval. A return value of MOREDATA indicates that more data is waiting for retrieval. A return value of the bitwise logical OR of MORECTL and MOREDATA indicates that both types of information remain. Subsequent getmsg() and getpmsg() calls retrieve the remainder of the message. However, if a message of higher priority has come in on the STREAM head read queue, the next call to getmsg() or getpmsg() retrieves that higher-priority message before retrieving the remainder of the previous message.

If unsuccessful, getmsg() and getpmsg() return -1 and set errno to one of the following values.

Note: z/OS UNIX services do not supply any STREAMS devices or pseudodevices. It is impossible for getmsg() and getpmsg() to get a message from a STREAMS file. It will always return -1 with errno set to indicate the failure. See [“open\(\) — Open a file”](#) on page 1157 for more information.

Error Code**Description****EAGAIN**

The O_NONBLOCK flag is set and no messages are available.

EBADF

The *fildev* argument is not a valid file descriptor open for reading.

EBADMSG

The queued message to be read is not valid for getmsg() or getpmsg() or a pending file descriptor is at the STREAM head.

EINTR

A signal was caught during `getmsg()` or `getpmsg()`

EINVAL

An illegal value was specified by *flagsp*, or the STREAM or multiplexer referenced by *fildes* is linked (directly or indirectly) downstream from a multiplexer.

ENOSTR

A STREAM is not associated with *fildes*.

In addition, `getmsg()` and `getpmsg()` will fail if the STREAM head had processed an asynchronous error before the call. In this case, the value of `errno` does not reflect the result of `getmsg()` or `getpmsg()` but reflects the prior error.

Related information

- [“stropts.h — Stream interface” on page 67](#)
- [“poll\(\) — Monitor activity on file descriptors and message queues” on page 1196](#)
- [“putmsg\(\), putpmsg\(\) — Send a message on a STREAM” on page 1355](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

getnameinfo() — Get name information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R4 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <sys/socket.h>
#include <netdb.h>

int getnameinfo(const struct sockaddr *sa, socklen_t salen,
                char *host, socklen_t hostlen,
                char *serv, socklen_t servlen,
                int flags);
```

SUSV3

```
#define _POSIX_C_SOURCE 200112L
#include <sys/socket.h>
#include <netdb.h>

int getnameinfo(const struct sockaddr *__restrict__ sa, socklen_t salen,
                char *__restrict__ host, socklen_t hostlen, char *__restrict__ serv,
                socklen_t servlen, int flags);
```

General description

The `getnameinfo()` function translates a socket address to a node name and service location. The `getnameinfo()` function looks up an IP address and port number provided by the caller in the DNS and system-specific database, and returns text strings for both in buffers provided by the caller.

The *sa* argument points to either a `sockaddr_in` structure (for IPv4) or a `sockaddr_in6` structure (for IPv6) that holds the IP address and port number. The `sockaddr_in6` structure may also contain a zone index

value, if the IPv6 address represented by this `sockaddr_in6` structure is a link-local address. The *salen* argument gives the length of the `sockaddr_in` or `sockaddr_in6` structure.

If the socket address structure contains an IPv4-mapped IPv6 address or an IPv4-compatible IPv6 address, the embedded IPv4 address is extracted and the lookup is performed on the IPv4 address.

Note: The IPv6 unspecified address (“::”) and the IPv6 loopback address (“::1”) are not IPv4-compatible addresses. If the address is the IPv6 unspecified address, a lookup is not performed, and the `EAI_NONAME` error code is returned.

The node name associated with the IP address is returned in the buffer pointed to by the *host* argument. The caller provides the size of this buffer in the *hostlen* argument. The caller specifies not to return the node name by specifying a zero value for *hostlen* or a null *host* argument. If the node's name cannot be located, the numeric form of the node's address is returned instead of its name. If a zone index value was present in the `sockaddr_in6` structure, the numeric form of the zone index, or the interface name associated with the zone index, is appended to the node name returned, using the format `node name%scope` information.

If the size of the buffer specified in the *hostlen* argument is insufficient to contain the entire node name, or node name and scope information combination, up to *hostlen* characters will be copied into the buffer as a null terminated string.

The service name associated with the port number is returned in the buffer pointed to by the *serv* argument, and the *servlen* argument gives the length of this buffer. The caller specifies not to return the service name by specifying a zero value for *servlen* or a null *serv* argument. If the service's name cannot be located, the numeric form of the service address (for example, its port number) will be returned instead of its name.

If the size of the buffer specified in the *servlen* argument is insufficient to contain the entire service name, up to *servlen* characters will be copied into the buffer as a null terminated string.

The final argument, *flags*, is a flag that changes the default actions of this function. By default the fully-qualified domain name (FQDN) for the host is returned.

If the flag bit `NI_NOFQDN` is set, only the node name portion of the FQDN is returned for local hosts.

If the flag bit `NI_NUMERICHOST` is set, the numeric form of the host's address is returned instead of its name.

If the flag bit `NI_NAMEREQD` is set, an error is returned if the host's name cannot be located.

If the flag bit `NI_NUMERICSERV` is set, the numeric form of the service address is returned (for example, its port number) instead of its name.

If the flag bit `NI_NUMERICSCOPE` is set, the numeric form of the scope identifier is returned (for example, zone index) instead of its name. This flag is ignored if the *sa* argument is not an IPv6 address.

If the flag bit `NI_DGRAM` is set, this specifies that the service is a datagram service, and causes `getservbyport()` to be called with a second argument of "udp" instead of its default of "tcp". This flag is required for the few ports (for example, [512,514]) that have different services for UDP and TCP.

Note: The three `NI_NUMERICxxx` flags are required to support the "-n" flag that many commands provide.

Special behavior for SUSv3: Starting with z/OS V1.9, environment variable `_EDC_SUSV3` can be used to control the behavior of `getnameinfo()` with respect to detecting if the buffer pointed to by the *host* or *serv* argument is too small to contain the entire resolved name. The function will fail and return `EAI_OVERFLOW`. By default, `getnameinfo()` will truncate the values pointed to by *host* or *serv* and return successfully. When `_EDC_SUSV3` is set to 1, `getnameinfo()` will check for insufficient size buffers to contain the resolved name.

Returned value

Upon successful completion, `getnameinfo()` returns the node and service names, if requested, in the buffers provided. The returned names are always null-terminated strings.

A zero return value for `getnameinfo()` indicates successful completion; a non-zero return value indicates failure. The possible values for the failures are listed as follows.

Error Code
Description

EAI_AGAIN

The specified host address could not be resolved within the configured time interval, or the resolver address space has not been started. The request can be retried later.

EAI_BADFLAGS

The flags parameter had an incorrect value.

EAI_FAIL

An unrecoverable error occurred.

EAI_FAMILY

The address family was not recognized, or the address length was not valid for the specified family.

EAI_MEMORY

A memory allocation failure occurred.

EAI_NONAME

The name does not resolve for the supplied parameter. One of the following occurred:

1. `NI_NAMEREQD` is set, and the host name cannot be located.
2. Both host name and service name were null.
3. The requested address is valid, but it does not have a record at the name server.

EAI_OVERFLOW

An argument buffer overflowed. The buffer specified for the host name or the service name was not sufficient to contain the entire resolved name, and the caller previously specified `_EDC_SUSV3=1`, indicating that truncation was not permitted.

EAI_SYSTEM

An unrecoverable error occurred.

For more information on the above error codes, refer to [z/OS Communications Server: IP and SNA Codes](#).

Related information

- [“gai_strerror\(\) — Address and name information error description” on page 683](#)
- [“getaddrinfo\(\) — Get address information” on page 685](#)
- [“getservbyname\(\) — Get a server entry by name” on page 772](#)
- [“getservbyport\(\) — Get a service entry by port” on page 773](#)
- [“inet_ntop\(\) — Convert Internet address format from binary to text ” on page 862](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“netdb.h — Network database operations” on page 45](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)

getnetbyaddr() — Get a network entry by address

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

XPG4.2:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct netent *getnetbyaddr(ip_addr_t net, int type);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <netdb.h>
struct netent *getnetbyaddr(uint32_t net, int type);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <netdb.h>

struct netent *getnetbyaddr(unsigned long net, int type);
```

General description

The `getnetbyaddr()` call searches the `tcpip.HOSTS.ADDRINFO` data set for the specified network address.

Parameter

Description

net

The network address.

type

The address domain supported (AF_INET).

If the name server is not present or the `RESOLVE_VIA_LOOKUP` option is in effect, you can use the **X_ADDR** environment variable to specify a data set other than `tcpip.HOSTS.ADDRINFO`.

Note: For more information on these data sets and environment variables, `tcpip.HOSTS.LOCAL`, `tcpip.HOSTS.ADDRINFO`, and `tcpip.HOSTS.SITEINFO`, see [z/OS Communications Server: IP Configuration Guide](#).

`getnetbyaddr()`, `getnetbyname()`, and `getnetent()` all use the same static area to return the `netent` structure. This static area is only valid until the next one of these functions is called on the same thread.

The `netent` structure is defined in the **netdb.h** include file and contains the following elements:

Element

Description

n_addrtype

The type of network address returned. The call always sets this value to AF_INET.

n_aliases

An array, terminated with a NULL pointer, of alternative names for the network.

n_name

The official name of the network.

n_net

The network number, returned in host byte order.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

If successful, `getnetbyaddr()` returns a pointer to a `netent` structure. The return value points to data that is overwritten by subsequent calls returning the same data structure.

If unsuccessful, `getnetbyaddr()` returns a NULL pointer, indicating an error or End Of File (EOF).

Related information

- “[netdb.h — Network database operations](#)” on page 45
- “[endhostent\(\)](#) — Close the host information data set” on page 420
- “[endnetent\(\)](#) — Close network information data sets” on page 421
- “[getnetbyname\(\)](#) — Get a network entry by name” on page 743
- “[getnetent\(\)](#) — Get the next network entry” on page 744
- “[setnetent\(\)](#) — Open the network information data set” on page 1556

getnetbyname() — Get a network entry by name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct netent *getnetbyname(const char *name);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct netent *getnetbyname(name);
```

General description

The `getnetbyname()` call searches the `tcpip.HOSTS.SITEINFO` data set for the specified network name.

Parameter

Description

name

The pointer to a network name.

You can use the **X_SITE** environment variable to specify a data set other than `tcpip.HOSTS.SITEINFO`.

Note: For more information on these data sets and environment variables, `tcpip.HOSTS.LOCAL`, `tcpip.HOSTS.SITEINFO`, and `tcpip.HOSTS.SITEINFO`, see [z/OS Communications Server: IP Configuration Guide](#).

The `getnetbyname()` call returns a pointer to a `netent` structure for the network name specified on the call. `getnetbyaddr()`, `getnetbyname()`, and `getnetent()` all use the same static area to return the `netent` structure. This static area is only valid until the next one of these functions is called on the same thread.

The netent structure is defined in the **netdb.h** include file and contains the following elements:

Element
Description

- n_addrtype***
The type of network address returned. The call always sets this value to AF_INET.
- n_aliases***
An array, terminated with a NULL pointer, of alternative names for the network.
- n_name***
The official name of the network.
- n_net***
The network number, returned in host byte order.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

If successful, `getnetbyname()` returns a pointer to a `netent` structure. The return value points to static data that is overwritten by subsequent calls.

If unsuccessful, `getnetbyname()` returns a NULL pointer, indicating an error or End Of File (EOF).

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endhostent\(\) — Close the host information data set” on page 420](#)
- [“endnetent\(\) — Close network information data sets” on page 421](#)
- [“getnetbyaddr\(\) — Get a network entry by address” on page 741](#)
- [“getnetent\(\) — Get the next network entry” on page 744](#)
- [“setnetent\(\) — Open the network information data set” on page 1556](#)

getnetent() — Get the next network entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct netent *getnetent(void);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct netent *getnetent(void);
```

General description

The `getnetent()` call reads the next entry of the `tcpip.HOSTS.ADDRINFO` data set.

You can use the **X_ADDR** environment variable to specify a data set other than `tcpip.HOSTS.ADDRINFO`.

Note: For more information on these data sets and environment variables, `tcpip.HOSTS.LOCAL`, `tcpip.HOSTS.ADDRINFO`, and `tcpip.HOSTS.SITEINFO`, see [z/OS Communications Server: IP Configuration Guide](#).

The `getnetent()` call returns a pointer to the next entry in the `tcpip.HOSTS.SITEINFO` data set.

`getnetbyaddr()`, `getnetbyname()`, and `getnetent()` all use the same static area to return the `netent` structure. This static area is only valid until the next one of these functions is called on the same thread.

The `netent` structure is defined in the **netdb.h** include file and contains the following elements:

| Element | Description |
|---------|-------------|
|---------|-------------|

| | |
|--------------------------------|---|
| <code>n_addrtype</code> | The type of network address returned. The call always sets this value to <code>AF_INET</code> . |
|--------------------------------|---|

| | |
|-------------------------------|---|
| <code>n_aliases</code> | An array, terminated with a NULL pointer, of alternative names for the network. |
|-------------------------------|---|

| | |
|----------------------------|-----------------------------------|
| <code>n_name</code> | The official name of the network. |
|----------------------------|-----------------------------------|

| | |
|---------------------------|--|
| <code>n_net</code> | The network number, returned in host byte order. |
|---------------------------|--|

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, `getnetent()` returns a pointer to a `netent` structure. The return value points to data that is overwritten by subsequent calls returning the same data structure.

If unsuccessful, `getnetent()` returns a NULL pointer, indicating an error or End Of File (EOF).

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endhostent\(\) — Close the host information data set” on page 420](#)
- [“endnetent\(\) — Close network information data sets” on page 421](#)
- [“gethostbyaddr\(\) — Get a host entry by address” on page 718](#)
- [“gethostbyname\(\) — Get a host entry by name” on page 720](#)
- [“setnetent\(\) — Open the network information data set” on page 1556](#)

getopt() — Command option parsing

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdio.h>
int getopt(int argc, char *const argv[], const char *optstring);

extern char *optarg;
extern int optind, opterr, optopt;
```

SUSV3:

```
#define _XOPEN_SOURCE 600
#include <unistd.h>

int getopt(int argc, char *const argv[], const char *optstring);

extern char *optarg;
extern int optind, opterr, optopt;
```

General description

The `getopt()` function is a command-line parser that can be used by applications that follow Utility Syntax Guidelines 3, 4, 5, 6, 7, 9 and 10 in *X/Open CAE Specification, System Interface Definitions, Issue 4, Version 2* Section 10.2, Utility Syntax Guidelines. The `getopt()` function provides the identical functionality described in the X/Open CAE Specification System Interfaces and Headers, Issue 4, Version 2 for the `getopt()` function with the following extensions:

- If the external variable `optind` is set to zero, the `getopt()` function treats this as an indication to restart the scan at the first byte of `argv[1]`.

If `getopt()` encounters an option character that is not contained in `optstring`, it returns the question-mark (?) character. If it detects a missing option-argument, it returns the colon character (:) if the first character of `optstring` was a colon, or a question-mark character (?) otherwise. In either case, `getopt()` sets the variable `optopt` to the option character that caused the error. If the application has not set the variable `opterr` to 0 and the first character of `optstring` is not a colon, `getopt()` also prints a diagnostic message to `stderr` in the format specified for the `getopts` utility.

Because the `getopt()` function returns thread-specific data the `getopt()` function can be used safely from a multithreaded application.

Returned value

If successful, `getopt()` returns the value of the next option character from `argv` that matches a character in `optstring`.

A colon (:) is returned if `getopt()` detects a missing argument and the first character of `optstring` was a colon (:).

A question-mark (?) is returned if `getopt()` encounters an option character not in `optstring` or detects a missing argument and the first character of `optstring` was not a colon (:).

Otherwise `getopt()` returns -1 when all command line arguments have been parsed or an unexpected error is encountered in the command line.

`getopt()` sets the external variables `optind`, `optarg` and `optopt` as described in the X/Open CAE Specification System Interfaces and Headers, Issue 4, Version 2 for the `getopt()` function.

The following functions defined in `<stdio.h>` should be used by multithreaded applications when attempting to reference or change the `optind`, `optopt`, `optarg` and `opterr` external variables:

```
int *__opindf(void);
int *__opoptf(void);
char **__opargf(void);
int *__operrf(void);
```

Also use these functions when you invoke `getopt()` in a DLL. These functions return a pointer to a thread-specific value for each variable.

`getopt()` does not return any `errno` values.

If `getopt()` detects a missing argument or an option character not in `optstring` it will write an error message to `stderr` describing the option character in error and the invoking program.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“getsubopt\(\) — Parse suboption arguments” on page 787](#)

getopt_long() — Command long option parsing

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <stdio.h>
#include <getopt.h>

int getopt_long(int argc, char *const argv[], const char *optstring, const struct option
*longopts, int *longindex);
```

General description

`getopt_long()` function is similar to `getopt()` except that it accepts long options, which begin with two dashes. (If the program accepts only long options, `optstring` must be specified as an empty string (""), not NULL.) Long option names might be abbreviated if the abbreviation is unique or is an exact match for some defined option. A long option might take a parameter of the form `--option=arg` or `--option arg`.

`longopts` is a pointer to the first element of an array of `struct option` that is declared in `<getopt.h>`.

```
struct option {
    const char *name;
    int      has_arg;
    int      *flag;
    int      val;
};
```

name

The name of the long option.

has_arg

This argument has one of the following values:

- `no_argument` (or 0) if the option does not take an argument.
- `required_argument` (or 1) if the option requires an argument.
- `optional_argument` (or 2) if the option takes an optional argument. In this case, `getopt_long()` can only parse the argument setting in the form of `--option=arg`.

flag

Specifies how results are returned for a long option. If `flag` is NULL, `getopt_long()` returns `val`. Otherwise, `getopt_long()` returns 0, and `flag` points to a variable that is set to `val` if the option is found, but left unchanged if the option is not found.

val

The value to return or to load into the variable that is pointed to by `flag`.

The last element of the array must be filled with zeros.

If `longindex` is not NULL, it points to a variable that is set to the index of the long option that is relative to `longopts`.

Returned value

If successful, `getopt_long()` returns the option character if a short option is recognized. For a long option, it returns `val` if `flag` is NULL; otherwise it returns 0 and stores `val` in the location pointed to by `flag`.

If `getopt_long()` encounters an unknown option, '?' is returned. If `getopt_long()` encounters an option with a missing argument, the return value depends on the first character in `optstring`: if it is ':', ':' is returned; otherwise, '?' is returned.

If an option is specified with an argument but the option is defined to be `no_argument` in `longopts`, `getopt_long()` returns '?'.

If `getopt_long()` detects a missing argument or an option string not in `longopts`, it writes an error message to `stderr` to describe the option character or string in error and the invoking program.

`getopt_long()` returns -1 when all command line arguments are parsed or an unexpected error is encountered in the command line. `getopt_long()` does not return any `errno` values.

If `getopt_long()` detects a missing argument or an option string not in `longopts`, it writes an error message to `stderr` describing the option character or string in error and the invoking program.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“getopt.h — z/OS UNIX function for parsing command line option” on page 27](#)
- [“getopt\(\) — Command option parsing” on page 745](#)

getpagesize() — Get the current page size

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int getpagesize(void);
```

General description

The `getpagesize()` function returns the current page size. The `getpagesize()` function is equivalent to `sysconf(_SC_PAGE_SIZE)` and `sysconf(_SC_PAGESIZE)`.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use `sysconf(_SC_PAGESIZE)` instead of `getpagesize()`.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

`getpagesize()` returns the current page size.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)

getpass() — Read a string of characters without echo

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE
#include <unistd.h>

char *getpass(const char *prompt);
```

General description

The `getpass()` function opens the process's controlling terminal, writes to that device the NULL-terminated string *prompt*, disables echoing, reads a string of characters up to the next newline character or EOF, restores the terminal state and closes the terminal.

`getpass()` only works in an environment where either a controlling terminal exists, or `stdin` and `stderr` refer to tty devices. Specifically, it does not work in a TSO environment.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `getpass()` returns a pointer to a NULL-terminated string of at most **PASS_MAX** bytes that were read from the terminal device.

If unsuccessful, `getpass()` returns a NULL pointer and the terminal state is restored.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

getpeername() – Get the name of the peer connected to a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int getpeername(int socket, struct sockaddr *__restrict__ name,
                socklen_t *__restrict__ namelen);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>

int getpeername(int socket, struct sockaddr *name,
                int *namelen);
```

General description

The `getpeername()` call returns the name of the peer connected to socket descriptor *socket*. *namelen* must be initialized to indicate the size of the space pointed to by *name* and is set to the number of bytes copied into the space before the call returns. The size of the peer name is returned in bytes. If the actual length of the address is greater than the length of the supplied *sockaddr*, the stored address is truncated. The *sa_len* member of the store structure contains the length of the untruncated address.

Parameter

Description

socket

The socket descriptor.

name

The Internet address of the connected socket that is filled by `getpeername()` before it returns. The exact format of *name* is determined by the domain in which communication occurs.

namelen

Must initially point to an integer that contains the size in bytes of the storage pointed to by *name*. On return, that integer contains the size required to represent the address of the connecting socket. If this value is larger than the size supplied on input, then the information contained in *sockaddr* is truncated to the length supplied on input. If *name* is NULL, *namelen* is ignored.

Sockets in the AF_INET6 domain: For an AF_INET6 socket, the address is returned in a `sockaddr_in6` address structure. The `sockaddr_in6` structure is defined in the header file `netinet/in.h`.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Note: The `getpeername()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `getpeername()` returns 0.

If unsuccessful, `getpeername()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

The *socket* parameter is not a valid socket descriptor.

EFAULT

Using the *name* and *namelen* parameters as specified would result in an attempt to access storage outside of the caller's address space.

EINVAL

The *namelen* parameter is not a valid length. The socket has been shut down.

ENOBUFS

`getpeername()` is unable to process the request due to insufficient storage.

ENOTCONN

The socket is not in the connected state.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The operation is not supported for the socket protocol.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“getsockname\(\) — Get the name of a socket” on page 777](#)
- [“socket\(\) — Create a socket” on page 1677](#)

getpgid() — Get process group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

pid_t getpgid(pid_t pid);
```

General description

The `getpgid()` function returns the process group ID of the process whose process ID is equal to *pid*. If *pid* is 0, `getpgid(0)` returns the process group ID of the calling process.

A test execution returns the following results:

- `getpgid(0)` 67439341
- `getpgid(getpid())` 67439341

Returned value

If successful, `getpgid()` returns a process group ID.

If unsuccessful, `getpgid()` returns `(pid_t)-1` and sets `errno` to one of the following values:

Error Code
Description

EPERM
The process whose process ID is equal to *pid* is not the same session as the calling process, and the implementation does not allow access to the process group ID of that process from the calling process.

ESRCH
There is no process with a process ID equal to *pid*.

`getpgid()` may fail if:

Error Code
Description

EINVAL
The value of the *pid* argument is not valid.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getpgrp\(\) — Get the process group ID” on page 752](#)
- [“getsid\(\) — Get process group ID of session leader” on page 776](#)
- [“setregid\(\) — Set real and effective group IDs” on page 1565](#)
- [“setsid\(\) — Create session, set process group ID” on page 1571](#)

getpgrp() — Get the process group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

pid_t getpgrp(void);
```

General description

Finds the process group ID of the calling process.

Returned value

Returns the found value. It is always successful.

There are no documented errno values.

Example

CELEBG13

```
/* CELEBG13

   This example gets all the process group IDs.

*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <sys/wait.h>

main() {
    int status;

    if (fork() == 0) {
        if (fork() == 0) {
            printf("grandchild's pid is %d, process group id is %d\n",
                (int) getpid(), (int) getpgrp());
            exit(0);
        }
        printf("child's pid is %d, process group id is %d\n",
            (int) getpid(), (int) getpgrp());
        wait(&status);
        exit(0);
    }
    printf("parent's pid is %d, process group id is %d\n",
        (int) getpid(), (int) getpgrp());
    printf("the parent's parent's pid is %d\n", (int) getppid());
    wait(&status);
}
```

Output

```
parent's pid is 5373959, process group id is 5111816
the parent's parent's pid is 5111816
child's pid is 5832710, process group id is 5111816
grandchild's pid is 196617, process group id is 5111816
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“setpgid\(\) — Set process group ID for job control” on page 1560](#)
- [“setsid\(\) — Create session, set process group ID” on page 1571](#)

getpid() — Get the process ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

pid_t getpid(void);
```

General description

Finds the process ID (PID) of the calling process.

Returned value

getpid() returns the found value. It is always successful.

There are no documented errno values.

Example

CELEBG14

```
/* CELEBG14 */
#define _POSIX_SOURCE
#include <stdio.h>
#include <sys/types.h>
#include <signal.h>
#include <unistd.h>

void catcher(int signum) {
    puts("catcher has control!");
}

main() {
    struct sigaction sact;

    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = catcher;
    sigaction(SIGUSR1, &sact, NULL);

    printf("sending SIGUSR1 to pid %d\n", (int) getpid());
    kill(getpid(), SIGUSR1);
}
```

Output

```
sending SIGUSR1 to pid 5570567
catcher has control!
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getppid\(\) — Get the parent process ID” on page 755](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)

getpmsg() — Receive next message from a STREAMS file

The information for this function is included in [“getmsg\(\), getpmsg\(\) — Receive next message from a STREAMS file” on page 737](#).

getppid() — Get the parent process ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

pid_t getppid(void);
```

General description

Gets the parent process ID (PPID).

Returned value

getppid() returns the parent process ID. It is always successful.

There are no documented errno values.

Example

CELEBG15

```
/* CELEBG15 */
#define _POSIX_SOURCE
#include <stdio.h>
#include <sys/types.h>
#include <signal.h>
#include <unistd.h>
#include <sys/wait.h> /*FIX: used to be <wait.h>*/

volatile short footprint=0;

void catcher(int signum) {
    switch (signum) {
        case SIGALRM: puts("caught SIGALRM");
                     break;
        case SIGUSR2: puts("caught SIGUSR2");
                     break;
        default: printf("caught unexpected signal %d\n", signum);
    }
}
```

```
    footprint++;
}

main() {
    struct sigaction sact;
    int status;

    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = catcher;
    sigaction(SIGUSR2, &sact, NULL);

    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = catcher;
    sigaction(SIGALRM, &sact, NULL);

    printf("parent (pid %d) is about to fork child\n", (int) getpid());

    if (fork() == 0) {
        printf("child is sending SIGUSR2 to pid %d\n", (int) getppid());
        kill(getppid(), SIGUSR2);
        exit(0);
    }

    alarm(30);
    while (footprint == 0);
    wait(&status);
    puts("parent is exiting");
}
```

Output

```
parent (pid 6094854) is about to fork child
is sending SIGUSR2 to pid 6094854
caught SIGUSR2
parent is exiting
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getpid\(\) — Get the process ID” on page 754](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)

getpriority() — Get process scheduling priority

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/resource.h>

int getpriority(int which, id_t who);
```

General description

getpriority() obtains the current priority of a process, process group or user.

Processes are specified by the values of the *which* and *who* arguments. The *which* argument may be any one of the following set of symbols defined in the *sys/resource.h* include file:

PRIO_PROCESS

indicates that the *who* argument is to be interpreted as a process ID

PRIO_PGRP

indicates that the *who* argument is to be interpreted as a process group ID

PRIO_USER

indicates that the *who* argument is to be interpreted as a user ID

The *who* argument specifies the ID (process, process group, or user). A 0 (zero) value for the *who* argument specifies the current process, process group or user ID.

Returned value

If successful, getpriority() returns the priority of the process, process group, or user ID requested in *who*. The priority is returned as an integer in the range -20 to 19 (the lower the numerical value, the higher the priority).

If more than one process is specified, getpriority() returns the highest priority pertaining to any of the specified processes.

If unsuccessful, getpriority() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

The symbol specified in the *which* argument was not recognized, or the value of the *who* argument is not a valid process ID, process group ID or user ID.

ESRCH

No process could be located using the *which* and *who* argument values specified.

Because getpriority() can return the value -1 on successful completion, it is necessary to set the external variable errno to 0 before a call to getpriority(). If getpriority() returns -1, then errno can be checked to see if an error occurred or if the value is a legitimate priority.

Related information

- [“sys/resource.h — XSI resource operations”](#) on page 70
- [“nice\(\) — Change priority of a process”](#) on page 1150
- [“setpriority\(\) — Set process scheduling priority”](#) on page 1563

getprotobyname() — Get a protocol entry by name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct protoent *getprotobyname(const char *name);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct protoent *getprotobyname(char name);
```

General description

The `getprotobyname()` call searches the `/etc/protocol` or `tcpip.ETC.PROTO` data set for the specified protocol name.

Parameter

Description

name

The name of the protocol.

The `getprotobyname()` call returns a pointer to a `protoent` structure for the network protocol specified on the call. `getprotobyname()`, `getprotobynumber()`, and `getprotoent()` all use the same static area to return the `protoent` structure. This static area is only valid until the next one of these functions is called on the same thread.

The `protoent` structure is defined in the **netdb.h** include file and contains the following elements:

Element

Description

p_aliases

An array, terminated with a NULL pointer, of alternative names for the protocol.

p_name

The official name of the protocol.

p_proto

The protocol number.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

If successful, `getprotobyname()` returns a pointer to a `protoent` structure. The return value points to data that is overwritten by subsequent calls returning the same data structure.

If unsuccessful, `getprotobyname()` returns a NULL pointer, indicating an error or End Of File (EOF).

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endprotoent\(\) — Work with a protocol entry” on page 422](#)
- [“getprotobynumber\(\) — Get a protocol entry by number” on page 759](#)
- [“getprotoent\(\) — Get the next protocol entry” on page 760](#)
- [“setprotoent\(\) — Open the protocol information data set” on page 1564](#)

getprotobynumber() — Get a protocol entry by number

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct protoent *getprotobynumber(int proto);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct protoent *getprotobynumber(int proto);
```

General description

The `getprotobynumber()` call searches the `/etc/protocol` or `tcpip.ETC.PROTO` data set for the specified protocol number.

Parameter

Description

proto

The protocol number.

The `getprotobynumber()` call returns a pointer to a `protoent` structure for the network protocol specified on the call. `getprotobyname()`, `getprotobynumber()`, and `getprotoent()` all use the same static area to return the `protoent` structure. This static area is only valid until the next one of these functions is called on the same thread.

The `protoent` structure is defined in the `netdb.h` include file and contains the following elements:

Element

Description

p_aliases

An array, terminated with a NULL pointer, of alternative names for the protocol.

p_name

The official name of the protocol.

p_proto

The protocol number.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

If successful, `getprotobynumber()` returns a pointer to a `protoent` structure. The return value points to data that is overwritten by subsequent calls returning the same data structure.

If unsuccessful, `getprotobynumber()` returns a NULL pointer, indicating an error or End Of File (EOF).

Related information

- “[netdb.h — Network database operations](#)” on page 45
- “[endprotoent\(\) — Work with a protocol entry](#)” on page 422
- “[getprotobyname\(\) — Get a protocol entry by name](#)” on page 757
- “[getprotoent\(\) — Get the next protocol entry](#)” on page 760
- “[setprotoent\(\) — Open the protocol information data set](#)” on page 1564

getprotoent() — Get the next protocol entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct protoent *getprotoent(void);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct protoent *getprotoent(void);
```

General description

The `getprotoent()` call reads */etc/protocol* or the *tcpip.ETC.PROTO* data set.

The `getprotoent()` call returns a pointer to the next entry in the */etc/protocol* or the *tcpip.ETC.PROTO* data set.

`getprotobyname()`, `getprotobynumber()`, and `getprotoent()` all use the same static area to return the `protoent` structure. This static area is only valid until the next one of these functions is called on the same thread.

The `protoent` structure is defined in the **netdb.h** include file and contains the following elements:

Element

Description

p_aliases

An array, terminated with a NULL pointer, of alternative names for the protocol.

p_name

The official name of the protocol.

p_proto

The protocol number.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

If successful, `getprotoent()` returns a pointer to a `protoent` structure. The return value points to data that is overwritten by subsequent calls returning the same data structure.

If unsuccessful, `getprotoent()` returns a NULL pointer, indicating an error or End Of File (EOF).

Related information

- “[netdb.h — Network database operations](#)” on page 45
- “[endprotoent\(\) — Work with a protocol entry](#)” on page 422
- “[getprotobyname\(\) — Get a protocol entry by name](#)” on page 757
- “[getprotobynumber\(\) — Get a protocol entry by number](#)” on page 759
- “[setprotoent\(\) — Open the protocol information data set](#)” on page 1564

getpwent() — Get user database entry

The information for this function is included in “[endpwent\(\) — User database functions](#)” on page 423.

getpwent_r() — Get user database entry reentrantly

The information for this function is included in “[endpwent\(\) — User database functions](#)” on page 423.

getpwnam() — Access the user database by user name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <pwd.h>

struct passwd *getpwnam(const char *name);
```

General description

Accesses the `passwd` structure (defined in the `pwd.h` header file), which contains the following members:

pw_name

User name

pw_uid

User ID (UID) number

pw_gid

Group ID (GID) number

pw_dir

Initial working directory

pw_shell

Initial user program

Returned value

If successful, `getpwnam()` returns a pointer to a `passwd` structure containing an entry from the user database with the specified *name*. Return values might point to the static data that is overwritten on each call.

If unsuccessful, `getpwnam()` returns a NULL pointer.

There are no documented `errno` values.

Example**CELEBG16**

```
/* CELEBG16

   This example provides information for the user data
   base, MEGA.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <pwd.h>

main() {
    struct passwd *p;
    char user[]="MEGA";

    if ((p = getpwnam(user)) == NULL)
        perror("getpwnam() error");
    else {
        printf("getpwnam() returned the following info for user %s:\n",
               user);
        printf(" pw_name   : %s\n",      p->pw_name);
        printf(" pw_uid    : %d\n", (int) p->pw_uid);
        printf(" pw_gid    : %d\n", (int) p->pw_gid);
        printf(" pw_dir    : %s\n",      p->pw_dir);
        printf(" pw_shell  : %s\n",      p->pw_shell);
    }
}
```

Output

```
pw_name   : MEGA
pw_uid    : 0
pw_gid    : 512
pw_dir    : /u/mega
pw_shell  : /bin/sh
```

Related information

- [“pwd.h — Access user database through password structure” on page 56](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“endpwent\(\) — User database functions” on page 423](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“getlogin_r\(\) — Get login name” on page 734](#)
- [“getpwnam_r\(\) — Search user database for a name” on page 763](#)
- [“getpwuid\(\) — Access the user database by user ID” on page 764](#)
- [“getpwuid_r\(\) — Search user database for a user ID” on page 765](#)

getpwnam_r() — Search user database for a name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <sys/types.h>
#include <pwd.h>

int getpwnam_r(const char *nam, struct passwd *pwd,
char *buffer, size_t bufsize, struct passwd **result);
```

General description

The `getpwnam_r()` function updates the `passwd` structure pointed to by `pwd` and stores a pointer to that structure at the location pointed to by `result`. The structure will contain an entry from the user database with a matching name. Storage referenced by the structure is allocated from the memory provided with the `buffer` parameter, which is `bufsize` characters in size. A NULL pointer is returned at the location pointed to by `result` on error or if the requested entry is not found.

Returned value

If successful, `getpwnam_r()` returns 0.

If unsuccessful, `getpwnam_r()` sets `errno` to one of the following values:

Error Code

Description

EINVAL

One of the input arguments was not valid. Arguments `pwd`, `buffer`, and `result` must not be NULL. Argument `bufsize` must not be 0.

ERANGE

Insufficient storage was supplied in `buffer` and `bufsize` to contain the data to be referenced by the resulting `passwd` structure.

Related information

- [“pwd.h — Access user database through password structure” on page 56](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“endpwent\(\) — User database functions” on page 423](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“getlogin_r\(\) — Get login name” on page 734](#)
- [“getpwnam\(\) — Access the user database by user name” on page 761](#)
- [“getpwuid\(\) — Access the user database by user ID” on page 764](#)
- [“getpwuid_r\(\) — Search user database for a user ID” on page 765](#)

getpwuid() — Access the user database by user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <pwd.h>

struct passwd *getpwuid(uid_t uid);
```

General description

Gets information about a user with the specified *uid*. `getpwuid()` returns a pointer to a `passwd` structure containing an entry from the user database for the specified *uid*. This structure (defined in the `pwd.h` header file), contains the following members:

pw_name

User name

pw_uid

User ID (UID) number

pw_gid

Group ID (GID) number

pw_dir

Initial working directory

pw_shell

Initial user program

Return values may point to the static data that is overwritten on each call.

Returned value

If successful, `getpwuid()` returns a pointer.

If unsuccessful, `getpwuid()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

EMVSSAF2ERR

The system authorization facility (SAF) or RACF Get GMAP or Get UMAP service had an error.

EMVSSAFEXTRERR

The SAF or RACF RACROUTE EXTRACT service had an error.

Example

CELEBG17

```
/* CELEBG17
   This example provides information for user ID 0.
```

```

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <pwd.h>

main() {
    struct passwd *p;
    uid_t uid=0;

    if ((p = getpwuid(uid)) == NULL)
        perror("getpwuid() error");
    else {
        printf("getpwuid() returned the following info for uid %d:\n",
               (int) uid);
        printf(" pw_name  : %s\n",      p->pw_name);
        printf(" pw_uid   : %d\n",      (int) p->pw_uid);
        printf(" pw_gid   : %d\n",      (int) p->pw_gid);
        printf(" pw_dir   : %s\n",      p->pw_dir);
        printf(" pw_shell : %s\n",      p->pw_shell);
    }
}

```

Output

```

getpwuid() returned the following info for uid 0:
pw_name  : MEGA
pw_uid   : 0
pw_gid   : 512
pw_dir   : /u/mega
pw_shell : /bin/sh

```

Related information

- [“pwd.h — Access user database through password structure” on page 56](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“endpwent\(\) — User database functions” on page 423](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“getlogin_r\(\) — Get login name” on page 734](#)
- [“getpwnam\(\) — Access the user database by user name” on page 761](#)
- [“getpwnam_r\(\) — Search user database for a name” on page 763](#)
- [“getpwuid_r\(\) — Search user database for a user ID” on page 765](#)

getpwuid_r() — Search user database for a user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 2 | both | OS/390 V2R8 |
| Single UNIX Specification, Version 3 | | |

Format

```

#define _XOPEN_SOURCE 500
#include <sys/types.h>
#include <pwd.h>

int getpwuid_r(uid_t uid, struct passwd *pwd,
               char *buffer, size_t bufsize, struct passwd **result);

```

General description

The `getpwuid_r()` function updates the `passwd` structure pointed to by *pwd* and stores a pointer to that structure at the location pointed to by *result*. The structure will contain an entry from the user database with a matching uid. Storage referenced by the structure is allocated from the memory provided with the *buffer* parameter, which is *bufsize* characters in size. A NULL pointer is returned at the location pointed to by *result* on error or if the requested entry is not found.

Returned value

If successful, `getpwuid_r()` returns 0.

If unsuccessful, `getpwuid_r()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

EINVAL

One of the input arguments was not valid. Arguments *pwd*, *buffer*, and *result* must not be NULL. Argument *bufsize* must not be 0.

EMVSSAF2ERR

The system authorization facility (SAF) or RACF Get GMAP or Get UMAP service had an error.

EMVSSAFEXTRERR

The SAF or RACF RACROUTE EXTRACT service had an error.

ERANGE

Insufficient storage was supplied in *buffer* and *bufsize* to contain the data to be referenced by the resulting `passwd` structure.

Related information

- [“pwd.h — Access user database through password structure” on page 56](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“endpwent\(\) — User database functions” on page 423](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)
- [“getlogin_r\(\) — Get login name” on page 734](#)
- [“getpwnam\(\) — Access the user database by user name” on page 761](#)
- [“getpwnam_r\(\) — Search user database for a name” on page 763](#)
- [“getpwuid\(\) — Access the user database by user ID” on page 764](#)

getrandom() — Obtain a series of random bytes

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/random.h>

ssize_t getrandom(void *buf, size_t buflen, unsigned int flags);
```


General description

`getrandom()` fills the buffer that is pointed to by *buf* with up to *buflen* random bytes. These bytes can be used to seed user-space random number generators or for cryptographic purposes.

The *flags* argument is a bit mask that can contain zero or more of the following values that are ORed together:

GRND_RANDOM

This bit is ignored. Random bytes are drawn from the random source. The number of bytes that are returned is only limited by the buffer size.

GRND_NONBLOCK

This bit is ignored. `getrandom()` does not block and returns the data that is specified in the *buflen*. Blocking for `getrandom()` is not supported.

Returned value

If successful, `getrandom()` returns the number of bytes that are copied to the buffer *buf*.

If unsuccessful, `getrandom()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EFAULT

The address that is referred to by *buf* is outside the accessible address space.

EINTR

The call is interrupted by a signal handler.

EINVAL

An invalid flag is specified in *flags*.

Related information

- [“getentropy\(\) — Fill a buffer with random bytes” on page 704](#)

getrlimit() — Get current or maximum resource consumption

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/resource.h>

int getrlimit(int resource, struct rlimit *rlp);
```

General description

The `getrlimit()` function gets resource limits for the calling process. A resource limit is a pair of values; one specifying the current (soft) limit, the other a maximum (hard) limit.

The value `RLIM_INFINITY` defined in `sys/resource.h`, is considered to be larger than any other limit value. If a call to `getrlimit()` returns `RLIM_INFINITY` for a resource, it means the implementation does not enforce limits on that resource.

The *resource* argument specifies which resource to get the hard and/or soft limits for, and may be one of the following values:

RLIMIT_CORE

The maximum size of a dump of memory (in bytes) allowed for the process. A value of 0 (zero) prevents file creation. Dump file creation will stop at this limit.

RLIMIT_CPU

The maximum amount of CPU time (in seconds) allowed for the process. If the limit is exceeded, a SIGXCPU signal is sent to the process and the process is granted a small CPU time extension to allow for signal generation and delivery. If the extension is used up, the process is terminated with a SIGKILL signal.

RLIMIT_DATA

The maximum size of the break value for the process, in bytes. In this implementation, this resource always has a hard and soft limit value of RLIM_INFINITY.

RLIMIT_FSIZE

The maximum file size (in bytes) allowed for the process. A value of 0 (zero) prevents file creation. If the size is exceeded, a SIGXFSZ signal is sent to the process. If the process is blocking, catching, or ignoring SIGXFSZ, continued attempts to increase the size of a file beyond the limit will fail with an errno of EFBIG.

RLIMIT_MEMLIMIT

The maximum amount of usable storage above the 2 gigabyte bar (in 1 megabyte segments) that can be allocated.

RLIMIT_NOFILE

The maximum number of open file descriptors allowed for the process. This number is one greater than the maximum value that may be assigned to a newly created descriptor. (That is, it is one-based.) Any function that attempts to create a new file descriptor beyond the limit will fail with an EMFILE errno.

RLIMIT_STACK

The maximum size of the stack for a process, in bytes. Note that in z/OS UNIX services, the stack is a per-thread resource. In this implementation, this resource always has a hard and soft limit value of RLIM_INFINITY. A call to setrlimit() to set this resource to any value other than RLIM_INFINITY will fail with an errno of EINVAL.

RLIMIT_AS

The maximum address space size for the process, in bytes. If the limit is exceeded, malloc() and mmap() functions will fail with an errno of ENOMEM. Automatic stack growth will also fail.

The *rlp* argument points to a `rlimit` structure. This structure contains the following members:

rlim_cur

The current (soft) limit

rlim_max

The maximum (hard) limit

See the <sys/resource.h> header for more detail.

The resource limit values are propagated across exec and fork.

Special behavior for z/OS UNIX System Services: An exception exists for exec processing in conjunction with daemon support. If a daemon process invokes exec and it had previously invoked setuid() before exec, the RLIMIT_CPU, RLIMIT_AS, RLIMIT_CORE, RLIMIT_FSIZE, and RLIMIT_NOFILE limit values are set based on the limit values specified in the kernel parmlib member BPXPRMxx.

For processes which are not the only process within an address space, the RLIMIT_CPU and RLIMIT_AS limits are shared with all the processes within the address space. For RLIMIT_CPU, when the soft limit is exceeded, action will be taken on the first process within the address space. If the action is termination, all processes within the address space will be terminated.

In addition to the RLIMIT_CORE limit values, the dump file defaults are set by SYSMDUMP defaults. Refer to *z/OS MVS Initialization and Tuning Reference* for information on setting up SYSMDUMP defaults using the IEADMR00 parmlib member.

Dumps of memory are taken in 4160 byte increments. Therefore, RLIMIT_CORE values affect the size of memory dumps in 4160 byte increments. For example, if the RLIMIT_CORE soft limit value is 4000, the dump will contain no data. If the RLIMIT_CORE soft limit value is 8000, the maximum size of a memory dump is 4160 bytes.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the _LARGE_FILES feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the _LARGE_FILES feature test macro as well.

Returned value

If successful, getrlimit() returns 0.

If unsuccessful, getrlimit() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

A non-valid *resource* was specified.

Related information

- [“sys/resource.h — XSI resource operations” on page 70](#)
- [“stropts.h — Stream interface” on page 67](#)
- [“brk\(\) — Change space allocation” on page 219](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getdtablesize\(\) — Get the file descriptor table size” on page 703](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“setrlimit\(\) — Control maximum resource consumption” on page 1568](#)
- [“sigaltstack\(\) — Set or get signal alternate stack context” on page 1622](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)
- [“ulimit\(\) — Get or set process file size limits” on page 1924](#)

getrusage() — Get information about resource utilization

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/resource.h>

int getrusage(int who, struct rusage *r_usage);
```

General description

The getrusage() function provides measures of the resources used by the current process or its terminated and waited-for-child processes. If the value of the *who* argument is RUSAGE_SELF, information is returned about resources used by the current process. If the value of the *who* argument is RUSAGE_CHILDREN, information is returned about resources used by the terminated and waited-for-children of the current process. If the child is never waited for (for instance, if the parent has SA_NOCLDWAIT set or sets SIGCHLD to SIG_IGN), the resource information for the child process is discarded and not included in the resource information provided by getrusage()

The *r_usage* argument is a pointer of an object of type struct rusage in which the returned information is stored.

Returned value

If successful, getrusage() returns 0.
If unsuccessful, getrusage() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|--------|--|
| EINVAL | The value of the <i>who</i> argument is not valid. |
|--------|--|

Related information

- [“sys/resource.h — XSI resource operations” on page 70](#)
- [“exit\(\) — End program” on page 449](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“time\(\),time64\(\) — Determine current UTC time” on page 1865](#)
- [“times\(\) — Get process and child process times” on page 1867](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)

gets() — Read a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

char *gets(char *buffer);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

char *gets_unlocked(char *buffer);
```

General description

Reads bytes from the standard input stream `stdin`, and stores them in the array pointed to by *buffer*. The line consists of all characters up to and including the first newline character (`\n`) or EOF. The `gets()` function discards any newline character, and the NULL character (`\0`) is placed immediately after the last byte read. If there is an error, the value stored in *buffer* is undefined.

`gets()` is not supported for files opened with `type=record` or `type=blocked`.

`gets()` has the same restriction as any read operation, such as a read immediately following a write, or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`gets_unlocked()` is functionally equivalent to `gets()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `gets()` returns its argument.

If unsuccessful, `gets()` returns a NULL pointer to indicate an error or an EOF condition with no characters read.

Use `ferror()` or `feof()` to determine which of these conditions occurred. Note that EOF is only reached when an attempt is made to read past the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Example

CELEBG18

```
/* CELEBG18

   This example gets a line of input from stdin.
*/
#include <stdio.h>
#define MAX_LINE 100

int main(void)
{
    char line[MAX_LINE];
    char *result;

    printf("Enter string:\n");
    if ((result = gets(line)) != NULL)
        printf("string is %s\n", result);
    else
        if (ferror(stdin))
            printf("Error\n");
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“feof\(\) — Test end of file \(EOF\) indicator” on page 510](#)
- [“ferror\(\) — Test for read and write errors” on page 512](#)
- [“fgets\(\) — Read a string from a stream” on page 536](#)
- [“fputs\(\) — Write a string” on page 608](#)
- [“puts\(\) — Write a string” on page 1357](#)

getservbyname() — Get a server entry by name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct servent *getservbyname(const char *name, const char *proto);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct servent *getservbyname(char *name, char *proto);
```

General description

The `getservbyname()` call searches the `/etc/services` or `tcpip.ETC.SERVICES` data set for the first entry that matches the specified service name and protocol name. If `proto` is `NULL`, only the service name must match.

Parameter

Description

name

The service name.

proto

The protocol name.

The `getservbyname()` call returns a pointer to a *servent* structure for the network service specified on the call. `getservbyname()`, `getservbyport()`, and `getservent()` all use the same static area to return the *servent* structure. This static area is only valid until the next one of these functions is called on the same thread.

The *servent* structure is defined in the **netdb.h** include file and contains the following elements:

Element

Description

s_aliases

An array, terminated with a `NULL` pointer, of alternative names for the service.

s_name

The official name of the service.

s_port

The port number of the service.

s_proto

The protocol required to contact the service.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

The return value points to data that is overwritten by subsequent calls returning the same data structure.

If successful, `getservbyname()` returns a pointer to a *servent* structure.

If unsuccessful or End Of File (EOF), `getservbyname()` returns a NULL pointer.

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endservent\(\) — Close network services information data sets” on page 424](#)
- [“getservbyport\(\) — Get a service entry by port” on page 773](#)
- [“getservent\(\) — Get the next service entry” on page 774](#)
- [“setservent\(\) — Open the network services information data set” on page 1570](#)

getservbyport() — Get a service entry by port

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**X/Open:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct servent *getservbyport(int port, const char *proto);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct servent *getservbyport(int port, char *proto);
```

General description

The `getservbyport()` call searches the */etc/services* or the *tcpip.ETC.SERVICES* data set for the first entry that matches the specified port number and protocol name. If *proto* is NULL, only the port number must match.

Parameter Description

port

The port number.

proto

The protocol name.

The `getservbyport()` call returns a pointer to a *servent* structure for the port number specified on the call. `getservbyname()`, `getservbyport()`, and `getservent()` all use the same static area to return the *servent* structure. This static area is only valid until the next one of these functions is called on the same thread.

The *servent* structure is defined in the **netdb.h** include file and contains the following elements:

Element Description

s_aliases

An array, terminated with a NULL pointer, of alternative names for the service.

s_name

The official name of the service.

s_port

The port number of the service.

s_proto

The protocol required to contact the service.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

The return value points to data that is overwritten by subsequent calls returning the same data structure.

If successful, `getservbyport()` returns a pointer to a *servent* structure.

If unsuccessful or End Of File (EOF), `getservbyport()` returns a NULL pointer.

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endservent\(\) — Close network services information data sets” on page 424](#)
- [“getservbyname\(\) — Get a server entry by name” on page 772](#)
- [“getservent\(\) — Get the next service entry” on page 774](#)
- [“setservent\(\) — Open the network services information data set” on page 1570](#)

getservent() — Get the next service entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

struct servent *getservent(void);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

struct servent *getservent(void);
```

General description

The `getservent()` call reads the next line of the */etc/services* or the *tcpip.ETC.SERVICES* data set.

The `getservent()` call returns a pointer to the next entry in the */etc/services* or the *tcpip.ETC.SERVICES* data set.

`getservbyname()`, `getservbyport()`, and `getservent()` all use the same static area to return the *servent* structure. This static area is only valid until the next one of these functions is called on the same thread.

The *servent* structure is defined in the **netdb.h** include file and contains the following elements:

Element

Description

s_aliases

An array, terminated with a NULL pointer, of alternative names for the service.

s_name

The official name of the service.

s_port

The port number of the service.

s_proto

The protocol required to contact the service.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

The return value points to data that is overwritten by subsequent calls returning the same data structure.

If successful, `getservent()` returns a pointer to a *servent* structure.

If unsuccessful or End Of File (EOF), `getservent()` returns a NULL pointer.

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endservent\(\) — Close network services information data sets” on page 424](#)
- [“getservbyname\(\) — Get a server entry by name” on page 772](#)
- [“getservbyport\(\) — Get a service entry by port” on page 773](#)
- [“setservent\(\) — Open the network services information data set” on page 1570](#)

getsid() — Get process group ID of session leader

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

pid_t getsid(pid_t pid);
```

General description

The `getsid()` function obtains the process group ID of the process that is the session leader of the process specified by *pid*. If *pid* is 0, the system uses the PID of the process calling `getsid()`.

Returned value

If successful, `getsid()` returns the process group ID of the session leader of the specified process.

If unsuccessful, `getsid()` returns `(pid_t)-1` and sets `errno` to one of the following values:

Error Code

Description

EPERM

The process specified by *pid* is not in the same session as the calling process, and the implementation does not allow access to the process group ID of the session leader of that process from the calling process.

ESRCH

There is no process with a process ID equal to *pid*.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getpid\(\) — Get the process ID” on page 754](#)
- [“getppid\(\) — Get the parent process ID” on page 755](#)
- [“setpgid\(\) — Set process group ID for job control” on page 1560](#)
- [“setsid\(\) — Create session, set process group ID” on page 1571](#)

getsockname() – Get the name of a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int getsockname(int socket, struct sockaddr *__restrict__ name,
                socklen_t *__restrict__ namelen);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>

int getsockname(int socket, struct sockaddr *name,
                int *namelen);
```

General description

The `getsockname()` call stores the current name for the socket specified by the *socket* parameter into the structure pointed to by the *name* parameter. It returns the address to the socket that has been bound. If the socket is not bound to an address, the call returns with the family set, and the rest of the structure set to zero. For example, an unbound socket in the Internet domain would cause the name to point to a **sockaddr_in** structure with the *sin_family* field set to `AF_INET` and all other fields zeroed.

If the actual length of the address is greater than the length of the supplied *sockaddr*, the stored address is truncated. The *sa_len* member of the store structure contains the length of the untruncated address.

Parameter

Description

socket

The socket descriptor.

name

The address of the buffer into which `getsockname()` copies the name of *socket*.

namelen

Must initially point to an integer that contains the size in bytes of the storage pointed to by *name*.

On return, that integer contains the size required to represent the address of the connecting socket.

If this value is larger than the size supplied on input, then the information contained in *sockaddr* is truncated to the length supplied on input. If *name* is NULL, *namelen* is ignored.

The `getsockname()` call is often used to discover the port assigned to a socket after the socket has been implicitly bound to a port. For example, an application can call `connect()` without previously calling `bind()`. In this case, the `connect()` call completes the binding necessary by assigning a port to the socket. This assignment can be discovered with a call to `getsockname()`.

Sockets in the AF_INET6 domain: For an `AF_INET6` socket, the address is returned in a *sockaddr_6* address structure. The *sockaddr_in6* structure is defined in the header file **netinet/in.h**.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Note: The `getsockname()` function has a dependency on the level of the Enhanced ASCII Extensions. See “Enhanced ASCII support ” on page 2123 for details.

Returned value

If successful, `getsockname()` returns 0.

If unsuccessful, `getsockname()` returns -1 and sets `errno` to one of the following values:

**Error Code
Description**

EBADF
The *socket* parameter is not a valid socket descriptor.

EFAULT
Using the *name* and *namelen* parameters as specified would result in an attempt to access storage outside of the caller's address space.

ENOBUFS
`getsockname()` is unable to process the request due to insufficient storage.

ENOTCONN
The socket is not in the connected state.

ENOTSOCK
The descriptor is for a file, not for a socket.

EOPNOTSUPP
The operation is not supported for the socket protocol.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“getpeername\(\) — Get the name of the peer connected to a socket” on page 750](#)
- [“socket\(\) — Create a socket” on page 1677](#)

getsockopt() — Get the options associated with a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int getsockopt(int socket, int level, int option_name,
```

```
void *__restrict__ option_value,
socklen_t *__restrict__ option_len);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>

int getsockopt(int socket, int level, int option_name,
               char *option_value,
               int *option_len);
```

IPv6: To include support for IPv6 socket options, add the following code:

```
#define _OPEN_SYS_SOCK_IPV6 1
#include <netinet/in.h>
```

icmp6_filter structure: To include the icmp6_filter structure in your program, add the following code:

```
#define _OPEN_SYS_SOCK_IPV6
#include <netinet/icmp6.h>
```

General description

The `getsockopt()` call gets options associated with a socket. Not all options are supported by all address families. See each option for details. Options can exist at multiple protocol levels.

Parameter

Description

socket

The socket descriptor.

level

The level for which the option is set.

option_name

The name of a specified socket option.

option_value

The pointer to option data.

option_len

The pointer to the length of the option data.

When manipulating socket options, you must specify the level at which the option resides and the name of the option. To manipulate options at the socket level, the *level* parameter must be set to `SOL_SOCKET` as defined in `sys/socket.h`. To manipulate options at the IPv4 or IPv6 level, the *level* parameter must be set to `IPPROTO_IP` as defined in `sys/socket.h` or `IPPROTO_IPV6` as defined in `netinet/in.h`. To manipulate options at any other level, such as the TCP level, supply the appropriate protocol number for the protocol controlling the option. The `getprotobyname()` call can be used to return the protocol number for a named protocol.

The *option_value* and *option_len* parameters are used to return data used by the particular get command. The *option_value* parameter points to a buffer that is to receive the data requested by the get command. The *option_len* parameter points to the size of the buffer pointed to by the *option_value* parameter. It must be initially set to the size of the buffer before calling `getsockopt()`. On return it is set to the actual size of the data returned.

All the socket level options except `SO_LINGER`, `SO_RCVTIMEO` and `SO_SNDTIMEO`, expect *option_value* to point to an integer and *option_len* to be set to the size of an integer. When the integer is nonzero, the option is enabled. When it is zero, the option is disabled. The `SO_LINGER` option expects *option_value* to point to a linger structure as defined in `sys/socket.h`. This structure is defined in the following example:

```
struct linger
{
    int    l_onoff;          /* option on/off */
```

```

    int    l_linger;          /* linger time */
};

```

The `l_onoff` field is set to zero if the `SO_LINGER` option is being disabled. A nonzero value enables the option. The `l_linger` field specifies the amount of time to linger on close.

The following options are recognized at the IPv4 level:

Option

Description

IP_MULTICAST_IF

(RAW and UDP) Used to get the interface IP address used for sending outbound multicast datagrams. The IP address is passed using the `in_addr` structure.

IP_MULTICAST_LOOP

(RAW and UDP) Used to determine whether loopback is enabled or disabled. The loopback indicator is passed as an `u_char`. The value 0 indicates loopback is disabled and the value 1 indicates it is enabled.

IP_MULTICAST_TTL

(RAW and UDP) Returns the IP time-to-live of outgoing multicast datagrams. The TTL value is passed as an `u_char`.

IP_RECVPKINFO

(RAW and UDP) Indicates whether returning the destination IP address of an incoming packet and the interface over which the packet was received is enabled or disabled. If the `setsockopt()` function is used to set this option, the set value is returned. The option value is passed as an `int`. The value 0 indicates the option is disabled and the value 1 indicates the option is enabled. When the option is enabled, the information is returned as `IP_PKTINFO` ancillary data on `recvmsg()` function calls.

This option is protected by the `_OPEN_SYS_SOCKET_EXT4` feature test macro.

IP_TTL

(TCP and UDP) This option is used to retrieve the time-to-live value that is set in the IP header for the `SOCK_STREAM`(TCP) and `SOCK_DGRAM` (UDP) sockets.

Note: `IP_TTL` can be used only when `_XPLATFORM_SOURCE` is defined.

The following options are recognized at IPv6 level:

Option

Description

IPV6_ADDR_PREFERENCES

(TCP and UDP) Used to get the source address selection preference flags for a given socket. The flags are defined as bits within the 32 bit unsigned integer returned option value. The flags returned will be either the default preference flags or will be the flags previously set by `setsockopt()`. The constants for the flag bit values are defined in `netinet/in.h`.

IPV6_CHECKSUM

(RAW) Used to determine if checksum processing is enabled for a RAW (non-ICMPv6) socket. The option value returned is the offset into the user data where the checksum is located. It is passed as `int`. A value of -1 means the function is disabled.

IPV6_DONTFRAG

(RAW and UDP) This option turns off the automatic inserting of a fragment header in the packet for UDP and raw sockets.

IPV6_DSTOPTS

(RAW and UDP) The application can remove any sticky destination options header by calling `setsockopt()` for this option with a zero option length.

IPV6_HOPOPTS

(RAW and UDP) The application can remove any sticky hop-by-hop options header by calling `setsockopt()` for this option with a zero option length.

IPV6_MULTICAST_HOPS

(RAW and UDP) Returns the hop limit value for outbound multicast datagrams. The hop limit value is passed as an int.

IPV6_MULTICAST_IF

(RAW and UDP) Returns the interface index for the interface used for sending outbound multicast datagrams. The interface index is passed as an u_int.

IPV6_MULTICAST_LOOP

(RAW and UDP) Used to determine whether loopback of outgoing multicast packets is enabled or disabled. The loopback indicator is passed as u_int. The value 0 indicates the option is disabled and the value 1 indicates it is enabled.

IPV6_NEXTHOP

(RAW and UDP) Specifies the next hop for the datagram as a socket address structure.

IPV6_RECVDSTOPTS

(RAW and UDP) To receive destination options header this option must be enabled.

IPV6_RECVHOPLIMIT

(RAW, TCP, and UDP) Returns the received hop limit as IPV6_HOPLIMIT ancillary data on recvmsg() function calls. The option value is passed as an int. The value 0 indicates the option is disabled and the value 1 indicates the option is enabled.

IPV6_RECVHOPTS

(RAW and UDP) To receive a hop-by-hop options header this option must be enabled.

IPV6_RECVPATHMTU

(RAW and UDP) Returns the path MTU as IPV6_PATHMTU ancillary data on recvmsg() function calls.

IPV6_RECVPKTINFO

(RAW and UDP) Indicates whether returning the destination IP address of an incoming packet and the interface over which the packet was received is enabled or disabled. The option value is passed as an int. The value 0 indicates the option is disabled and the value 1 indicates the option is enabled. When the option is enabled, the information is returned as IPV6_PKTINFO ancillary data on recvmsg() function calls.

IPV6_RECVRTHDR

(RAW and UDP) To receive a routing header this option must be enabled.

IPV6_RECVTCLASS

(RAW, TCP, and UDP) To receive the traffic class this option must be enabled.

IPV6_RTHDR

(RAW and UDP) The application can remove any sticky routing header by calling setsockopt() for this option with a zero option length.

IPV6_RTHDRDSTOPTS

(RAW and UDP) The application can remove any sticky destination options header by calling setsockopt() for this option with a zero option length.

IPV6_TCLASS

(RAW, TCP, and UDP) To specify the traffic class value this option must be enabled.

IPV6_UNICAST_HOPS

(RAW and UDP) Returns the hop limit value for outbound unicast datagrams. The hop limit value is passed as an int.

IPV6_USE_MIN_MTU

(RAW, TCP, and UDP) Indicates whether the IP layer will use the minimum MTU size (1280) for sending packets, bypassing path MTU discovery. The option value is passed as an int. A value of -1 causes the default values for unicast (disabled) and multicast (enabled) destinations to be used. A value of 0 disables this option for unicast and multicast destinations. A value of 1 enables this option for unicast and multicast destinations and the minimum MTU size will be used. If a setsockopt() call has not been made prior to a getsockopt() call, the default value of -1 is returned.

IPV6_V6ONLY

(RAW, TCP, and UDP) Used to determine whether a socket is restricted to IPv6 communications only. The option value is passed as an int. A non-zero value means the option is enabled (socket can only be used for IPv6 communications). 0 means the option is disabled.

The following option is recognized at ICMPv6 level:

Option**Description****ICMP6_FILTER**

(RAW) Used to filter ICMPv6 messages. It returns the filter value being used for this socket. It is back in an icmp6_filter structure as defined in `netinet/icmp6.h`.

The following options are recognized at the socket level:

Option**Description****SO_ACCEPTCONN**

The socket had a listen() call.

SO_BROADCAST

Toggles the ability to broadcast messages. If this option is enabled, it allows the application to send broadcast messages over *socket*, if the interface specified in the destination supports the broadcasting of packets. This option has no meaning for stream sockets. This option is valid only for the AF_INET domain.

SO_DEBUG

Reports whether debugging information is being recorded. This option stores an int value.

SO_ERROR

Returns any pending error on the socket and clears the error status. You can use SO_ERROR to check for asynchronous errors on connected datagram sockets or for other asynchronous errors (errors that are not returned explicitly by one of the socket calls).

SO_KEEPAIVE

Toggles the TCP keep-alive mechanism for a stream socket. When activated, the keep-alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is ended with the error ETIMEDOUT. Processes writing to that socket are notified with a SIGPIPE signal. This option stores an int value. This option is valid only for the AF_INET and AF_INET6 domains.

SO_LINGER

Lingers on close if data is present. When this option is enabled and there is unsent data present when close() is called, the calling application is blocked during the close() call until the data is transmitted or the connection has timed out. If this option is disabled, the TCP/IP address space waits to try to send the data. Although the data transfer is usually successful, it cannot be guaranteed, because the TCP/IP address space waits only a finite amount of time trying to send the data. The close() call returns without blocking the caller. This option has meaning only for stream sockets.

SO_OOINLINE

Toggles reception of out-of-band data. When this option is enabled, out-of-band data is placed in the normal data input queue as it is received; it is then available to recv(), recvfrom(), and recvmsg() without the need to specify the MSG_OOB flag in those calls. When this option is disabled, out-of-band data is placed in the priority data input queue as it is received; it is then available to recv(), recvfrom(), and recvmsg() only if the MSG_OOB flag is specified in those calls. This option has meaning only for stream sockets.

_SO_PROPAGATEUSERID

Toggles propagating a user ID (UID) over an AF_UNIX stream socket. When enabled, user (UID) information is extracted from the system when the connect() function is invoked. Then, when the accept() function is invoked, the acceptor assumes the identity of the connector until the accepted socket is closed.

SO_RCVBUF

Reports receive buffer size information. This option stores an int value.

SO_RCVTIMEO

Reports the timeout value with the amount of time an input function waits until it completes.

If a receive operation has blocked for this much time without receiving additional data, it returns with a partial count or errno set to EWOULDBLOCK if no data is received. The default for this option is zero, which indicates that a receive operation does not time out.

SO_REUSEADDR

Toggles local address reuse. When enabled, this option allows local addresses that are already in use to be bound. SO_REUSEADDR alters the normal algorithm used in the bind() call.

The system checks at connect time to ensure that the local address and port do not have the same foreign address and port. The error EADDRINUSE is returned if the association already exists.

After the 'SO_REUSEADDR' option is active, the following situation is supported:

A server can bind() the same port multiple times as long as every invocation uses a different local IP address and the wildcard address INADDR_ANY is used only one time per port.

This option is valid only for the AF_INET and AF_INET6 domains.

SO_SECINFO

Toggles receiving security information. When enabled on an AF_UNIX UDP socket, the recvmsg() function will return security information about the sender of each datagram as ancillary data. This information contains the sender's user ID, uid, gid, and jobname and it is mapped by the secsinfo structure in sys/socket.h.

SO_SNDBUF

Reports send buffer size information. This option stores an int value.

SO_SNDTIMEO

Reports the timeout value specifying the amount of time that an output function blocks due to flow control preventing data from being sent.

If a send operation has blocked for this time, it returns with a partial count or with errno set to EWOULDBLOCK if no data is sent. The default for this option is zero, which indicates that a send operation does not time out.

SO_TYPE

This option returns the type of the socket. On return, the integer pointed to by *option_value* is set to SOCK_STREAM or SOCK_DGRAM. This option is valid for the AF_UNIX, AF_INET and AF_INET6 domains.

Special behavior for C++: To use this function with C++, you must use the _XOPEN_SOURCE_EXTENDED 1 feature test macro.

Returned value

If successful, getsockopt() returns 0.

If unsuccessful, getsockopt() returns -1 and sets errno to one of the following values:

Error Code**Description****EBADF**

The *socket* parameter is not a valid socket descriptor.

EFAULT

Using *option_value* and *option_len* parameters would result in an attempt to access storage outside the caller's address space.

EINVAL

The specified option is not valid at the specified socket level.

ENOBUFS

Buffer space is not available to send the message.

ENOPROTOPT

The *option_name* parameter is unrecognized, or the *level* parameter is not SOL_SOCKET.

ENOSYS

The function is not implemented. You attempted to use a function that is not yet available.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The operation is not supported by the socket protocol. At least the following options are not supported:

- IPV6_JOIN_GROUP
- IPV6_LEAVE_GROUP
- IP_ADD_SOURCE_MEMBERSHIP
- IP_DROP_SOURCE_MEMBERSHIP
- IP_DROP_MEMBERSHIP
- IP_ADD_MEMBERSHIP
- IP_BLOCK_SOURCE
- IP_UNBLOCK_SOURCE
- MCAST_JOIN_GROUP
- MCAST_LEAVE_GROUP
- MCAST_BLOCK_SOURCE
- MCAST_UNBLOCK_SOURCE
- MCAST_JOIN_SOURCE_GROUP
- MCAST_LEAVE_SOURCE_GROUP

Example

The following are examples of the getsockopt() call. See [“setsockopt\(\) — Set options associated with a socket”](#) on page 1573 for examples of how the setsockopt() call options are set.

```
int rc;
int s;
int option_value;
int option_len;
struct linger l;
int getsockopt(int s, int level, int option_name,
char *option_value,
int *option_len);

:
/* Is out-of-band data in the normal input queue? */
option_len = sizeof(int);
rc = getsockopt(
    s, SOL_SOCKET, SO_OOBINLINE, (
char *) &option_value, &option_len);
if (rc == 0)
{
    if (option_len == sizeof(int))
    {
        if (option_value)
            /* yes it is in the normal queue */
        else
            /* no it is not
            */
        }
    }
}
```

```

:
/* Do I linger on close? */
option_len = sizeof(l);
rc = getsockopt(
    s, SOL_SOCKET, SO_LINGER, (char *) &l, &option_len);
if (rc == 0)
{
    if (option_len == sizeof(l))
    {
        if (l.l_onoff)
            /* yes I linger */
        else
            /* no I do not */
        }
    }
}

```

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“close\(\) — Close a file” on page 293](#)
- [“getprotobyname\(\) — Get a protocol entry by name” on page 757](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- For more information about IPv4 socket options, see [z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference](#).
- For more information about IPv6 socket options, see [z/OS Communications Server: IPv6 Network and Appl Design Guide](#).

getsourcefilter() — Get source filter

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3678 | both | z/OS V1.9 |

Format

```

#define _XOPEN_SYS_SOCKET_EXT3
#include <netinet/in.h>

int getsourcefilter(int s, uint32_t interface, struct sockaddr *group,
    socklen_t grouplen, uint32_t *fmode, uint32_t *numsrc,
    struct sockaddr_storage *slist);

```

General description

This function allow applications to get a previously set multicast filtering state for a tuple consisting of socket, interface, and multicast group values.

A multicast filter is described by a filter mode, which is MCAST_INCLUDE or MCAST_EXCLUDE, and a list of source addresses which are filtered.

This function is protocol-independent. It can be on either AF_INET or AF_INET6 sockets of the type SOCK_DGRAM or SOCK_RAW.

If the function is unable to obtain the required storage, control will not return to the caller. Instead the application will terminate due to an out of memory condition (if the reserve stack is available and the caller is not XPLINK), or it will terminate with an abend indicating that storage could not be obtained.

Argument

Description

s

Identifies the socket.

interface

Holds the index of the interface.

group

Points to either a sockaddr_in structure for IPv4 or a sockaddr_in6 structure for IPv6 that holds the IP multicast address of the group.

grouplen

Gives the length of the sockaddr_in or sockaddr_in6 structure.

fmode

Points to an integer that will contain the filter mode on a successful return. The value of this field will be either MCAST_INCLUDE or MCAST_EXCLUDE, which are likewise defined in <netinet/in.h>.

numsrc

It is a pointer that on input, points to the number of source addresses that will fit in the slist array. On return, points to the total number of sources associated with the filter.

slist

Points to buffer into which an array of IP addresses of included or excluded (depending on the filter mode) sources will be written. If numsrc was 0 on input, a NULL pointer may be supplied.

Returned value

If successful, the function returns 0. Otherwise, it returns -1 and sets errno to one of the following values.

errno

Description

EADDRNOTAVAIL

The tuple consisting of socket, interface, and multicast group values does not exist; or the specified interface address is not multicast capable.

EAFNOSUPPORT

The address family of the input sockaddr is not AF_INET or AF_INET6.

EBADF

s is not a valid socket descriptor.

EINVAL

Interface or group is not a valid address, or the socket s has already requested multicast setsockopt options (refer to z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference for details.) Or if the group address family is AF_INET and grouplen is not at least size of sockaddr_in or if the group address family is AF_INET6 and grouplen is not at least size of sockaddr_in6 or if grouplen is not at least size of sockaddr_in.

ENXIO

The specified interface index provided in the interface parameter does not exist.

EPROTOTYPE

The socket s is not of type SOCK_DGRAM or SOCK_RAW.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“setsourcefilter\(\) — Set source filter” on page 1581](#)

getstablesize() — Get the socket table size

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>

int getstablesize(void);
```

General description

Bulk mode sockets are not supported. Do not use this function.

Returned value

If successful, `getstablesize()` returns the current limit for this process.

If it has not been changed by the `maxdesc()` function, then the default is returned. The default is the hard limit returned by `getrlimit()` for `RLIMIT_NOFILE`. This is the value set by a BPXPRMnn parmlib member on its MAXFILEPROC statement.

There are no `errno` values defined.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“getrlimit\(\) — Get current or maximum resource consumption” on page 767](#)
- [“maxdesc\(\) — Get socket numbers to extend beyond the default range” on page 1043](#)

getsubopt() — Parse suboption arguments

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

int getsubopt(char **optionp, char *const *tokens, char **valuep);
```

General description

The `getsubopt()` function parses suboption arguments in a flag argument that was initially parsed by `getopt()`. These suboption arguments must be separated by commas and may consist of either a single token, or a token-value pair separated by an equal sign. Because commas delimit suboption arguments in the option string, they are not allowed to be part of the suboption arguments or the value of a suboption argument. Similarly, because the equal sign separates a token from its value, a token must not contain an equal sign.

The `getsubopt()` function takes the address of a pointer to the option argument string, a vector of possible tokens, and the address of a value string pointer. If the option argument string at *optionp* contains only one suboption argument, `getsubopt()` updates *optionp* to point to the NULL at the end of the string. Otherwise, it isolates the suboption argument by replacing the comma separator with a NULL, and updates *optionp* to point to the start of the next suboption argument. If the suboption argument has an associated value, `getsubopt()` updates *valuep* to point to the value's first character. Otherwise it sets *valuep* to a NULL pointer.

The token vector is organized as a series of pointers to strings. The end of the token vector is identified by a NULL pointer.

When `getsubopt()` returns, if *valuep* is not a NULL pointer, then the suboption argument processed included a value. The calling program may use this information to determine if the presence or lack of a value for the suboption is an error.

Additionally, when `getsubopt()` fails to match the suboption argument with the tokens in the *tokens* array, the calling program should decide if this is an error, or if the unrecognized option should be passed on to another program.

Because the `getsubopt()` function returns thread-specific data the `getsubopt()` function can be used safely from a multithreaded application.

Returned value

If successful, `getsubopt()` returns the index of the matched token string.

If no token strings were matched, `getsubopt()` returns -1.

`getsubopt()` does not return any `errno` values.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“getopt\(\) — Command option parsing” on page 745](#)

getsyntax() — Return LC_SYNTAX characters

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <variant.h>

struct variant *getsyntax(void);
```

General description

Determines the encoding of the special characters defined in the LC_SYNTAX category of the current locale, and stores the encoding values in the structure of type *variant*. For details of the variant structure, see [“variant.h — LC_SYNTAX characters” on page 79](#).

Returned value

Returns the pointer to the structure containing the values of the special characters.

If the information about the special characters is not available in the current locale, getsyntax() returns a NULL pointer.

The structure returned is not modified by the program that this function is used in. The structure may be invalidated by calls to the setlocale() function with LC_ALL, LC_CTYPE, LC_COLLATE, or LC_SYNTAX.

Example

CELEBG19

```
/* CELEBG19 */
#include <stdio.h>
#include <stdlib.h>
#include <variant.h>
#include <wchar.h>

int main(void)
{
    struct variant *var;

    var = getsyntax();
    printf("codeset           : %s\n", var->codeset      );
    printf("backslash        : %3d\n", var->backslash     );
    printf("right_bracket       : %3d\n", var->right_bracket    );
    printf("left_bracket        : %3d\n", var->left_bracket     );
    printf("right_brace         : %3d\n", var->right_brace      );
    printf("left_brace          : %3d\n", var->left_brace       );
    printf("circumflex          : %3d\n", var->circumflex      );
    printf("tilde               : %3d\n", var->tilde           );
    printf("exclamation_mark: %3d\n", var->exclamation_mark);
    printf("number_sign        : %3d\n", var->number_sign     );
    printf("vertical_line       : %3d\n", var->vertical_line    );
    printf("dollar_sign         : %3d\n", var->dollar_sign     );
    printf("commercial_at      : %3d\n", var->commercial_at    );
    printf("grave_accent       : %3d\n", var->grave_accent     );
}
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- [“locale.h — Locale settings” on page 36](#)
- [“variant.h — LC_SYNTAX characters” on page 79](#)
- [“setlocale\(\) — Set locale” on page 1547](#)

__get_system_settings() — Retrieves system parameters

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R10 |

Format

```
#define _OPEN_SYS_EXT 1
#include <sys/ps.h>

struct _Optn *__get_system_settings(void);
```

General description

The `__get_system_settings()` function retrieves system parameter information from the BPXPRM member used during IPL, or updated by the OMVS operator command.

Returned value

If successful, `__get_system_settings()` returns a pointer to an `_Optn` structure containing the values set for the BPXPRMxx member process during IPL, or updated by the OMVS operator command.

If unsuccessful, `__get_system_settings()` returns NULL and may set `errno` to one of the following values:

Error Code

Description

ENOMEM

Insufficient memory available to allocate `_Optn` structure.

Related information

- [“sys/ps.h — w_getpsent\(\) function and w_psproc structure” on page 70](#)

gettimeofday(), gettimeofday64() — Get date and time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1

#undef _ALL_SOURCE
#include <sys/time.h>

int gettimeofday(struct timeval *__restrict__ tp,
                 void *__restrict__ tzp);

#define _ALL_SOURCE
#include <sys/time.h>

int gettimeofday(struct timeval *__restrict__ tp,
                 struct timezone *__restrict__ tzp);

#define _LARGE_TIME_API
#include <sys/time.h>

int gettimeofday64(struct timeval64 *__restrict__ tp,
                  void *__restrict__ tzp);
```


General description

The `gettimeofday()` function obtains the current time, expressed as seconds and microseconds since 00:00:00 Coordinated Universal Time (UTC), January 1, 1970, and stores it in the `timeval` structure pointed to by *tp*.

Special behavior for `_ALL_SOURCE`: The `gettimeofday()` function has two prototypes. Which one is used depends on whether or not you define the `_ALL_SOURCE` feature test macro when you compile your program. If `_ALL_SOURCE` is NOT defined when the C/370 preprocessor processes the `<sys/time.h>` header, it includes a prototype for `gettimeofday()` which defines the second argument, *tzp*, as a void pointer and includes a C/370 pragma map statement for a C/370 version of `gettimeofday()` which ignores *tzp*.

If `_ALL_SOURCE` is defined, the C/370 preprocessor includes a prototype for `gettimeofday()` which defines *tzp* as a pointer to a `timezone` structure and includes a pragma map statement for a C/370 version of `gettimeofday()` which stores time zone information in the `timezone` structure to which the second argument points. The `timezone` structure contains the following members:

```
int tz_minuteswest; /* Time west of Greenwich in minutes */
int tz_dsttime;     /* Type of DST correction to apply   */
```

When `_ALL_SOURCE` is defined, the `gettimeofday()` function:

1. invokes `tzset()` to set the values of the `timezone` and `daylight` external variables.
2. converts the value of the `timezone` external variable to minutes and stores the converted value, rounded up to the nearest minute, in `tzp->tz_minuteswest`.
3. stores the value of the `daylight` external variable in `tzp->tz_dsttime`.

The function `gettimeofday64()` will behave exactly like `gettimeofday()` except it will support calendar times beyond 03:14:07 UTC on January 19, 2038.

There is no support for an `_ALL_SOURCE` version of `gettimeofday64()`.

Returned value

If successful, `gettimeofday()` returns 0.

If overflow occurs, `gettimeofday()` returns nonzero. Overflow occurs when the current time in seconds since 00:00:00 UTC, January 1, 1970 exceeds the capacity of the `tv_sec` member of the `timeval` structure pointed to by *tp*. The `tv_sec` member is type `time_t`.

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“sys/time.h — Time types” on page 71](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“ftime\(\), ftime64\(\) — Set the date and time” on page 661](#)

getuid() – Get the real user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

uid_t getuid(void);
```

General description

Finds the real user ID (UID) of the calling process.

Returned value

getuid() returns the found value. It is always successful.

There are no documented errno values.

Example

CELEBG20

```
/* CELEBG20

   This example provides information for your user ID.

*/
#define _POSIX_SOURCE
#include <pwd.h>
#include <sys/types.h>
#include <unistd.h>

main() {
    struct passwd *p;
    uid_t uid;

    if ((p = getpwuid(uid = getuid())) == NULL)
        perror("getpwuid() error");
    else {
        puts("getpwuid() returned the following info for your userid:");
        printf(" pw_name  : %s\n",      p->pw_name);
        printf(" pw_uid   : %d\n", (int) p->pw_uid);
        printf(" pw_gid   : %d\n", (int) p->pw_gid);
        printf(" pw_dir   : %s\n",      p->pw_dir);
        printf(" pw_shell : %s\n",      p->pw_shell);
    }
}
```

Output

```
pw_name  : MVSUSR1
pw_uid   : 25
pw_gid   : 500
pw_dir   : /u/mvsusr1
pw_shell : /bin/sh
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“geteuid\(\) — Get the effective user ID” on page 708](#)
- [“seteuid\(\) — Set the effective user ID” on page 1526](#)
- [“setreuid\(\) — Set real and effective user IDs” on page 1566](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)

__getuserid() — Retrieve the active MVS user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R9 |

Format

```
#define _OPEN_SYS_EXT
#include <sys/ps.h>

int __getuserid(char *userid, int userlen);
```

General description

Retrieves the current active user ID for the requester. When successful, the output in user ID is the active MVS user ID.

userid is an output parameter. It points to the active MVS user ID that is a NULL terminated string.
userlen is an input parameter. It represents the length of the active MVS user ID that contains a NULL terminator.

Returned value

If successful, `__getuserid()` returns 0.

If unsuccessful, `__getuserid()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

One of the following error conditions exists:

- The length supplied by *userlen* does not allow enough storage in the string to retrieve the MVS user ID.
- The z/OS UNIX system service returned a failure.

Related information

- [“sys/ps.h — w_getpsent\(\) function and w_psproc structure” on page 70](#)

getutxent(), getutxent64() – Read next entry in utmpx database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

getutxent:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <utmpx.h>

struct utmpx *getutxent(void);
```

getutxent64:

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _LARGE_TIME_API
#include <utmpx.h>

struct utmpx64 *getutxent64(void);
```

General description

The `getutxent()` function reads in the next entry from the `utmpx` database. If the database is not already open, it opens it. If it reaches the end of the database, it fails.

The `pututxline()` function obtains an exclusive lock in the `utmpx` database on the byte range of the record which is ready to write and releases the lock before returning to its caller. The functions `getutxent()`, `getutxid()`, and `getutxline()` might continue to read and are not affected by `pututxline()`.

Because the `getutxent()` function returns thread-specific data the `getutxent()` function can be used safely from a multithreaded application. If multiple threads in the same process open the database, then each thread opens the database with a different file descriptor. The thread's database file descriptor is closed when the calling thread terminates or the `endutxent()` function is called by the calling thread.

The name of the database file defaults to `/etc/utmpx`. To process a different database file name use the `__utmpxname()` function.

For all entries that match a request, the `ut_type` member indicates the type of the entry. Other members of the entry will contain meaningful data based on the value of the `ut_type` member as follows:

EMPTY

No other members have meaningful data.

BOOT_TIME

`ut_tv` is meaningful.

__RUN_LVL

`ut_tv` and `ut_line` are meaningful

OLD_TIME

`ut_tv` is meaningful.

NEW_TIME

`ut_tv` is meaningful.

USER_PROCESS

`ut_id`, `ut_user` (login name of the user), `ut_line`, `ut_pid`, and `ut_tv` are meaningful.

INIT_PROCESS

ut_id, ut_pid, and ut_tv are meaningful.

LOGIN_PROCESS

ut_id, ut_user (implementation-specific name of the login process), ut_pid, and ut_tv are meaningful.

DEAD_PROCESS

ut_id, ut_pid, and ut_tv are meaningful.

The `getutxent64()` function behaves exactly like `getutxent()` except `getutxent64()` uses structure `utmpx64` instead of `struct utmpx` to support time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, `getutxent()` returns a pointer to a `utmpx` structure containing a copy of the requested entry in the user accounting database.

If unsuccessful, `getutxent()` returns a NULL pointer.

No errors are defined for this function.

Related information

- [“utmpx.h — User accounting database” on page 78](#)
- [“endutxent\(\) — Close the utmpx database” on page 425](#)
- [“getutxid\(\), getutxid64\(\) — Search by ID utmpx database” on page 795](#)
- [“getutxline\(\), getutxline64\(\) — Search by line utmpx database” on page 797](#)
- [“pututxline\(\), pututxline64\(\) — Write entry to utmpx database” on page 1359](#)
- [“setutxent\(\) — Reset to start of utmpx database” on page 1588](#)
- [“__utmpxname\(\) — Change the utmpx database name” on page 1957](#)

getutxid(), getutxid64() — Search by ID utmpx database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**getutxid:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <utmpx.h>

struct utmpx *getutxid(const struct utmpx *id);
```

getutxid64:

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _LARGE_TIME_API
#include <utmpx.h>

struct utmpx64 *getutxid64(const struct utmpx64 *id);
```

General description

The `getutxid()` function searches forward from the current point in the `utmpx` database. If the database is not already open, it opens it. If the `ut_type` value of the `utmpx` structure pointed to by *id* is **BOOT_TIME**, **__RUN_LVL**, **OLD_TIME**, or **NEW_TIME**, then it stops when it finds an entry with a matching `ut_type` value. If the `ut_type` value is **INIT_PROCESS**, **LOGIN_PROCESS**, **USER_PROCESS**, or **DEAD_PROCESS**, then it stops when it finds an entry whose type is one of these four and whose `ut_id` member matches the `ut_id` member of the `utmpx` structure pointed to by *id*. If the `ut_type` value is **EMPTY**, `getutxid()` fails (returns `NULL`) without repositioning the `utmpx` database to the end. If the end of the database is reached without a match, `getutxid()` fails.

The `pututxline()` function obtains an exclusive lock in the `utmpx` database on the byte range of the record which is ready to write and releases the lock before returning to its caller. The functions `getutxent()`, `getutxid()`, and `getutxline()` might continue to read and are not affected by `pututxline()`.

Because the `getutxid()` function returns thread-specific data the `getutxid()` function can be used safely from a multithreaded application. If multiple threads in the same process open the database, then each thread opens the database with a different file descriptor. The thread's database file descriptor is closed when the calling thread terminates or the `endutxent()` function is called by the calling thread.

The name of the database file defaults to `/etc/utmpx`. To process a different database file name use the `__utmpxname()` function.

For all entries that match a request, the `ut_type` member indicates the type of the entry. Other members of the entry will contain meaningful data based on the value of the `ut_type` member as follows:

EMPTY

No other members have meaningful data.

BOOT_TIME

`ut_tv` is meaningful.

__RUN_LVL

`ut_tv` and `ut_line` are meaningful

OLD_TIME

`ut_tv` is meaningful.

NEW_TIME

`ut_tv` is meaningful.

USER_PROCESS

`ut_id`, `ut_user` (login name of the user), `ut_line`, `ut_pid`, and `ut_tv` are meaningful.

INIT_PROCESS

`ut_id`, `ut_pid`, and `ut_tv` are meaningful.

LOGIN_PROCESS

`ut_id`, `ut_user` (implementation-specific name of the login process), `ut_pid`, and `ut_tv` are meaningful.

DEAD_PROCESS

`ut_id`, `ut_pid`, and `ut_tv` are meaningful.

The `getutxid64()` function behaves exactly like `getutxid()` except `getutxid64()` uses structure `utmpx64` instead of `struct utmpx` to support time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, `getutxid()` returns a pointer to a `utmpx` structure containing a copy of the requested entry in the user accounting database.

If unsuccessful, `getutxid()` returns a `NULL` pointer.

No errors are defined for this function.

Related information

- “[utmpx.h — User accounting database](#)” on page 78
- “[endutxent\(\)](#) — Close the utmpx database” on page 425
- “[getutxent\(\), getutxent64\(\)](#) — Read next entry in utmpx database” on page 794
- “[getutxline\(\), getutxline64\(\)](#) — Search by line utmpx database” on page 797
- “[pututxline\(\), pututxline64\(\)](#) — Write entry to utmpx database” on page 1359
- “[setutxent\(\)](#) — Reset to start of utmpx database” on page 1588
- “[__utmpxname\(\)](#) — Change the utmpx database name” on page 1957

getutxline(), getutxline64() — Search by line utmpx database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

getutxline:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <utmpx.h>

struct utmpx *getutxline(const struct utmpx *line);
```

getutxline64:

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _LARGE_TIME_API
#include <utmpx.h>

struct utmpx64 *getutxline64(const struct utmpx64 *line);
```

General description

The `getutxline()` function searches forward from the current point in the utmpx database until it finds an entry of the type **LOGIN_PROCESS** or **USER_PROCESS** which also has a `ut_line` value matching that in the utmpx structure pointed to by argument `line`. If the database is not already open, it opens it. If it reaches the end of the database, it fails.

The `pututxline()` function obtains an exclusive lock in the utmpx database on the byte range of the record which is ready to write and releases the lock before returning to its caller. The functions `getutxent()`, `getutxid()`, and `getutxline()` might continue to read and are not affected by `pututxline()`.

Because the `getutxline()` function returns thread-specific data the `getutxline()` function can be used safely from a multithreaded application. If multiple threads in the same process open the database, then each thread opens the database with a different file descriptor. The thread's database file descriptor is closed when the calling thread terminates or the `endutxent()` function is called by the calling thread.

The name of the database file defaults to `/etc/utmpx`. To process a different database file name use the `__utmpxname()` function.

The functions `getutxent()`, `getutxid()`, and `getutxline()` cache the last entry read from the database. For this reason, to use `getutxline()` function to search for multiple occurrences, it is necessary to zero out the utmpx structure pointed to by the return value from these functions.

For all entries that match a request, the `ut_type` member indicates the type of the entry. Other members of the entry will contain meaningful data based on the value of the `ut_type` member as follows:

EMPTY

No other members have meaningful data.

BOOT_TIME

`ut_tv` is meaningful.

__RUN_LVL

`ut_tv` and `ut_line` are meaningful

OLD_TIME

`ut_tv` is meaningful.

NEW_TIME

`ut_tv` is meaningful.

USER_PROCESS

`ut_id`, `ut_user` (login name of the user), `ut_line`, `ut_pid`, and `ut_tv` are meaningful.

INIT_PROCESS

`ut_id`, `ut_pid`, and `ut_tv` are meaningful.

LOGIN_PROCESS

`ut_id`, `ut_user` (implementation-specific name of the login process), `ut_pid`, and `ut_tv` are meaningful.

DEAD_PROCESS

`ut_id`, `ut_pid`, and `ut_tv` are meaningful.

The `getutxline64()` function behaves exactly like `getutxline()` except `getutxline64()` uses structure `utmpx64` instead of `struct utmpx` to support time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, `getutxline()` returns a pointer to a `utmpx` structure containing a copy of the requested entry in the user accounting database.

If unsuccessful, `getutxline()` returns a NULL pointer.

No errors are defined for this function.

Related information

- [“utmpx.h — User accounting database” on page 78](#)
- [“endutxent\(\) — Close the utmpx database” on page 425](#)
- [“getutxent\(\), getutxent64\(\) — Read next entry in utmpx database” on page 794](#)
- [“getutxid\(\), getutxid64\(\) — Search by ID utmpx database” on page 795](#)
- [“pututxline\(\), pututxline64\(\) — Write entry to utmpx database” on page 1359](#)
- [“setutxent\(\) — Reset to start of utmpx database” on page 1588](#)
- [“__utmpxname\(\) — Change the utmpx database name” on page 1957](#)

getw() — Get a machine word from a stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdio.h>

int getw(FILE *stream);
```

General description

The `getw()` function reads the next word from the *stream*. The size of the word is the size of an `int`, and varies from machine to machine. The `getw()` function presumes no special alignment in the file.

The `getw()` function may mark the `st_atime` field of the file associated with *stream* for update. The `st_atime` field will be marked for update by the first successful execution of `fgetc()`, `fgets()`, `fread()`, `getc()`, `getchar()`, `gets()`, `fscanf()` or `scanf()` using *stream* that returns data not supplied by a prior call to `ungetc()`.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use character-based input functions to replace `getw()` for portability.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `getw()` returns the next word from the input stream pointed to by *stream*. If the stream is at End Of File (EOF), the End Of File indicator for the stream is set and `getw()` returns EOF. If a read error occurs, the error indicator for the stream is set, `getw()` returns EOF and sets `errno` to indicate the error.

Refer to [“fgetc\(\) — Read a character” on page 533](#) for `errno` values.

Because the representation of EOF is a valid integer, applications wishing to check for errors should use `ferror()` and `feof()`.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“fwrite\(\) — Write items” on page 678](#)
- [“putw\(\) — Put a machine word on a stream” on page 1361](#)

getwc() — Get a wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <wchar.h>

wint_t getwc(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t getwc_unlocked(FILE *stream);
```

General description

Obtains the next multibyte character from `stdin`, converts it to a wide character, and advances the associated file position indicator for `stdin`.

The `getwc()` function is equivalent to the `fgetwc()` function. Therefore, the argument should never be an expression with side effects.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Using non-wide-character functions with `getwc()` results in undefined behavior. This happens because `getwc()` processes a whole multibyte character and does not expect to be “within” such a character. In addition, `getwc()` expects state information to be set already. Because functions like `fgetc()` and `fputc()` do not obey such rules, their results fail to meet the assumptions made by `getwc()`.

`getwc()` has the same restriction as any read operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`getwc_unlocked()` is functionally equivalent to `getwc()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

Returns the next wide character from the input stream pointed to by *stream* or else the function returns WEOF.

If there is an error, `getwc()` sets the error indicator. If the EOF is encountered, it sets the EOF indicator. If an encoding error is encountered, it sets EILSEQ in `errno`.

Use `ferror()` or `feof()` to determine whether an error or an EOF condition occurred. Note that EOF is only reached when an attempt is made to read past the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Example

CELEBG21

```
/* CELEBG21 */
#include <errno.h>
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>

int main(void)
{
    FILE    *stream;
    wint_t   wc;

    if ((stream = fopen("myfile.dat", "r")) == NULL) {
        printf("Unable to open file.");
        exit(1);
    }
```

```

}

errno = 0;
while ((wc = getwc(stream)) != WEOF)
    printf("wc=0x%lx\n", wc);

if (errno == EILSEQ) {
    printf("An invalid wide character was encountered.\n");
    exit(1);
}

fclose(stream);
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fgetwc\(\) — Get next wide character” on page 538](#)

getwchar() — Get a wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```

#include <wchar.h>

wint_t getwchar(void)

#define _OPEN_SYS_UNLOCKED_EXT 1;
#include <wchar.h>

wint_t getwchar_unlocked(void)

```

General description

The `getwchar()` function is equivalent to `getwc()` with the argument `stdin`.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

`getwchar_unlocked()` is functionally equivalent to `getwchar()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

Returns the next wide character from the input stream pointed to by `stdin` or else the function returns `WEOF`. If the stream is at EOF, the EOF indicator for the stream is set and `fgetwc()` returns `WEOF`. If a read error occurs, the error indicator for the stream is set and `fgetwc()` returns `WEOF`. If an encoding error occurs, the value of the macro `EILSEQ` is stored in `errno` and `WEOF` is returned.

Use `ferror()` or `feof()` to determine whether an error or an EOF condition occurred. Note that EOF is only reached when an attempt is made to read past the last byte of data. Reading up to and including the last byte of data does *not* turn on the EOF indicator.

Example

CELEBG22

```
/* CELEBG22 */
#include <errno.h>
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>

int main(void)
{
    wint_t    wc;

    errno = 0;
    while ((wc = getwchar()) != WEOF)
        printf("wc=0x%X\n", wc);

    if (errno == EILSEQ) {
        printf("An invalid wide character was encountered.\n");
        exit(1);
    }
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fgetwc\(\) — Get next wide character” on page 538](#)
- [“getwc\(\) — Get a wide character” on page 799](#)

getwd() — Get the current working directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

char *getwd(char *path_name);
```

General description

The `getwd()` function determines an absolute path name of the current working directory of the calling process, and copies that path name into the array pointed to by *path_name* argument.

If the length of the path name of the current working directory is greater than (**PATH_MAX**+1) including the NULL byte, `getwd()` fails and returns a NULL pointer.

For portability to implementations conforming to earlier versions of the standards, `getcwd()` is preferred over this function.

Note: The `getwd()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `getcwd()` function is preferred for portability.

Returned value

If successful, `getwd()` returns a pointer to the string containing the absolute path name of the current working directory.

If unsuccessful, `getwd()` returns a NULL pointer and the contents of the array pointed to by *path_name* are undefined.

There are no `errno` values defined.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getcwd\(\) — Get path name of the working directory” on page 697](#)

getwmccoll() — Get next collating element from wide string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <collate.h>

collcl_t getwmccoll(wchar_t **src);
```

General description

If the object pointed to by *src* is not a NULL pointer, the `getwmccoll()` library function determines the longest sequence of wide characters in the array pointed to by *str* that constitute a valid multi-wide-character collating element. It then produces the value of type `collcl_t` corresponding to that collating element. The object pointed to by *src* is assigned the address just past the last wide character of the multi-wide-character collating element processed.

Returned value

If successful, `getwmccoll()` returns the value of type `collcl_t` that represents the collating element found.

If the object pointed to by *src* is a NULL pointer or if it points to a NULL wide character, `getwmccoll()` returns 0.

If the object pointed to by *src* points to a non-valid wide character, `getwmccoll()` returns -1 and sets `errno` to `EILSEQ`.

Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“cclass\(\) — Return characters in a character class” on page 243](#)
- [“collequiv\(\) — Return a list of equivalent collating elements” on page 300](#)

- [“collorder\(\) — Return list of collating elements” on page 301](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“colltostr\(\) — Return a string for a collating element” on page 304](#)
- [“getmccoll\(\) — Get next collating element from string” on page 736](#)
- [“ismccollet\(\) — Identify a multicharacter collating element” on page 915](#)
- [“maxcoll\(\) — Return maximum collating element” on page 1043](#)
- [“strtcoll\(\) — Return collating element for string” on page 1757](#)

getxattr(), lgetxattr(), fgetxattr() — Retrieve an extended attribute value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/xattr.h>

ssize_t getxattr(const char *path, const char *name, void *value, size_t size);
ssize_t lgetxattr(const char *path, const char *name, void *value, size_t size);
ssize_t fgetxattr(int fd, const char *name, void *value, size_t size);
```

General description

Extended attributes are extensions to the normal attributes that are associated with all inodes in the system. They are used as name : value pairs that are associated with files and directories to provide more functions to a file system.

getxattr() retrieves the value of the extended attribute that is identified by *name* and associated with the given path in the file system. The attribute value is placed in the buffer that is pointed to by *value* and *size* specifies the size of that buffer. If *size* is specified as zero, only the current size of the named extended attribute is returned, and the buffer pointed by *value* remains unchanged.

lgetxattr() is identical to getxattr() except that lgetxattr() interrogates a symbolic link but not the file that it refers to.

fgetxattr() is identical to getxattr() except that fgetxattr() interrogates the open file that is referred to by *fd* in place of *path*.

Returned value

If successful, the size of the extended attribute value in bytes is returned.
If unsuccessful, -1 is returned and errno is set to one of the following values:

Error Code

| Description |
|---|
| ENOATTR The specified attribute is not set. Attribute name is NULL or blank. |
| ENAMETOOLONG <i>pathname</i> is longer than PATH_MAX characters. |

ENODATA

The specified attribute is not set.
Attribute name is NULL or blank.

ENOTSUP

Extended attributes are not supported by the file system.

ERANGE

The size of the value buffer is too small to hold the result.
Attribute name is longer than PATH_MAX characters.

Related information

- [“sys/xattr.h — Extended attributes handling” on page 73](#)
- [“listxattr\(\), llistxattr\(\), flistxattr\(\) — List extended attribute names” on page 978](#)
- [“removexattr\(\), lremovexattr\(\), fremovexattr\(\) — Remove an extended attribute” on page 1430](#)
- [“setxattr\(\), lsetxattr\(\), fsetxattr\(\) — Set an extended attribute value” on page 1591](#)

givesocket() — Make the specified socket available

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>

int givesocket(int d, struct clientid *clientid);
```

General description

The givesocket() call makes the specified socket available to a takesocket() call issued by another program. Any socket can be given. Typically, givesocket() is used by a main program that obtains sockets by means of accept() and gives them to application programs that handle one socket at a time.

Parameter**Description****d**

The descriptor of a socket to be given to another application.

clientid

A pointer to a client ID structure specifying the program to which the socket is to be given.

To pass a socket, the giving program first calls givesocket() with the client ID structure filled in as follows:

The clientid structure:

```
struct clientid {
    int domain;
    union {
        char name[8];
        struct {
            int NameUpper;
            pid_t pid;
        } c_pid;
    } c_name;
    char subtaskname[8];
```

```

    struct {
        char type;
        union {
            char specific[19];
            struct {
                char unused[3];
                int SockToken;
            } c_close;
        } c_func;
    } c_reserved;
};

```

Element**Description*****domain***

The domain of the input socket descriptor.

c_name.name

If the *clientid* was set by a `getclientid()` call, *c_name.name* can be

- set to the application program's address space name, left-justified and padded with blanks. The application program can run in the same address space as the main program, in which case this field is set to the main program's address space.
- set to blanks, so any z/OS address space can take the socket.

subtaskname

If the *clientid* was set by a `getclientid()` call, *subtaskname* can be

- set to the task identifier of the taker. This, combined with a *c_name.name* value, allows only a process with this *c_name.name* and *subtaskname* to take the socket.
- set to blanks. If *c_name.name* has a value and *subtaskname* is blank, any task with that *c_name.name* can take the socket.

c_pid.pid

If the *clientid* was set by a `__getclientid()` call, *c_pid.pid* should be set to the process id (PID) of the taker, so only a process with that PID can take the socket. The *subtaskname* field is ignored when the *c_pid* has a value.

c_reserved.type

When set to `SO_CLOSE`, this indicates the socket should be automatically closed by `givesocket()`, and a unique socket identifying token is to be returned in *c_close.SockToken*. The *c_close.SockToken* should be passed to the taking program to be used as input to `takesocket()` instead of the socket descriptor. The now closed socket descriptor could be re-used by the time the `takesocket()` is called, so the *c_close.SockToken* should be used for `takesocket()`.

When set to `_SO_SELECT`, this indicates that the application intends to block on the `select()` for exception, waiting for the `takesocket()` to occur before closing the socket. If *c_reserved.type* is set to `_SO_SELECT` and the caller of `givesocket()` closes the socket before it has been taken, the connection will be severed. `_SO_SELECT` also allows `select()` to return exception status if `select()` is done after the socket was taken with `takesocket()`.

When set to zero, this indicates that the application will not be calling `select()` to coordinate with the taker of the socket. Either the socket is not going to be closed or the giver and taker have some other method of coordination for the giver to know when the taker has called `takesocket()`. Note that if `select()` for exception is called before `takesocket()`, the `select` will return when `takesocket()` is called but if `select()` is called after `takesocket()`, it will hang. `_SO_SELECT` should be used if `select()` is going to be called by the giver.

Also, if the given socket is closed before the `takesocket()` is issued, it is possible for that socket descriptor number to be reused in the giver's process. A sequence of `accept()`, `givesocket()`, and `close()` calls issued several times before any `takesocket()` calls can result in several sockets with the same descriptor number waiting to be taken. In this case, the oldest given socket will be taken; that is, in FIFO order. Note that if `select()` is called when there are several given sockets with the same

descriptor number waiting to be taken, `select()` will operate on the current active socket for that descriptor. It effectively waits for the last (newest) given socket to be taken; that is, in LIFO order.

`c_close.SockToken`

The unique socket identifying token returned by `givesocket()` to be used as input to `takesocket()`, instead of the socket descriptor when `c_reserved.type` has been set to `SO_CLOSE`.

`c_reserved`

Specifies binary zeros if an automatic close of a socket is not to be done by `givesocket()`.

Using name and subtaskname for givesocket/takesocket:

1. The giving program calls `getclientid()` to obtain its client ID. The giving program calls `givesocket()` to make the socket available for a `takesocket()` call. The giving program passes its client ID along with the descriptor of the socket to be given to the taking program by the taking program's startup parameter list.
2. The taking program calls `takesocket()`, specifying the giving program's client ID and socket descriptor.
3. Waiting for the taking program to take the socket, the giving program uses `select()` to test the given socket for an exception condition. When `select()` reports that an exception condition is pending, the giving program calls `close()` to free the given socket.
4. If the giving program closes the socket before a pending exception condition is indicated, the connection is immediately reset, and the taking program's call to `takesocket()` is unsuccessful. Calls other than the `close()` call issued on a given socket return -1, with `errno` set to `EBADF`.

Note: For backward compatibility, a client ID can point to the struct client ID structure obtained when the target program calls `getclientid()`. In this case, only the target program, and no other programs in the target program's address space, can take the socket.

Using process id (PID) for givesocket/takesocket:

1. The giving program calls `__getclientid()` to obtain its client ID. The giving program sets the `c_pid.pid` in the clientid structure to the PID of the taking program that will take the socket (that is, issue the `takesocket()` call). This ensures only a process that has obtained the giver's PID can take the specified socket. If the giving program wants the socket to be automatically closed by `givesocket()`, `c_reserved.type` should be set to `SO_CLOSE`. The giving program calls `givesocket()` to make the socket available for a `takesocket()` call. The giving program passes its client ID, the descriptor of the socket to be given, and the giving program's PID to the taking program by the taking program's startup parameter list.
2. The taking program sets the `c_pid.pid` in the clientid structure to the PID of the giving program to identify the process from which the socket is to be taken. If the `c_reserved.type` field was set to `SO_CLOSE` on `givesocket()`, the `c_close.SockToken` should be used as input to the `takesocket()` instead of the normal socket descriptor. The taking program calls `takesocket()`, specifying the giving program's client ID and either the socket descriptor or `c_close.SockToken`.
3. If the `c_reserved.type` field in the clientid structure was set to `SO_CLOSE` on the `givesocket()` call, the socket is closed and the giving program does not have to wait for the taking program to issue the `takesocket()`. Otherwise, steps 3 and 4 of "Using name and subtaskname for givesocket/takesocket" should be followed.

Returned value

If successful, `givesocket()` returns 0.

If unsuccessful, `givesocket()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

The *d* parameter is not a valid socket descriptor. The socket has already been given.

EFAULT

Using the *clientid* parameter as specified would result in an attempt to access storage outside the caller's address space.

EINVAL

The *clientid* parameter does not specify a valid client identifier or the *clientid* domain does not match the domain of the input socket descriptor.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“close\(\) — Close a file” on page 293](#)
- [“getclientid\(\) — Get the identifier for the calling application” on page 692](#)
- [“listen\(\) — Prepare the server for incoming client requests” on page 977](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“takesocket\(\) — Acquire a socket from another program” on page 1806](#)

glob() — Generate path names matching a pattern

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <glob.h>

int glob(const char *__restrict__ pattern, int flags,
        int (*errfunc)(const char *epath, int eerrno),
        glob_t *__restrict__ pglob);
```

General description

The *glob()* function is a path name generator that implements the rules defined in topic about pattern matching notation in *X/Open CAE Specification, Commands and Utilities, Issue 4, Version 2*, with optional support for rule 3 in the topic about patterns used for file name expansion.

The structure *glob_t* is defined in the header *<glob.h>* and includes at least the following members:

gl_pathc

Count of paths matched by *pattern*.

gl_pathv

Pointer to a list of matched file names.

gl_offs

Slots to reserve at the beginning of *gl_pathv*.

The argument *pattern* is a pointer to a path name pattern to be expanded. The *glob()* function matches all accessible path names against this pattern and develops a list of all path names that match. In order to have access to a path name, *glob()* requires search permission on every component of a path except the

last, and read permission on each directory of any file name component of *pattern* that contains any of the following special characters:

* ? [

The `glob()` function stores the number of matched path names into `pglob->gl_pathc` and a pointer to a list of pointers to path names into `pglob->gl_pathv`. The path names are in sort order as defined by the current setting of the `LC_COLLATE` category, see *X/Open CAE Specification, System Interface Definitions, Issue 4, Version 2* Section 5.3.2, `LC_COLLATE`. The first pointer after the last path name is a NULL pointer. If the pattern does not match any path names, the returned number of matched paths is set to 0, and the contents of `pglob->gl_pathv` are implementation-dependent.

It is the caller's responsibility to create the structure pointed to by `pglob`. The `glob()` function allocates other space as needed, including the memory pointed to by `gl_pathv`.

The *flags* argument is used to control the behavior of `glob()`. The value of *flags* is a bitwise inclusive-OR of zero or more of the following constants, which are defined in the header `<glob.h>`:

GLOB_APPEND

Append path names generated to the ones from a previous call to `glob()`.

GLOB_DOOFFS

Make use of `pglob->gl_offs`. If this flag is set, `pglob->gl_offs` is used to specify how many NULL pointers to add to the beginning of `pglob->gl_pathv`. In other words, `pglob->gl_pathv` will point to `pglob->gl_offs` NULL pointers, followed by `pglob->gl_pathc` path name pointers, followed by a NULL pointer.

GLOB_ERR

Causes `glob()` to return when it encounters a directory that it cannot open or read. Ordinarily, `glob()` continues to find matches.

GLOB_MARK

Each path name that is a directory that matches *pattern* has a slash appended.

GLOB_NOCHECK

Support rule 3 in the XCU specification, Section 2.13.3, Patterns Used for Filename Expansion. If *pattern* does not match any path name, then `glob()` returns a list consisting of only *pattern*, and the number of matched path names is 1.

GLOB_NOESCAPE

Disable backslash escaping.

GLOB_NOSORT

Ordinarily, `glob()` sorts the matching path names according to the current setting of the `LC_COLLATE` category, see the XBD specification, Section 5.3.2, `LC_COLLATE`. When this flag is used the order of path names returned is unspecified.

The `GLOB_APPEND` flag can be used to append a new set of path names to those found in a previous call to `glob()`. The following rules apply when two or more calls to `glob()` are made with the same value of `pglob` and without intervening calls to `globfree()`:

1. The first such call must not set `GLOB_APPEND`. All subsequent calls must set it.
2. All calls must set `GLOB_DOOFFS`, or all must not set it.
3. After the second call, `pglob->gl_pathv` points to a list containing the following:
 - a. Zero or more NULL pointers, as specified by `GLOB_DOOFFS` and `pglob->gl_offs`.
 - b. Pointers to the path names that were in the `pglob->gl_pathv` list before the call, in the same order as before.
 - c. Pointers to the new path names generated by the second call, in the specified order.
4. The count returned in `pglob->gl_pathc` will be the total number of path names from the two calls.
5. The application can change any of the fields after a call to `glob()`. If it does, it must reset them to the original value before a subsequent call, using the same `pglob` value, to `globfree()` or `glob()` with the `GLOB_APPEND` flag.

If, during the search, a directory is encountered that cannot be opened or read and *errfunc* is not a NULL pointer, *glob()* calls (**errfunc()*) with two arguments:

- 1. The *epath* argument is a pointer to the path that failed.
- 2. The *eerrno* argument is the value of *errno* from the failure, as set by *opendir()*, *readdir()* or *stat()*. (Other values may be used to report other errors not explicitly documented for those functions.)

Returned value

If successful, *glob()* returns 0. The argument *pglob->gl_pathc* returns the number of matched path names and the argument *pglob->gl_pathv* contains a pointer to a NULL-terminated list of matched and sorted path names. However, if *pglob->gl_pathc* is 0, the content of *pglob->gl_pathv* is undefined.

If *glob()* terminates due to an error, it returns one of the following nonzero constants defined in *<glob.h>* as error return values for *glob()*:

GLOB_ABORTED

The scan was stopped because *GLOB_ERR* was set or (**errfunc()*) returned nonzero.

GLOB_NOMATCH

The pattern does not match any existing path name, and *GLOB_NOCHECK* was notset in *flags*.

GLOB_NOSPACE

An attempt to allocate memory failed.

If (**errfunc()*) is called and returns nonzero, or if the *GLOB_ERR* flag is set in *flags*, *glob()* stops the scan and returns *GLOB_ABORTED* after setting *gl_pathc* and *gl_pathv* in *pglob* to reflect the paths already scanned. If *GLOB_ERR* is not set and either *errfunc* is a NULL pointer or (**errfunc()*) returns 0, the error is ignored.

Related information

- [“glob.h — Pathname pattern matching types” on page 27](#)
- [“exec functions” on page 442](#)
- [“fnmatch\(\) — Match file name or path name” on page 569](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“wordexp\(\) — Perform shell word expansions” on page 2067](#)

globfree() — Free storage allocated by glob()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <glob.h>

void globfree(glob_t *pglob);
```

General description

The `globfree()` function frees storage associated with *pglob* by a previous call to `glob()`.

Returned value

`globfree()` returns no values.

Related information

- “[glob.h — Pathname pattern matching types](#)” on page 27
- “[glob\(\) — Generate path names matching a pattern](#)” on page 808

gmtime(), gmtime64() — Convert time to broken-down UTC time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <time.h>

struct tm *gmtime(const time_t *timer);

#define _LARGE_TIME_API
#include <time.h>

struct tm *gmtime64(const time64_t *timer);
```

General description

Converts the calendar time pointed to by *timer* into a broken-down time, expressed as Coordinated Universal Time (UTC).

²

The value pointed to by *timer* is usually obtained by a call to the `time()` function.

The relationship between a time in seconds since the Epoch used as an argument to `gmtime()` and the `tm` structure (defined in the `<time.h>` header) is that the result is as specified in the expression given in the definition of seconds since the Epoch, where the names in the structure and in the expression correspond.

The function `gmtime64()` will behave exactly like `gmtime()` except it will break down a `time64_t` value pointing to a calendar time beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

² Coordinated Universal Time (UTC) was formerly known as Greenwich Mean Time (GMT).

Returned value

Returns a pointer to a *tm* structure containing the broken-down time, expressed in Coordinated Universal Time (UTC) corresponding to calendar time pointed to by *timer*. The fields in *tm* are shown in [Table 16 on page 76](#). If the calendar time pointed to by *timer* cannot be converted to broken-down time (in UTC), `gmtime()` returns a NULL pointer.

Error code

Description

EOVERFLOW

The result cannot be represented.

Notes:

1. The range (0-60) for *tm_sec* allows for as many as one leap second.
2. The `gmtime()` and `localtime()` functions may use a common, statically allocated buffer for the conversion. Each call to one of these functions may alter the result of the previous call.
3. The calendar time returned by the `time()` function begins at the epoch, which was at 00:00:00 Coordinated Universal Time (UTC), January 1, 1970.

Example

CELEBG23

```
/* CELEBG23

   This example uses the &gmtime. function to convert a
   time_t representation to a Coordinated Universal Time
   character string and then converts it to a printable string
   using &asctime..

*/
#include <stdio.h>
#include <time.h>

int main(void)
{
    time_t ltime;
    time(&ltime);
    printf ("Coordinated Universal Time is %s\n",
           asctime(gmtime(&ltime)));
}
```

Output

```
Coordinated Universal Time (UTC) is Fri Jun 16 21:01:44 2006
```

Related information

- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) — Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)

- [“time\(\),time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

gmtime_r(), gmtime64_r() — Convert a time value to broken-down UTC time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 Language Environment | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <time.h>

struct tm *gmtime_r(const time_t *__restrict__ clock,
                    struct tm *__restrict__ result);
```

```
#define _LARGE_TIME_API
#include <time.h>

struct tm *gmtime64_r(const time64_t *__restrict__ clock,
                     struct tm *__restrict__ result);
```

General description

The `gmtime_r()` function converts the calendar time pointed to by *clock* into a broken-down time expressed as Coordinated Universal Time (UTC). The broken-down time is stored in the structure referred to by *result*. The `gmtime_r()` function also returns the address of the same structure.

The relationship between a time in seconds since the Epoch used as an argument to `gmtime()` and the `tm` structure (defined in the `<time.h>` header) is that the result is as specified in the expression given in the definition of seconds since the Epoch, where the names in the structure and in the expression correspond.

The function `gmtime64_r()` will behave exactly like `gmtime_r()` except it will break down a `time64_t` value pointing to a calendar time beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Returned value

If successful, `gmtime_r()` returns the address of the structure pointed to by the argument *result*.

If an error is detected or UTC is not available, `gmtime_r()` returns a NULL pointer.

There are no documented `errno` values.

Error Code

Description

EOVERFLOW

The result cannot be represented.

Related information

- [“time.h — Time and date” on page 75](#)

- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“localdtconv\(\) — Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)
- [“time\(\), time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

grantpt() — Grant access to the subsidiary pseudoterminal device

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

int grantpt(int fildev);
```

General description

The `grantpt()` function changes the mode and ownership of the subsidiary pseudoterminal device. *fildev* should be the file descriptor of the corresponding manager pseudoterminal. The user ID of the subsidiary is set to the real UID of the calling process and the group ID is set to the group ID associated with the group name specified by the installation in the `TTYGROUP()` initialization parameter. The permission mode of the subsidiary pseudoterminal is set to readable and writable by the owner, and writable by the group.

You can provide secure connections by either using `grantpt()` and `unlockpt()`, or by simply issuing the first open against the subsidiary pseudoterminal from the first userid or process that opened the manager terminal.

Returned value

If successful, `grantpt()` returns 0.

If unsuccessful, `grantpt()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The subsidiary pseudoterminal was opened before `grantpt()`, or a `grantpt()` was already issued. In either case, subsidiary pseudoterminal permissions and ownership have already been updated. If you use `grantpt()` to change subsidiary pseudoterminal permissions, you must issue `grantpt()` between the manager open and the first pseudoterminal open, and `grantpt()` can only be issued once.

EBADF

The *fil*des argument is not a valid open file descriptor.

EINVAL

The *fil*des argument is not associated with a manager pseudoterminal device.

ENOENT

The subsidiary pseudoterminal device was not found during lookup.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“ptsname\(\) — Get name of the subsidiary pseudoterminal device” on page 1351](#)
- [“unlockpt\(\) — Unlock a pseudoterminal manager and subsidiary pair” on page 1948](#)

hcreate() — Create hash search tables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <search.h>

int hcreate(size_t nel);
```

General description

The `hcreate()` function allocates sufficient space for a hash table containing *nel* elements, and must be called before `hsearch()` is used.

The *nel* argument is an estimate of the maximum number of entries that the table will contain. This number may be adjusted upward by `hcreate()` for the actual table allocation in order to obtain certain mathematically favorable circumstances.

Threading Behavior: see [“hsearch\(\) — Search hash tables” on page 818](#).

Returned value

If successful, `hcreate()` returns nonzero.

If `hcreate()` cannot allocate sufficient space for the table, it returns 0 and sets `errno` to one of the following values:

Error Code**Description****ENOMEM**

Insufficient storage space is available.

Related information

- [“search.h — Searching tables” on page 58](#)

- [“bsearch\(\) — Search arrays” on page 221](#)
- [“hdestroy\(\) — Destroy hash search tables” on page 816](#)
- [“hsearch\(\) — Search hash tables” on page 818](#)
- [“lsearch\(\) — Linear search and update” on page 1022](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“tsearch\(\) — Binary tree search” on page 1903](#)

hdestroy() — Destroy hash search tables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <search.h>

void hdestroy(void);
```

General description

The `hdestroy()` function disposes of the search table, and may be followed by another call to `hcreate()`. After the call to `hdestroy()`, the data can no longer be considered accessible.

Threading Behavior: see [“hsearch\(\) — Search hash tables” on page 818](#).

Returned value

`hdestroy()` returns no values.

Related information

- [“search.h — Searching tables” on page 58](#)
- [“bsearch\(\) — Search arrays” on page 221](#)
- [“hcreate\(\) — Create hash search tables” on page 815](#)
- [“hsearch\(\) — Search hash tables” on page 818](#)
- [“lsearch\(\) — Linear search and update” on page 1022](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“tsearch\(\) — Binary tree search” on page 1903](#)

__heaprpt() — Obtain dynamic heap storage report

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdlib.h>

typedef struct{long __uheap_size;
               long __uheap_bytes_alloc;
               long __uheap_bytes_free;
            } hreport_t;

int __heaprpt(hreport_t *heap_report_structure);
```

General description

__heaprpt() gets statistics about the application's storage utilization and places them in the area pointed to by the *heap_report_structure* argument. The storage report is similar in content to the user heap storage report that is generated with the RPTSTG(ON) runtime option.

To use this function, the calling program must obtain storage where the user's heap storage report will be stored. The address of this storage is passed as an argument to __heaprpt().

Returned value

If successful, __heaprpt() fills the struct hreport_t with the user's heap storage report information.

If the address is not valid, __heaprpt() returns -1 and sets errno to EFAULT.

Example

```
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    hreport_t * strptr;

    strptr = (hreport_t *) malloc(sizeof(hreport_t));

    if (__heaprpt(strptr) != 0)
        perror("__heaprpt() error");

    else
    {
        printf("Total amount of user heap storage      : %ld\n",
              strptr->__uheap_size);
        printf("Amount of user heap storage in use      : %ld\n",
              strptr->__uheap_bytes_alloc);
        printf("Amount of available user heap storage: %ld\n",
              strptr->__uheap_bytes_free);
    }
}
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)

hsearch() — Search hash tables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <search.h>

ENTRY *hsearch(ENTRY item, ACTION action);
```

General description

The `hsearch()` function is a hash-table search routine. It returns a pointer into a hash table indicating the location at which an entry can be found. The *item* argument is a structure of type `ENTRY` (defined in the `<search.h>` header) containing two pointers: *item.key* points to the comparison key (a `char *`), and *item.data* (a `void *`) points to any other data to be associated with that key. The comparison function used by `hsearch()` is `strcmp()`. The *action* argument is a member of an enumeration type `ACTION` indicating the disposition of the entry if it cannot be found in the table. *ENTER* indicates that the item should be inserted in the table at an appropriate point. *FIND* indicates that no entry should be made.

Threading Behavior: The `hcreate()` function allocates a piece of storage for use as the hash table. This storage is not exposed to the user, and is referred to by all threads. In other words, these functions operate on one hash table global to the process. The library serializes access to the table and attendant data across threads using an internal mutex.

Returned value

`hsearch()` returns a `NULL` pointer if either the action is *FIND* and the item could not be found or the action is *ENTER* and the table is full.

If an error occurs, `hsearch()` sets `errno` to one of the following values:

Error Code

Description

ENOMEM

Insufficient storage space is available.

Related information

- [“search.h — Searching tables” on page 58](#)
- [“bsearch\(\) — Search arrays” on page 221](#)
- [“hcreate\(\) — Create hash search tables” on page 815](#)
- [“hdestroy\(\) — Destroy hash search tables” on page 816](#)
- [“lsearch\(\) — Linear search and update” on page 1022](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“tsearch\(\) — Binary tree search” on page 1903](#)

htonl() — Translate address host to network long

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

XPG4.2

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

in_addr_t htonl(in_addr_t hostlong);
```

SUSV3

```
#define _POSIX_C_SOURCE 200112L
#include <arpa/inet.h>

uint32_t htonl(uint32_t hostlong);
```

Berkeley Sockets

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <arpa/inet.h>
#include <netinet/in.h>

unsigned long htonl(unsigned long a);
```

General description

The `htonl()` function translates a long integer from host byte order to network byte order.

Parameter

Description

a

The unsigned long integer to be put into network byte order.

`in_addr_t hostlong`

Is typed to the unsigned long integer to be put into network byte order.

Notes:

1. For MVS, host byte order and network byte order are the same.
2. Since this function is implemented as a macro, you need one of the feature test macros and the `inet` header file.

Returned value

`htonl()` returns the translated long integer.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)

- [“htons\(\) — Translate an unsigned short integer into network byte order” on page 820](#)
- [“ntohl\(\) — Translate a long integer into host byte order” on page 1154](#)
- [“ntohs\(\) — Translate an unsigned short integer into host byte order” on page 1155](#)

htons() — Translate an unsigned short integer into network byte order

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

XPG4.2

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

in_port_t htons(in_port_t hostshort);
```

SUSV3

```
#define _POSIX_C_SOURCE 200112L
#include <arpa/inet.h>

uint16_t htons(uint16_t hostshort);
```

Berkeley Sockets

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/inet.h>

unsigned short htons(unsigned short a);
```

General description

The `htons()` function translates a short integer from host byte order to network byte order.

Parameter

Description

a

The unsigned short integer to be put into network byte order.

in_port_t hostshort

Is typed to the unsigned short integer to be put into network byte order.

Notes:

1. For MVS, host byte order and network byte order are the same.
2. Since this function is implemented as a macro, you need one of the feature test macros and the `inet` header file.

Returned value

`htons()` returns the translated short integer.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“htonl\(\) — Translate address host to network long” on page 819](#)
- [“ntohl\(\) — Translate a long integer into host byte order” on page 1154](#)
- [“ntohs\(\) — Translate an unsigned short integer into host byte order” on page 1155](#)

hypot(), hypotf(), hypotl() — Calculate the square root of the squares of two arguments

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| SAA XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

SAA:

```
#include <math.h>

double hypot(double side1, double side2);
```

This function must be used with the [runtime library extensions](#) or under the [SAA based language constructs](#).

XPG4:

```
#define _XOPEN_SOURCE
#include <math.h>

double hypot(double side1, double side2);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

float hypotf(float side1, float side2);
long double hypotl(long double side1, long double side2);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float hypot(float side1, float side2);
long double hypot(long double side1, long double side2);
```

General description

The hypot() family of functions calculates the length of the hypotenuse of a right-angled triangle based on the lengths of two sides *side1* and *side2*. A call to hypot() is equal to:

```
sqrt(side1* side1 + side2 * side2);
```

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | SPC | Hex | IEEE |
|----------|-----|-----|------|
| hypot | X | X | X |
| hypotf | | X | X |
| hypotl | | X | X |

Restriction: The hypotf() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

The hypot() family of functions returns the calculated length of the hypotenuse.

If the correct value is outside the range of representable values, ±HUGE_VAL is returned, according to the sign of the value. The value of the macro ERANGE is stored in errno, to show the calculated value is out of range. If the correct value would cause an underflow, zero is returned and the value of the macro ERANGE is stored in errno.

Special behavior for IEEE: If successful, The hypot() family of functions returns the calculated length of the hypotenuse. If the correct value overflows, hypot() sets errno to ERANGE and returns HUGE_VAL.

Example

CELEBH01

```
/* CELEBH01

   This example calculates the hypotenuse of a right-angled
   triangle with sides of 3.0 and 4.0.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y, z;

    x = 3.0;
    y = 4.0;
    z = hypot(x,y);

    printf("The hypotenuse of the triangle with sides %lf and %lf"
           " is %lf\n", x, y, z);
}
```

Output

```
The hypotenuse of the triangle with sides 3.000000 and 4.000000 is 5.000000
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“sqrt\(\), sqrtf\(\), sqrtl\(\) — Calculate square root” on page 1700](#)

hypotd32(), hypotd64(), hypotd128() – Calculate the square root of the squares of two arguments

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 hypotd32(_Decimal32 x, _Decimal32 y);
_Decimal64 hypotd64(_Decimal64 x, _Decimal64 y);
_Decimal128 hypotd128(_Decimal128 x, _Decimal128 y);

_Decimal32 hypot(_Decimal32 x, _Decimal32 y);    /* C++ only */
_Decimal64 hypot(_Decimal64 x, _Decimal64 y);    /* C++ only */
_Decimal128 hypot(_Decimal128 x, _Decimal128 y); /* C++ only */
```

General description

The `hypot()` family of functions calculates the length of the hypotenuse of a right-angled triangle based on the lengths of two sides `x` and `y`. A call to `hypot()` is equal to:

```
sqrt(x* x + y * y);
```

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point”](#) on page 97 IEEE Decimal Floating-Point for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, The `hypot()` family of functions returns the calculated length of the hypotenuse.

If the correct value overflows, `hypot()` sets `errno` to `ERANGE` and returns `HUGE_VAL_D32`, `HUGE_VAL_D64`, or `HUGE_VAL_D128` accordingly.

Example

```
/* CELEBH03
   This example illustrates the hypotd64() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

void main(void)
{
    _Decimal64 x, y, z;

    x = 3.0DD;
    y = 4.0DD;
    z = hypotd64(x,y);

    printf("The hypotenuse of a triangle with sides %Df and %Df"
```

```
        " is %Df\n", x, y, z);
    }
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“sqrtd32\(\), sqrtd64\(\), sqrt128\(\) — Calculate square root” on page 1701](#)

ibmsflush() — Flush the application-side datagram queue

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS SOCK_EXT
#include <sys/socket.h>

int ibmsflush(int s);
```

General description

Bulk mode sockets are not supported. This function always returns 0.

Returned value

ibmsflush() always returns 0.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

iconv() — Code conversion

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#include <iconv.h>

size_t iconv(iconv_t cd, char **__restrict__ inbuf,
             size_t *__restrict__ inbytesleft, char **__restrict__ outbuf,
             size_t *__restrict__ outbytesleft);
```

General description

Converts a sequence of characters, indirectly pointed to by *inbuf*, from one encoded character set into a sequence of corresponding characters in another encoded character set. The resulting character sequence is then stored into the array indirectly pointed to by *outbuf*. The encoded character sets are those specified in the `iconv_open()` call that returned the conversion descriptor, *cd*. If the descriptor refers to the state-dependent encoding, then before it is first used, the *cd* descriptor is in its initial shift state.

The *inbuf* argument points to a variable that points to the first character in the input buffer. *inbytesleft* indicates the number of bytes to the end of the buffer to be converted. The *outbuf* argument points to a variable that points to the first character in the output buffer. *outbytesleft* indicates the number of available bytes to the end of the buffer.

If the output character set refers to the state-dependent encoding—if it contains the multibyte characters with shift-states—the conversion descriptor *cd* is placed in its initial state by a call for which *inbuf* is a NULL pointer, or for which *inbuf* points to a NULL pointer. When `iconv()` is called in this way, and if *outbuf* is not a NULL pointer or a pointer to a NULL pointer, and *outbytesleft* points to a positive value, `iconv()` places in the output buffer the byte sequence to change the output buffer to the initial shift state. If the output buffer is not large enough to hold the entire reset sequence, `iconv()` fails, and sets `errno` to `E2BIG`. Subsequent calls with *inbuf* as other than a NULL pointer or a pointer to a NULL pointer cause conversion from the current state of the conversion descriptor.

If a sequence of input bytes does not form a valid character in the specified encoded character set, conversion stops after the previous successfully converted character, and `iconv()` sets `errno` to `EILSEQ`. If the input buffer ends with an incomplete character or shift sequence, conversion stops after the previous successfully converted bytes, and `iconv()` sets `errno` to `EINVAL`. If the output buffer is not large enough to hold the entire converted input, conversion stops just before the input bytes that would cause the output buffer to overflow.

The variable pointed to by *inbuf* is updated to point to the byte following the last byte of a successfully converted character. The value pointed to by *inbytesleft* is decremented to reflect the number of bytes still not converted in the input buffer. The variable pointed to by *outbuf* is updated to point to the byte following the last byte of converted output data. The value pointed to by *outbytesleft* is decremented to reflect the number of bytes still available in the output buffer. For state-dependent encoding, the conversion descriptor is updated to reflect the shift state in effect at the end of the last successfully converted byte sequence.

If `iconv()` encounters a character in the input buffer that is valid, but for which a conversion is not defined in the conversion descriptor *cd*, the substitution character (SUB code point) of the target character set is put in the target buffer and the conversion continues. The definition of SUB code point is based on IBM's Character Data Representation Architecture (CDRA).

The `<iconv.h>` header file declares the `iconv_t` type that is a pointer to the object capable of storing the information about the converters used to convert characters in one coded character set to another. For state-dependent encoding, the object must be capable of storing the encoded information about the current shift state.

Special considerations for bidirectional language support: If the `_BIDION` environment variable is set to `TRUE`, `iconv()` performs bidirectional layout transformation to the converted characters. The required attributes for bidirectional layout transformation can be specified using the environment variable `_BIDIATTR`. For example, `export _BIDIATTR="@ls typeoftext=visual:implicit, orientation=ltr:ltr,numerals=nominal:national"`. For a detailed description of the bidirectional layout transformation, see [Bidirectional language support in z/OS XL C/C++ Programming Guide](#). If the environment variable `_BIDIATTR` is not set, the default values will be used.

`iconv()` can perform bidirectional layout transformation while converting the data from the `fromCodePage` to the `toCodePage`. Bidirectional layout transformation will take place only if bidirectional language support is activated, see [“iconv_open\(\) — Allocate code conversion descriptor” on page 828](#) for more information about activating bidirectional layout transformation. In case `iconv` encounters any error in input or output buffers in the bidirectional part it will bypass the bidirectional layout transformation and continue its normal function as usual.

Special behavior for POSIX C: In the POSIX environment, a conversion descriptor returned from a successful `iconv_open()` may be used safely within a single thread. In addition, it may be opened on one thread (`iconv_open()`), used on a second thread (`iconv()`), and closed (`iconv_close()`) on a third thread. However, you must ensure correct cross-thread sequencing and synchronization (that is: `iconv_open()`, followed by optional `iconv()` calls, followed by `iconv_close()`). The use of a shared conversion descriptor by `iconv()` across multiple threads may result in undefined behavior.

Special behavior for UTF-8: When the `_ICONV_OVERLONG_CHECK` environment variable is set to ON, if an overlong byte sequence of UTF-8 encoding is detected, `iconv()` returns `(size_t) - 1` and sets `errno` to `EILSEQ`.

Returned value

If successful, `iconv()` updates the variables pointed to by the arguments to reflect the extent of the conversion and returns the number of nonidentical conversions performed.

If the entire string in the input buffer is converted, the value pointed to by *inbytesleft* will be 0. If the input conversion is stopped because of any conditions mentioned above, the value pointed to by *inbytesleft* will be nonzero and `errno` is set to indicate the condition.

If an error occurs, `iconv()` returns `(size_t) - 1` and sets `errno` to one of the following values:

Error Code

Description

EBADF

cd is not a valid descriptor.

ECUNNOENV

A `CUN_RS_NO_UNI_ENV` error was issued by Unicode Conversion Services.

See [z/OS Unicode Services User's Guide and Reference](#) documentation for user action.

ECUNNOCONV

A `CUN_RS_NO_CONVERSION` error was issued by Unicode Conversion Services.

See [z/OS Unicode Services User's Guide and Reference](#) documentation for user action.

ECUNNOTALIGNED

A `CUN_RS_TABLE_NOT_ALIGNED` error was issued by Unicode Conversion Services.

See [z/OS Unicode Services User's Guide and Reference](#) documentation for user action.

ECUNERR

Function `iconv()` encountered an unexpected error while using Unicode Conversion Services.

See message EDC6258 for additional information.

EILSEQ

Input conversion stopped due to an input byte that does not belong to the input codeset.

EINVAL

Input conversion stopped due to an incomplete character or shift sequence at the end of the input buffer.

E2BIG

Input conversion stopped due to lack of space in the output buffer.

Example

CELEBI01

```
/* CELEBI01
```

```
   This example converts an array of characters coded in encoded character
   set IBM-1047 to an array of characters coded in encoded character set
```

```

IBM-037.
Input is in inbuf, output will be in outbuf.

*/
#include <iconv.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

main ()
{
    char    *inptr; /* Pointer used for input buffer */
    char    *outptr; /* Pointer used for output buffer */
    char    inbuf[20] =
        "ABCDEFGH!@#$1234";
                                /* input buffer */
    unsigned char    outbuf[20]; /* output buffer */
    iconv_t          cd; /* conversion descriptor */
    size_t           inleft; /* number of bytes left in inbuf */
    size_t           outleft; /* number of bytes left in outbuf */
    int              rc; /* return code of iconv() */

    if ((cd = iconv_open("IBM-037", "IBM-1047")) == (iconv_t)(-1)) {
        fprintf(stderr, "Cannot open converter from %s to %s\n",
                "IBM-1047", "IBM-037");
        exit(8);
    }

    inleft = 16;
    outleft = 20;
    inptr = inbuf;
    outptr = (char*)outbuf;

    rc = iconv(cd, &inptr, &inleft, &outptr, &outleft);
    if (rc == -1) {
        fprintf(stderr, "Error in converting characters\n");
        exit(8);
    }
    iconv_close(cd);
}

```

Related information

- “Internationalization: Locales and Character Sets” in *z/OS XL C/C++ Programming Guide*
- “[iconv.h — Code conversion](#)” on page 28
- “[locale.h — Locale settings](#)” on page 36
- “[iconv_close\(\) — Deallocate code conversion descriptor](#)” on page 827
- “[iconv_open\(\) — Allocate code conversion descriptor](#)” on page 828
- “[setlocale\(\) — Set locale](#)” on page 1547

iconv_close() — Deallocate code conversion descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#include <iconv.h>

int iconv_close(iconv_t cd);

```

General description

Deallocates the conversion descriptor *cd* and all other associated resources allocated by the `iconv_open()` function. For an illustration of using `iconv_open()`, see [“Example” on page 826](#).

Returned value

If successful, `iconv_close()` returns 0.
If unsuccessful, `iconv_close()` returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|--------------|--------------------------------------|
| EBADF | <i>cd</i> is not a valid descriptor. |
|--------------|--------------------------------------|

Related information

- [“Internationalization: Locales and Character Sets” in *z/OS XL C/C++ Programming Guide*](#)
- [“iconv.h — Code conversion” on page 28](#)
- [“locale.h — Locale settings” on page 36](#)
- [“iconv\(\) — Code conversion” on page 824](#)
- [“iconv_open\(\) — Allocate code conversion descriptor” on page 828](#)
- [“setlocale\(\) — Set locale” on page 1547](#)

iconv_open() — Allocate code conversion descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#include <iconv.h>

iconv_t iconv_open(const char *tocode, const char *fromcode);
```

General description

Performs all the initialization needed to convert characters from the encoded character set specified in the array pointed to by the *fromcode* argument to the encoded character set specified in the array pointed to by the *tocode* argument.

The conversion descriptor relates the two encoded character sets.

For state-dependent encodings, the conversion descriptor will be in an encoded-character-set-dependent initial shift state, ready for immediate use with `iconv()`. The conversion descriptor remains valid until it is closed with `iconv_close()`.

Settings of *fromcode*, *tocode*, and their permitted combinations are implementation-dependent.

Note: The `iconv()` family of functions has been modified to utilize character conversion services provided by Unicode Services. The `iconv_open()`, `iconv()` and `iconv_close()`’s function interfaces will remain

unchanged except for the addition of four new errno values and two new environment variables described in the following paragraphs.

There are differences in externals between the iconv() family of functions and Unicode Services. However, these differences will be managed by the iconv() family of functions except where noted in the *z/OS XL C/C++ Compiler and Runtime Migration Guide for the Application Programmer*. All conversions listed in the section of the *z/OS XL C/C++ Programming Guide* entitled “Code Set Converters Supplied” will continue to work as they did prior to the integration of Unicode Services, as long as _ICONV_TECHNIQUE is left undefined. If the application does not define the _ICONV_TECHNIQUE environment variable, iconv_open() uses a default value of LMREC.

Unicode Services supports conversions between thousands of additional character sets not listed in the *z/OS XL C/C++ Programming Guide*. A complete list of conversions supported by Unicode Services can be found in the *z/OS Unicode Services User's Guide and Reference*. To set up a conversion using iconv_open() for any of the character sets listed in these tables, the user needs to use a character string representing the CCSID's for *fromcode* and *toCode*. For example, to set up a conversion from CCSID 00256 to CCSID 00870 using conversion technique R, the user would set the _ICONV_TECHNIQUE environment variable to R and call iconv_open() as follows:

```
cd = iconv_open("00870", "00256");
```

and continue to use iconv() and iconv_close() as in previous releases.

iconv() uses the following environment variables.

_ICONV_UCS2

Tells iconv_open(Y, X) what type of conversion method to setup when there is a choice between "direct" conversion from X to Y and "indirect" X to UCS-2 to Y.

_ICONV_UCS2_PREFIX

Tells iconv_open() what z/OS dataset name prefix to use to find UCS-2 tables if they cannot be found.

_ICONV_MODE

Selects the behavior mode for iconv_open(), iconv() and iconv_close()..

_ICONV_TECHNIQUE

This is the technique value used while using Unicode Conversion Services. For more information regarding the Unicode Conversion Services technique value, refer to Chapter 3 - Creating a Unicode Environment section of the *z/OS Unicode Services User's Guide and Reference*.

For illustration of using iconv_close(), see “Example” on page 826.

Special considerations for bidirectional language support: Performs all the initialization needed to activate the bidirectional layout transformation to be used by iconv. The following three conditions must be satisfied to enable the bidirectional layout transformation:

1. The _BIDION environment variable must be set to TRUE.
2. The current locale environment at iconv_open() time must be an Arabic or Hebrew locale (eg. Ar_AA or Iw_IL).
3. The conversion code set must be an Arabic or Hebrew code set.

Conversion code sets differ in the following three cases:

1. Case fromCodeSet is UCS-2 and toCodeSet is single byte code set. In this case toCodeSet must be an Arabic or Hebrew code set.
2. Case fromCodeSet is single byte code set and toCodeSet is UCS-2. In this case fromCodeSet must be an Arabic or Hebrew code set.
3. Case both fromCodeSet and toCodeSet are single byte code sets. In this case toCodeSet must be an Arabic or Hebrew code set.

iconv_open() checks for the existence of the environment variable _BIDIATTR to get the bidirectional layout transformation attributes. It will use default values in case _BIDIATTR is not defined, is unset, or in case of the existence of some erroneous values in the _BIDIATTR environment variable. The default values are code set dependent according to the Arabic or Hebrew code set used. For the Arabic 420 code

set the default values will be: orientation RTL, type of text visual, shaping shaped, numerals national and swapping on. For the Hebrew 424 code set the default values will be: orientation RTL, type of text visual and swapping on. For the rest of the Arabic code sets the default values will be: orientation RTL, type of text implicit, shaping nominal, numerals national and swapping on.

iconv_open() uses the following environment variables.

_BIDION

Tells iconv_open() whether to activate bidirectional handling of the converted data or not. _BIDION can be assigned either the value TRUE, if you want to turn on bidirectional layout transformation, or the value FALSE, if you want to turn off the BiDi layout transformation. Bidirectional layout transformation can also be turned off if the variable _BIDION is not defined in the environment.

_BIDIATTR

Holds the bidirectional layout transformation attributes which will be used later by iconv, _BIDIATTR will be read only in iconv_open() time. The _BIDIATTR environment variable is in the form of input/output pairs separated by colon, at the beginning of the string there is an @ that identifies the beginning of the attributes list, then followed by the attributes in the form of <attribute_name1>=<input1>:<output1>, <attribute_name2>=<input2>:<output2> (eg. export _BIDIATTR="@ls typeoftext=visual:implicit,orientation=ltr:ltr, numerals=nominal:national").

Returned value

If successful, iconv_open() returns a conversion descriptor.

If unsuccessful, iconv_open() returns (iconv_t)-1 and sets errno to one of the following values:

Error Code

Description

EINVAL

The conversion between encoded character sets specified is not supported.

ECUNNOENV

A CUN_RS_NO_UNI_ENV error was issued by Unicode Conversion Services.

See [z/OS Unicode Services User's Guide and Reference](#) for user action.

ECUNNOCONV

A CUN_RS_NO_CONVERSION error was issued by Unicode Conversion Services.

See [z/OS Unicode Services User's Guide and Reference](#) for user action.

ECUNNOTALIGNED

A CUN_RS_TABLE_NOT_ALIGNED error was issued by Unicode Conversion Services.

See [z/OS Unicode Services User's Guide and Reference](#) for user action.

ECUNERR

Function iconv() encountered an unexpected error while using Unicode Conversion Services.

Refer to message EDC6258 for additional information.

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “iconv.h — Code conversion” on page 28
- “locale.h — Locale settings” on page 36
- “iconv() — Code conversion” on page 824
- “iconv_close() — Deallocate code conversion descriptor” on page 827
- “setlocale() — Set locale” on page 1547

if_freenameindex() — Free the memory allocated by if_nameindex()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R4 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <net/if.h>

void if_freenameindex(struct if_nameindex *ptr);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <net/if.h>

void if_freenameindex(struct if_nameindex *ptr);
```

General description

The `if_freenameindex()` function frees the memory allocated by `if_nameindex()`. The *ptr* argument must be a pointer that was returned by `if_nameindex()`.

Returned value

No return value is defined.

Related information

- [“if_indextoname\(\) — Map a network interface index to its corresponding name”](#) on page 831
- [“if_nameindex\(\) — Return all network interface names and indexes”](#) on page 832
- [“if_nametoindex\(\) — Map a network interface name to its corresponding index”](#) on page 833

if_indextoname() — Map a network interface index to its corresponding name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R4 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <net/if.h>

char *if_indextoname(unsigned int ifindex, char *ifname);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <net/if.h>

char *if_indextoname(unsigned int ifindex, char *ifname);
```

General description

The if_indextoname() function maps an interface index to its corresponding interface name. When this function is called, ifname must point to a buffer of at least IF_NAMESIZE bytes into which the interface name corresponding to interface index ifindex is returned. Otherwise, the function shall return a NULL pointer and set errno to indicate the error.

Returned value

| Error Code | Description |
|------------|-------------|
|------------|-------------|

- EINVAL**
The ifindex parameter was zero, or the ifname parameter was NULL, or both.
- ENOMEM**
Insufficient storage is available to obtain the information for the interface name.
- ENXIO**
The ifindex does not yield an interface name.

Related information

- [“if_freenameindex\(\) — Free the memory allocated by if_nameindex\(\)” on page 831](#)
- [“if_nameindex\(\) — Return all network interface names and indexes” on page 832](#)
- [“if_nametoindex\(\) — Map a network interface name to its corresponding index” on page 833](#)

if_nameindex() — Return all network interface names and indexes

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R4 |

Format

```
#define _OPEN_SYS_SOCK_IPV6
#include <net/if.h>

struct if_nameindex *if_nameindex(void);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <net/if.h>

struct if_nameindex *if_nameindex(void);
```

General description

The `if_nameindex()` function returns an array of `if_nameindex` structures, one structure per interface. The end of the array is indicated by a structure with an `if_index` of zero and an `if_name` of `NULL`.

The `if_nameindex` structure holds the information about a single interface and is defined as a result of including the `<net/if.h>` header.

```
struct if_nameindex {
    unsigned int if_index; /* 1, 2, ... */
    char        *if_name; /* null terminated name: "le0", ... */
};
```

The memory used for this array of structures along with the interface names pointed to by the `if_name` members is obtained dynamically. This memory is freed by calling the `if_freenameindex()` function.

Returned value

When successful, `if_nameindex()` returns a pointer to an array of `if_nameindex` structures. Upon failure, `if_nameindex()` returns `NULL` and sets `errno` to one of the following:

Error Code

Description

ENOMEM

Insufficient storage is available to supply the array.

Related information

- [“if_freenameindex\(\) — Free the memory allocated by if_nameindex\(\)” on page 831](#)
- [“if_indextoname\(\) — Map a network interface index to its corresponding name” on page 831](#)
- [“if_nametoindex\(\) — Map a network interface name to its corresponding index” on page 833](#)

if_nametoindex() — Map a network interface name to its corresponding index

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R4 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <net/if.h>

unsigned int if_nametoindex(const char *ifname);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <net/if.h>

unsigned int if_nametoindex(const char *ifname);
```

General description

The `if_nametoindex()` function returns the interface index corresponding to the interface name *ifname*.

Returned value

When successful, if_nametoindex() returns the interface index corresponding to the interface name *ifname*. Upon failure, if_nametoindex() returns 0 and sets errno to one of the following:

Error Code
Description

EINVAL
Non-valid parameter was specified. The *ifname* parameter was NULL.

ENOMEM
Insufficient storage is available to obtain the information for the interface name.

ENXIO
The specified interface name provided in the *ifname* parameter does not exist.

Related information

- [“if_freenameindex\(\) — Free the memory allocated by if_nameindex\(\)” on page 831](#)
- [“if_indextoname\(\) — Map a network interface index to its corresponding name” on page 831](#)
- [“if_nameindex\(\) — Return all network interface names and indexes” on page 832](#)

ilogb(), ilogbf(), ilogbl() — Integer unbiased exponent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

int ilogb(double x);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

int ilogbf(float x);
int ilogbl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

int ilogb(float x);
int ilogb(long double x);
```

General description

The ilogb() functions returns the unbiased exponent of its argument x as an integer.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| ilogb | X | X |
| ilogbf | X | X |
| ilogbl | X | X |

Returned value

If successful, the `ilogb()` functions return the unbiased exponent of x as an integer.

If x is 0, the value `FP_ILOGB0` is returned.

if x is a NaN, `ilogb()` will return `FP_ILOGBNAN`

if x is infinity, `ilogb()` will return `INT_MAX`

If the correct value is greater than `{INT_MAX}`, `{INT_MAX}` is returned and a domain error occurs.

If the correct value is less than `{INT_MIN}`, `{INT_MIN}` is returned and a domain error occurs.

Special behavior for hex: This function will return the unbiased exponent minus 1 (Because hex representation has no hidden bit, this treatment is needed to satisfy the `logb()` inequality).

Error Code

Description

EDOM

The x argument is zero, NaN, or $\pm\text{inf}$, or the correct value is not representable as an integer.

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“logb\(\), logbf\(\), logbl\(\) — Unbiased exponent”](#) on page 996

ilogbd32(), ilogbd64(), ilogbd128() — Integer unbiased exponent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

int ilogbd32(_Decimal32 x);
int ilogbd64(_Decimal64 x);
int ilogbd128(_Decimal128 x);
int ilogb(_Decimal32 x); /* C++ only */
int ilogb(_Decimal64 x); /* C++ only */
int ilogb(_Decimal128 x); /* C++ only */
```

General description

Returns the unbiased exponent of its argument x as an integer. For typical numbers, the value returned is the logarithm of $|x|$ rounded down (toward $-\text{INF}$) to the nearest integer value.

Notes:

- 1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
- 2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, these functions return the unbiased exponent of x as an integer.

If x is equal to 0.0, `ilogb()` will return `_FP_DEC_ILOGB0` (`= -INT_MAX`).

If x is a NaN or infinity, `ilogb()` will return `INT_MAX`.

Example

```
/* CELEBI11
   This example illustrates the ilogbd128() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x = -12345.678901DL;
    int y;

    y = ilogbd128(x);

    printf("The result of ilogbd128(%DDf) is %d\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“frexpd32\(\), frexpd64\(\), frexpd128\(\) — Extract mantissa and exponent of the decimal floating-point value” on page 625](#)
- [“ilogb\(\), ilogbf\(\), ilogbl\(\) — Integer unbiased exponent” on page 834](#)
- [“logbd32\(\), logbd64\(\), logbd128\(\) — Unbiased exponent” on page 998](#)

imaxabs() — Absolute value for intmax_t

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <inttypes.h>

intmax_t imaxabs(intmax_t j);
```

Compile requirement: Function `imaxabs()` requires `long long` to be available.

General description

The `imaxabs()` function computes the absolute value of j . When the input value is `INTMAX_MIN`, the value is undefined. The `imaxabs()` function is similar to `labs()` and `llabs()`. The only difference being that the return value and the argument passed in are of type `intmax_t`.

Returned value

The `imaxabs` function returns the absolute value of j .

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>
int main(void)
{
    intmax_t a = -1234;

    intmax_t b = imaxabs(a);

    printf("%jd \n", b );
}
```

Output:

1234

Related information

- `inttypes.h`
- `labs()`
- `llabs()`

imaxdiv() — Quotient and remainder for `intmax_t`

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <inttypes.h>

imaxdiv_t imaxdiv(intmax_t numer, intmax_t denom);
```

Compile requirement: Function `imaxdiv()` requires `long long` to be available.

General description

The `imaxdiv()` function computes `number / denom` and `number % denom` in a single operation. The `imaxdiv` function is similar to `lldiv()` and `ldiv()`. The only difference being that the return value is of type `imaxdiv_t` and those being passed in are of type `intmax_t`.

Returned value

`imaxdiv()` returns a structure of type `imaxdiv_t` comprising both the quotient and the remainder. If either part of the result cannot be represented, the behavior is undefined. If the denominator is zero, a divide by zero exception is raised.

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>

int main(void)
{
    intmax_t num = 45;
    intmax_t den = 7;
    imaxdiv_t res;
    printf("Original numerator: %jd and denominator: %jd "
           , num, den);
    res = imaxdiv(num, den);
    printf("Quotient: %jd Remainder: %jd\n"
           , res.quot, res.rem);
}

Output

Original numerator: 45 and denominator: -7 Quotient: -6 Remainder: 3
```

Related information

- `inttypes.h`
- `ldiv()`
- `lldiv()`

ImportWorkUnit() – WLM import service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R9 |

Format

```
#include <sys/__wlm.h>

int ImportWorkUnit(wlmtok_t *exporttoken,
                  wlmetok_t *enclavetoken,
                  unsigned int *conntoken);
```

General description

Imports an enclave that has been previously exported using the `ExportWorkUnit()` function. The caller must invoke `UnDoImportWorkUnit()` when it no longer needs access to the enclave.

The `ImportWorkUnit()` function uses the following parameters:

***enclavetoken**

Points to a work unit export token that was returned from a call to ExportWorkUnit().

***exporttoken**

Points to a data field of type wlmetok_t where the ImportWorkUnit() function is to return the WLM work unit enclave token.

***conntoken**

Specifies the connect token that represents the WLM connection.

Returned value

If successful, ImportWorkUnit() returns 0.

If unsuccessful, ImportWorkUnit() returns -1 and sets errno to one of the following values:

Error Code**Description****EFAULT**

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained a value that is not correct.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

A WLM service failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class, if the BPX.WLMSEVER class is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“ExportWorkUnit\(\) — WLM export service” on page 458](#)
- [“UnDoExportWorkUnit\(\) — WLM undo export service” on page 1938](#)
- [“UnDoImportWorkUnit\(\) — WLM undo import service” on page 1939](#)
- For more information, see *z/OS MVS Programming: Workload Management Services*

index() — Search for character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <strings.h>

char *index(const char *string, int c);
```

General description

The `index()` function locates the first occurrence of `c` (converted to an unsigned char) in the string pointed to by *string*. The character `c` can be the NULL character (`\0`); the ending NULL is included in the search.

The string argument to the function must contain a NULL character (`\0`) marking the end of the string.

The `index()` function is identical to [“strchr\(\) — Search for character” on page 1720](#).

Note: The `index()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `strchr()` function is preferred for portability.

Returned value

If successful, `index()` returns a pointer to the first occurrence of `c` (converted to an unsigned character) in the string pointed to by *string*.

If unsuccessful because `c` was not found, `index()` returns a NULL pointer.

There are no `errno` values defined.

Related information

- [“strings.h — String operations” on page 67](#)
- [“memchr\(\) — Search buffer” on page 1063](#)
- [“rindex\(\) — Search for character” on page 1453](#)
- [“strchr\(\) — Search for character” on page 1720](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) — Search string” on page 1755](#)
- [“strstr\(\) — Locate substring” on page 1756](#)

inet6_is_srcaddr() - Socket address verification

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC 5014 | both | |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

short inet6_is_srcaddr(struct sockaddr_in6 *srcaddr, uint32_t flags);
```

General description

The `inet6_is_srcaddr()` function validates source address selection preference flags against the given socket address.

Argument

Description

srcaddr

A non-NULL pointer to a `sockaddr_in6` structure initialized as follows:

- Clear the entire structure for `sizeof(struct sockaddr_in6)`.
- *sin6_family* must be set to `AF_INET6`.

- Set *sin6_len* to the correct length for AF_INET6.
- Set *sin6_addr* to a 128-bit IPv6 source address to validate against the flags.
- The *sin6_scope_id* must be set if the address is link-local.

flags

The source preference flags which can be set to any of the following:

- IPV6_PREFER_SRC_HOME - prefer home address as source
- IPV6_PREFER_SRC_COA - prefer care-of address as source
- IPV6_PREFER_SRC_TMP - prefer temporary address as source
- IPV6_PREFER_SRC_PUBLIC - prefer public address as source
- IPV6_PREFER_SRC_CGA - prefer CGA address as source
- IPV6_PREFER_SRC_NONCGA - prefer a non-CGA address as source

These flags can be combined into a flag set to express complex address preferences, but some can result in a contradictory flag set.

For example, the following flags are mutually exclusive:

- IPV6_PREFER_SRC_HOME and IPV6_PREFER_SRC_COA
- IPV6_PREFER_SRC_TMP and IPV6_PREFER_SRC_PUBLIC
- IPV6_PREFER_SRC_CGA and IPV6_PREFER_SRC_NONCGA

Returned value

When the IPv6 address corresponds to a valid address in the node and satisfies the given preference flags, `inet6_is_srcaddr()` returns 1.

If the input address matches an address in the node, but does not satisfy the preference flags indicated, the function returns 0.

If unsuccessful, `inet6_is_srcaddr()` returns -1 and sets `errno` to the following:

Error Code

Description

EADDRNOTAVAIL

The address provided does not match a home address in the node.

EAFNOSUPPORT

The address provided does not have a family of AF_INET6.

EAGAIN

A TCP/IP stack is not active to process the request.

EINVAL

Undefined flags were used, or a link-local IPv6 address was used with a zero scopeid, or a global address was used with a non-zero scopeid.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“bind2addrsel\(\) - Bind with source address selection” on page 217](#)
- [“getaddrinfo\(\) — Get address information” on page 685](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)

inet6_opt_append() – Add an option with length "len" and alignment "align"

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

int inet6_opt_append(void *extbuf, socklen_t extlen, int offset,
                    uint8_t type, socklen_t len, uint8_t align,
                    void **databufp);
```

General description

inet6_opt_append() returns the updated total length after adding an option with length *len* and alignment *align*. If *extbuf* is not NULL, it inserts any necessary padding and sets the type and length fields. A pointer to the location for the option content in *databufp* is then returned.

offset should be the length returned by inet6_opt_init() or the previous inet6_opt_append(). *type* is the 8-bit option type and *len* is the length of the option data (excluding the option type and option length fields).

Returned value

If successful, inet6_opt_append() returns the updated total length of the extension header.

Upon failure, returns -1 and errno is set to one of the following:

EINVAL If one of the following is true:

- *extbuf* is NULL and *extlen* is non-zero;
- *extbuf* is non-NULL and *extlen* is not a positive multiple of 8;
- *offset* is less than the size of the empty extension header;
- *type* is not valid (specifies one of the PAD options);
- *len* is less than 0 or greater than 255;
- *align* is not 1, 2, 4, or 8;
- *align* is greater than *len*;
- new updated total length would exceed *extlen* (*extbuf* is non-NULL);
- *databufp* is NULL (*extbuf* is non-NULL).

Usage notes

1. The option, *type*, must have a value from 2 to 255 (0 and 1 are reserved for the Pad1 and PadN options).
2. The option data length must have a value between 0 and 255, including the values 0 and 255. It is the length of the option data that follows.
3. The *align* parameter must have a value of 1, 2, 4, or 8 and can not exceed the value of *len*.
4. Once inet6_opt_append() has been called, the application can use *databufp* directly or use inet6_opt_set_val() to specify the content of the option.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_opt_find\(\) — Search for an option specified by the caller ” on page 843](#)
- [“inet6_opt_finish\(\) — Return the updated total length of extension header ” on page 844](#)
- [“inet6_opt_get_val\(\) — Extract data items in the data portion of the option ” on page 845](#)
- [“inet6_opt_init\(\) — Return the number of bytes for empty extension header” on page 846](#)
- [“inet6_opt_next\(\) — Parse received option headers returning the next option ” on page 846](#)
- [“inet6_opt_set_val\(\) — Insert data items into the data portion of the option ” on page 848](#)

inet6_opt_find() — Search for an option specified by the caller

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

int inet6_opt_find(void *extbuf, socklen_t extlen, int offset,
                  uint8_t type, socklen_t *lenp, void **databufp);
```

General description

inet6_opt_find() is similar to inet6_opt_next(), except it lets the caller specify the option type to be searched for.

Returned value

If successful, inet6_opt_find() returns the updated "previous" total length computed by advancing past the option that was returned and past any options that did not match the type.

Upon failure, returns -1 and errno is set to one of the following:

EINVAL If one of the following is true:

- *extbuf* is NULL;
- *extlen* is not a positive multiple of 8;
- *offset* is less than 0 or greater than or equal to *extlen*;
- *lenp* or *databufp* is NULL;
- the option was not located;
- the extension header is malformed.

Usage notes

The returned "previous" length can be passed to subsequent calls of inet6_opt_find() for finding the next occurrence of the same option type.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)

- [“inet6_opt_append\(\) — Add an option with length "len" and alignment "align" ” on page 842](#)
- [“inet6_opt_finish\(\) — Return the updated total length of extension header ” on page 844](#)
- [“inet6_opt_get_val\(\) — Extract data items in the data portion of the option ” on page 845](#)
- [“inet6_opt_init\(\) — Return the number of bytes for empty extension header” on page 846](#)
- [“inet6_opt_next\(\) — Parse received option headers returning the next option ” on page 846](#)
- [“inet6_opt_set_val\(\) — Insert data items into the data portion of the option ” on page 848](#)

inet6_opt_finish() — Return the updated total length of extension header

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

int inet6_opt_finish(void *extbuf, socklen_t extlen, int offset);
```

General description

inet6_opt_finish() returns the updated total length taking into account the final padding of the extension header to make it a multiple of 8 bytes. If *extbuf* is not NULL the function also initializes the option by inserting a Pad1 or PadN option of the proper length.

Returned value

If successful, inet6_opt_finish() returns the total length of the extension header including the final padding.

Upon failure, returns -1 and errno is set to one of the following:

EINVAL If one of the following is true:

- *extbuf* is NULL and *extlen* is non-zero;
- *extbuf* is non-NULL and *extlen* is not a positive multiple of 8;
- *extbuf* is non-NULL and offset is greater than *extlen*;
- *offset* is less than the size of the empty extension header.

Usage notes

offset should be the length returned by inet6_opt_init() or inet6_opt_append().

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_opt_append\(\) — Add an option with length "len" and alignment "align" ” on page 842](#)
- [“inet6_opt_find\(\) — Search for an option specified by the caller ” on page 843](#)
- [“inet6_opt_get_val\(\) — Extract data items in the data portion of the option ” on page 845](#)

- [“inet6_opt_init\(\) — Return the number of bytes for empty extension header”](#) on page 846
- [“inet6_opt_next\(\) — Parse received option headers returning the next option ”](#) on page 846
- [“inet6_opt_set_val\(\) — Insert data items into the data portion of the option ”](#) on page 848

inet6_opt_get_val() — Extract data items in the data portion of the option

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

int inet6_opt_get_val(void *databuf, int offset,
                    void *val, socklen_t vallen);
```

General description

inet6_opt_get_val() extracts data items of various sizes in the data portion of the option.

Returned value

If successful, inet6_opt_get_val() returns the offset for the next field (*offset + vallen*) that can be used when extracting option content with multiple fields.

Upon failure, returns -1 and sets errno to one of the following:

EINVAL If one of the following is true:

- *databuf* is NULL;
- *val* is null;
- *offset* is less than 0;
- *offset + vallen* is greater than the option length.

Usage notes

1. *databuf* should be a pointer returned by inet6_opt_next() or inet6_opt_find().
2. *val* should point to the destination for the extracted data.
3. *offset* specifies from where in the data portion of the option the value should be extracted; the first byte after the option type and length is accessed by specifying an *offset* of zero.

Related information

- [“netinet/in.h — Internet protocol family”](#) on page 50
- [“inet6_opt_append\(\) — Add an option with length “len” and alignment “align” ”](#) on page 842
- [“inet6_opt_find\(\) — Search for an option specified by the caller ”](#) on page 843
- [“inet6_opt_finish\(\) — Return the updated total length of extension header ”](#) on page 844
- [“inet6_opt_init\(\) — Return the number of bytes for empty extension header”](#) on page 846
- [“inet6_opt_next\(\) — Parse received option headers returning the next option ”](#) on page 846

- [“inet6_opt_set_val\(\) — Insert data items into the data portion of the option ” on page 848](#)

inet6_opt_init() — Return the number of bytes for empty extension header

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

int inet6_opt_init(void *extbuf, socklen_t extlen);
```

General description

inet6_opt_init() returns the number of bytes needed for the empty extension header. If *extbuf* is not NULL, the extension header is initialized to have the correct length field and the *extlen* value must be a positive, non-zero, multiple of 8, or the function will fail.

Returned value

If successful, inet6_opt_init() returns the number of bytes needed for the empty extension header.

Upon failure, returns -1 and errno is set to one of the following:

EINVAL If one of the following is true:

- *extbuf* is NULL and *extlen* is non-zero;
- *extbuf* is non-NULL and *extlen* is not a positive multiple of 8.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_opt_append\(\) — Add an option with length "len" and alignment "align" ” on page 842](#)
- [“inet6_opt_find\(\) — Search for an option specified by the caller ” on page 843](#)
- [“inet6_opt_finish\(\) — Return the updated total length of extension header ” on page 844](#)
- [“inet6_opt_get_val\(\) — Extract data items in the data portion of the option ” on page 845](#)
- [“inet6_opt_next\(\) — Parse received option headers returning the next option ” on page 846](#)
- [“inet6_opt_set_val\(\) — Insert data items into the data portion of the option ” on page 848](#)

inet6_opt_next() — Parse received option headers returning the next option

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

int inet6_opt_next(void *extbuf, socklen_t extlen, int offset,
                  uint8_t *typep, socklen_t *lenp, void **databufp);
```

General description

inet6_opt_next() parses received option extension headers and returns the next option.

Returned value

If successful, inet6_opt_next() returns the updated "previous" length computed by advancing past the option that was returned. This returned "previous" length can then be passed to subsequent calls to inet6_opt_next(). This function does not return any PAD1 or PADN options.

Upon failure, returns -1 and errno is set to one of the following:

EINVAL If one of the following is true:

- *extbuf* is NULL;
- *extlen* is not a positive multiple of 8;
- *offset* is less than 0 or greater than or equal to *extlen*;
- *typep*, *lenp*, or *databufp* is NULL;
- there are no more options;
- the extension header is malformed.

Usage notes

1. *extbuf* and *extlen* specifies the extension header.
2. *offset* should either be zero (for the first option) or the length returned by a previous call to inet6_opt_next() or inet6_opt_find(). It specifies the position to continue scanning the extension buffer. The next option is returned by updating *typep*, *lenp*, and *databufp*.
3. *typep* points to the option type field.
4. *lenp* stores the length of the option data (excluding the option type and option length fields).
5. *databufp* points to the data field of the of the option.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_opt_append\(\) — Add an option with length "len" and alignment "align" ” on page 842](#)
- [“inet6_opt_find\(\) — Search for an option specified by the caller ” on page 843](#)
- [“inet6_opt_finish\(\) — Return the updated total length of extension header ” on page 844](#)
- [“inet6_opt_get_val\(\) — Extract data items in the data portion of the option ” on page 845](#)
- [“inet6_opt_init\(\) — Return the number of bytes for empty extension header” on page 846](#)
- [“inet6_opt_set_val\(\) — Insert data items into the data portion of the option ” on page 848](#)

inet6_opt_set_val() — Insert data items into the data portion of the option

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

int inet6_opt_set_val(void *databuf, int offset,
                     void *val, socklen_t vallen);
```

General description

inet6_opt_set_val() inserts items of various sizes in the data portion of the option.

Returned value

If successful, inet6_opt_set_val() returns the *offset* for the next field (*offset* + *vallen*) that can be used when composing option content with multiple fields.

Upon failure, returns -1 and errno is set to one of the following:

EINVAL If one of the following is true:

- *databuf* is NULL;
- *val* is NULL;
- *offset* is less than 0;
- *offset* + *vallen* is greater than the option length.

Usage notes

1. *databuf* should be a pointer returned by inet6_opt_append().
2. *val* should point to the data to be inserted.
3. *offset* specifies where in the data portion of the option the value should be inserted; the first byte after the option type and length is accessed by specifying an *offset* of 0.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_opt_append\(\) — Add an option with length “len” and alignment “align” ” on page 842](#)
- [“inet6_opt_find\(\) — Search for an option specified by the caller ” on page 843](#)
- [“inet6_opt_finish\(\) — Return the updated total length of extension header ” on page 844](#)
- [“inet6_opt_get_val\(\) — Extract data items in the data portion of the option ” on page 845](#)
- [“inet6_opt_init\(\) — Return the number of bytes for empty extension header ” on page 846](#)
- [“inet6_opt_next\(\) — Parse received option headers returning the next option ” on page 846](#)

inet6_rth_add() — Add an IPv6 address to end of the routing header

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCK_IPV6
#include <netinet/in.h>

int inet6_rth_add(void *bp, const struct in6_addr *addr);
```

General description

inet6_rth_add() adds the IPv6 address pointed to by *addr* to the end of the routing header that is being constructed.

Returned value

If successful, inet6_rth_add() returns 0 and the segleft member of the routing header is updated to account for the new address.

Upon failure, returns -1 and errno is set to one of the following:

EINVAL If one of the following is true:

- *bp* is NULL;
- the routing header indicates an unsupported header type;
- the routing header contains a non-valid number of segments for the type;
- there is not enough room to add the address.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_rth_getaddr\(\) — Return pointer to the IPv6 address specified ” on page 849](#)
- [“inet6_rth_init\(\) — Initialize an IPv6 routing header buffer” on page 850](#)
- [“inet6_rth_reverse\(\) — Reverse the order of the addresses” on page 851](#)
- [“inet6_rth_segments\(\) — Return number of segments contained in header” on page 852](#)
- [“inet6_rth_space\(\) — Return number of bytes for a routing header ” on page 853](#)

inet6_rth_getaddr() — Return pointer to the IPv6 address specified

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

struct in6_addr *inet6_rth_getaddr(const void *bp, int index);
```

General description

inet6_rth_getaddr() returns a pointer to the IPv6 address specified by *index* in the routing header described by *bp*.

Returned value

If successful, inet6_rth_getaddr() returns a pointer to the IPv6 address.

Upon failure, returns NULL and errno is set to one of the following:

EINVAL If one of the following is true:

- *bp* is NULL;
- the routing header indicates an unsupported header type;
- the routing header contains a non-valid number of segments;
- *index* is less than 0 or greater than or equal to the number of segments.

Usage notes

1. To obtain the number of segments in the routing header, a call to inet6_rth_segments() should be made first.
2. *index* must have a value between 0 and one less than the value returned by inet6_rth_segments().

Related information

- [“netinet/in.h – Internet protocol family” on page 50](#)
- [“inet6_rth_add\(\) – Add an IPv6 address to end of the routing header ” on page 849](#)
- [“inet6_rth_init\(\) – Initialize an IPv6 routing header buffer” on page 850](#)
- [“inet6_rth_reverse\(\) – Reverse the order of the addresses” on page 851](#)
- [“inet6_rth_segments\(\) – Return number of segments contained in header” on page 852](#)
- [“inet6_rth_space\(\) – Return number of bytes for a routing header ” on page 853](#)

inet6_rth_init() – Initialize an IPv6 routing header buffer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

void *inet6_rth_init(void *bp, socklen_t bp_len,
                    int type, int segments);
```

General description

inet6_rth_init() initializes the buffer pointed to by *bp* to contain a routing header of the specified *type* and sets *ip6r_len* based on the *segments* parameter.

Returned value

When successful, inet6_rth_init() returns the pointer to the buffer, *bp*. This is then used as the first argument to the inet6_rth_add() function.

Upon failure, returns NULL and *errno* is set to one of the following:

EINVAL If one of the following is true::

- *bp* is NULL;
- *type* indicates an unsupported header type;
- *segments* is not valid for the *type*;
- the buffer is not large enough, *bp_len* is too small.

Usage notes

1. The caller must allocate the buffer; its size can be determined by calling inet6_rth_space().
2. Any cmsghdr fields must be initialized when the application uses ancillary data.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_rth_add\(\) — Add an IPv6 address to end of the routing header ” on page 849](#)
- [“inet6_rth_getaddr\(\) — Return pointer to the IPv6 address specified ” on page 849](#)
- [“inet6_rth_reverse\(\) — Reverse the order of the addresses” on page 851](#)
- [“inet6_rth_segments\(\) — Return number of segments contained in header” on page 852](#)
- [“inet6_rth_space\(\) — Return number of bytes for a routing header ” on page 853](#)

inet6_rth_reverse() — Reverse the order of the addresses

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

int inet6_rth_reverse(const void *in, void *out);
```

General description

inet6_rth_reverse() takes a routing header, pointed to by *in*, and writes a new routing header that sends datagrams along the reverse of that route. It reverses the order of the addresses and sets the *segleft* member in the new routing header to the number of segments required to send the datagram back to where it originated. Both arguments are allowed to point to the same buffer (the reversal can occur in place).

Returned value

If successful, `inet6_rth_reverse()` returns 0.

Upon failure, returns -1 and `errno` is set to one of the following:

EINVAL If one of the following is true:

- *in* is NULL or *out* is NULL;
- the input routing header indicates an unsupported header type;
- the input routing header contains a non-valid number of segments;
- *in* and *out* overlap, but *in* and *out* are not the same buffer.

Related information

- [“netinet/in.h – Internet protocol family” on page 50](#)
- [“inet6_rth_add\(\) – Add an IPv6 address to end of the routing header ” on page 849](#)
- [“inet6_rth_getaddr\(\) – Return pointer to the IPv6 address specified ” on page 849](#)
- [“inet6_rth_init\(\) – Initialize an IPv6 routing header buffer” on page 850](#)
- [“inet6_rth_segments\(\) – Return number of segments contained in header” on page 852](#)
- [“inet6_rth_space\(\) – Return number of bytes for a routing header ” on page 853](#)

inet6_rth_segments() – Return number of segments contained in header

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCK_IPV6
#include <netinet/in.h>

int inet6_rth_segments(const void *bp);
```

General description

`inet6_rth_segments()` returns the number of segments (addresses) contained in the routing header described by *bp*.

Returned value

If successful, `inet6_rth_segments()` returns the number of segments or 0, if there are none in the header.

Upon failure, returns -1 and `errno` is set to one of the following:

EINVAL If one of the following is true:

- *bp* is NULL;
- the routing header indicates an unsupported header type;
- the routing header contains a non-valid number of segments.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_rth_add\(\) — Add an IPv6 address to end of the routing header ” on page 849](#)
- [“inet6_rth_getaddr\(\) — Return pointer to the IPv6 address specified ” on page 849](#)
- [“inet6_rth_init\(\) — Initialize an IPv6 routing header buffer” on page 850](#)
- [“inet6_rth_reverse\(\) — Reverse the order of the addresses” on page 851](#)
- [“inet6_rth_space\(\) — Return number of bytes for a routing header ” on page 853](#)

inet6_rth_space() — Return number of bytes for a routing header

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3542 | both | z/OS V1R7 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/in.h>

socklen_t inet6_rth_space(int type, int segments);
```

General description

inet6_rth_space() calculates the number of bytes required to hold a routing header for the specified *type* containing the specified number of *segments* (addresses).

Returned value

If successful, inet6_rth_space() returns the number of bytes, space required, for the routing header.

Upon failure, returns 0 and errno is set to one of the following:

EINVAL If one of the following is true:

- *type* indicates an unsupported header type;
- *segments* is not valid for the *type*.

Usage notes

1. This function returns the size but does not allocate the space required for the ancillary data. This allows an application to allocate a larger buffer, if other ancillary data objects are desired, because all the ancillary data objects must be specified to sendmsg() as a single msg_control buffer.
2. For an IPv6 Type 0 routing header, the number of *segments* must be between 0 and 127, inclusive. When the application uses ancillary data it must pass the returned length to CMSG_SPACE() to determine how much memory is needed for the ancillary data object (including the cmsghdr structure).

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“inet6_rth_add\(\) — Add an IPv6 address to end of the routing header ” on page 849](#)
- [“inet6_rth_getaddr\(\) — Return pointer to the IPv6 address specified ” on page 849](#)
- [“inet6_rth_init\(\) — Initialize an IPv6 routing header buffer” on page 850](#)

- [“inet6_rth_reverse\(\) — Reverse the order of the addresses” on page 851](#)
- [“inet6_rth_segments\(\) — Return number of segments contained in header” on page 852](#)

inet_addr() — Translate an Internet address into network byte order

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

in_addr_t inet_addr(const char *cp);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

unsigned long inet_addr(char *cp);
```

General description

The `inet_addr()` function interprets character strings representing host addresses expressed in standard dotted-decimal notation and returns host addresses suitable for use as an Internet address.

Parameter

Description

cp

A character string in standard dotted-decimal (.) notation.

Values specified in standard dotted-decimal notation take one of the following forms:

```
a.b.c.d
a.b.c
a.b
a
```

When a 4-part address is specified, each part is interpreted as a byte of data and assigned, from left to right, to one of the 4 bytes of an Internet address.

When a three-part address is specified, the last part is interpreted as a 16-bit quantity and placed in the two rightmost bytes of the network address. This makes the three-part address format convenient for specifying class-B network addresses as **128.net.host**.

When a two-part address is specified, the last part is interpreted as a 24-bit quantity and placed in the three rightmost bytes of the network address. This makes the two-part address format convenient for specifying class-A network addresses as **net.host**.

When a one-part address is specified, the value is stored directly in the network address space without any rearrangement of its bytes.

Numbers supplied as address parts in standard dotted-decimal notation can be decimal, hexadecimal, or octal. Numbers are interpreted in C language syntax. A leading 0x implies hexadecimal; a leading 0 implies octal. A number without a leading 0 implies decimal.

The address must be terminated with a null or other white space character to be valid. Any or all of the parts of the address may be empty strings. Each empty part resolves to the value 0. Input character strings that begin with a null or other white space character is treated as an empty address and will result in the value INADDR_ANY being returned.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Notes:

1. To provide an ASCII input/output format for applications using this function, define the feature test macro `__LIBASCII` as described in topic “`__LIBASCII`” on page 6.
2. The `inet_addr()` function has a dependency on the level of the Enhanced ASCII Extensions. See “Enhanced ASCII support” on page 2123 for details.

Returned value

If successful, `inet_addr()` returns the Internet address in network byte order.

If the input character string is not in the correct format, the value `INADDR_NONE` is returned and `errno` is set to `EINVAL`.

Related information

- “[arpa/inet.h — Internet operations](#)” on page 16
- “[netinet/in.h — Internet protocol family](#)” on page 50
- “[sys/socket.h — Sockets definitions](#)” on page 70
- “[sys/types.h — typedef symbols and structures](#)” on page 71
- “[inet_makeaddr\(\) — Create an Internet host address](#)” on page 857
- “[inet_netof\(\) — Get the network number from the Internet host address](#)” on page 859
- “[inet_network\(\) — Get the network number from the decimal host address](#)” on page 860
- “[inet_ntoa\(\) — Get the decimal Internet host address](#)” on page 861
- “[inet_ntop\(\) — Convert Internet address format from binary to text](#)” on page 862
- “[inet_pton\(\) — Convert Internet address format from text to binary](#)” on page 864

inet_aton() — Convert Internet address format from text to binary

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <arpa/inet.h>

int inet_aton(const char *cp, struct in_addr *inp);
```

General description

The `inet_aton()` function converts the Internet host address *cp* from the IPv4 numbers-and-dots notation into binary form in network byte order and stores it in the structure that *inp* points to. The address that is supplied in *cp* can be in one of the following forms:

a.b.c.d

Each of the four numeric parts specifies a byte of the address. The bytes are assigned in left-to-right order to produce the binary address.

a.b.c

Parts *a* and *b* specify the first 2 bytes of the binary address. Part *c* is interpreted as a 16-bit value that defines the rightmost 2 bytes of the binary address. This notation is suitable for specifying (outmoded) Class B network addresses.

a.b

Part *a* specifies the first byte of the binary address. Part *b* is interpreted as a 24-bit value that defines the rightmost 3 bytes of the binary address. This notation is suitable for specifying (outmoded) Class A network addresses.

a

The value *a* is interpreted as a 32-bit value that is stored directly into the binary address without any byte rearrangement.

In all these forms, components of the dotted address can be specified in decimal, octal with a leading 0, or hexadecimal with a leading 0X. Addresses in any of these forms are collectively termed IPv4 numbers-and-dots notation. The form that uses exactly four decimal numbers is referred to as IPv4 dotted decimal notation, or sometimes IPv4 dotted-quad notation.

Returned value

`inet_aton()` returns 1 if the supplied string is successfully interpreted.

`inet_aton()` returns 0 if the string is invalid. `errno` is not set on error.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“inet_addr\(\) — Translate an Internet address into network byte order” on page 854](#)
- [“inet_network\(\) — Get the network number from the decimal host address” on page 860](#)
- [“inet_ntoa\(\) — Get the decimal Internet host address” on page 861](#)
- [“inet_ntop\(\) — Convert Internet address format from binary to text ” on page 862](#)
- [“inet_pton\(\) — Convert Internet address format from text to binary” on page 864](#)

inet_lnaof() — Translate a local network address into host byte order

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

in_addr_t inet_lnaof(struct in_addr in);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

unsigned long inet_lnaof(struct in_addr in);
```

General description

The `inet_lnaof()` function breaks apart the Internet host address and returns the local network address portion.

Parameter

Description

in

The host Internet address.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

The local network address is returned in host byte order.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“inet_makeaddr\(\) — Create an Internet host address” on page 857](#)
- [“inet_netof\(\) — Get the network number from the Internet host address” on page 859](#)
- [“inet_network\(\) — Get the network number from the decimal host address” on page 860](#)
- [“inet_ntoa\(\) — Get the decimal Internet host address” on page 861](#)

inet_makeaddr() — Create an Internet host address

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

struct in_addr inet_makeaddr(in_addr_t net, in_addr_t lna);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

struct in_addr inet_makeaddr(unsigned long net, unsigned long lna);
```

General description

The `inet_makeaddr()` function takes a network number and a local network address and constructs an Internet address.

Parameter

Description

net

The network number.

lna

The local network address.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

The Internet address is returned in network byte order.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“inet_lnaof\(\) — Translate a local network address into host byte order” on page 856](#)
- [“inet_netof\(\) — Get the network number from the Internet host address” on page 859](#)
- [“inet_network\(\) — Get the network number from the decimal host address” on page 860](#)
- [“inet_ntoa\(\) — Get the decimal Internet host address” on page 861](#)
- [“inet_ntop\(\) — Convert Internet address format from binary to text ” on page 862](#)
- [“inet_pton\(\) — Convert Internet address format from text to binary” on page 864](#)

inet_netof() — Get the network number from the Internet host address

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

in_addr_t inet_netof(struct in_addr in);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

unsigned long inet_netof(struct addr_in in);
```

General description

The `inet_netof()` function breaks apart the Internet host address and returns the network number portion.

Parameter

Description

in

The Internet address in network byte order.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

The network number is returned in host byte order.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“inet_lnaof\(\) — Translate a local network address into host byte order” on page 856](#)
- [“inet_makeaddr\(\) — Create an Internet host address” on page 857](#)
- [“inet_ntoa\(\) — Get the decimal Internet host address” on page 861](#)
- [“inet_ntop\(\) — Convert Internet address format from binary to text ” on page 862](#)
- [“inet_pton\(\) — Convert Internet address format from text to binary” on page 864](#)

inet_network() — Get the network number from the decimal host address

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

in_addr_t inet_network(const char *cp);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

unsigned long inet_network(char cp);
```

General description

The `inet_network()` function interprets character strings representing addresses expressed in standard dotted-decimal notation and returns numbers suitable for use as a network number.

Parameter

Description

cp

A character string in standard, dotted-decimal (.) notation.

Note: The input value is handled as an octal number when there are 3 integers within the dotted-decimal notation. For example, the input value of `inet_network("40.001.016.000")` validly returns `X'28010e00'` (40.1.14.0) since the 016 is treated as an octal number.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Note: The `inet_network()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

The network number is returned in host byte order.

Related information

- [“arpa/inet.h — Internet operations”](#) on page 16
- [“netinet/in.h — Internet protocol family”](#) on page 50
- [“sys/socket.h — Sockets definitions”](#) on page 70
- [“sys/types.h — typedef symbols and structures”](#) on page 71
- [“inet_lnaof\(\) — Translate a local network address into host byte order”](#) on page 856

- “[inet_makeaddr\(\)](#) — Create an Internet host address” on page 857
- “[inet_ntoa\(\)](#) — Get the decimal Internet host address” on page 861
- “[inet_ntop\(\)](#) — Convert Internet address format from binary to text ” on page 862
- “[inet_pton\(\)](#) — Convert Internet address format from text to binary” on page 864

inet_ntoa() — Get the decimal Internet host address

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

char *inet_ntoa(struct in_addr in);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

char *inet_ntoa(struct in_addr in);
```

General description

The `inet_ntoa()` function returns a pointer to a string expressed in the dotted-decimal notation. `inet_ntoa()` accepts an Internet address expressed as a 32-bit quantity in network byte order and returns a string expressed in dotted-decimal notation.

Parameter

Description

in

The host Internet address.

To provide an ASCII input/output format for applications using this function, define feature test macro `__LIBASCII` as described “[__LIBASCII](#)” on page 6.

Note: The `inet_ntoa()` function has a dependency on the level of the Enhanced ASCII Extensions. See “[Enhanced ASCII support](#)” on page 2123 for details.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

Returns a pointer to the Internet address expressed in dotted-decimal notation. The storage pointed to exists on a per-thread basis and is overwritten by subsequent calls.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“inet_addr\(\) — Translate an Internet address into network byte order” on page 854](#)
- [“inet_lnaof\(\) — Translate a local network address into host byte order” on page 856](#)
- [“inet_makeaddr\(\) — Create an Internet host address” on page 857](#)
- [“inet_netof\(\) — Get the network number from the Internet host address” on page 859](#)
- [“inet_network\(\) — Get the network number from the decimal host address” on page 860](#)
- [“inet_ntop\(\) — Convert Internet address format from binary to text ” on page 862](#)
- [“inet_pton\(\) — Convert Internet address format from text to binary” on page 864](#)

inet_ntop() — Convert Internet address format from binary to text

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R2 |

Format

```
#define _OPEN_SYS_SOCK_IPV6
#include <arpa/inet.h>

const char *inet_ntop(int af, const void *src, char *dst, socklen_t size);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <arpa/inet.h>

const char *inet_ntop(int af, const void *__restrict__ src,
                     char * __restrict__ dst, socklen_t size);
```

General description

The `inet_ntop()` function converts from an Internet address in binary format, specified by *src*, to standard text format, and places the result in *dst*, when *size*, the space available in *dst*, is sufficient. The argument *af* specifies the family of the Internet address. This can be `AF_INET` or `AF_INET6`.

The argument *src* points to a buffer holding an IPv4 Internet address if the *af* argument is `AF_INET`, or an IPv6 Internet address if the *af* argument is `AF_INET6`. The address must be in network byte order.

The argument *dst* points to a buffer where the function will store the resulting text string. The *size* argument specifies the size of this buffer. The application must specify a non-NULL *dst* argument. For IPv6 addresses, the buffer must be at least 46 bytes. For IPv4 addresses, the buffer must be at least 16 bytes.

In order to allow applications to easily declare buffers of the proper size to store IPv4 and IPv6 addresses in string form, the following two constants are defined in `<netinet/in.h>`:

```
#define INET_ADDRSTRLEN 16
#define INET6_ADDRSTRLEN 46
```


Note: The `inet_ntop()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `inet_ntop()` returns a pointer to the buffer containing the converted address.

If unsuccessful, `inet_ntop()` returns NULL and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The address family specified in *af* is unsupported.

ENOSPC

The destination buffer *size* is too small.

Note: For Enhanced ASCII usage, the `inet_ntop()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Example

```
#define _OPEN_SYS_SOCKET_IPV6 1
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <arpa/inet.h>
#include <netinet/in.h>

int main(){
    char ipstripv4[INET_ADDRSTRLEN];
    unsigned int ipv4 = 0x0A0A647B;
    const char* result=inet_ntop(AF_INET,&ipv4,ipstripv4,INET_ADDRSTRLEN);

    if(result==NULL){
        perror("inet_ntop");
        return 1;
    }
    printf("The IP address is %s\n",ipstripv4);
    return 0;
}
```

Related information

- [“arpa/inet.h — Internet operations”](#) on page 16
- [“netinet/in.h — Internet protocol family”](#) on page 50
- [“sys/socket.h — Sockets definitions”](#) on page 70
- [“inet_addr\(\) — Translate an Internet address into network byte order”](#) on page 854
- [“inet_makeaddr\(\) — Create an Internet host address”](#) on page 857
- [“inet_netof\(\) — Get the network number from the Internet host address”](#) on page 859
- [“inet_network\(\) — Get the network number from the decimal host address”](#) on page 860
- [“inet_ntoa\(\) — Get the decimal Internet host address”](#) on page 861
- [“inet_pton\(\) — Convert Internet address format from text to binary”](#) on page 864

inet_pton() — Convert Internet address format from text to binary

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| RFC2553 Single UNIX Specification, Version 3 | both | z/OS V1R2 |

Format

```
#define _OPEN_SYS_SOCK_IPV6
#include <arpa/inet.h>

int inet_pton(int af, const char *src, void *dst);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <arpa/inet.h>

int inet_pton(int af, const char *__restrict__ src, void *__restrict__ dst);
```

General description

The `inet_pton()` function converts an Internet address in its standard text format into its numeric binary form. The argument *af* specifies the family of the address.

Note: AF_INET and AF_INET6 address families are currently supported.

The input argument *src* is a null terminated string. It points to the string being passed in. The argument *dst* points to a buffer into which `inet_pton()` stores the numeric address. The address is returned in network byte order. The caller must ensure that the buffer pointed to by *dst* is large enough to hold the numeric address.

If the *af* argument is AF_INET, `inet_pton()` accepts a string in the standard IPv4 dotted-decimal form:

```
ddd.ddd.ddd.ddd
```

where *ddd* is a 1 to 3 digit decimal number between 0 and 255.

If the *af* argument is AF_INET6, the *src* string must be in one of the following standard IPv6 text forms:

1. The preferred form is *x:x:x:x:x:x:x:x*, where the *x*'s are the hexadecimal values of the eight 16-bit pieces of the address. Leading zeros in individual fields can be omitted, but there should be at least one numeral in every field.
2. A string of contiguous zero fields in the preferred form can be shown as *::*. The *::* can only appear once in an address. Unspecified addresses (*0:0:0:0:0:0:0:0*) may be represented simply as *::*.
3. A third form that is sometimes more convenient when dealing with a mixed environment of IPv4 and IPv6 is *x:x:x:x:x:d.d.d.d*, where *x*'s are the hexadecimal values of the six high-order 16-bit pieces of the address, and the *d*'s are the decimal values of the four low-order 8-bit pieces of the address (standard IPv4 representation).

Notes:

1. A more extensive description of the IPv6 standard representations can be found in RFC2373.
2. The `inet_pton()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, `inet_pton()` returns 1 and stores the binary form of the Internet address in the buffer pointed to by *dst*.

If unsuccessful because the input buffer pointed to by *src* is not a valid string, `inet_pton()` returns 0.

If unsuccessful because the *af* argument is unknown, `inet_pton()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The address family specified in *af* is unsupported.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“inet_addr\(\) — Translate an Internet address into network byte order” on page 854](#)
- [“inet_makeaddr\(\) — Create an Internet host address” on page 857](#)
- [“inet_netof\(\) — Get the network number from the Internet host address” on page 859](#)
- [“inet_network\(\) — Get the network number from the decimal host address” on page 860](#)
- [“inet_ntoa\(\) — Get the decimal Internet host address” on page 861](#)
- [“inet_ntop\(\) — Convert Internet address format from binary to text ” on page 862](#)

initgroups() — Initialize the supplementary group ID list for the process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS
#include <sys/types.h>
#include <grp.h>

int initgroups(const char *user, const gid_t basegid);
```

General description

The `initgroups()` function obtains the supplementary group membership of *user*, and sets the current process supplementary group IDs to that list. The *basegid* is also included in the supplementary group IDs list.

The caller of this function must be a superuser or must specify the password of the target user name specified on the `initgroups()` call - issue the `passwd()` function before `initgroups()`.

Returned value

If successful, `initgroups()` returns 0.

If unsuccessful, `initgroups()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EINVAL

The number of supplementary groups for the specified user plus the basegid group exceeds the maximum number of groups allowed, or a non-valid *user* is specified.

EMVSERR

An MVS environmental or internal error occurred.

EMVSSAF2ERR

The Security Authorization Facility (SAF) had an error.

EPERM

The caller is not authorized, only authorized users are allowed to alter the supplementary group IDs list.

Related information

- [“grp.h — Access group databases” on page 27](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“getgroupsbyname\(\) — Get supplementary group IDs by user name” on page 717](#)
- [“setgroups\(\) — Set the supplementary group ID list for the process” on page 1533](#)

initstate() — Initialize generator for random()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

char *initstate(unsigned seed, char *state, size_t size);
```

General description

The `initstate()` function allows a state array, pointed to by the *state* argument, to be initialized for future use in calls to the `random()` functions by the calling thread. The *size* argument, which specifies the size in bytes of the state array, is used by the `initstate()` function to decide how sophisticated a random-number generator to use; the larger the state array, the more random the numbers. Values for the amount of state information are 8, 32, 64, 128, and 256 bytes. While other amounts are rounded down to the nearest known value. The *seed* argument specifies a starting point for the random-number sequence and provides for restarting at the same point. The `initstate()` function returns a pointer to the previous state information array.

Returned value

If successful, `initstate()` returns a pointer to the previous state array.

If unsuccessful, `initstate()` returns a NULL pointer. If `initstate()` is called with *size* less than 8, it will return NULL.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“drand48\(\) — Pseudo-random number generator” on page 403](#)
- [“random\(\) — A better random-number generator” on page 1379](#)
- [“setstate\(\) — Change generator for random\(\)” on page 1583](#)
- [“srandom\(\) — Use seed to initialize generator for random\(\)” on page 1704](#)

inotify_add_watch() — Add a watch to an initialized inotify instance

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/inotify.h>

int inotify_add_watch(int fd, const char *pathname, uint32_t mask);
```

General description

`inotify_add_watch()` manipulates the watch list that is associated with an `inotify` instance that is returned by `inotify_init()`. Each watched item in the watch list specifies *pathname* of a file or directory, along with some set of events that the kernel monitors for the file that is referred to by *pathname*. `inotify_add_watch()` either creates a new watch item or modifies an existing watch. Each watch has a unique watch descriptor, which is an integer that is returned by the call to `inotify_add_watch()` when the watch item is created.

Parameter

Description

fd

File descriptor that refers to the `inotify` instance whose watch list is to be modified.

pathname

Path name of a file or directory.

mask

Bit-mask form of the events to be monitored. Valid values are:

IN_ACCESS

File is accessed.

IN_ATTRIB

Metadata is changed.

IN_CLOSE_WRITE

File that is opened for writing is closed.

IN_CLOSE_NOWRITE

File or directory that is not opened for writing is closed.

IN_CREATE

File or directory is created in watched directory.

IN_DELETE

File or directory is deleted from watched directory.

IN_DELETE_SELF

Watched file or directory is itself deleted.

IN_MODIFY

File is modified.

IN_MOVE_SELF

Watched file or directory is itself moved.

IN_MOVED_FROM

Generated for the directory that contains the old filename when a file is renamed.

IN_MOVED_TO

Generated for the directory that contains the new filename when a file is renamed.

IN_OPEN

File or directory is opened.

IN_ALL_EVENTS

Defined as a bit mask of all of the previous events.

IN_MOVE

Equates to `IN_MOVED_FROM | IN_MOVED_TO`.

IN_CLOSE

Equates to `IN_CLOSE_WRITE | IN_CLOSE_NOWRITE`.

IN_DONT_FOLLOW

Do not dereference *pathname* if it is a symbolic link.

IN_EXCL_UNLINK

By default, when watching events on the children of a directory, events are generated for children even after they are unlinked from the directory. This can result in large numbers of uninteresting events for some applications (for example, many applications create temporary files whose names are immediately unlinked in the `/tmp` folder). Specifying `IN_EXCL_UNLINK` changes the default behavior, so that events are not generated for children after they are unlinked from the watched directory.

IN_MASK_ADD

If a watch instance exists for the filesystem object corresponding to *pathname*, add (OR) the events in mask to the watch mask (instead of replacing the mask); the error `EINVAL` results if `IN_MASK_CREATE` is also specified.

IN_ONESHOT

Monitor the filesystem object corresponding to *pathname* for one event, then remove from watch list.

IN_ONLYDIR

Watch *pathname* only if it is a directory; the error `ENOTDIR` results if *pathname* is not a directory. Using this flag provides an application with a race-free way of ensuring that the monitored object is a directory.

IN_MASK_CREATE

Watch *pathname* only if it does not have a watch that is associated with it; the error `EEXIST` results if *pathname* is watched.

When events occur for monitored files and directories, those events are made available to the application as structured data that can be read from the `inotify` file descriptor by `read()`. Each successful `read()` call returns a buffer that contains one or more of the following structure.

Compile requirement: Using this structure requires the compiler support for C99.

```
struct inotify_event {
    int      wd;           /* Watch descriptor */
    uint32_t mask;         /* Mask describing event */
    uint32_t cookie;       /* Unique cookie associating related events */
    uint32_t len;          /* Size of name field */
    char     name[];       /* Optional null-terminated name */
}
```

wd identifies the watch for which this event occurs. It is one of the watch descriptors that are returned by a previous call to `inotify_add_watch()`.

mask contains bits that describe the event that occurred. The following bits might be set in the mask field that is returned by `read()`.

IN_IGNORED

Watch is removed by calling `inotify_rm_watch()` or when the file is deleted or the filesystem is unmounted.

IN_ISDIR

Subject of this event is a directory.

IN_Q_OVERFLOW

Event queue overflows.

IN_UNMOUNT

The file system that contains watched object is unmounted.

Returned value

If successful, `inotify_add_watch()` returns a watch descriptor, which is a nonnegative integer.

If unsuccessful, `inotify_add_watch()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Read access to the given file is not permitted.

EBADF

The given file descriptor is not valid.

EEXIST

mask contains `IN_MASK_CREATE` and *pathname* refers to a file that is watched by the same *fd*.

EFAULT

pathname points outside of the process's accessible address space.

EINVAL

The given event mask contains no valid events, or *mask* contains both `IN_MASK_ADD` and `IN_MASK_CREATE`, or *fd* is not an `inotify` file descriptor.

ENAMETOOLONG

pathname is too long.

ENOENT

A directory component in *pathname* does not exist or is a dangling symbolic link.

ENOMEM

Kernel memory is insufficient.

ENOSPC

The user limit on the total number of `inotify` watches is reached, or the kernel fails to allocate a needed resource.

ENOTDIR

mask contains `IN_ONLYDIR` and *pathname* is not a directory.

Related information

- [“sys/inotify.h — Monitor and notify file system change functions” on page 68](#)
- [“inotify_init\(\), inotify_init1\(\) — Initialize an inotify instance” on page 870](#)
- [“inotify_rm_watch\(\) — Remove an existing watch from an inotify instance” on page 871](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)

inotify_init(), inotify_init1() – Initialize an inotify instance

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/inotify.h>

int inotify_init(void);
int inotify_init1(int flags);
```

General description

`inotify_init()` creates a new `inotify` instance and returns a file descriptor that is associated with a new `inotify` event queue. The returned `inotify` instance can then be used to add interest in watching in particular file descriptors by using the `inotify_add_watch()` function.

`inotify_init1()` is similar to `inotify_init()` but accepts a *flags* argument. If *flags* is 0, `inotify_init1()` is the same as `inotify_init()`. The following values can be bitwise ORed in *flags* to obtain different behavior:

IN_NONBLOCK

Set the Non-Block file status flag on the file description that is referred to by the new file descriptor. This is the same as the `O_NONBLOCK` flag in the `open()` function.

IN_CLOEXEC

Set the close-on-exec flag on the new file descriptor. See the description of the `O_CLOEXEC` flag in the `open()` function for more information.

Returned value

If successful, `inotify_init()` and `inotify_init1()` return a new file descriptor.

If unsuccessful, `inotify_init()` and `inotify_init1()` return -1 and set `errno` to one of the following values:

Error Code

Description

EINVAL

An invalid value is specified in *flags* for `inotify_init1()`.

EMFILE

The user limit on the total number of `inotify` instances or the per-process limit on the number of open file descriptors is reached.

ENFILE

The system-wide limit on the total number of open files is reached.

ENOMEM

Kernel memory is insufficient.

Related information

- [“sys/inotify.h – Monitor and notify file system change functions” on page 68](#)
- [“open\(\) – Open a file” on page 1157](#)

inotify_rm_watch() — Remove an existing watch from an inotify instance

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/inotify.h>

int inotify_rm_watch(int fd, int wd);
```

General description

`inotify_rm_watch()` removes the watch that is associated with the watch descriptor, which is returned by `inotify_add_watch()` from the `inotify` instance that is associated with the file descriptor. Removing a watch causes an `IN_IGNORED` event to be generated for this watch descriptor.

Parameter

Description

fd

File descriptor of an `inotify` instance.

wd

File descriptor of a watched item.

Returned value

If successful, `inotify_rm_watch()` returns 0.

If unsuccessful, `inotify_rm_watch()` returns -1 and set `errno` to one of the following values:

Error Code

Description

EBADF

fd is not a valid file descriptor.

EINVAL

The watch descriptor *wd* is not valid; or *fd* is not an `inotify` file descriptor.

Related information

- [“sys/inotify.h — Monitor and notify file system change functions” on page 68](#)
- [“inotify_add_watch\(\) — Add a watch to an initialized inotify instance” on page 867](#)

insque() — Insert an element into a doubly-linked list

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <search.h>

void insque(void *element, void *pred);
```

General description

The insque() function inserts the element pointed to by *element* into a doubly-linked list immediately after the element pointed to by *pred*. The function operates on pointers to structures which have a pointer to their successor in the list as their first element, and a pointer to their predecessor as the second. The application is free to define the remaining contents of the structure, and manages all storage itself. To insert the first element into a linear (non-circular) list, an application would call *insque(element, NULL)*;. To insert the first element into a circular list, the application would set the element's forward and back pointers to point to the element.

Returned value

insque() returns no values.

Related information

- [“search.h — Searching tables” on page 58](#)
- [“remque\(\) — Remove an element from a double linked list” on page 1431](#)

ioctl() — Control device

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

Terminals:

```
#include <sys/ioctl.h>

int ioctl(int fildes int cmd, ... /* arg */);
```

Sockets:

```
#define _XOPEN_SOURCE_EXTENDED 1

/**      OR      **/

#define _OE_SOCKETS

#include <sys/ioctl.h>
#include <net/rtroute.h>
#include <net/if.h>
int ioctl(int fildes, int cmd, ... /* arg */);
```

STREAMS:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stropts.h>
int ioctl(int fildes int cmd, ... /* arg */);
```

General description

`ioctl()` performs a variety of control functions on devices. The *cmd* argument and an optional third argument (with varying type) are passed to and interpreted by the device associated with *fdes*.

The *cmd* argument selects the control function to be performed and will depend on the device being addressed.

The *arg* argument represents additional information that is needed by this specific device to perform the requested function. The type of *arg* depends upon the particular control request, but it is either an integer or a pointer to a device-specific data structure.

`ioctl()` information is divided into the following section s:

- Terminals
- Sockets
- STREAMS
- ACLs

Terminals

The following `ioctl()` commands are used with terminals:

Command Description

TIOCSWINSZ

Set window size. Used as the second operand in an `ioctl()` against a terminal. The window size information pointed to by the third operand is copied into an area in the kernel associated with the terminal, and a SIGWINCH signal is generated against the foreground process group.

TIOCGWINSZ

Get window size. Used as the second operand in an `ioctl()` against a terminal. The current window size is returned in the area pointed to by the third operand - a `winsize` structure.

The `winsize` structure is the third operand in an `ioctl()` call when you use `TIOCSWINSZ` or `TIOCGWINSZ`. The structure contains four unsigned short integers:

Field Description

ws_row

Number of rows in the window, in characters.

ws_col

Number of columns in the window, in characters. This assumes single-byte characters. Multibyte characters may take more room.

ws_xpixel

Horizontal size of the window, in pixels.

ws_ypixel

Vertical size of the window, in pixels.

Sockets

The following `ioctl()` commands are used with sockets:

Command Description

FIONBIO

Sets or clears nonblocking I/O for a socket. *arg* is a pointer to an integer. If the integer is 0, nonblocking I/O on the socket is cleared. Otherwise, the socket is set for nonblocking I/O.

FIONREAD

Gets the number of immediately readable bytes for the socket. *arg* is a pointer to an integer. Sets the value of the integer to the number of immediately readable characters for the socket.

FIONWRITE

Returns the number of bytes that can be written to the connected peer AF_UNIX stream socket before the socket blocks or returns EWOULDBLOCK. The number of bytes returned is not guaranteed unless there is serialization by the using applications.

FIOGETOWN

Returns the PID that has been set that designates the recipient of signals.

FIOSETOWN

Sets the PID to be used when sending signals

FIOGETOWN and FIOSETOWN are equivalent to the F_GETOWN and F_SETOWN commands of fcntl(). For information on the values for pid, refer to that function. This function is only valid for AF_INET stream sockets.

SECIGET

Gets the peer socket's security identity values for an AF_UNIX connected stream socket. The MVS user ID, effective UID, and effective GID of the peer process are returned in the **seci** structure, which is mapped by BPXYSECI. This option is valid only for the AF_UNIX domain.

SECIGET_T

Returns both the process and, if available, the task level security information of the peer for an AF_UNIX stream connected to the socket. The task level security information is from the task that issued the connect() or accept(). The security information is returned in a struct **__sect_s** as defined in <sys/ioctl.h>. The security information is not available until accept() completes. The availability of the peer's task level security data is determined by the task level userid length field. If zero, the peer does not have task level security data.

SIOCADDRT

Adds a routing table entry. *arg* is a pointer to a **rtentry** structure, as defined in <net/rtroute.h>. The routing table entry, passed as an argument, is added to the routing tables. This option is valid only for the AF_INET domain.

SIOCATMARK

Queries whether the current location in the data input is pointing to out-of-band data. *arg* is a pointer to an integer. SIOCATMARK sets the argument to 1 if the socket points to a mark in the data stream for out-of-band data; otherwise, it sets the argument to 0. Refer to recv(), recvfrom() and recvmsg() for more information on receiving out-of-band data.

SIOCDELRT

Deletes a routing table entry. *arg* is a pointer to a **rtentry** structure, as defined in <net/rtroute.h>. If it exists, the routing table entry passed as an argument is deleted from the routing tables. This option is valid only for the AF_INET domain.

SIOCGIFADDR

Gets the network interface address. *arg* is a pointer to an **ifreq** structure, as defined in <net/if.h>. The interface address is returned in the argument. This option is valid only for the AF_INET domain.

This macro is protected by the _OPEN_SYS_IF_EXT feature.

SIOCGIFBRDADDR

Gets the network interface broadcast address. *arg* is a pointer to an **ifreq** structure, as defined in <net/if.h>. The interface broadcast address is returned in the argument. This option is valid only for the AF_INET domain.

This macro is protected by the _OPEN_SYS_IF_EXT feature.

SIOCGIFCONF

Gets the network interface configuration. *arg* is a pointer to an **ifconf** structure, as defined in <net/if.h>. The interface configuration is returned in the buffer pointed to by the **ifconf** structure. The

returned data's length is returned in the field that had originally contained the length of the buffer. This option is valid only for the AF_INET domain.

This macro is protected by the _OPEN_SYS_IF_EXT feature.

SIOCGIFCONF6

Gets the name, address, and other information about the IPv6 network interfaces that are configured. This is similar to the SIOCGIFCONF command for IPv4.

To request OSM interfaces, the application must have READ authorization to the EZB.OSM.sysname.tcpname resource.

A struct `__net_ifconf6header_s` is passed as the argument of the ioctl. This structure specifies the buffer where the configuration information is to be written and is returned with the number of entries and entry length of each struct, and `__net_ifconf6entry_s` that was written to the output buffer. These structures are defined in `<sys/ioctl.h>`.

If `__nif6h_buflen` and `__nif6h_buffer` are both zero, a query function is performed and the header is returned with:

`__nif6h_version`

The maximum supported version.

Note: If the version number is supplied (not zero), the entry length returned will be for the specified version. (If it is supported)

`__nif6h_entries`

The total number of entries that will be output.

`__nif6h_entrylen`

The length of each individual entry.

If a call to get information fails with either

```
errno = ERANGE, or
errno = EINVAL and __nif6h_version has changed
```

The call was converted into a query function and the header has been filled in as described above. In these cases, the content of the output buffer is undefined.

If Common INET is configured and multiple TCP/IP stacks are attached to the socket, the output from each stack that is enabled for IPv6 will be concatenated in the output buffer and the header will contain the total number of entries returned from all the stacks. The version returned with the query function will be the highest version supported by all the stacks.

This ioctl can be issued on an AF_INET or AF_INET6 socket.

Error Code

Description

EINVAL

No IPv6 enabled TCP/IP stacks are active.

EINVAL

The input version number is not supported.

ERANGE

The buffer is too small to contain all of the IPv6 network interface entries.

SIOCGIFDSTADDR

Gets the network interface destination address. *arg* is a pointer to an **ifreq** structure, as defined in `<net/if.h>`. The interface destination (point-to-point) address is returned in the argument. This option is valid only for the AF_INET domain.

This macro is protected by the _OPEN_SYS_IF_EXT feature.

SIOCGIFFLAGS

Gets the network interface flags. *arg* is a pointer to an **ifreq** structure, as defined in <net/if.h>. The interface flags are returned in the argument. This option is valid only for the AF_INET domain.

This macro is protected by the _OPEN_SYS_IF_EXT feature.

SIOCGIFMETRIC

Gets the network interface routing metric. *arg* is a pointer to an **ifreq** structure, as defined in <net/if.h>. The interface routing metric is returned in the argument. This option is valid only for the AF_INET domain.

This macro is protected by the _OPEN_SYS_IF_EXT feature.

SIOCGIFMTU

Gets the network interface MTU (maximum transmission unit). *arg* is a pointer to an ifreq structure, as defined in <net/if.h>. The interface MTU is returned in the argument, *arg->ifr_mtu*. This option is only valid for the AF_INET domain.

This macro is protected by the _OPEN_SYS_IF_EXT feature.

SIOCGIFNETMASK

Gets the network interface network mask. *arg* is a pointer to an **ifreq** structure, as defined in <net/if.h>. The interface network mask is returned in the argument. This option is valid only for the AF_INET domain.

This macro is protected by the _OPEN_SYS_IF_EXT feature.

SIOCGSPLXFQDN

Gets the fully qualified domain name for a given server and domain name in a sysplex. This is an special purpose command to support applications that have registered with WorkLoad Manager (WLM) for connection optimization services using the Domain Name System (DNS). 'arg' is a pointer to sysplexFqDn structure, as defined in <ezbzsdc.h>. sysplexFqDn contains pointer to sysplexFqDnData structure, as defined in <ezbzsdc.h>.

sysplexFqDnData structure contains server name(input), group name(input) and fully qualified domain name(output).

ioctl() with the SIOCGSPLXFQDN command will fail if:

Error Code**Description****EFAULT**

Write user storage failed

EINVAL

One of the following:

- Group name required
- Buffer length not valid
- Socket call parameter error

ENXIO

One of the following:

- Sysplex address not found
- Res not found In DNS
- Time out
- Time Unexpected Error

Example: The following is an example of the `ioctl()` call used with `SIOCGSPLXFQDN`.

```
#include <ezbzdnc.h>
sysplexFqDn      splxFqDn;
sysplexFqDnData  splxData;
int              rc;

splxFqDn.splxVersion = splxDataVersion;
splxFqDn.splxBuflen  = sizeof(sysplexFqDnData);
splxFqDn.splxBufAddr = &splxData;

/* Assign values to splxData.groupName, */
/* splxData.serverName if required      */
/*                                     */
/*                                     */
/* Get the fully qualified domain name */
rc = ioctl(s, SIOCGSPLXFQDN, (char *) &splxFqDn);

/* splxData.domainName contains the fully */
/* qualified domain name.                  */
/*                                     */
```

SIOCSECNVR

Used to SET or GET the security environment for a server socket. `arg` points to a struct `__seco_s` where element `__seco_argument` is set to 1 for a SET and 2 for a GET request.

When used with the SET argument, the AF_UNIX stream socket server will designate the server socket as one that requires the full security environment of the connecting client to be available before the connect will complete successfully. During connect processing, connect obtains the security environment of the connector and anchors it off the connector's socket for use by the server. If the security environment cannot be obtained during connect processing, the connect will fail. This command has no effect on sockets that do not become server sockets.

When used with the GET argument, the AF_UNIX stream socket server will copy the previously SET security environment from the connector's address space to the server's address space so it can be used as input on calls to the security product. This command has meaning only for server sockets that previously issued SIOCSECNVR with the SET argument.

SIOCSIFMETRIC

Sets the network interface routing metric. `arg` is a pointer to an **ifreq** structure, as defined in `<net/if.h>`. SIOCSIFMETRIC sets the interface routing metric to the value passed in the argument. This option is valid only for the AF_INET domain.

This macro is protected by the `_OPEN_SYS_IF_EXT` feature.

SIOCSPARTNERINFO

Sets an indicator to retrieve the partner security credentials during connection setup and saves the information, enabling an application to issue a SIOCGPARTNERINFO ioctl without suspending the application, or at least minimizing the time to retrieve the information. The SIOCSPARTNERINFO ioctl must be issued prior to the SIOCGPARTNERINFO ioctl. For more information, see [z/OS Communications Server: IP Programmer's Guide and Reference](#).

SIOCSVIPA

Defines or deletes an IPv4 dynamic VIPA. `arg` is a pointer to a **dvreq** structure as defined in `<ezbzdvp.h>`. This option is valid only for the AF_INET domain.

SIOCSVIPA6

Defines or deletes an IPv6 dynamic VIPA. `arg` is a pointer to a **dvreq6** structure as defined in `<ezbzdvp.h>`. This option is valid only for the AF_INET6 domain.

SIOCTIEDESTHRD

Associates (ties) or disassociates (unties) a descriptor with a thread. `arg` is a pointer to an int. When `*arg` is 1, the descriptor is tied to the calling thread. When `*arg` is 0, the descriptor is untied from the calling thread. If the task should terminate before the descriptor is closed or untied from the task, z/OS UNIX file system thread termination processing will close the descriptor. This command can be used on both heavy weight and medium weight threads.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Terminal and sockets returned value

If successful, `ioctl()` returns 0.

If unsuccessful, `ioctl()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

The *fdes* parameter is not a valid socket descriptor.

EINVAL

The request is not valid or not supported.

EIO

The process group of the process issuing the function is an orphaned, background process group, and the process issuing the function is not ignoring or blocking SIGTTOU.

EMVSPARM

Incorrect parameters were passed to the service.

ENODEV

The device is incorrect. The function is not supported by the device driver.

ENOTTY

An incorrect file descriptor was specified. The file type was not character special.

Example of terminal and sockets

The following is an example of the `ioctl()` call.

```
int s;
int dontblock;
int rc;
:
/* Place the socket into nonblocking mode */
dontblock = 1;
rc = ioctl(s, FIONBIO, (
char *) &dontblock);
:
```

STREAMS

The following `ioctl()` commands are used with STREAMS:

L_PUSH

Pushes the module whose name is pointed to by *arg* onto the top of the current STREAM, just below the STREAM head. It then calls the `open()` function of the newly-pushed module.

`ioctl()` with the `L_PUSH` command will fail if:

Error Code

Description

EINVAL

Non-valid module name.

ENXIO

Open function of new module failed.

ENXIO

Hang-up received on *fdes*

L_POP

Removes the module just below the STREAM pointed to by *fildes*. The *arg* argument should be 0 in an I_POP request.

ioctl() with the I_POP command will fail if:

Error Code**Description****EINVAL**

No module present in the STREAM.

ENXIO

Hang-up received on *fildes*.

L_LOOK

Retrieves the name of the module just below the STREAM head of the STREAM pointed to by *fildes* and places it in a character string pointed to by *arg*. The buffer pointed to by *arg* should be at least FMNAMESZ+1 bytes long, where FMNAMESZ is defined in <stropts.h>.

ioctl() with the I_LOOK command will fail if:

Error Code**Description****EINVAL**

No module present in the STREAM.

L_FLUSH

This request flushes read and/or write queues, depending on the value of *arg*. Valid *arg* values are:

FLUSHR

Flush all read queues.

FLUSHW

Flush all write queues.

FLUSHRW

Flush all read and all write queues.

ioctl() with the I_FLUSH command will fail if:

Error Code**Description****EAGAIN or ENOSR**

Unable to allocate buffers for flush message.

EINVAL

Non-valid *arg* value.

ENXIO

Hang-up received on *fildes*.

I_FLUSHBAND

Flushes a particular band of messages. The *arg* argument points to a bandinfo structure. The bi_flag member may be one of FLUSHER, FLUSHW, or FLUSHRW as described above. The bi_pri member determines the priority band to be flushed.

I_SETSIG

Requests that the STREAMS implementation send the SIGPOLL signal to the calling process when a particular event has occurred on the STREAM associated with *fildes*. I_SETSIG supports an asynchronous processing capability in STREAMS. The value of *arg* is a bitmask that specifies the events for which the process should be signaled. It is the bitwise OR of any combination of the following constants:

S_RDNORM

A normal (priority band set to 0) message has arrived at the head of a STREAM head read queue. A signal will be generated even if the message is of zero length.

S_RDBAND

A message with a nonzero priority band has arrived at the head of a STREAM head read queue. A signal will be generated even if the message is of zero length.

S_INPUT

A message, other than a high-priority message, has arrived at the head of a STREAM head read queue. A signal will be generated even if the message is of zero length.

S_HIPRI

A high-priority message is present on a STREAM head read queue. A signal will be generated even if the message is of zero length.

S_OUTPUT

The write queue for normal data (priority band 0) just below the STREAM head is no longer full. This notifies the process that there is room on the queue for sending (or writing) normal data downstream.

S_WRNORM

Same as S_OUTPUT.

S_WRBAND

The write queue for a nonzero priority band just below the STREAM head is no longer full. This notifies the process that there is no room on the queue for sending (or writing) priority data downstream.

S_MSG

A STREAMS signal message that contains the SIGPOLL signal has reached the front of the STREAM head read queue.

S_ERROR

Notification of an error condition has reached the STREAM head.

S_HANGUP

When used in conjunction with S_RDBAND, SIGURG is generated instead of SIGPOLL when a priority message reaches the front of the STREAM head read queue.

If *arg* is 0, the calling process will be unregistered and will not receive further SIGPOLL signals for the STREAM associated with *fildes*.

Processes that wish to receive SIGPOLL signals must explicitly register to receive them using I_SETSIG. If several processes register to receive this signal for the same event on the same STREAM, each process will be signaled when the event occurs.

ioctl() with the I_SETSIG command will fail if:

Error Code

Description

EAGAIN

There were insufficient resources to store the signal request.

EINVAL

The value of *arg* is not valid.

EINVAL

The value of *arg* is 0 and the calling process is not registered to receive the SIGPOLL signal.

I_GETSIG

Returns the events for which the calling process is currently registered to be sent a SIGPOLL signal. The events are returned as a bitmask in an int pointed to by *arg*, where the events are those specified in the description of I_SETSIG above.

ioctl() with the I_GETSIG command will fail if:

Error Code

Description

EINVAL

Process is not registered to receive the SIGPOLL signal.

I_FIND

This request compares the names of all modules currently present in the STREAM to the name pointed to by *arg*, and returns 1 if the name module is present in the STREAM, or returns 0 if the named module is not present.

ioctl() with the I_FIND command will fail if:

Error Code**Description****EINVAL**

arg does not contain a valid module name.

I_PEEK

This request allows a process to retrieve the information in the first message on the STREAM head read queue without taking the message off the queue. It is analogous to getmsg() except that this command does not remove the message from the queue. The *arg* argument points to a strpeek structure.

The maxlen member in the ctlbuf and databuf strbuf structure must be set to the number of bytes of control information and/or data information, respectively, to retrieve. The flags member may be marked RS_HIPRI or 0, as described by getmsg() - getpmsg(). If the process sets flags to RS_HIPRI, for example, I_PEEK will only look for a high-priority message on the STREAM head read queue.

I_PEEK returns 1 if a message was retrieved, and returns 0 if no message was found on the STREAM head read queue, or if the RS_HIPRI flag was set in flags and a high-priority message was not present on the STREAM head read queue. It does not wait for a message to arrive. On return, ctlbuf specifies information in the control buffer, databuf specifies information in the data buffer, and flags contains the value RS_HIPRI or 0.

I_SRDOPT

Sets the read mode using the value of the argument *arg*. Read modes are described in read(). Valid *arg* flags are:

RNORM

Byte-stream mode, the default.

RMSGD

Message-discard mode.

RMSGN

Message-nondiscarded mode.

The bitwise inclusive-OR of RMSGD and RMSGN will return EINVAL. The bitwise inclusive-OR of RNORM and either RMSGD or RMSGN will result in the other flag overriding RNORM which is the default.

In addition, treatment of control messages by the STREAM head may be changed by setting any of the following flag in *arg*:

RPROTNORM

Fail read() with EBADMSG if a message containing a control part is at the front of the STREAM head read queue.

RPROTDAT

Deliver the control part of a message as data when a process issues a read().

RPROTDIS

Discard the control part of a message, deliver any data portion, when a process issues a read().

ioctl() with the I_SRDOPT command will fail if:

Error Code**Description****EINVAL**

The *arg* argument is not valid.

I_GRDOPT

Returns the current read mode setting, as described above, in an int pointed to by the argument *arg*. Read modes are described in read().

I_NREAD

Counts the number of data bytes in the data part of the first message on the STREAM head read queue and places this value in the int pointed to by *arg*. The return value for the command is the number of messages on the STREAM head read queue. For example, if 0 is returned in *arg*, but the ioctl() return value is greater than 0, this indicates that a zero-length message is next on the queue.

I_FDINSERT

Creates a message from specified buffer(s), adds information about another STREAM, and sends the message downstream. The message contains a control part and an optional data part. The data and control parts to be sent are distinguished by placement in separate buffers, as described below. The *arg* argument points to a **strfdinsert** structure.

The **len** member in the **ctlbuf** **strbuf** structure must be set to the size of a pointer plus the number of bytes of control information to be sent with the message. The *fildev* member specifies the file descriptor of the other STREAM, and the *offset* member, which must be suitably aligned for use as a pointer, specifies the offset from the start of the control buffer where I_FDINSERT will store a pointer whose interpretation is specific to the STREAM end. The **len** member in the **databuf** **strbuf** structure must be set to the number of bytes of data information to be sent with the message, or 0 if no data part is to be sent.

The **flags** member specifies the type of message to be created. A normal message is created if **flags** is set to 0, and a high-priority message is created if **flags** is set to RS_HIPRI. For non-priority messages, I_FDINSERT will block if the STREAM write queue is full due to internal flow control conditions. For priority messages, I_FDINSERT does not block on this condition. For non-priority messages, I_FDINSERT does not block when the write queue is full and O_NONBLOCK is set. Instead, it fails and sets *errno* to EAGAIN.

I_FDINSERT also blocks, unless prevented by lack of internal resources, waiting for the availability of message blocks in the STREAM, regardless of priority or whether O_NONBLOCK has been specified. No partial message is sent.

ioctl() with the I_FDINSERT command will fail if:

Error Code**Description****EAGAIN**

A non-priority message is specified, the O_NONBLOCK flag is set, and the STREAM write queue is full due to internal flow control conditions.

EAGAIN or ENOSR

Buffers can not be allocated for the message that is to be created.

EINVAL

One of the following:

- The *fd* member of the **strfdinsert** structure is not a valid, open STREAM file descriptor.
- The size of a pointer plus *offset* is greater than the *len* member for the buffer specified through *ctlptr*
- the *offset* member does not specify a properly-aligned location in the data buffer.
- An undefined value is stored in **flags**

ENXIO

Hang-up received for *fd* or *fildev*.

ERANGE

The *len* member for the buffer specified through *databuf* does not fall within the range specified by the maximum and minimum packet sizes of the topmost STREAM module or the *len* member for the buffer specified through *databuf* is larger than the maximum configured size of the data

part of a message; or the *len* member for the buffer specified through *ctlbuf* is larger than the maximum configured size of the control part of a message.

I_STR

Constructs an internal STREAMS ioctl() message from the data pointed to by *arg*, and sends that message downstream.

This mechanism is provided to send ioctl() requests to downstream modules and drivers. It allows information to be sent with ioctl(), and returns to the process any information sent upstream by the downstream recipient. I_STR blocks until the system responds with either a positive or negative acknowledgement message, or until the request "times out" after some period of time. If the request times out, it fails with *errno* set to ETIME.

At most, one I_STR can be active on a STREAM. Further I_STR calls will block until the active I_STR completes at the STREAM head. The default timeout interval for these requests is 15 seconds. The O_NONBLOCK flag has no effect on this call.

To send requests downstream, *arg* must point to a **strioctl** structure.

The **ic_cmd** member is the internal ioctl() command intended for a downstream module or driver and **ic_timeout** is the number of seconds (-1 = infinite, 0 = use implementation-dependent timeout interval, >0 = as specified) an I_STR request will wait for acknowledgement before timing out. **ic_len** member has two uses: on input, it contains the length of the data argument passed in, and on return from the command, it contains the number of bytes being returned to the process (the *buffer* pointed to by **ic_dp** should be large enough to contain the maximum amount of data that any module or the driver in the STREAM can return.)

The STREAM head will convert the information pointed to by the **strioctl** structure to an internal ioctl() command message and send it downstream.

ioctl() with the I_STR command will fail if:

Error Code

Description

EAGAIN or ENOSR

Unable to allocate buffers for the ioctl() message.

EINVAL

This *ic_len* member is less than 0 or larger than the maximum configured size of the data part of a message, or *ic_timeout* is less than -1.

ENXIO

Hang-up received on *fildev*.

ETIME

A downstream ioctl() timed out before acknowledgement was received.

An I_STR can also fail while waiting for an acknowledgement if a message indicating an error or a hang-up is received at the STREAM head. In addition, an error code can be returned in the positive or negative acknowledgement message, in the event the ioctl() command sent downstream fails. For these cases, I_STR fails with *errno* set to the value in the message.

I_SWROPT

Sets the write mode using the value of the argument *arg*. Valid bit settings for *arg* are:

SNDZERO

Send a zero-length message downstream when a write() of 0 bytes occurs. To not send a zero-length message when a write() of 0 bytes occurs, this bit must not be set in *arg* (for example, *arg* would be set to 0).

ioctl() with the I_SWROPT command will fail if:

Error Code

Description

EINVAL

arg is not the above value.

I_GWROPT

Returns the current write mode setting as described above, in the `int` that is pointed to by the argument *arg*.

I_SENDFD

I_SENDFD creates a new reference to the open file description associated with the file descriptor *arg* and writes a message on the STREAMS-based pipes *fildev* containing the reference, together with the user ID and group ID of the calling process.

`ioctl()` with the **I_SENDFD** command will fail if:

Error Code**Description****EAGAIN**

The sending STREAM is unable to allocate a message block to contain the file pointer; or the read queues of the receiving STREAM head is full and cannot accept the message sent by **I_SENDFD**.

EBADF

The *arg* argument is not a valid, open file descriptor.

EINVAL

The *fildev* argument is not connected to a STREAM pipe.

ENXIO

Hang-up received on *fildev*.

I_RECVFD

Retrieves the reference to an open file description from a message within a STREAMS-based pipe using the **I_SENDFD** command, and allocates a new file descriptor in the calling process that refers to this open file description. The *arg* argument is a pointer to an **strrecvfd** data structure as defined in `<stropts.h>`.

The **fd** member is a file descriptor. The **uid** and **gid** members are the effective user ID and effective group ID, respectively, of the sending process.

If **O_NONBLOCK** is not set **I_RECVFD** blocks until a message is present at the STREAM head. If **O_NONBLOCK** is set, **I_RECVFD** fails with `errno` set to **EAGAIN** if no message is present at the STREAM head.

If the message at the STREAM head is a message sent by an **I_SENDFD**, a new file descriptor is allocated for the open file descriptor referenced in the message. The new file descriptor is placed in the **fd** member of the **strrecvfd** structure pointed to by *arg*.

`ioctl()` with the **I_RECVFD** command will fail if:

Error Code**Description****EAGAIN**

A message is not present at the STREAM head read queue and the **O_NONBLOCK** flag is set.

EBADMSG

The message at the STREAM head read queue is not a message containing a passed file descriptor.

EMFILE

The process has the maximum number of file descriptors currently open that is allowed.

ENXIO

Hang-up received on *fildev*.

I_LIST

This request allows the process to list all the module names on the STREAM, up to and including the topmost driver names. If *arg* is a `NULL` pointer, the return value is the number of modules, including the driver, that are on the STREAM pointed to by *fildev*. This lets the process allocate enough space for the module names. Otherwise, it should point to an **str_list** structure.

The **sl_nmods** member indicates the number of entries the process has allocated in the array. Upon return, the **sl_modlist** member of the **str_list** structure contains the list of module names. The number of entries that have been filled into the **sl_modlist** array is found in the **sl_nmode** member (the number includes the number of module including the driver). The return value from **ioctl()** is 0. The entries are filled in starting at the top of the STREAM and continuing downstream until either the end of the STREAM is reached, or the number of requested modules (**sl_nmods**) is satisfied.

ioctl() with the **I_LIST** command will fail if:

Error Code

Description

EAGAIN or ENOSR

Unable to allocate buffers.

EINVAL

The **sl_nmods** member is less than 1.

I_ATMARK

This request allows the process to see if the message at the head of the STREAM head read queue is marked by some module downstream. The *arg* argument determines how the checking is done when there may be multiple marked messages on the STREAM head read queue. It may take on the following values:

ANYMARK Check if the message is marked.

LASTMARK Check if the message is the last one marked on the queue.

The bitwise inclusive-OR of the flags ANYMARK and LASTMARK is permitted.

The return value is 1 if the mark condition is satisfied and 0 otherwise.

ioctl() with the **I_ATMARK** command will fail if:

EINVAL Non-valid *arg* value.

I_CKBAND

Check if the message of a given priority band exists on the STREAM head read queue. This returns 1 if a message of the given priority exists, 0 if no message exists, or -1 on error. *arg* should be of type int.

ioctl() with the **I_CKBAND** command will fail if :

EINVAL Non-valid *arg* value.

I_GETBAND

Return the priority band of the first message on the STREAM head read queue in the integer referenced by *arg*.

ioctl() with the **I_GETBAND** command will fail if:

ENODATA No message on the STREAM head read queue.

I_CANPUT

Check if a certain band is writable. *arg* is set to the priority band in question. The return value is 0 if the band is flow-controlled, 1 if the band is writable, or -1 on error.

ioctl() with the **I_CANPUT** command will fail if:

EINVAL Non-valid *arg* value.

I_SETCLTIME

This request allows the process to set the time the STREAM head will delay when a STREAM is closing and there is data on the write queues. Before closing each module or driver, if there is a data on its write queue, the STREAM head will delay for the specified amount of time to allow the data to drain. If, after the delay, data is still present, it will be flushed. The *arg* argument is a pointer to an integer specifying the number of milliseconds to delay, rounded up to the nearest valid value. If **I_SETCLTIME** is not performed on a STREAM, an implementation-dependent default timeout interval is used.

ioctl() with the **I_SETCLTIME** command will fail if:

EINVAL Non-valid *arg* value.

I_GETCLTIME

This request returns the close time delay in the integer pointed to by *arg*

Multiplexed STREAMS configurations: The following four commands are used for connecting and disconnecting multiplexed STREAMS configurations. These commands use an implementation-dependent default timeout interval.

I_LINK

Connects two STREAMS, where *fildev* is the file descriptor of the STREAM connected to the multiplexing driver, and *arg* is the file descriptor of the STREAM connected to another driver. The STREAM designated by *arg* gets connected below the multiplexing driver. I_LINK requires the multiplexing driver to send an acknowledgement message to the STREAM head regarding the connection. This call returns a multiplexer ID number (an identifier used to disconnect the multiplexer; see (I_UNLINK) on success, and -1 on failure.

ioctl() with the I_LINK command will fail if:

Error Code

Description

EAGAIN or ENOSR

Unable to allocate STREAMS storage to perform the I_LINK.

EBADF

The *arg* argument is not a valid, open file descriptor.

EINVAL

The *fildev* does not support multiplexing; or *arg* is not a STREAM or is already connected downstream from a multiplexer, or the specified I_LINK operation would connect the STREAM head in more than one place in the multiplexed STREAM.

ENXIO

Hang-up received on *fildev*.

ETIME

Time out before acknowledgement message was received at STREAM head.

An I_LINK can also fail while waiting for the multiplexing driver to acknowledge the request, if a message indicating an error or a hang-up is received at the STREAM head of *fildev*. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, I_LINK fails with *errno* set to the value in the message.

I_UNLINK

Disconnects the two STREAMS specified by *fildev* and *arg*. *fildev* is the file descriptor of the STREAM connected to the multiplexing driver. The *arg* argument is the multiplexer ID number that was returned by the I_LINK ioctl() command when a STREAM was connected downstream from the multiplexing driver. If *arg* is MUXID_ALL, then all STREAMS that were connected to *fildev* are disconnected. As in I_LINK, this command requires acknowledgement.

ioctl() with the I_UNLINK command will fail if:

Error Code

Description

EAGAIN or ENOSR

Unable to allocate buffers for the acknowledgement message.

EINVAL

Non-valid multiplexer ID number.

ENXIO

Hang-up received on *fildev*.

ETIME

Time out before acknowledgement message was received at STREAM head.

An `I_UNLINK` can also fail while waiting for the multiplexing driver to acknowledge the request if a message indicating an error or a hang-up is received at the STREAM head of *fildev*. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, `I_UNLINK` fails with `errno` set to the value in the message.

I_PLINK

Creates a *persistent connection* between two STREAMs, where *fildev* is the file descriptor of the STREAM connected to another driver. This call creates a persistent connection which can exist even if the file descriptor *fildev* associated with the upper STREAM to the multiplexing driver is closed. The STREAM designated by *arg* gets connected using a persistent connection below the multiplexing driver. `I_PLINK` requires the multiplexing driver to send an acknowledgement message to the STREAM head. This call returns a multiplexer ID number (an identifier that may be used to disconnect the multiplexer, see `I_PUNLINK`) on success, and -1 on failure.

`ioctl()` with the `I_PLINK` command will fail if:

Error Code

Description

EAGAIN or ENOSR

Unable to allocate STREAMS storage to perform the `I_PLINK`.

EBADF

The *arg* argument is not valid, open file descriptor.

EINVAL

The *fildev* argument does not support multiplexing; or *arg* is not a STREAM or is already connected downstream from a multiplexer; or the specified `I_PLINK` operation would connect the STREAM head in more than one place in the multiplexed STREAM.

ENXIO

Hang-up received on *fildev*.

ETIME

Time out before acknowledgement message was received at STREAM head.

An `I_PLINK` can also fail while waiting for the multiplexing driver to acknowledge the request, if a message indicating an error or a hang-up is received at the STREAM head of *fildev*. In addition, an error code can be returned in the positive or negative acknowledgement message. For these cases, `I_PLINK` fails with `errno` set to the value in the message.

I_PUNLINK

Disconnects the two STREAMs specified by *fildev* and *arg* from a persistent connection. The *fildev* argument is the file descriptor of the STREAM connected to the multiplexing driver. The *arg* argument is the multiplexer ID number that was returned by the `I_PLINK` `ioctl()` command when a STREAM was connected downstream from the multiplexing driver. If *arg* is `MUXID_ALL` then all STREAMs which are persistent connections to *fildev* are disconnected. As in `I_PLINK`, this command requires the multiplexing driver to acknowledge the request.

`ioctl()` with the `I_PUNLINK` command will fail if:

Error Code

Description

EAGAIN or ENOSR

Unable to allocate buffers for the acknowledgement message.

EINVAL

Non-valid multiplexer ID number.

ENXIO

Hang-up received on *fildev*.

ETIME

Time out before acknowledgement message was received at STREAM head.

An `I_PUNLINK` can also fail while waiting for the multiplexing driver to acknowledge the request if a message indicating an error or a hang-up is received at the STREAM head of *fildev*. In addition, an

error code can be returned in the positive or negative acknowledgement message. For these cases, I_PUNLINK fails with errno set to the value in the message.

STREAMS returned value

If successful, ioctl() returns a value other than -1 that depends upon the STREAMS device control function.

If unsuccessful, ioctl() returns -1 and sets errno to one of the following values.

Note: It is impossible for ioctl() to perform any STREAMS type commands successfully, since z/OS UNIX services do not provide any STREAMS-based files. The function will always return -1 with errno set to indicate the failure. See [“open\(\) — Open a file”](#) on page 1157 for more information.

Under the following general conditions, ioctl() will fail if:

Error Code

Description

EBADF

The *fdes* argument is not a valid open file descriptor.

EINTR

A signal was caught during the ioctl() operation.

EINVAL

The STREAM or multiplexer referenced by *fdes* is linked (directly or indirectly) downstream from a multiplexer.

If an underlying device driver detects an error, ioctl() will fail if:

Error Code

Description

EINVAL

The *cmd* or *arg* argument is not valid for this device.

EIO

Some physical I/O error has occurred.

ENODEV

The *fdes* argument refers to a valid STREAMS device, but the corresponding device driver does not support ioctl().

ENOTTY

The *fdes* argument is not associated with a STREAMS device that accepts control functions.

ENXIO

The *cmd* or *arg* argument is not valid for this device driver, but the service requested can not be performed on this particular sub-device.

If a STREAM is connected downstream from a multiplexer, any ioctl() command except I_UNLINK and I_PUNLINK will set errno to EINVAL.

ACLs

The following ioctl() commands are used with ACLs:

Command

Description

SETFACL

Set ACL. Used to set information into an Access Control List. *arg* specifies the user buffer containing the input ACL which is mapped by struct ACL_buf followed immediately by an array of struct ACL_ents. *arglen* specifies the combined length of the struct ACL_buf and the array of struct ACL_ents. See [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#) for more information about ACL_buf and the ACL_ents.

GETFACL

Get ACL. Used to retrieve information from an Access Control List. *arg* specifies the user buffer into which the requested ACL will be returned. The data is mapped by struct ACL_BUF followed immediately by an array of struct ACL_entrys. See *z/OS UNIX System Services Programming: Assembler Callable Services Reference* for more information about ACL_buf and the ACL_entrys. *Arglen* specifies the combined length of the struct ACL and the array of struct ACL_entrys in the user buffer.

ACLs returned value

If successful, ioctl() returns 0.

If unsuccessful, ioctl() returns -1 and sets errno to one of the following values:

Error Code**Description****EBADF**

The *filde*s parameter is not a valid file descriptor.

EINVAL

The request is not valid or not supported.

EMVSPARM

Incorrect parameters were passed to the service.

ENODEV

The device is incorrect. The function is not supported by the device driver.

Example of ACLs

The following is an example of the ioctl() call.

```
int s;
int rc;
int acllen;
ext_acl_t aclbufp;
s = open("datafile", O_RDWR);
acllen = sizeof struct ACL_buf + (1024 * sizeof ACL_entry);
aclbufp = (ext_acl_t) malloc(acllen);
rc = ioctl(s, GETFACL, acllen, aclbufp)
```

Related information

- [“net/if.h — Network interface structures and definitions” on page 46](#)
- [“net/rtroute.h — Network routing structures and definitions” on page 47](#)
- [“stropts.h — Stream interface” on page 67](#)
- [“sys/ioctl.h — System I/O definitions and structures” on page 69](#)
- [“close\(\) — Close a file” on page 293](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getmsg\(\), getpmsg\(\) — Receive next message from a STREAMS file” on page 737](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“poll\(\) — Monitor activity on file descriptors and message queues” on page 1196](#)
- [“putmsg\(\), putpmsg\(\) — Send a message on a STREAM” on page 1355](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

__ipdbcs() – Retrieve the list of requested DBCS tables to load

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <__ftp.h>

struct __ipdbcss *__ipdbcs(void);
```

General description

The `__ipdbcs()` function determines the values that IP address resolution initialization found in the resolver configuration data set for the keywords `LoadDBCSTables`. If the `LoadDBCSTables` keywords are not found in the resolver configuration data set, the structure returned has a count of zero and each element in the structure list points to a NULL string.

Returned value

If successful, `__ipdbcs()` returns a NULL-terminated character string containing the complete structure `__ipdbcss` with each entry in `__ip_dbcs_list[]` initialized either to a valid name or to a NULL string. The number of valid names, up to the maximum of 8, is placed in `__ipdbcsnum`. If no table names are specified then `__ipdbcsnum` is set to zero.

If unsuccessful, `__ipdbcs()` returns NULL and stores one of the following error values in `h_errno`. `__ipdbcs()` is only unsuccessful if IP Address Resolution initialization fails to complete.

Error Code

Description

NO_RECOVERY

An error occurred that will continue to fail if tried again. Storage could not be obtained for this thread to contain the `_res` structure.

TRY_AGAIN

An error occurred while initializing the `__res_state` structure name selected, which can be retried.

Related information

- “[__ftp.h – FTP resolver functions](#)” on page 27
- “[__ipdsp\(\) – Retrieve the data set prefix specified](#)” on page 891
- “[__ipmsgc\(\) – Determine the case to use for FTP messages](#)” on page 893

__ipDomainName() – Retrieve the resolver supplied domain name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | OS/390 V2R9 |

Format

```
#include <__ftp.h>

char *__ipDomainName(void);
```

General description

Lets an application get the values which IP address resolution initialization established for the domain name (supplied by keywords Domain or DomainOrigin).

Returned value

If successful, __ipDomainName() returns the NULL-terminated character string which is the name found for the domain name or a NULL string if no domain name was found in the IP address resolution initialization.

If unsuccessful, __ipDomainName() returns NULL and stores one of the following error values in h_errno. The __ipDomainName() function is only unsuccessful if IP address resolution initialization fails to complete.

Error Code Description

NO_RECOVERY

An error occurred that will continue to fail if tried again. Storage could not be obtained for this thread to contain the _res structure.

TRY_AGAIN

An error occurred while initializing the __res_state structure name selected, which can be retried.

Related information

- [“__ftp.h – FTP resolver functions” on page 27](#)
- [“__ipdbcs\(\) – Retrieve the list of requested DBCS tables to load” on page 890](#)
- [“__ipdspx\(\) – Retrieve the data set prefix specified” on page 891](#)
- [“__iphost\(\) – Retrieve the resolver supplied hostname” on page 892](#)
- [“__ipmsgc\(\) – Determine the case to use for FTP messages” on page 893](#)
- [“__ipnode\(\) – Retrieve the resolver supplied node name” on page 894](#)
- [“__iptcpn\(\) – Retrieve the resolver supplied jobname or user ID” on page 894](#)

[__ipdspx\(\) – Retrieve the data set prefix specified](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <__ftp.h>

char *__ipdspx(void);
```

General description

The __ipdspx() function determines the value that IP address resolution initialization found in the resolver configuration data set for the keyword DataSetPrefix. If no DataSetPrefix keyword is found in the resolver configuration data set, then the default value is returned.

Returned value

If successful, __ipdspx() returns the NULL-terminated character string that was supplied in the configuration data set. If the configuration data set did not supply a value for the keyword DataSetPrefix, then __ipdspx() returns the string TCPIP.

If unsuccessful, __ipdspx() returns NULL and stores one of the following error values in h_errno. __ipdspx() is only unsuccessful if IP Address Resolution initialization fails to complete.

| Error Code | Description |
|------------|-------------|
|------------|-------------|

NO_RECOVERY
An error occurred that will continue to fail if tried again. Storage could not be obtained for this thread to contain the _res structure.

TRY_AGAIN
An error occurred while initializing the __res_state structure name selected, which can be retried.

Related information

- [“__ftp.h – FTP resolver functions” on page 27](#)
- [“__ipdbcs\(\) – Retrieve the list of requested DBCS tables to load” on page 890](#)
- [“__ipmsgc\(\) – Determine the case to use for FTP messages” on page 893](#)

__iphost() – Retrieve the resolver supplied hostname

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <__ftp.h>

char *__iphost(void);
```

General description

The __iphost() function lets an application determine the values that IP address resolution initialization found in the resolver configuration data set for the keyword HOSTname. If the keyword is not found in the resolver configuration data set, the char string returned will be a NULL string.

Returned value

If successful, __iphost() returns the NULL-terminated character string, which is the name supplied on the HOSTname keyword found in the resolver configuration file.

If unsuccessful, __iphost() returns NULL and stores one of the following error values in h_errno. __iphost() is only unsuccessful if IP Address Resolution initialization fails to complete.

Error Code Description

NO_RECOVERY

An error occurred that will continue to fail if tried again. Storage could not be obtained for this thread to contain the `_res` structure.

TRY_AGAIN

An error occurred while initializing the `__res_state` structure name selected, which can be retried.

Related information

- [“__ftp.h — FTP resolver functions” on page 27](#)
- [“__ipdbcs\(\) — Retrieve the list of requested DBCS tables to load” on page 890](#)
- [“__ipdsp\(\) — Retrieve the data set prefix specified” on page 891](#)
- [“__ipmsgc\(\) — Determine the case to use for FTP messages” on page 893](#)
- [“__ipnode\(\) — Retrieve the resolver supplied node name” on page 894](#)
- [“__iptcpn\(\) — Retrieve the resolver supplied jobname or user ID” on page 894](#)

[__ipmsgc\(\) — Determine the case to use for FTP messages](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <__ftp.h>

int __ipmsgc(void);
```

General description

The `__ipmsgc()` function determines the value that IP address resolution initialization found in the resolver configuration data set for the keyword `MessageCase`. If no `MessageCase` keyword is found in the resolver configuration data set, then the default value is returned.

The *init* argument returned is one of the following set of symbols defined in the `__ftp.h` header file, each one stands for a message case selection.

__MIXED

Represents mixed case value selected for the messages FTP will send.

__UPPER

Represents uppercase value selected for the messages FTP will send.

Returned value

`__ipmsgc()` is always successful and returns either the value of the `__MIXED` or the value of `__UPPER` for all requests. `__MIXED` is the default value.

Related information

- [“__ftp.h — FTP resolver functions” on page 27](#)
- [“__ipdbcs\(\) — Retrieve the list of requested DBCS tables to load” on page 890](#)
- [“__ipdsp\(\) — Retrieve the data set prefix specified” on page 891](#)

__ipnode() – Retrieve the resolver supplied node name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <__ftp.h>

char *__ipnode(void);
```

General description

The `__ipnode()` function lets an application determine the values that IP address resolution initialization found as the NodeID name used by the VMCF platform. If the VMCF nodeID name is not found, the char string returned will be a NULL string.

Returned value

If successful, `__ipnode()` returns the NULL-terminated character string, which is the name found for the VMCF platform.

If unsuccessful, `__ipnode()` returns NULL and stores one of the following error values in `h_errno`. `__ipnode()` is only unsuccessful if IP Address Resolution initialization fails to complete.

Error Code

Description

NO_RECOVERY

An error occurred that will continue to fail if tried again. Storage could not be obtained for this thread to contain the `_res` structure.

TRY_AGAIN

An error occurred while initializing the `__res_state` structure name selected, which can be retried.

Related information

- [“__ftp.h – FTP resolver functions” on page 27](#)
- [“__ipdbcs\(\) – Retrieve the list of requested DBCS tables to load” on page 890](#)
- [“__ipdsp\(\) – Retrieve the data set prefix specified” on page 891](#)
- [“__iphos\(\) – Retrieve the resolver supplied hostname” on page 892](#)
- [“__ipmsgc\(\) – Determine the case to use for FTP messages” on page 893](#)
- [“__iptcpn\(\) – Retrieve the resolver supplied jobname or user ID” on page 894](#)

__iptcpn() – Retrieve the resolver supplied jobname or user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <__ftp.h>

char *__iptcpn(void);
```

General description

The `__iptcpn()` function lets an application determine the values that IP address resolution initialization found in the resolver configuration data set for either of the keywords `TCPIPuserid` or `TCPIPjobname`, whichever is the last one read. If neither keyword is found in the resolver configuration data set, the char string returned will be a NULL string.

Returned value

If successful, `__iptcpn()` returns the NULL-terminated character string which is the name supplied on the `TCPIPuserid` or `TCPIPjobname` keyword found in the resolver configuration file.

If unsuccessful, `__iptcpn()` returns NULL and stores one of the following error values in `h_errno`. `__iptcpn()` is only unsuccessful if IP Address Resolution initialization fails to complete.

Error Code

Description

NO_RECOVERY

An error occurred that will continue to fail if tried again. Storage could not be obtained for this thread to contain the `_res` structure.

TRY_AGAIN

An error occurred while initializing the `__res_state` structure name selected, which can be retried.

Related information

- “[__ftp.h – FTP resolver functions](#)” on page 27
- “[setibmopt\(\) – Set IBM TCP/IP image](#)” on page 1536

isalnum() to isxdigit() – Test integer value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <ctype.h>

int isalnum(int c);
int isalpha(int c);
int iscntrl(int c);
int isdigit(int c);
int isgraph(int c);
int islower(int c);
int isprint(int c);
int ispunct(int c);
```

```
int isspace(int c);
int isupper(int c);
int isxdigit(int c);
```

General description

The functions that are listed above, which are all declared in `ctype.h`, test a given integer value. The valid integer values for `c` are those representable as an *unsigned char* or EOF.

By default, the functions are defined as macros when `ctype.h` is included. For better performance, the macro forms are recommended over the functional forms.

However, to get the functional forms, do one or more of the following:

- For C only: do *not* include `ctype.h`.
- Specify `#undef`, for example, `#undef islower`
- Surround the call statement by parentheses, for example, `(islower)('a')`

Here are descriptions of each function in this group.

isalnum()

Test for an upper- or lowercase letter, or a decimal digit, as defined in the `alnum` locale source file and in the `alnum` class of the `LC_CTYPE` category of the current locale.

isalpha()

Test for an alphabetic character, as defined in the `alpha` locale source file and in the `alpha` class of the `LC_CTYPE` category of the current locale.

If the macro `_EXTEND_CTABLE` is defined, the integer values for `c` are those representable as an `unsigned char`, `signed char`, or EOF.

If the environment variable `_CTYPE_FUNC_EXT` is set, the functional forms support integer values representable as an `unsigned char`, `signed char`, or EOF.

iscntrl()

Test for any control character, as defined in the `cntrl` locale source file and in the `cntrl` class of the `LC_CTYPE` category of the current locale.

isdigit()

Test for a decimal digit, as defined in the `digit` locale source file and in the `digit` class of the `LC_CTYPE` category of the current locale.

isgraph()

Test for a printable character excluding space, as defined in the `graph` locale source file and in the `graph` class of the `LC_CTYPE` category of the current locale.

islower()

Test for a lowercase character, as defined in the `lower` locale source file and in the `lower` class of the `LC_CTYPE` category of the current locale.

isprint()

Test for a printable character including space, as defined in the `print` locale source file and in the `print` class of the `LC_CTYPE` category of the current locale.

ispunct()

Test for any nonalphanumeric printable character, excluding space, as defined in the `punct` locale source file and in the `punct` class of the `LC_CTYPE` category of the current locale.

isspace()

Test for a white space character, as defined in the `space` locale source file and in the `space` class of the `LC_CTYPE` category of the current locale.

isupper()

Test for an uppercase character, as defined in the `upper` locale source file and in the `upper` class of the `LC_CTYPE` category of the current locale.

isxdigit()

Test for a hexadecimal digit, as defined in the `xdigit` locale source file and in the `xdigit` class of the `LC_CTYPE` category of the current locale.

The space, uppercase, and lowercase characters can be redefined by their respective class of the `LC_CTYPE` in the current locale. The `LC_CTYPE` category is discussed in the “Internationalization: Locales and Character Sets” in *z/OS XL C/C++ Programming Guide*.

Returned value

If the integer satisfies the test condition, these functions return nonzero.

If the integer does not satisfy the test condition, these functions return 0.

Example**CELEBI02**

```
/* CELEBI02

This example analyzes all characters between code 0x0 and
code UPPER_LIMIT.
The output of this example is a 256-line table showing the
characters from 0 to 255, and a notification of whether they
have the attributes tested.

*/
#include <stdio.h>
#include <ctype.h>

#define UPPER_LIMIT 0xFF

int main(void)
{
    int ch;

    for ( ch = 0; ch <= UPPER_LIMIT; ++ch )
    {
        printf("%3d ", ch);
        printf("%#04x ", ch);
        printf(" %c", isprint(ch) ? ch : ' ');
        printf("%3s", isalnum(ch) ? "Alphanumeric" : " ");
        printf("%2s", isalpha(ch) ? "Alphabetic" : " ");
        printf("%2s", iscntrl(ch) ? "Control" : " ");
        printf("%2s", isdigit(ch) ? "Digit" : " ");
        printf("%2s", isgraph(ch) ? "Graphic" : " ");
        printf("%2s", islower(ch) ? "Lower" : " ");
        printf("%3s", ispunct(ch) ? "Punctuation" : " ");
        printf("%2s", isspace(ch) ? "Space" : " ");
        printf("%3s", isprint(ch) ? "Printable" : " ");
        printf("%2s", isupper(ch) ? "Upper" : " ");
        printf("%2s", isxdigit(ch) ? "Hex" : " ");

        putchar('\n');
    }
}
```

Related information

- [“ctype.h – Character classification” on page 17](#)
- [“isblank\(\) – Test for blank character classification” on page 905](#)
- [“iswalnum\(\) to iswxdigit\(\) – Test wide integer value” on page 920](#)
- [“setlocale\(\) – Set locale” on page 1547](#)
- [“tolower\(\), toupper\(\) – Convert character case” on page 1883](#)

isalpha() – Test for an alphabetic character

The information for this function is included in [“isalnum\(\) to isxdigit\(\) – Test integer value” on page 895](#).

isascii() – Test for 7-bit US-ASCII character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

_XOPEN_SOURCE:

```
#define _XOPEN_SOURCE
#include <ctype.h>

int isascii(int c);
```

_ALL_SOURCE:

```
#define _ALL_SOURCE
#include <ctype.h>

int isascii(int c);
```

General description

Special behavior for _XOPEN_SOURCE: The isascii() function tests whether c is a 7-bit US-ASCII character code. The isascii() function is defined on all integer values.

Special behavior for _ALL_SOURCE: The isascii() function tests whether the character with EBCDIC encoding c in the current locale is a member of the set of POSIX Portable Characters and POSIX Control Characters shown below.

Returned value

Special behavior for _XOPEN_SOURCE: isascii() returns nonzero if c is a 7-bit US-ASCII character code between 0 and hexadecimal 007F inclusive; otherwise it returns 0.

Special behavior for _ALL_SOURCE: isascii() returns nonzero if c is the EBCDIC encoding in the current locale for a character in the set of POSIX Portable Characters and Control Characters; otherwise it returns 0.

Following is a list of the symbolic names, IBM-1047 EBCDIC code page encoding, and ISO8859-1 ASCII encoding for the set of POSIX Portable Characters and POSIX Control Characters. Cases where EBCDIC character encoding varies across EBCDIC Country Extended Code Pages (CECPs) are noted.

| Table 34. Characters for which isascii() returns nonzero | | |
|--|-------------------------|--------------------------|
| Character (Symbolic Name) | IBM-1047 Encoding (Hex) | ISO8859-1 Encoding (Hex) |
| <NUL> | 00 | 00 |
| <SOH> | 01 | 01 |
| <STX> | 02 | 02 |
| <ETX> | 03 | 03 |

Table 34. Characters for which `isascii()` returns nonzero (continued)

| Character (Symbolic Name) | IBM-1047 Encoding (Hex) | ISO8859-1 Encoding (Hex) |
|---------------------------|-------------------------|--------------------------|
| <EOT> | 37 | 04 |
| <ENQ> | 2D | 05 |
| <ACK> | 2E | 06 |
| <BEL> <alert> | 2F | 07 |
| <BS> <backspace> | 16 | 08 |
| <HT> <tab> | 05 | 09 |
| <NL> <newline> | 15 | 0A |
| <VT> <vertical-tab> | 0B | 0B |
| <FF> <form-feed> | 0C | 0C |
| <CR> <carriage-return> | 0D | 0D |
| <SO> | 0E | 0E |
| <SI> | 0F | 0F |
| <DLE> | 10 | 10 |
| <DC1> | 11 | 11 |
| <DC2> | 12 | 12 |
| <DC3> | 13 | 13 |
| <DC4> | 3C | 14 |
| <NAK> | 3D | 15 |
| <SYN> | 32 | 16 |
| <ETB> | 26 | 17 |
| <CAN> | 18 | 18 |
| | 19 | 19 |
| <SUB> | 3F | 1A |
| <ESC> | 27 | 1B |
| <IFS/IS4> | 1C | 1C |
| <IGS/IS3> | 1D | 1D |
| <IRS/IS2> | 1E | 1E |
| <IUS/ITB/IS1> | 1F | 1F |
| <space> | 40 | 20 |
| <exclamation-mark> | 5A (cecp variant) | 21 |
| <quotation-mark> | 7F | 22 |
| <number-sign> | 7B (cecp variant) | 23 |
| <dollar-sign> | 5B (cecp variant) | 24 |
| <percent-sign> | 6C | 25 |

Table 34. Characters for which isascii() returns nonzero (continued)

| Character (Symbolic Name) | IBM-1047 Encoding (Hex) | ISO8859-1 Encoding (Hex) |
|---------------------------|-------------------------|--------------------------|
| <ampersand> | 50 | 26 |
| <apostrophe> | 7D | 27 |
| <left-parenthesis> | 4D | 28 |
| <right-parenthesis> | 5D | 29 |
| <asterisk> | 5C | 2A |
| <plus-sign> | 4E | 2B |
| <comma> | 6B | 2C |
| <hyphen> | 60 | 2D |
| <period> | 4B | 2E |
| <slash> | 61 | 2F |
| <zero> | F0 | 30 |
| <one> | F1 | 31 |
| <two> | F2 | 32 |
| <three> | F3 | 33 |
| <four> | F4 | 34 |
| <five> | F5 | 35 |
| <six> | F6 | 36 |
| <seven> | F7 | 37 |
| <eight> | F8 | 38 |
| <nine> | F9 | 39 |
| <colon> | 7A | 3A |
| <semicolon> | 5E | 3B |
| <less-than-sign> | 4C | 3C |
| <equals-sign> | 7E | 3D |
| <greater-than-sign> | 6E | 3E |
| <question-mark> | 6F | 3F |
| <commercial-at> | 7C (cecp variant) | 40 |
| <A> | C1 | 41 |
| | C2 | 42 |
| <C> | C3 [®] | 43 |
| <D> | C4 | 44 |
| <E> | C5 | 45 |
| <F> | C6 | 46 |
| <G> | C7 | 47 |

Table 34. Characters for which `isascii()` returns nonzero (continued)

| Character (Symbolic Name) | IBM-1047 Encoding (Hex) | ISO8859-1 Encoding (Hex) |
|---------------------------|-------------------------|--------------------------|
| <H> | C8 | 48 |
| <I> | C9 | 49 |
| <J> | D1 | 4A |
| <K> | D2 | 4B |
| <L> | D3 | 4C |
| <M> | D4 | 4D |
| <N> | D5 | 4E |
| <O> | D6 | 4F |
| <P> | D7 | 50 |
| <Q> | D8 | 51 |
| <R> | D9 | 52 |
| <S> | E2 | 53 |
| <T> | E3 | 54 |
| <U> | E4 | 55 |
| <V> | E5 | 56 |
| <W> | E6 | 57 |
| <X> | E7 | 58 |
| <Y> | E8 | 59 |
| <Z> | E9 | 5A |
| <left-square-bracket> | AD (cecp variant) | 5B |
| <backslash> | E0 (cecp variant) | 5C |
| <right-square-bracket> | BD (cecp variant) | 5D |
| <circumflex> | 5F (cecp variant) | 5E |
| <underscore> | 6D | 5F |
| <grave-accent> | 79 (cecp variant) | 60 |
| <a> | 81 | 61 |
| | 82 | 62 |
| <c> | 83 | 63 |
| <d> | 84 | 64 |
| <e> | 85 | 65 |
| <f> | 86 | 66 |
| <g> | 87 | 67 |
| <h> | 88 | 68 |
| <i> | 89 | 69 |

Table 34. Characters for which `isascii()` returns nonzero (continued)

| Character (Symbolic Name) | IBM-1047 Encoding (Hex) | ISO8859-1 Encoding (Hex) |
|---------------------------|-------------------------|--------------------------|
| <j> | 91 | 6A |
| <k> | 92 | 6B |
| <l> | 93 | 6C |
| <m> | 94 | 6D |
| <n> | 95 | 6E |
| <o> | 96 | 6F |
| <p> | 97 | 70 |
| <q> | 98 | 71 |
| <r> | 99 | 72 |
| <s> | A2 | 73 |
| <t> | A3 | 74 |
| <u> | A4 | 75 |
| <v> | A5 | 76 |
| <w> | A6 | 77 |
| <x> | A7 | 78 |
| <y> | A8 | 79 |
| <z> | A9 | 7A |
| <left-brace> | C0 (cecp variant) | 7B |
| <vertical-line> | 4F (cecp variant) | 7C |
| <right-brace> | D0 (cecp variant) | 7D |
| <tilde> | A1 (cecp variant) | 7E |
| | 07 | 7F |

Related information

- [“ctype.h — Character classification” on page 17](#)
- [“toascii\(\) — Translate integer to a 7-bit ASCII character” on page 1877](#)

isastream() — Test a file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stropts.h>

int isastream(int fildes);
```

General description

The `isastream()` function tests whether *fildes*, an open file descriptor, is associated with a STREAMS-based file.

Returned value

If successful, `isastream()` returns 1 if *fildes* refers to a STREAMS-based file and 0 if not.

If unsuccessful, `isastream()` returns -1 and sets `errno` to one of the following values.

Note: z/OS UNIX services do not supply any STREAMS devices or pseudodevices. It is impossible for `isastream()` to return 1 since there are no STREAMS-based file descriptors. It will return 0 unless *fildes* is not a valid open file descriptor, in which case it will return -1 with `errno` set to indicate the failure. See [“open\(\) — Open a file” on page 1157](#)

Error Code

Description

EBADF

The *fildes* argument is not a valid open file descriptor.

Related information

- [“stropts.h — Stream interface” on page 67](#)

isatty() — Test if descriptor represents a terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int isatty(int fildes);
```

General description

Determines if a file descriptor, *fildes*, is associated with a terminal.

`isatty()` only works in an environment where either a controlling terminal exists, or `stdin` and `stderr` refer to tty devices. Specifically, it does not work in a TSO environment.

Returned value

isatty() returns 1 if the given file descriptor is a terminal, or 0 otherwise.

Special behavior for XPG4

isatty() returns 1 if the given file descriptor is a terminal, or 0 otherwise and sets errno to one of the following values:

Error Code

Description

EBADF

The *filides* argument is not a valid open file descriptor.

ENOTTY

The *filides* argument is not associated with a terminal.

Example

CELEBIO3

```
/* CELEBIO3

   This example determines if a file descriptor is
   associated with a terminal.

   */
#define _POSIX_SOURCE
#include <unistd.h>
#include <stdio.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <fcntl.h>

void check_fd(int fd) {
    printf("fd %d is ", fd);
    if (!isatty(fd))
        printf("NOT ");
    puts("a tty");
}

main() {
    int p[2], fd;
    char fn[]="temp.file";

    if (pipe(p) != 0)
        perror("pipe() error");
    else {
        if ((fd = creat(fn, S_IWUSR)) < 0)
            perror("creat() error");
        else {
            check_fd(0);
            check_fd(fileno(stderr));
            check_fd(p[1]);
            check_fd(fd);
            close(fd);
            unlink(fn);
        }
        close(p[0]);
        close(p[1]);
    }
}
```

Output

```
fd 0 is a tty
fd 2 is a tty
fd 4 is NOT a tty
fd 5 is NOT a tty
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

- [“ttyname\(\) — Get the name of a terminal”](#) on page 1913

__isBFP() — Determine application floating-point format

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | OS/390 V2R6 |

Format

```
#include <_Ieee754.h>

int __isBFP(void);
```

General description

The `__isBFP()` function determines the application floating-point mode.

Returned value

`__isBFP()` returns 1 if the floating-point mode of the caller is IEEE, and returns 0 if the floating-point mode of the caller is hexadecimal.

Related information

- [“_Ieee754.h — IEEE 754 interfaces”](#) on page 28
- [“fp_read_rnd\(\) — Determine rounding mode”](#) on page 585
- [“fp_swap_rnd\(\) — Swap rounding mode”](#) on page 586

isblank() — Test for blank character classification

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Language Environment Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <ctype.h>

int isblank(int c);
```

General description

Tests whether the current `LC_CTYPE` locale category assigns `c` the blank character attribute. The *tab* and *space* characters have the blank attribute in the POSIX locale (with name “POSIX” or “C”).

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Note: The `isblank()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

`isblank()` returns nonzero if the current `LC_CTYPE` locale category assigns `c` the blank character attribute. Otherwise, `isblank()` returns 0.

Example

```
/* This example tests if c is a blank type. */
#include <stdio.h>
#include <ctype.h>
#include <locale.h>

void check(char c) {
    if ((c != ' ') && (isprint(c)))
        printf(" %c is ", c);
    else
        printf("x%02x is ", c);
    if (!isblank(c))
        printf("not ");
    puts("a blank type character");
}

main() {
    printf("\nIn LC_CTYPE category of locale \ with name \"%s\":\n",
        setlocale(LC_CTYPE, NULL));
    check('a');
    check(' ');
    check(0x00);
    check('\n');
    check('\t');
}
```

Output:

```
In LC_CTYPE category of locale with name ".....";
 a  is not a blank type character
x40 is a blank type character
x00 is not a blank type character
x15 is not a blank type character
x05 is a blank type character
```

Related information

- [“ctype.h – Character classification”](#) on page 17
- [“iswalnum\(\) to iswxdigit\(\) – Test wide integer value”](#) on page 920
- [“iswblank\(\) – Test for blank character classification”](#) on page 922
- [“setlocale\(\) – Set locale”](#) on page 1547

iscics() – Verify whether CICS is running

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <cics.h>

int iscics(void);
```

General description

Determines whether the program is running under CICS.

Returned value

If your program is currently running under CICS, `iscics()` returns nonzero.

If not running under CICS, `iscics()` returns 0.

Example

CELEBI04

```
/* CELEBI04

   This example tests to see if the program is running under CICS.
   If not, it calls a subroutine ABCPGM; otherwise, it uses a CICS EXEC
   statement to invoke ABCPGM.

*/
#define _POSIX_SOURCE
#ifdef __cplusplus
extern "C" void ABCPGM(char *);
#else
#pragma linkage(ABCPGM, OS)
void ABCPGM(char *);
#endif

#include <stdio.h>
#include <cics.h>
#include <string.h>
#include <sys/wait.h>
#include <sys/types.h>
#include <unistd.h>

int main(void)
{
    char mydata[123];

    if (iscics() == 0)
    {
        /* not a CICS environment */
        ABCPGM(mydata);
    }

    else {
        /* this is a CICS environment */
        EXEC CICS, LINK PROGRAM,("ABCPGM  "), COMMAREA(mydata);
    }
}
```

Related information

- [“cics.h — Verify CICS” on page 17](#)

iscntrl() — Test for control classification

The information for this function is included in [“isalnum\(\) to isxdigit\(\) — Test integer value” on page 895](#).

isdigit() — Test for decimal-digit classification

The information for this function is included in [“isalnum\(\) to isxdigit\(\) — Test integer value” on page 895](#).

isfinite() – Determines if its argument has a finite value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int isfinite(real-floating x);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int isfinite(real-floating x); /* C only */
int isfinite(decimal-floating x); /*C only */
bool isfinite(real-floating x); /* C++ only */

#define _TR1_C99
#include <math.h>

bool isfinite(real-floating x); /* C++ only */
```

General description

The isfinite() macro or function template determines if its argument has a finite value.

| Function | Hex | IEEE |
|----------|-----|------|
| isfinite | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The isfinite() macro returns 1 if and only if its argument value is finite, else returns 0. The C++ function template returns true if and only if its argument value is finite, else returns false.

Special behavior in hex: The isfinite() macro always returns 1. The C++ function template always returns true.

Related information

- [“math.h – Floating-point math functions”](#) on page 40

isgraph() – Test for graphic classification

The information for this function is included in [“isalnum\(\) to isxdigit\(\) – Test integer value”](#) on page 895.

isgreater() — Determines if X is greater than Y

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int isgreater(real-floating x, real-floating y);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int isgreater(real-floating x, real-floating y); /* C only */
int isgreater(decimal-floating x, decimal-floating y); /* C only */
bool isgreater(real-floating x, real-floating y); /* C++ only */
bool isgreater(decimal-floating x, decimal-floating y); /* C++ only */

#define _TR1_C99
#include <math.h>

bool isgreater(real-floating x, real-floating y); /* C++ onl */
```

General description

The `isgreater()` macro or function template determines whether the argument `x` is greater than `y`. It is equivalent to `(x) > (y)`, but no exception is raised if `x` or `y` are NaN.

| Function | Hex | IEEE |
|------------------------|-----|------|
| <code>isgreater</code> | X | X |

Note:

- To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
- This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `isgreater()` macro returns 1 if the value of `x` is greater than `y`, else returns 0. The C++ function template returns `true` if the value of `x` is greater than `y`, else returns `false`.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

isgreaterqual() — Determines if X is greater than or equal to Y

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int isgreaterqual(real-floating x, real-floating y);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int isgreaterqual(real-floating x, real-floating y); /* C only */
int isgreaterqual(decimal-floating x, decimal-floating y); /* C only */
bool isgreaterqual(real-floating x, real-floating y); /* C++ only */
bool isgreaterqual(decimal-floating x, decimal-floating y); /* C++ only */

#define _TR1_C99
#include <math.h>

bool isgreaterqual(real-floating x, real-floating y); /* C++ only */
```

General description

The `isgreaterqual()` macro or function template determines whether the argument `x` is greater than or equal to `y`. It is equivalent to $(x) \geq (y)$, but no exception is raised if `x` or `y` are NaN.

| Function | Hex | IEEE |
|----------------------------|-----|------|
| <code>isgreaterqual</code> | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `isgreaterqual()` macro returns 1 if the value of `x` is greater than or equal to `y`, else returns 0. The C++ function template returns `true` if the value of `x` is greater than or equal to `y`, else returns `false`.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

isinf() — Determines if X is \pm infinity

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int isinf(real-floating x);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int isinf(real-floating x); /* C only */
int isinf(decimal-floating x); /* C only */
bool isinf(real-floating x); /* C++ only */

#define _TR1_C99
#include <math.h>

bool isinf(real-floating x); /* C++ only */
```

General description

The `isinf()` macro or function template determines if its argument is plus or minus infinity.

| Function | Hex | IEEE |
|----------|-----|------|
| isinf | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `isinf()` macro returns 1 if the argument is plus or minus infinity, else returns 0. The C++ function template returns true if the argument is plus or minus infinity, else returns false.

Special behavior in hex: The `isinf()` macro returns 0. The C++ function template returns false.

Related information

- [“math.h — Floating-point math functions”](#) on page 40

isless() — Determines if X is less than Y

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int isless(real-floating x, real-floating y);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int isless(real-floating x, real-floating y); /* C only */
int isless(decimal-floating x, decimal-floating y); /* C only */
bool isless(real-floating x, real-floating y); /* C++ only */
bool isless(decimal-floating x, decimal-floating y); /* C++ only */

#define _TR1_C99
#include <math.h>

bool isless(real-floating x, real-floating y); /* C++ only */
```

General description

The `isless()` macro or function template determines whether the argument `x` is less than `y`. It is equivalent to `(x) < (y)`, but no exception is raised if `x` or `y` are NaN.

| Function | Hex | IEEE |
|----------|-----|------|
| isless | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `isless()` macro returns 1 if the value of `x` is less than `y`, else returns 0. The C++ function template returns true if the value of `x` is less than `y`, else returns false.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

islessequal() — Determines if X is less than or equal to Y

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int islessequal(real-floating x, real-floating y);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int islessequal(real-floating x, real-floating y); /* C only */
int islessequal(decimal-floating x, decimal-floating y); /* C only */
bool islessequal(real-floating x, real-floating y); /* C++ only */
bool islessequal(decimal-floating x, decimal-floating y); /* C++ only */

#define _TR1_C99
#include <math.h>

bool islessequal(real-floating x, real-floating y); /* C++ only */
```

General description

The `islessequal()` macro or function template determines whether the argument `x` is less than or equal to `y`. It is equivalent to $(x) \leq (y)$, but no exception is raised if `x` or `y` are NaN.

| Function | Hex | IEEE |
|--------------------------|-----|------|
| <code>islessequal</code> | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `islessequal()` macro returns 1 if the value of `x` is less than or equal to `y`, else returns 0. The C++ function template returns `true` if the value of `x` is less than or equal to `y`, else returns `false`.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

islessgreater() — Determines if X is less or greater than Y

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int islessgreater(real-floating x, real-floating y);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int islessgreater(real-floating x, real-floating y); /* C only */
int islessgreater(decimal-floating x, decimal-floating y); /* C only */
bool islessgreater(real-floating x, real-floating y); /* C++ only */
bool islessgreater(decimal-floating x, decimal-floating y); /* C++ only */

#define _TR1_C99
#include <math.h>

bool islessgreater(real-floating x, real-floating y); /* C++ only */
```

General description

The `islessgreater()` macro or function template determines whether the argument `x` is less or greater than `y`. It is equivalent to `(x) || (y)`, but no exception is raised if `x` or `y` are NaN.

| Function | Hex | IEEE |
|----------------------------|-----|------|
| <code>islessgreater</code> | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `islessgreater()` macro returns 1 if the value of `x` is less or greater than `y`, else returns 0. The C++ function template returns `true` if the value of `x` is less or greater than `y`, else returns `false`.

Related information

- [“math.h — Floating-point math functions”](#) on page 40

islower() — Test for lowercase

The information for this function is included in [“isalnum\(\) to isxdigit\(\) — Test integer value”](#) on page 895.

ismccollet() — Identify a multicharacter collating element

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <collate.h>

int ismccollet(coll_t c);
```

General description

Determines whether a character is a multicharacter collating element. A collating element is a glyph, usually a character, that has a value used to define its order in a collating sequence. A multicharacter collating element is a sequence of two or more characters that are to be collated as one entity.

Returned value

ismccollet() returns:

- 1**
if coll_t represents a multicharacter collating element
- 0**
if coll_t represents a single-character collating element
- 1**
if coll_t is out of range, or otherwise not valid

Example

CELEBI05

```
/* CELEBI05

   This example prints all of the collating elements in the
   collating sequence, by using the &ismc. function to determine
   if the collating element is a multi-character collating
   element.

*/
#include <collate.h>
#include <locale.h>
#include <stdio.h>
#include <wchar.h>
#include <wctype.h>

main(int argc, char *argv[]) {
    coll_t e, *rp;
    int i;

    setlocale(LC_ALL, "");
    i = collorder(&rp);
    for (; i-- > 0; rp++) {
        if (ismccollet(*rp))
            printf("%s' ", colltostr(*rp));
        else if (iswprint(*rp))
            printf("%lc' ", *rp);
        else
            printf("%x' ", *rp);
    }
}
```

Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“cclass\(\) — Return characters in a character class” on page 243](#)
- [“collequiv\(\) — Return a list of equivalent collating elements” on page 300](#)
- [“collorder\(\) — Return list of collating elements” on page 301](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“colltostr\(\) — Return a string for a collating element” on page 304](#)
- [“getmccoll\(\) — Get next collating element from string” on page 736](#)
- [“getwmccoll\(\) — Get next collating element from wide string” on page 803](#)
- [“maxcoll\(\) — Return maximum collating element” on page 1043](#)
- [“strtocoll\(\) — Return collating element for string” on page 1757](#)

isnan() — Test for NaN

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _XOPEN_SOURCE
#include <math.h>

int isnan(double x);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int isnan(real-floating x); /* C only */
int isnan(decimal-floating x); /* C only */
bool isnan(real-floating x); /* C++ only */
bool isnan(decimal-floating x); /* C++ only */

#define _TR1_C99
#include <math.h>

bool isnan(double x); /* C++ only */
```

General description

The `isnan()` function tests whether `x` is NaN (not a number).

`isnan()` is available as a macro. For better performance, the macro form is recommended over the functional form. For C compiles only, to use the functional form, do one of the following:

- Do not include `math.h`.
- Specify `#undef isnan` after the inclusion of `math.h`.
- Enclose the call statement in parentheses.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

For IEEE Decimal Floating Point numbers and Binary Floating Point numbers, a non-zero value is returned if *x* is a NaN. The C++ function template returns true if *x* is a NaN.

Special behavior in Hex

The `isnan()` macro returns 0. The C++ function template returns false.

Related information

- [“math.h — Floating-point math functions”](#) on page 40

isnormal() — Determines if X is normal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int isnormal(real-floating x);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int isnormal(real-floating x); /* C only */
int isnormal(decimal-floating x); /* C only */
bool isnormal(real-floating x); /* C++ only */
bool isnormal(decimal-floating x); /* C++ only */

#define _TR1_C99
#include <math.h>

bool isnormal(real-floating x); /* C++ only */
```

General description

The `isnormal()` macro or function template determines if its argument value is normal, that is, not zero, infinity, subnormal or a NaN.

| Function | Hex | IEEE |
|-----------------------|-----|------|
| <code>isnormal</code> | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `isnormal()` macro returns 1 if the argument value is normal, else returns 0. The C++ template returns true if the argument value is normal, else returns false.

Special behavior in Hex: For normalized numbers, `isnormal()` returns one. For zero or an unnormalized number, `isnormal()` returns 0. The C++ function template for normalized numbers, `isnormal()` returns true. For zero or a number that is not normalized, `isnormal()` returns false.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

__isPosixOn() — Test for POSIX runtime option

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <unistd.h>

int __isPosixOn(void);
```

General description

The `__isPosixOn()` function returns 1 if the kernel is active and the POSIX runtime option is in effect for the calling process.

Returned value

The `__isPosixOn()` function returns 1 if the POSIX runtime option is in effect for the calling process and returns 0 otherwise.

If POSIX is in effect, then the kernel is active, although the kernel may be active without POSIX being in effect.

There are no `errno` values defined.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

isprint() — Test for printable character classification

The information for this function is included in [“isalnum\(\) to isxdigit\(\) — Test integer value” on page 895](#).

ispunct() — Test for punctuation classification

The information for this function is included in [“isalnum\(\) to isxdigit\(\) — Test integer value” on page 895](#).

isspace() — Test for space character classification

The information for this function is included in “[isalnum\(\) to isxdigit\(\) — Test integer value](#)” on page 895.

isunordered() — Determine if either X or Y is unordered

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 C/C++ DFP C++ TR1 C99 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int isunordered(real-floating x, real-floating y);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int isunordered(real-floating x, real-floating y); /* C only */
int isunordered(decimal-floating x, decimal-floating y); /* C only */
bool isunordered(real-floating x, real-floating y); /* C++ only */
bool isunordered(decimal-floating x, decimal-floating y); /* C++ only */

#define _TR1_C99
#include <math.h>

bool isunordered(real-floating x, real-floating y); /* C++ only */
```

General description

The `isunordered()` macro or function template determines if either `x` or `y` is unordered, that is if `x` or `y` is a NaN.

| Function | Hex | IEEE |
|--------------------------|-----|------|
| <code>isunordered</code> | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `isunordered()` macro returns 1 if either `x` or `y` is unordered, else returns 0. The C++ function template returns true if either `x` or `y` is unordered, else returns false.

Special behavior in hex: The `isunordered()` macro always returns 0. The C++ function template always returns false.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

isupper() — Test for uppercase letter classification

The information for this function is included in [“isalnum\(\) to isxdigit\(\) — Test integer value” on page 895](#).

iswalnum() to iswxdigit() — Test wide integer value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wctype.h>

int iswalnum(wint_t wc);
int iswalpna(wint_t wc);
int iswcntrl(wint_t wc);
int iswdigit(wint_t wc);
int iswgraph(wint_t wc);
int iswlower(wint_t wc);
int iswprint(wint_t wc);
int iswpunct(wint_t wc);
int iswspace(wint_t wc);
int iswupper(wint_t wc);
int iswxdigit(wint_t wc);
```

General description

The functions listed above, which are all declared in wctype.h, test a given wide integer value. These functions are sensitive to locale. For locale descriptions, see “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#). Here are descriptions of each function in this group.

- iswalnum()**
Test for a wide alphanumeric character, as defined in the `alnum` locale source file and in the `alnum` class of the `LC_CTYPE` category of the current locale.
- iswalpna()**
Test for a wide alphabetic character, as defined in the `alpha` locale source file and in the `alpha` class of the `LC_CTYPE` category of the current locale.
- iswcntrl()**
Test for a wide control character, as defined in the `cntrl` locale source file and in the `cntrl` class of the `LC_CTYPE` category of the current locale.
- iswdigit()**
Test for a wide decimal-digit character: 0 through 9, as defined in the `digit` locale source file and in the `digit` class of the `LC_CTYPE` category of the current locale.
- iswgraph()**
Test for a wide printing character, not a space. as defined in the `graph` locale source file and in the `graph` class of the `LC_CTYPE` category of the current locale.

iswlower()

Test for a wide lowercase letter, as defined in the `lower` locale source file and in the `lower` class of the `LC_CTYPE` category of the current locale.

iswprint()

Test for any wide printing character, as defined in the `print` locale source file and in the `print` class of the `LC_CTYPE` category of the current locale.

iswpunct()

Test for a wide nonalphanumeric, nonspace character, as defined in the `punct` locale source file and in the `punct` class of the `LC_CTYPE` category of the current locale.

iswspace()

Test for a wide white space character, as defined in the `space` locale source file and in the `space` class of the `LC_CTYPE` category of the current locale.

iswupper()

Test for a wide uppercase letter, as defined in the `upper` locale source file and in the `upper` class of the `LC_CTYPE` category of the current locale.

iswxdigit()

Test for a wide hexadecimal digit 0 through 9, a through f, or A through F, as defined in the `xdigit` locale source file and in the `xdigit` class of the `LC_CTYPE` category of the current locale.

The behavior of these wide-character function are affected by the `LC_CTYPE` category of the current locale. The space, uppercase, and lowercase characters can be redefined by their respective class of the `LC_CTYPE` in the current locale. If you change the category, undefined results can occur.

Returned value

If the wide integer satisfies the test value, these functions return nonzero.

If the wide integer does not satisfy the test value, these functions return 0.

The value for `wc` must be representable as a wide unsigned character. `WEOF` is a valid input value.

Example**CELEBI06**

```
/* CELEBI06

   This example tests for various wide integer values and prints a result.

*/
#include <stdio.h>
#include <wctype.h>

int main(void)
{
    wint_t wc;

    for (wc=0; wc <= 0xFF; wc++) {
        printf("%3d", wc);
        printf(" %#4x ", wc);
        printf("%3s", iswalnum(wc) ? "AN" : " ");
        printf("%2s", iswalph(wc) ? "A" : " ");
        printf("%2s", iswcntl(wc) ? "C" : " ");
        printf("%2s", iswdigit(wc) ? "D" : " ");
        printf("%2s", iswgraph(wc) ? "G" : " ");
        printf("%2s", iswlower(wc) ? "L" : " ");
        printf(" %c", iswprint(wc) ? wc : ' ');
        printf("%3s", iswpunct(wc) ? "PU" : " ");
        printf("%2s", iswspace(wc) ? "S" : " ");
        printf("%3s", iswprint(wc) ? "PR" : " ");
        printf("%2s", iswupper(wc) ? "U" : " ");
        printf("%2s", iswxdigit(wc) ? "X" : " ");

        putchar('\n');
    }
}
```

Related information

- [“wctype.h — Wide character properties” on page 81](#)

iswblank() — Test for blank character classification

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Language Environment C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <wctype.h>

int iswblank(wint_t wc);
```

C99:

```
#define _ISOC99_SOURCE
#include <wctype.h>

int iswblank(wint_t wc);
```

General description

Tests for a wide blank character.

The space, uppercase, and lowercase characters can be redefined by their respective classes of the LC_CTYPE in the current locale.

For use as a C library function: To avoid infringing on the user's name space, this nonstandard function has two names. One name, `__iswblk()`, and the other as shown above. The name shown above is exposed only when under the [extended language level](#) or define the `_EXT` feature test macro.

For use as a z/OS UNIX function: Define the `_OPEN_SYS` feature test macro.

Note: The `iswblank()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support” on page 2123](#) for details.

Returned value

If the wide integer satisfies the test value, `iswblank()` returns nonzero.

If the wide integer does not satisfy the test value, `iswblank()` returns 0.

The value for `wc` must be representable as a wide unsigned char. WEOF is a valid input value.

The behavior of `iswblank()` is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Related information

- [“wctype.h — Wide character properties” on page 81](#)
- [“isblank\(\) — Test for blank character classification” on page 905](#)
- [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value” on page 920](#)

iswcntrl() — Test for control classification

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value”](#) on page 920.

iswctype() — Test for character property

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wctype.h>

int iswctype(wint_t wc, wctype_t wc_prop);
```

General description

Determines whether the wide character *wc* has the property *wc_prop*. If the value of *wc* is neither WEOF nor any value of the wide character that corresponds to a multibyte character, the behavior is undefined. If the value of *wc_prop* is not valid (that is, not obtained by a previous call to *wctype()*, or *wc_prop* has been invalidated by a subsequent call to *setlocale()* that has affected category LC_CTYPE), the behavior is undefined.

These twelve strings are reserved for the standard (basic) character classes: *alnum*, *alpha*, *blank*, *cntrl*, *digit*, *graph*, *lower*, *print*, *punct*, *space*, *upper*, and *xdigit*.

The functions are shown below with their equivalent *isw*()* function:

```
iswctype(wc, wctype("alnum")); - iswalnum(wc);
iswctype(wc, wctype("alpha")); - iswalpha(wc);
iswctype(wc, wctype("blank")); - iswblank(wc);
iswctype(wc, wctype("cntrl")); - iswcntrl(wc);
iswctype(wc, wctype("digit")); - iswdigit(wc);
iswctype(wc, wctype("graph")); - iswgraph(wc);
iswctype(wc, wctype("lower")); - iswlower(wc);
iswctype(wc, wctype("print")); - iswprint(wc);
iswctype(wc, wctype("punct")); - iswpunct(wc);
iswctype(wc, wctype("space")); - iswspace(wc);
iswctype(wc, wctype("upper")); - iswupper(wc);
iswctype(wc, wctype("xdigit")); - iswxdigit(wc);
```

Returned value

iswctype() returns nonzero (true) if the wide character *wc* has the property *wc_prop*.

Example

CELEBI07

```
/* CELEBI07

This example test various wide characters for certain properties and
prints the result.
```

```

    */
#include <stdio.h>
#include <wchar.h>
#include <wctype.h>

int main(void)
{
    int wc;

    for (wc=0; wc <= 0xFF; wc++) {
        printf("%3d", wc);
        printf(" %#4x ", wc);
        printf("%3s", iswctype(wc, wctype("alnum")) ? "AN" : " ");
        printf("%2s", iswctype(wc, wctype("alpha")) ? "A" : " ");
        printf("%2s", iswctype(wc, wctype("cntrl")) ? "C" : " ");
        printf("%2s", iswctype(wc, wctype("digit")) ? "D" : " ");
        printf("%2s", iswctype(wc, wctype("graph")) ? "G" : " ");
        printf("%2s", iswctype(wc, wctype("lower")) ? "L" : " ");
        printf("%c", iswctype(wc, wctype("print")) ? wc : ' ');
        printf("%3s", iswctype(wc, wctype("punct")) ? "PU" : " ");
        printf("%2s", iswctype(wc, wctype("space")) ? "S" : " ");
        printf("%3s", iswctype(wc, wctype("print")) ? "PR" : " ");
        printf("%2s", iswctype(wc, wctype("upper")) ? "U" : " ");
        printf("%2s", iswctype(wc, wctype("xdigit")) ? "X" : " ");

        putchar('\n');
    }
}

```

Related information

- [“wctype.h — Wide character properties” on page 81](#)
- [“wctype\(\) — Obtain handle for character property classification” on page 2042](#)

iswdigit() — Test for hexadecimal-digit classification

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value” on page 920](#).

iswgraph() — Test for graphic classification

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value” on page 920](#).

iswlower() — Test for lowercase

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value” on page 920](#).

iswprint() — Test for printable character classification

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value” on page 920](#).

iswpunct() — Test for punctuation classification

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value” on page 920](#).

iswspace() — Test for space character classification

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value” on page 920](#).

iswupper() — Test for uppercase letter classification

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value”](#) on page 920.

iswxdigit() — Test for hexadecimal-digit classification

The information for this function is included in [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value”](#) on page 920.

isxdigit() — Test for hexadecimal-digit classification

The information for this function is included in [“isalnum\(\) to isxdigit\(\) — Test integer value”](#) on page 895.

itoa() — Convert int into a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

```
#define _OPEN_SYS_ITOA_EXT
#include <stdlib.h>

char * itoa(int n, char * buffer, int radix);
```

General description

The `itoa()` function converts the integer `n` into a character string. The string is placed in the buffer passed, which must be large enough to hold the output. The radix values can be OCTAL, DECIMAL, or HEX. When the radix is DECIMAL, `itoa()` produces the same result as the following statement:

```
(void) sprintf(buffer, "%d", n);
```

with `buffer` the returned character string. When the radix is OCTAL, `itoa()` formats integer `n` into an unsigned octal constant. When the radix is HEX, `itoa()` formats integer `n` into an unsigned hexadecimal constant. The hexadecimal value will include lower case `abcdef`, as necessary.

Returned value

String pointer (same as `buffer`) will be returned. When passed a non-valid radix argument, function will return NULL and set `errno` to `EINVAL`.

Portability considerations

This is a non-standard function. Even though the prototype given is commonly used by compilers on other platforms, there is no guarantee that this function will behave the same on all platforms, in all cases. You can use this function to help port applications from other platforms, but you should avoid using it when writing new applications, in order to ensure maximum portability.

Example

CELEBI12

```

/* CELEBI12

   This example reads an int and formats it to decimal, unsigned
   octal, and unsigned hexadecimal constants converted to a
   character string.

*/

#define _OPEN_SYS_ITOA_EXT
#include <stdio.h>
#include <stdlib.h>

int main ()
{
    int i;
    char buffer [sizeof(int)*8+1];
    printf ("Enter a number: ");
    if (scanf ("%d",&i) == 1) {
        itoa (i,buffer,DECIMAL);
        printf ("decimal: %s\n",buffer);
        itoa (i,buffer,HEX);
        printf ("hexadecimal: %s\n",buffer);
        itoa (i,buffer,OCTAL);
        printf ("octal: %s\n",buffer);
    }
    return 0;
}

```

Output

If the input is 1234, then the output should be:

```

decimal: 1234
hexadecimal: 4d2
octal: 2322

```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“lltoa\(\) — Convert long long into a string” on page 985](#)
- [“ltoa\(\) — Convert long into a string” on page 1030](#)
- [“ulltoa\(\) — Convert unsigned long long into a string” on page 1925](#)
- [“ultoa\(\) — Convert unsigned long into a string” on page 1927](#)
- [“utoa\(\) — Convert unsigned int into a string” on page 1958](#)

JoinWorkUnit() — Join a WLM work unit

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#include <sys/_wlm.h>

int JoinWorkUnit(wlmetok_t *enclavetoken);

```


General description

The JoinWorkUnit function provides the ability for an application to join a WLM work unit.

***enclavetoken**

Points to a work unit enclave token that was returned from a call to either CreateWorkUnit() or ContinueWorkUnit().

Returned value

If successful, JoinWorkUnit() returns 0.

If unsuccessful, JoinWorkUnit() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM join enclave failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSERVER Facility class. The caller's address space must be permitted to the BPX.WLMSERVER Facility class if it is defined. If BPX.WLMSERVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) — Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) — Connect to WLM as a work manager” on page 318](#)
- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“CreateWorkUnit\(\) — Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

jrand48() — Pseudo-random number generator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

long int jrand48(unsigned short int x16v[3]);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrand48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The functions drand48() and erand48() return nonnegative, double-precision, floating-point values, uniformly distributed over the interval [0.0,1.0).

The functions lrand48() and nrand48() return nonnegative, long integers, uniformly distributed over the interval [0,2**31).

The functions mrand48() and jrand48() return signed long integers, uniformly distributed over the interval [-2**31,2**31).

The jrand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \quad n \geq 0$$

The jrand48() function uses storage provided by the argument array, x16v[3], to save the most recent 48-bit integer value in the sequence, X(i). The jrand48() function uses x16v[0] for the low-order (rightmost) 16 bits, x16v[1] for the middle-order 16 bits, and x16v[2] for the high-order 16 bits of this value.

The initial values of a, and c are:

```
a  = 5deece66d (base 16)
c  = b         (base 16)
```

The values a and c, may be changed by calling the lcong48() function. The initial values of a and c are restored if either the seed48() or srand48() function is called.

Special behavior for z/OS UNIX Services: You can make the jrand48() function and other functions in the drand48 family thread-specific by setting the environment variable _RAND48 to the value THREAD before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested and the jrand48() function is called from thread t, the jrand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(t,i), for the thread according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t)) \bmod (2^{**}48) \quad n \geq 0$$

The jrand48() function uses storage provided by the argument array, x16v[3], to save the most recent 48-bit integer value in the sequence, X(t,i). The jrand48() function uses x16v[0] for the low-order (rightmost) 16 bits, x16v[1] for the middle-order 16 bits, and x16v[2] for the high-order 16 bits of this value.

The initial values of a(t) and c(t) on the thread t are:

```
a(t) = 5deece66d (base 16)
c(t) = b         (base 16)
```

The values a(t) and c(t) may be changed by calling the lcong48() function from the thread t. The initial values of a(t) and c(t) are restored if either the seed48() or srand48() function is called from the thread.

Returned value

`jrand48()` saves the generated 48-bit value, $X(n+1)$, in storage provided by the argument array, `x16v[3]`. `jrand48()` transforms the generated 48-bit value to a signed long integer value on the interval $[-2^{31}, 2^{31})$ and returns this transformed value.

Special behavior for z/OS UNIX Services: If thread-specific behavior is requested for the `drand48` family and the `jrand48()` function is called on thread `t`, the `jrand48()` function saves the generated 48-bit value, $X(t, n+1)$, in storage provided by the argument array, `x16v[3]`. The `jrand48()` function transforms the generated 48-bit value to a signed long integer value on the interval $[-2^{31}, 2^{31})$ and returns this transformed value.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“drand48\(\) — Pseudo-random number generator” on page 403](#)
- [“erand48\(\) — Pseudo-random number generator” on page 430](#)
- [“lcong48\(\) — Pseudo-random number initializer” on page 939](#)
- [“lrand48\(\) — Pseudo-random number generator” on page 1013](#)
- [“mrand48\(\) — Pseudo-random number generator” on page 1108](#)
- [“nrand48\(\) — Pseudo-random number generator” on page 1153](#)
- [“seed48\(\) — Pseudo-random number initializer” on page 1470](#)
- [“srand48\(\) — Pseudo-random number initializer” on page 1705](#)

j0(), j1(), jn() — Bessel functions of the first kind

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| SAA XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

SAA:

```
#include <math.h>

double j0(double x);
double j1(double x);
double jn(int n, double x);
```

This function must be used with the [runtime library extensions](#) or under the [SAA based language constructs](#).

General description

The `j0()`, `j1()`, and `jn()` functions are Bessel functions of the *first kind*, for orders 0, 1, and n , respectively. Bessel functions are solutions to certain types of differential equations. The argument x must be positive. The argument n should be greater than or equal to 0. If n is less than 0, there will be a negative exponent in the result.

Note: This function works in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

Returned value

If successful, the calculated value is returned.

For j0(), j1(), y0(), or y1(), if the absolute value of x is too large, the function sets errno to ERANGE to indicate a value that is out of range, and returns 0.

Special behavior for IEEE: If x is negative, y0(), y1(), and yn() return the value NaNQ. If x is 0, y0(), y1(), and yn() return the value -HUGE_VAL. In all cases, errno remains unchanged.

Example

CELEBJ01

```
/* CELEBJ01

   This example computes y to be the order 0 Bessel function of
   the first kind for x, and z to be the order 3 Bessel function
   of the second kind for x.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y, z;
    x = 4.27;

    y = j0(x);      /* y = -0.3660 is the order 0 bessel */
                   /* function of the first kind for x */
    z = yn(3,x);    /* z = -0.0875 is the order 3 bessel */
                   /* function of the second kind for x */
    printf("x = %f\n y = %f\n z = %f\n", x, y, z);
}
```

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“erf\(\), erfc\(\), erff\(\), erfl\(\), erfcf\(\), erfcl\(\) — Calculate error and complementary error functions”](#) on page 432
- [“gamma\(\) — Calculate gamma function”](#) on page 683
- [“y0\(\), y1\(\), yn\(\) — Bessel functions of the second kind”](#) on page 2082

kill() — Send a signal to a process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _POSIX_SOURCE
#include <signal.h>
```

```
int kill(pid_t pid, int sig);
```

General description

Sends a signal to a process or process group. A process has permission to send a signal if the real or effective user ID of the sender is the same as the real or effective user ID of the intended recipient. A process can also send signals if it has appropriate privileges. If `_POSIX_SAVED_IDS` is defined in the `unistd.h` header file, the saved set user ID of the intended recipient is checked instead of its effective user ID.

Regardless of user ID, a process can always send a `SIGCONT` signal to a process that is a member of the same session (same session ID) as the sender.

You can use either `signal()` or `sigaction()` to specify how a signal will be handled when `kill()` is invoked.

A process can use `kill()` to send a signal to itself. If the signal is not blocked or ignored, at least one pending unblocked signal is delivered to the sender before `kill()` returns. If there are no other pending unblocked signals, the delivered signal is `sig`.

`pid` can be used to specify these processes:

pid_t pid;

Specifies the processes that the caller wants to send a signal to:

- If `pid` is greater than 0, `kill()` sends its signal to the process whose ID is equal to `pid`.
- If `pid` is equal to 0, `kill()` sends its signal to all processes whose process group ID is equal to that of the sender, except for those that the sender does not have appropriate privileges to send a signal to.
- If `pid` is -1, `kill()` returns -1.
- **Special behavior for XPG4.2:** If `pid` is -1, `kill()` sends the signal, `sig`, to all processes, except for those to which the sender does not have appropriate privileges to send a signal.
- If `pid` is less than -1, `kill()` sends its signal to all processes whose process group ID is equal to the absolute value of `pid`, except for those that the sender does not have appropriate privileges to send a signal to.

int sig;

The signal that should be sent to the processes specified by `pid`. (For a list of signals, see Table 57 on page 1606.) This must be 0 or one of the signals defined in the `signal.h` header file. If `sig` is 0, `kill()` performs error checking but does not send a signal. You can code `sig` as 0 to check whether the `pid` argument is valid.

This function is supported only in a POSIX program. You can use it to pass `SIGIOERR`.

Usage notes

The use of the `SIGTSTP` and `SIGTCONT` signal is not supported with this function.

Returned value

`kill()` returns 0 if it has permission to send `sig` to any of the processes specified by `pid`.

If `kill()` fails to send a signal, it returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of `sig` is incorrect or is not the number of a supported signal.

EPERM

The caller does not have permission to send the signal to any process specified by `pid`.

ESRCH

There are no processes or process groups corresponding to `pid`.

Example

CELEBK01

```

/* CELEBK01 */
#define _POSIX_SOURCE
#include <signal.h>
#include <stdio.h>
#include <sys/types.h>
#include <unistd.h>
#include <sys/wait.h> /*FIX: used to be <wait.h>*/

main() {
    sigset_t sigset;
    int     p[2], status;
    char    c='z';
    pid_t   pid;

    if (pipe(p) != 0)
        perror("pipe() error");
    else {
        if ((pid = fork()) == 0) {
            sigemptyset(&sigset);
            puts("child is letting parent know he's ready for signal");
            write(p[1], &c, 1);
            puts("child is waiting for signal");
            sigsuspend(&sigset);
            exit(0);
        }

        puts("parent is waiting for child to say he's ready for signal");
        read(p[0], &c, 1);
        puts("child has told parent he's ready for signal");

        kill(pid, SIGTERM);

        wait(&status);
        if (WIFSIGNALED(status))
            if (WTERMSIG(status) == SIGTERM)
                puts("child was ended with a SIGTERM");
            else
                printf("child was ended with a %d signal\n", WTERMSIG(status));
            else puts("child was not ended with a signal");

        close(p[0]);
        close(p[1]);
    }
}

```

Output

```

parent is waiting for child to say he's ready for signal
child is letting parent know he's ready for signal
child is waiting for signal
child has told parent he's ready for signal
child was ended with a SIGTERM

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“getpid\(\) — Get the process ID” on page 754](#)
- [“killpg\(\) — Send a signal to a process group” on page 933](#)
- [“pthread_kill\(\) — Send a signal to a thread” on page 1293](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“setsid\(\) — Create session, set process group ID” on page 1571](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)

- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigrelse\(\) — Remove a signal from a thread” on page 1647](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)

killpg() — Send a signal to a process group

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int killpg(pid_t pgrp, int sig);
```

General description

The `killpg()` function sends a signal to a process group.

A process has permission to send a signal if the real or effective user ID of the sender is the same as the real or effective user ID of the intended recipient. A process can also send signals if it has appropriate privileges. If `_POSIX_SAVED_IDS` is defined in the `<unistd.h>` include file, the saved set user ID of the intended recipient is checked instead of its effective user ID.

Regardless of user ID, a process can always send a `SIGCONT` signal to a process group that is a member of the same session (same session ID) as the sender.

pid_t pgrp;

Specifies the process group that the caller wants to send a signal to:

- If *pgrp* is greater than one, `killpg()` sends the signal, *sig*, to the process whose process group ID is equal to *pgrp* and which the sender has appropriate privileges to send a signal.
- If *pgrp* is equal to or less than one, `killpg()` returns a -1 and sets `errno` to `EINVAL`.

int sig;

The signal that should be sent to the processes specified by *pid*. (For a list of signals, see [Table 57 on page 1606](#).) This must be zero, or one of the signals defined in the `<signal.h>` include file. If *sig* is zero, `killpg()` performs error checking but doesn't really send a signal. You can code *sig* as zero to check whether the *pid* argument is valid.

This function is supported only in a POSIX program.

Usage notes

The use of the `SIGTSTP` and `SIGTCONT` signal is not supported with this function.

Returned value

If successful, `killpg()` returns 0 if it has permission to send *sig* to any of the processes in the process group ID specified by *pgrp*.

If unsuccessful, `killpg()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EINVAL

The value of *sig* is incorrect or is not the number of a supported signal, or the value of *pgrp* is less than or equal to one.

EPERM

The caller does not have permission to send the signal to any process in the process group ID specified by *pgrp*.

ESRCH

There are no process groups corresponding to *pgrp*.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“getpgid\(\) — Get process group ID” on page 751](#)
- [“getpid\(\) — Get the process ID” on page 754](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“setsid\(\) — Create session, set process group ID” on page 1571](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigrelse\(\) — Remove a signal from a thread” on page 1647](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)

labs() — Calculate long absolute value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

long int labs(long int n);
```


General description

Calculates the absolute value of its long integer argument *n*. The result is undefined when the argument is equal to LONG_MIN, the smallest available long integer (-2 147 483 648). The value LONG_MIN is defined in the limits.h header file.

Returned value

Returns the absolute value of the long integer argument *n*.

Example

CELEBL01

```
/* CELEBL01

   This example computes y as the absolute value of
   the long integer -41567.

*/
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    long x, y;

    x = -41567L;
    y = labs(x);

    printf("The absolute value of %ld is %ld\n", x, y);
}
```

Output

```
The absolute value of -41567 is 41567
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“abs\(\), absf\(\), absi\(\) — Calculate integer absolute value” on page 105](#)
- [“fabs\(\), fabsf\(\), fabsl\(\) — Calculate floating-point absolute value” on page 465](#)

__lchattr(), __lchattr64() — Change the attributes of a file or directory when they point to a symbolic or external link

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

__lchattr:

```
#define _OPEN_SYS_FILE_EXT 1
#include <sys/stat.h>

int __lchattr (char *pathname, attrib_t *attributes, int attributes_len);
```

__lchattr64:

```
#define _LARGE_TIME_API
#define _OPEN_SYS_FILE_EXT 1
#include <sys/stat.h>

int __lchattr64(char *pathname, attrib64_t *attributes, int attributes_len);
```

Compile requirement: Use of the `__lchattr64` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The `__lchattr()` function modifies the attributes that are associated with a file. The *pathname* specifies a symbolic or external link (a pointer to another file, directory, or data set).

The `__lchattr()` service changes the attributes of the symbolic link itself, provided the attributes requested can apply to a symbolic link. Only the owner and security label can be changed for a symbolic link, all other attributes do not apply and will be ignored.

The attributes argument is the address of an `attrib_t` structure which is used to identify the attributes to be modified and the new values desired. The `attrib_t` type is an `f_attributes` structure as defined in `<sys/stat.h>` for use with the `__lchattr()` function. For proper behavior, the user should ensure that this structure has been initialized to zeros before it is populated. The `f_attributes` structure is defined as indicated in [Table 20 on page 262](#).

The `__lchattr64()` function behaves exactly like `__lchattr()` except `__lchattr64()` uses `struct attrib64_t` instead of `struct attrib_t` to support time beyond 03:14:07 UTC on January 19, 2038.

The `attrib64_t` type is an `f_attributes64` structure as defined in `<sys/stat.h>` for use with the `__lchattr64()` function.

Returned value

If successful, `__lchattr()` returns 0.

If unsuccessful, `__lchattr()` returns -1 and sets `errno` to one of the following values:

EACCES

The calling process did not have appropriate permissions. Possible reasons include:

- The calling process was attempting to set access time or modification time to current time, and the effective UID of the calling process does not match the owner of the file; the process does not have write permission for the file; or the process does not have appropriate privileges.
- The calling process was attempting to truncate the file, and it does not have write permission for the file.

EFBIG

The calling process was attempting to change the size of a file, but the specified length is greater than the maximum file size limit for the process.

EINVAL

The attributes structure containing the requested changes is not valid.

ELOOP

A loop exists in symbolic links that were encountered during resolution of the *pathname* argument. This error is issued if more than 24 symbolic links are detected in the resolution of *pathname*.

ENAMETOOLONG

pathname is longer than 1023 characters, or a component of the *pathname* is longer than 255 characters (Filename truncation is not supported).

ENOENT

No file named *pathname* was found.

ENOTDIR

Some component of *pathname* is not a directory.

EPERM

The operation is not permitted for one of the following reasons:

- The calling process was attempting to change the mode or the file format, but the effective UID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.
- The calling process was attempting to change the owner, but it does not have appropriate privileges.
- The calling process was attempting to change the general attribute bits, but it does not have write permission for the file.
- The calling process was attempting to set a time value (not current time), but the effective user ID does not match the owner of the file, and it does not have appropriate privileges.
- The calling process was attempting to set the change time or reference time to current time, but it does not have write permission for the file.
- The calling process was attempting to change auditing flags, but the effective UID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.
- The calling process was attempting to change the Security Auditor's auditing flags, but the user does not have auditor authority.
- Attributes indicate that the security label is to be set, and one or more of the following conditions applies:
 - The calling process does not have RACF SPECIAL authorization and appropriate privileges.
 - The security label currently associated with the file is already set.

EROFS

pathname specifies a file that is on a read-only file system.

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“__fchattr\(\), __fchattr64\(\) — Change the attributes of a file or directory by file descriptor” on page 471](#)
- [“__chattr\(\), __chattr64\(\) — Change the attributes of a file or directory” on page 261](#)

lchown() — Change owner and group of a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int lchown(const char *path, uid_t owner, gid_t group);
```

General description

The `lchown()` function has the same effect as `chown()` except in the case where the named file is a symbolic link. In this case `lchown()` changes the ownership of the symbolic link file itself, while `chown()` changes the ownership of the file or directory to which the symbolic link refers.

Returned value

If successful, `lchown()` returns 0.

If unsuccessful, `lchown()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Search permission is denied on a component of the path prefix of *path*.

EINVAL

The owner or group id is not a value supported by the implementation.

ELOOP

Too many symbolic links were encountered in resolving *path*

ENAMETOOLONG

The length of a pathname exceeds **PATH_MAX** or a pathname component is longer than **NAME_MAX**.

ENOENT

A component of *path* does not name an existing file or *path* is an empty string.

ENOTDIR

A component of the path prefix of *path* is not a directory.

EOPNOTSUPP

The *path* argument names a symbolic link and the implementation does not support setting the owner or group of a symbolic link.

EPERM

The effective user ID does not match the owner of the file and the process does not have appropriate privileges.

EROFS

The file resides on a read-only file system.

The `lchown()` function may fail if:

Error Code

Description

EINTR

A signal was caught during execution of the function.

EIO

An I/O error occurred while reading or writing to the file system.

ENAMETOOLONG

Pathname resolution of a symbolic link produced an intermediate result whose length exceeds **PATH_MAX**.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)

lcong48() – Pseudo-random number initializer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

void lcong48(unsigned short int param[7]);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrand48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The lcong48(), seed48(), and srand48() functions are initialization functions, one of which should be invoked before either the drand48(), lrand48() or mrand48() function is called.

The drand48(), lrand48() and mrand48() functions generate a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \quad n \geq 0$$

The initial values of X, a, and c are:

```
X(0) = 1
a    = 5deece66d (base 16)
c    = b          (base 16)
```

C/370 provides storage to save the most recent 48-bit integer value of the sequence, X(i). This storage is shared by the drand48(), lrand48() and mrand48() functions. The lcong48() function is used to reinitialize the most recent 48-bit value in this storage. The lcong48() function replaces the low-order (rightmost) 16 bits of this storage with *param*[0], the middle-order 16 bits with *param*[1], and the high-order 16 bits with *param*[2].

The values a and c, may also be changed by calling the lcong48() function. The lcong48() function replaces the low-order (rightmost) 16 bits of a with *param*[3], the middle-order 16 bits with *param*[4], and the high-order 16 bits with *param*[5]. The lcong48() function replaces c with *param*[6].

Special behavior for z/OS UNIX Services: You can make the lcong48() function and other functions in the drand48 family thread-specific by setting the environment variable `_RAND48` to the value `THREAD` before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested, calls to the drand48(), lrand48() and mrand48() functions from thread *t* generate a sequence of 48-bit integer values, X(t,i), according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t)) \bmod (2^{**}48) \quad n \geq 0$$

C/370 provides thread-specific storage to save the most recent 48-bit integer value of the sequence, X(t,i). When the lcong48() function is called from thread *t*, it reinitializes the most recent 48-bit value

in this storage. The `lcong48()` function replaces the low-order (rightmost) 16 bits of this storage with `param[0]`, the middle-order 16 bits with `param[1]`, and the high-order 16 bits with `param[2]`.

The `lcong48()` function may also be used to change values of `a(t)` and `c(t)` for the thread `t`. The `lcong48()` function replaces the low-order (rightmost) 16 bits of `a(t)` with `param[3]`, the middle-order 16 bits with `param[4]`, and the high-order 16 bits with `param[5]`. The `lcong48()` function replaces `c(t)` with `param[6]`.

Returned value

After `lcong48()` has used values from the argument array, `param[7]`, to change the values of `a` and `c` and to reinitialized storage for the most recent 48-bit integer value in the sequence, `X(i)`, it returns.

Special behavior for z/OS UNIX Services: If thread-specific behavior is requested for the `drand48` family and `lcong48()` is called on thread `t`, it uses the argument array, `param[7]`, to change the values of `a(t)` and `c(t)` and to reinitialize storage for the most recent 48-bit integer value in the sequence, `X(t,i)`, for the thread. Then it returns.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“drand48\(\) — Pseudo-random number generator” on page 403](#)
- [“erand48\(\) — Pseudo-random number generator” on page 430](#)
- [“jrand48\(\) — Pseudo-random number generator” on page 927](#)
- [“lrand48\(\) — Pseudo-random number generator” on page 1013](#)
- [“mrand48\(\) — Pseudo-random number generator” on page 1108](#)
- [“nrand48\(\) — Pseudo-random number generator” on page 1153](#)
- [“seed48\(\) — Pseudo-random number initializer” on page 1470](#)
- [“srand48\(\) — Pseudo-random number initializer” on page 1705](#)

ldexp(), ldexpf(), ldexpl() — Multiply by a power of two

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double ldexp(double x, int exp);
float ldexp(float x, int exp);          /* C++ only */
long double ldexp(long double x, int exp); /* C++ only */
float ldexpf(float x, int exp);
long double ldexpl(long double x, int exp);
```

General description

Calculates the value of $x \cdot (2^{\text{exp}})$.

Restriction: The `ldexpf()` and `ldexpl()` functions do not support the `_FP_MODE_VARIABLE` feature test macro.

Returned value

Returns the calculated value.

Otherwise, if the correct calculated value is outside the range of representable values, `±HUGE_VAL` is returned, according to the sign of the value. The value `ERANGE` is stored in `errno` to indicate that the result was out of range.

Special behavior for XPG4.2:

Error Code

Description

ERANGE

The result underflowed. `ldexp()` returns 0.0.

Example

CELEBL02

```
/* CELEBL02
   This example computes y = 1.5*2**5.
*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y;
    int p;

    x = 1.5;
    p = 5;
    y = ldexp(x,p);

    printf("%lf times 2 to the power of %d is %Lf\n", x, p, y);
}
```

Output

```
1.500000 times 2 to the power of 5 is 48.000000
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“frexp\(\), frexpf\(\), frexpl\(\) — Extract mantissa and exponent of the floating-point value” on page 624](#)
- [“modf\(\), modff\(\), modfl\(\) — Extract fractional and integral parts of floating-point value” on page 1092](#)

ldexpd32(), ldexpd64(), ldexpd128() — Multiply by a power of ten

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 ldexpd32(_Decimal32 x, int exp);
_Decimal64 ldexpd64(_Decimal64 x, int exp);
_Decimal128 ldexpd128(_Decimal128 x, int exp);

_Decimal32 ldexp(_Decimal32 x, int exp); /* C++ only */
_Decimal64 ldexp(_Decimal64 x, int exp); /* C++ only */
_Decimal128 ldexp(_Decimal128 x, int exp); /* C++ only */
```

General description

Calculates the value of $x \cdot 10^{\text{exp}}$.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

Returns the calculated value.

Otherwise, if the correct calculated value is outside the range of representable values, $\pm\text{HUGE_VAL_D32}$, $\pm\text{HUGE_VAL_D64}$, or $\pm\text{HUGE_VAL_D128}$ is returned, according to the sign of the value. The value ERANGE is stored in errno to indicate that the result was out of range.

Example

```
/* CELEBL19

   This example illustrates the ldexpd32() function.

   This example computes y = 1.5*10**5

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal32 x, y;
    int p;

    x = 1.5DF;
    p = 5;
    y = ldexpd32(x, p);

    printf("%Hf times 10 to the power of %d is %Hf\n", x, p, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“frexp32\(\), frexp64\(\), frexp128\(\) — Extract mantissa and exponent of the decimal floating-point value” on page 625](#)
- [“ldexp\(\), ldexpf\(\), ldexpl\(\) — Multiply by a power of two” on page 940](#)
- [“modfd32\(\), modfd64\(\), modfd128\(\) — Extract fractional and integral parts of decimal floating-point value” on page 1093](#)

ldiv() — Compute quotient and remainder of integral division

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

ldiv_t ldiv(long int numerator, long int denominator);
```

General description

Calculates the quotient and remainder of the division of *numerator* by *denominator*.

Returned value

Returns a structure of type `ldiv_t`, containing both the quotient `long int quot` and the remainder `long int rem`.

If the value cannot be represented, the returned value is undefined. If *denominator* is 0, a divide by 0 exception is raised.

Example

CELEBL03

```
/* CELEBL03

   This example uses the &ldiv. function to calculate the
   quotients and remainders for a set of two dividends and two
   divisors.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    long int num[2] = {45,-45};
    long int den[2] = {7,-7};
    ldiv_t ans; /* ldiv_t is a struct type containing two long ints:
                  'quot' stores quotient; 'rem' stores remainder */
    short i,j;

    printf("Results of long division:\n");
    for (i = 0; i < 2; i++)
        for (j = 0; j < 2; j++)
        {
            ans = ldiv(num[i], den[j]);
            printf("Dividend: %6ld Divisor: %6ld", num[i], den[j]);
            printf(" Quotient: %6ld Remainder: %6ld\n", ans.quot, ans.rem);
        }
}
```

Output

```
Results of long division:
Dividend: 45 Divisor: 7 Quotient: 6 Remainder: 3
Dividend: 45 Divisor: -7 Quotient: -6 Remainder: 3
Dividend: -45 Divisor: 7 Quotient: -6 Remainder: -3
Dividend: -45 Divisor: -7 Quotient: 6 Remainder: -3
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“div\(\) — Calculate quotient and remainder” on page 385](#)

LeaveWorkUnit() — Leave a WLM work unit

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/__wlm.h>

int LeaveWorkUnit(wlmetok_t *enclavetoken);
```

General description

The LeaveWorkUnit() function provides the ability for an application to leave a WLM work unit.

***enclavetoken**

Points to a work unit enclave token that was returned from a call to CreateWorkUnit() or ContinueWorkUnit().

Returned value

If successful, LeaveWorkUnit() returns 0.

If unsuccessful, LeaveWorkUnit() returns -1 and sets errno to one of the following values:

Error Code**Description****EFAULT**

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM leave enclave failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class if it is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/ __wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) — Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) — Connect to WLM as a work manager” on page 318](#)
- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“CreateWorkUnit\(\) — Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

__le_ceegtjs() — Retrieve the value of an exported JCL symbol

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>

void __le_ceegtjs(_INT4 * function_code,
                 _VSTRING * symbol_name,
                 _CHAR255 * symbol_value,
                 _INT4 * value_length,
                 _FEEDBACK * fc);
```

General description

The `__le_ceegtjs()` function retrieves and returns to the caller the symbol value and length of the requested exported JCL symbol.

Parameter Description

function_code

A fullword integer containing the function code of the following value:

1

Retrieve the value and its associate length of an exported JCL symbol.

symbol_name

A halfword length-prefixed character string(VSTRING), representing the name of an exported JCL symbol to be retrieved.

symbol_value

A 255-byte fixed-length string. On return from this service, the *symbol_value* contains the value of the exported JCL symbol. If the length of the exported JCL symbol is shorter than 255 characters, the returned string is padded with blanks.

value_length

A fullword integer containing the length of the value of the specified JCL symbol.

fc

A 16-byte Feedback Code indicating the results of this function.

| Table 35. Feedback Codes for __le_ceegtjs() | | | |
|---|----------|----------------|--|
| Code | Severity | Message Number | Message Text |
| CEE000 | 0 | - - | The function completed successfully. |
| CEE3L9 | 0 | 3753 | The input symbol cannot be found in the current job step. |
| CEE3LA | 3 | 3754 | Incorrect parameters detected. |
| CEE3QS | 1 | 3932 | The system service failed with return code <i>return_code</i> and reason code <i>reason_code</i> . |

Usage notes

1. Lower case characters in the *symbol_name* will be converted to upper case by the __le_ceegtjs function.
2. For more information about JCL symbols and their usage, see "Using System Symbols and JCL symbols" in [z/OS MVS JCL Reference](#).

Example

CELEBL31

```

/* CELEBL31

   This example retrieves the value of an exported JCL symbol.

*/
#include <stdio.h>
#include <string.h>
#include <__le_api.h>

int main()
{
    _FEEDBACK fc;
    _INT4 funcode;
    _CHAR255 symvalue;
    _VSTRING symname;
    _INT4 valuelen;
    char *symbol="SYM1";

    /* Setting the function code */
    funcode=1;

    /* Preparing the JCL symbol name */
    symname.length=strlen(symbol);
    memcpy(symname.string, symbol,strlen(symbol));

    /* Retrieving the value of the JCL symbol */
    _le_ceegtjs(&funcode,&symname,symvalue,&valuelen,&fc);
    if( fc.tok_sev > 0) {
        printf("__le_ceegtjs failed with message number %d\n",
               fc.tok_msgno);
        exit(1);
    }
    symvalue[valuelen]='\0';
    printf("The value of JCL symbol %s is %s. The length
           of the value is %d\n",symbol,symvalue,valuelen);
}

```

Output

Use the following JCL to run CELEBL31:

```

//JOB1      JOB      FELE,MSGLEVEL=(2,0)
//STEP1     EXEC     PGM=CELEBL31

```

```
//E1      EXPORT SYMLIST=(SYM1,SYM2,SYM3)
//S1      SET    SYM1=XXXX
//S2      SET    SYM2=YYYY
//STEPLIB DD     DSN=USER.LOADLIB,DISP=SHR
//SYSPRINT DD     SYSOUT=*
//SYSOUT  DD     SYSOUT=*
```

Running this example would produce the following output:

```
The value of JCL symbol SYM1 is XXXX. The length of the value is 4.
```

Related information

- [“__le_api.h — AMODE 64 C functions in Language Environment” on page 34](#)

__le_ceemict() — Manage the interoperability state of current task

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | Both | AMODE 64 |

Format

```
#include<__le_api.h>
void __le_ceemict (_INT4 *function_code, POINTER *MICT_ptr, FEED_BACK *fc)
```

General description

The `__le_ceemict()` function allows high level language programs to manage the interoperability state of current task.

Parameter

Description

function_code (input)

A required parameter; a fullword integer containing the function code of one of the following values:

- 1** QUERY: Get `state_ptr` and `state_flag`.
- 2** SET: Set `state_flag` for current task.
- 3** UNSET: Unset `state_flag` for current task.

MICT_ptr (input/output)

A pointer that points to the `MICT_CB` structure, which describes the input/output parameters of `__le_ceemict()`.

| Table 36. <i>MICT_CB</i> structure | |
|------------------------------------|---------------------|
| Name | Description |
| <code>state_flag</code> | A 32-bit flag |
| <code>state_ptr</code> | A full word pointer |

fc

A 12-byte Feedback Code that indicates the results of the service. The following symbolic conditions can result from the service:

| Table 37. Feedback Codes for __le_ceemict() | | | |
|---|----------|----------------|-------------------------------------|
| Code | Severity | Message Number | Message Text |
| CEE000 | 0 | N/A | The service completed successfully. |
| CEE3LA | 3 | 3754 | Incorrect parameters detected. |

Usage

The usage of MICT_CB is decided by *function_code* as shown in the [Table 38 on page 948](#).

| Table 38. MICT_CB and function_code | |
|-------------------------------------|--|
| function_code | MICT_CB description |
| 1 (QUERY) | <p>state_flag (output) A 32-bit flag that obtains or sets state_flag.</p> <ul style="list-style-type: none"> Bit 0 (leftmost bit): The current TCB shares a Db2® connection in the Java Interlanguage Batch environment using RRSAF. Bit 1-31: Reserved. All reserved bits are initialized to zero by Language Environment. <p>state_ptr (output) A full word pointer that contains the address of SW3164. If state_ptr is not zero, the current task is in AMODE 31 and AMODE 64 switching state.</p> |
| 2 (SET) | <p>state_flag (input) A 32-bit mask that sets state_flag. If a bit within the mask is set to 1, the corresponding flag bit is turned ON; otherwise, the flag bit is unchanged.</p> <p>state_ptr (output) Not used.</p> |
| 3 (UNSET) | <p>state_flag (input) A 32-bit mask that sets state_flag. If a bit within the mask is set to 1, the corresponding flag bit is turned OFF; otherwise, the flag bit is unchanged.</p> <p>state_ptr (output) Not used.</p> |

Related information

- “__le_api.h — AMODE 64 C functions in Language Environment” on page 34
- For the AMODE 31 equivalent function, see [CEEMICT—Manage the interoperability state of the current task in z/OS Language Environment Programming Reference](#).
- For more information about SW3164, see [Introduction to AMODE 31 and AMODE 64 programs interoperability in z/OS Language Environment Vendor Interfaces](#).

__le_ceedsgd() – Usage data collection service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | Both | AMODE 64 |

Format

```
#include<__le_api.h>
void __le_ceedsgd(_INT4 *function_code, void **in_buf, void **out_buf,
                 unsigned char *fbfe, _FEEDBACK *fc);
```

Compile requirement:

- Use of this function requires the long long data type.
- Use of this function requires [hexadecimal floating point representation](#) when **FORMAT=FLOAT** is specified.

General description

function_code

(Input) A required parameter, a fullword integer that contains the function code of one of the following values:

1

REGISTER: Identify Product for Usage Data Collection and provide the Domain and Scope options to be used.

2

DEREGISTER: End Data Collection for the Product in the current Domain and Scope.

3

FUNCTIONBEGIN: Collect Function-level Data for the Product in the current Domain and Scope.

4

FUNCTIONDATA: Provide Product-Specific Usage Data for the Product in the current Domain and Scope.

5

FUNCTIONEND: End Collecting Function-level Data for the Product in the current Domain and Scope.

6

STATUS: Check the status (Available and Active) of the Usage Data Collection Service and the installation recording request for the System-Wide Usage Data Record (Type 89).

in_buf

(Input) A pointer points to an input structure. The structure type is decided by *function_code*:

When *function_code*= 1, the *in_buf* structure is:

```
typedef struct __ceedsgd_reg_in{
    unsigned char product_owner[16];
    unsigned char product_name[16];
    unsigned char product_version[8];
    unsigned char product_qualifier[8];
    unsigned char product_ID[8];
    unsigned char domain;
    unsigned char scope;
    unsigned char unauth_serv;
} __ceedsgd_reg_in;
```

product_owner

A 16-character field stands for Product's Owner or Vendor Name for this request.

product_name

A 16-character field stands for the Name of the product for the request.

product_version

An 8-character field stands for the Version of the product for the request. The input value of None followed by 4 white spaces (8 characters total) indicates that the *product_version* is not set.

product_qualifier

An 8-character field stands for the Qualifier of the product for the request. The input value of None followed by 4 white spaces (8 characters total) indicates that the *product_qualifier* is not set.

product_ID

An 8-character field stands for the ID of the Product. For example, the PID Number. The input value of None followed by 4 white spaces (8 characters total) indicates that the *product_ID* is not set.

domain

A field stands for the level of data to be collected for this product. Only the following choices can be used:

- `__DOMAIN_ADDRSP`: Provide Data Collection at the Address Space Level. `__DOMAIN_ADDRSP` is used by default for unexpected input.
- `__DOMAIN_TASK`: Request Data Collection for the current task.

scope

A field stands for the level of data collection within the task that is being requested. Need to be set when domain is `__DOMAIN_TASK`. When domain is `__DOMAIN_ADDRSP`, input value of 0 indicates that scope is not set. Only the following choices can be used:

- `__SCOPE_ALL`: Requests that all the CPU Time in the task that is associated with the requesting product. `__SCOPE_ALL` is used by default for unexpected input.
- `__SCOPE_FUNCTION`: Requests that only the CPU time that is accumulated during the invocation of the FUNCTION - BEGIN and END requests be associated with this product. More invocations of the IFAUSAGE macro for FUNCTIONBEGIN and FUNCTIONEND requests are expected.

unauthserv

A field stands for the level of authorized services to which the unauthorized caller requires access. Authorized callers can use all services without SAF authorization. Only the following choices can be used:

- `__UNAUTHSERV_BASE`: Specifies that the unauthorized caller does not need access to any IFAUSAGE services other than REGISTER and STATUS. Unauthorized invokers that do not have SAF authorization are limited to 2 IFAUSAGE REGISTER requests per address space. `__UNAUTHSERV_BASE` is used by default for unexpected input.
- `__UNAUTHSERV_LEVEL1`: Specifies that the unauthorized caller requires access to IFAUSAGE services that are available to authorized callers. These include: Unregister, FUNCTIONBEGIN, FUNCTIONEND, and FUNCTIONDATA. In addition, the unauthorized caller might issue more than 2 IFAUSAGE REGISTER requests. The SAF facility is used to validate that the installation has authorized the user ID associated with this job or task to use LEVEL1 features.

When *function_code* equals 2, 3, or 5, the *in_buf* structure is:

```
typedef struct __ceedsgd_dereg_fbegend_in{
    unsigned char  prtoken[8];
    unsigned char  product_owner[16];
    unsigned char  product_name[16];
    unsigned char  product_version[8];
    unsigned char  product_qualifier[8];
}
```



```
    unsigned char product_ID[8];
} __ceedsgd_dereg_fbegin_in;
```

prtoken

An 8-character field stands for the Product token that is returned on the associated function code 1 REGISTER request.

product_owner

A 16-character field stands for Product's Owner or Vendor Name for this request.

product_name

A 16-character field stands for the Name of the product for the request.

product_version

An 8-character field that stands for the Version of the product for the request.

product_qualifier

An 8-character field stands for the Qualifier of the product for the request.

product_ID

An 8-character field stands for the ID of the Product. For example, the PID Number.

Notes:

- *prtoken* cannot be specified when *product_owner*, *product_name*, *product_version*, *product_qualifier*, and *product_ID* are all specified. You can either specify *prtoken* or *product_owner* + *product_name* + *product_version* + *product_qualifier* + *product_ID*.
- *product_name*, *product_version*, *product_qualifier*, and *product_ID* take effects only when *product_owner* is specified.
- The input value of None followed by 4 or 12 white spaces (8 or 16 characters total) indicates that the field is not set.

When *function_code* equals 4, the *in_buf* structure is:

```
typedef struct __ceedsgd_fundata_in{
    unsigned char prtoken[8];
    unsigned char product_owner[16];
    unsigned char product_name[16];
    unsigned char product_version[8];
    unsigned char product_qualifier[8];
    unsigned char product_ID[8];
    union{
        long long data_cputime_binary;
        /* when format is __FORMAT_CPUTIME or __FORMAT_BINARY*/
        double data_longfloat;
        /* when format is __FORMAT_FLOAT */
    } __data;
    unsigned char format;
    /*values are __FORMAT_CPUTIME, __FORMAT_BINARY, __FORMAT_FLOAT*/
} __ceedsgd_fundata_in;
```

prtoken

An 8-character field stands for the Product token that is returned on the associated function code 1 REGISTER request.

product_owner

A 16-character field stands for Product's Owner or Vendor Name for this request.

product_name

A 16-character field stands for the Name of the product for the request.

product_version

An 8-character field that stands for the Version of the product for the request.

product_qualifier

An 8-character field stands for the Qualifier of the product for the request.

product_ID

An 8-character field stands for the ID of the Product. For example, the PID Number.

__data

An 8-byte field contains resource data to be accumulated. Fixed-type data are right justified and padded with hex 0's. The data type is determined by *format*.

__data.data_cputime_binary

When *format* is `__FORMAT_CPUTIME` or `__FORMAT_BINARY`, use `long` as data type.

__data.data_longfloat

When *format* is `__FORMAT_FLOAT`, use `double` as data type.

format

A field stands for the data type of value in data parameter. Only the following choices can be used:

__FORMAT_CPUTIME

The value in the data is a CPU Time, in STCK format. `__FORMAT_CPUTIME` is used by default for unexpected input.

__FORMAT_BINARY

The value in the data is in 64-bit binary format.

__FORMAT_FLOAT

The value in the data is in long floating point hex format.

Note: Use of this function requires hexadecimal floating point representation when **FORMAT=FLOAT** is specified.

When function_code equals 6

User specified *in_buf* is not needed and ignored.

out_buf

(Output) A pointer points to an output structure. The structure type is decided by *function_code*.

| Table 39. out_buf structure and function_code | |
|---|--|
| function_code | out_buf structure |
| 1 | An 8-character field stands for the Product token that is returned on the associated function code 1 REGISTER request. |
| 2 or 5 | <pre>typedef struct __ceedsgd_dereg_fend_out{ unsigned char endtime[8]; unsigned char enddata[8]; } __ceedsgd_dereg_fend_out;</pre> <p>endtime An 8-character field where ending TCB time level is returned to the invoker.</p> <p>enddata An 8-character field where ending product specific data is returned to the invoker.</p> |
| 3 | An 8-character field where beginning CPU time level is returned. |
| 4 | An 8-character field where current resource level is returned to the invoker (after adding the input value). |
| 6 | User specified <i>out_buf</i> is not needed and ignored. |

fbfe

(Input) A field stands for whether the caller intends to use FUNCTIONBEGIN and FUNCTIONEND to account for time. Only the following choices can be used:

__FBFE_NO

Specifies that FUNCTIONBEGIN/FUNCTIONEND is not to be done. `__FBFE_NO` is used by default for unexpected input.

__FEBE_YES

Specifies that FUNCTIONBEGIN/FUNCTIONEND is to be done.

fc

(Output) A 16-byte Feedback Code indicating the results of this function.

| Table 40. Feedback Codes for __le_ceedsgd() | | | |
|---|----------|----------------|---|
| Code | Severity | Message number | Message text |
| CEE000 | 0 | - | The service completed successfully. |
| CEE3LA | 3 | 3754 | Incorrect parameters detected. |
| CEE3QS | 1 | 3932 | The system service service failed with return_code and reason_code. |

Related information

- “[__le_api.h — AMODE 64 C functions in Language Environment](#)” on page 34
- For more information about IFAUSAGE, see [IFAUSAGE — Collecting usage data in z/OS MVS System Management Facilities \(SMF\)](#).
- For information on how to make long long available, see [z/OS XL C/C++ Language Reference](#).

__le_cib_get() — Get condition information block

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>
struct cib *__le_cib_get(void);
```

General description

Returns the Condition Information Block (CIB) structure associated with the current signal.

Notes:

1. This function is valid when called while a Language Environment exception handler is running.
2. This function is valid when called while a POSIX(OFF) signal catcher is running.
3. This function is valid when called while a POSIX(ON) signal catcher is running, if the signal is generated and caught immediately to the same thread. __le_cib_get() will fail if called from POSIX(ON) signal catchers that are driven as a result of signals generated by another thread or process. It may also fail when called from a catcher, if the caught signal is from the same thread but was delayed by blocking or by other signals being delivered at the same time.

Returned value

If there is an active condition the returned value is a pointer to the currently active CIB. If there is more than one active condition, the returned CIB will be for the most recent (most deeply nested) condition.

NULL is returned there is no active CIB, and the errno will be set to EMVSERR.

Error Code
Description

EMVSERR
No active CIB is available.

__le_condition_token_build() – Build a Language Environment condition token

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>

void *__le_condition_token_build(_INT2 * c_1, _INT2 * c_2,
                                _INT2 * format, _INT2 * severity,
                                _INT2 * control, _CHAR3 facility_ID,
                                _INT4 * i_s_info,
                                _FEEDBACK * cond_token,
                                _FEEDBACK * fc);
```

General description

Dynamically constructs a 16-byte Language Environment condition token. The condition token is only to be used to retrieve messages from a Language Environment message file.

Parameter
Description

c_1
c_1 is a 2-byte binary integer representing the value of the first 2 bytes of the 4-byte condition_ID. c_1 and c_2 make up the condition_ID portion of the condition token.

c_2
c_2 is a 2-byte binary integer representing the value of the second 2 bytes of the 4-byte condition_ID.

For format 1, this is the Msg_No; for format 2, the cause_code.

format
A 2-byte binary integer defining the format of the condition_ID portion of the token.

severity
A 2-byte binary integer indicating the condition's severity. In both format 1 and 2 conditions, this field is used to test the condition's severity. For format 1 conditions, the value of this field is the same as the severity value specified in the condition_ID.

Possible severity Values:

0 = Information only, if entire token is 0 there is no information.

- 1 = Warning
- 2 = Error
- 3 = Severe Error
- 4 = Critical Error

control

A 2-byte binary integer containing flags describing or controlling various aspects of condition handling. Valid values for the control field are 1 and 0. 1 indicates the *facility_ID* assigned by IBM, 0 indicates the *facility_ID* assigned by the user.

facility_ID

A 3 character field containing three alphanumeric characters (A-Z, a-z, and 0-9) identifying the product or component of a product generating this condition or feedback information, for example, CEE.

The *facility_ID* is associated with the repository of the runtime messages. If a unique ID is required (for IBM and non-IBM products), an ID can be obtained by contacting an IBM project office.

If you create a new *facility_ID* to use with a message table, created using the CEEBLDTX utility, be aware that the *facility_ID* must be part of the Language Environment message table name. For more information about the CEEBLDTX utility, see *z/OS Language Environment Programming Guide*. It is important to follow the naming guidelines below in order to have a module name that does not cause your application to abend.

First, begin a non-IBM assigned product *facility_ID* with letters J through Z. (See the *control* parameter above to indicate whether the *facility_ID* has been assigned by IBM.) Secondly, special characters, including blank spaces, cannot be used in a *facility_ID*. Lastly, there are no other constraints (besides the alphanumeric requirement) on a non-IBM assigned *facility_ID*.

i_s_info

A fullword binary integer identifying the ISI, that contains insert data.

cond_token

A 16-byte representation of the constructed condition token.

fc

A 16-byte Feedback Code indicating the results of this function.

| Table 41. Feedback Codes for __le_condition_token_build() | | | |
|---|----------|----------------|--|
| Code | Severity | Message Number | Message Text |
| CEE000 | 0 | - - | The function completed successfully. |
| CEE0CH | 3 | 401 | A non-valid case code <i>case-code</i> was passed to routine <i>routine-name</i> . |
| CEE0CI | 3 | 402 | A non-valid control code <i>control-code</i> was passed to routine <i>routine-name</i> . |
| CEE0CJ | 3 | 403 | A non-valid severity code <i>severity-code</i> was passed to routine <i>routine-name</i> . |
| CEE0CK | 3 | 404 | Facility ID, <i>facility-id</i> , with non-alphanumeric characters was passed to routine <i>routine-name</i> . |
| CEE0E4 | 1 | 452 | An invalid facility ID <i>facility-id</i> was passed to routine <i>routine-name</i> . |

Usage notes

1. The structure of the condition token (type `_FEEDBACK`) is described in the "`__le_api.h`" header file shipped with Language Environment. You can assign values directly to the fields of the token in the header file without using the `__le_condition_token_build()` function.

2. This condition token is **only** to be used to retrieve messages from a Language Environment message table.

Related information

- “[__le_api.h — AMODE 64 C functions in Language Environment](#)” on page 34

`__le_debug_set_resume_mch()` — Move the resume cursor to a predefined location represented by a machine state

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>

void __le_debug_set_resume_mch(__mch_t * position, _FEEDBACK * fc);
```

General description

Moves the resume cursor to a predefined location represented by the machine state.

Parameter

Description

position

A pointer to a valid machine state block to which the resume cursor is moved.

fc

A 16-byte Feedback Code indicating the results of this function.

| Table 42. Feedback Codes for <code>__le_debug_set_resume_mch()</code> | | | |
|---|----------|----------------|---|
| Code | Severity | Message Number | Message Text |
| CEE000 | 0 | - - | The function completed successfully. |
| CEE07V | 3 | 255 | <i>Position</i> parameter not a machine state |

Related information

- “[__le_api.h — AMODE 64 C functions in Language Environment](#)” on page 34

`__le_msg_add_insert()` — Add insert to a Language Environment message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>

void *__le_msg_add_insert(_FEEDBACK * cond_token,
                          _INT4 * insert_seq_num,
                          _VSTRING * insert_data,
                          _FEEDBACK * fc);
```

General description

Copies message insert data and loads the address of that data into the Instance Specific Information (ISI) associated with the condition being processed. The number of ISIs per thread is limited to 15.

Parameter Description

cond_token

A 16-byte condition token that defines the condition for which the q_data_token is retrieved.

insert_seq_num

A 4-byte integer that contains the insert sequence number (such as insert 1 insert 2). It corresponds to an insert number specified with an :ins. tag in the message source file created by the CEEBLDTX utility. For more information about the CEEBLDTX utility see [z/OS Language Environment Programming Guide](#).

insert_data

A halfword-prefixed length string, used without truncation, that represents the insert data. DBCS strings must be enclosed within shift-out (0x0E) and shift-in (0x0F) characters.

Note: The maximum size for an individual insert item is 254 bytes.

fc

A 16-byte Feedback Code indicating the results of this function.

| Table 43. Feedback Codes for __le_msg_add_insert() | | | |
|--|----------|----------------|--|
| Code | Severity | Message Number | Message Text |
| CEE000 | 0 | - - | The function completed successfully. |
| CEE0EB | 3 | 459 | Not enough storage was available to create a new Instance Specific Information block. |
| CEE0EC | 1 | 460 | Multiple instances of the condition token with message number <i>message-number</i> and facility ID <i>facility-id</i> were detected. |
| CEE0ED | 3 | 461 | The maximum number of unique message insert blocks was reached. This condition token had it's I_S_info field set to 1. |
| CEE0EE | 3 | 462 | Instance Specific Information for the condition token with message number <i>message-number</i> and facility ID <i>facility-id</i> could not be found. |
| CEE0EF | 3 | 463 | The maximum size for an insert data item was exceeded be located. |
| CEE0H9 | 3 | 553 | An internal error was detected in creating the inserts for a condition. |

Usage notes

1. z/OS UNIX System Services consideration – In multithreaded applications, __le_msg_add_insert() applies to message insert data for only the invoking thread.

Related information

- “[__le_api.h — AMODE 64 C functions in Language Environment](#)” on page 34
- “[__le_msg_get\(\) — Get a Language Environment message](#)” on page 958
- “[__le_msg_get_and_write\(\) — Get and output a Language Environment message](#)” on page 960
- “[__le_msg_write\(\) — Output a Language Environment message to stderr](#)” on page 961

__le_msg_get() — Get a Language Environment message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>

void *__le_msg_get(_FEEDBACK * cond_token,
                  _CHAR80 message_area,
                  _INT4 * msg_index,
                  _FEEDBACK * fc);
```

General description

Retrieves, formats, and stores, in a passed message area, a Language Environment message corresponding to a user supplied condition token. The caller can later retrieve the message to modify or to write as output.

Parameter

Description

cond_token

A 16-byte condition token supplied by the invoker.

message_area

A fixed-length 80 character string, where the message is placed.

Note: The message is left-justified and padded on the right with blanks.

msg_index

A 4-byte binary integer returned to the invoker.

The *msg_index* should be set to zero on the first invocation of `__le_msg_get()`. If a message is too large to be contained in the *message_area*, *msg_index* is returned as an index into the message. This index is used on subsequent invocations to retrieve the remaining portion of the message. Feedback Code is also returned, indicating the message has been truncated. When the entire message is returned, *msg_index* is zero.

msg_idx contains different results based on the length of the message.

- If a message contains fewer than 80 characters, the entire message is returned on the first invocation. *msg_index* contains 0.
- If a message contains exactly 80 characters, the entire message is returned on the first invocation. *msg_index* contains 0.
- If the message is more than 80 characters it is split into segments. The *msg_index* does not contain the cumulative index for the entire message returned, but contains only the index of the segment that was just returned. It is up to the user to maintain the cumulative count if needed. When a message is too long, the following can occur:

- If a message contains more than 80 characters and at least one blank is contained in the first 80 characters, the string up to and including the last blank is returned on the first invocation.
- If the 80th character is non-blank (even if the 81st character is a blank), *msg_index* contains the index of the last blank (something less than 80), and the next invocation starts with the next character.
- If the 80th character is a blank, *msg_index* contains 80 and the next invocation starts with the 81st character, blank or non-blank.
- If a message contains more than 80 characters and at least the first 80 are all non-blank, the first 80 are returned. The next invocation does not add any blanks and starts with the 81st character. *msg_index* contains 80.

fc

A 16-byte Feedback Code indicating the results of this function.

| Table 44. Feedback Codes for __le_msg_get() | | | |
|---|----------|----------------|--|
| Code | Severity | Message Number | Message Text |
| CEE000 | 0 | - - | The function complete successfully. |
| CEE036 | 3 | 102 | An unrecognized condition token was passed to the function and could not be used. |
| CEE0E2 | 3 | 450 | The message inserts for the condition token with message number <i>message-number</i> and facility ID <i>facility-id</i> could not be located. |
| CEE0E6 | 3 | 454 | The message number <i>message-number</i> could not be found for facility ID <i>facility-id</i> . |
| CEE0E7 | 1 | 455 | The message with message number <i>message-number</i> and facility ID <i>facility-id</i> was truncated. |
| CEE0EA | 1 | 458 | The message repository <i>repository-name</i> could not be located. |

Usage notes

1. z/OS UNIX System Services consideration – In multithreaded applications, __le_msg_get() affects only the invoking thread. However, __le_msg_get() uses the NATLANG value of the enclave. Any subsequent calls to __le_msg_get(), for a given condition, use the NATLANG value in effect at the time of the first invocation.

Related information

- [“__le_api.h — AMODE 64 C functions in Language Environment” on page 34](#)
- [“__le_msg_add_insert\(\) — Add insert to a Language Environment message” on page 956](#)
- [“__le_msg_get_and_write\(\) — Get and output a Language Environment message” on page 960](#)
- [“__le_msg_write\(\) — Output a Language Environment message to stderr” on page 961](#)

__le_msg_get_and_write() – Get and output a Language Environment message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>

void *__le_msg_get_and_write(_FEEDBACK * cond_token,
                             _INT4 * destination_code,
                             _FEEDBACK * fc);
```

General description

Retrieves, formats, and stores, in a passed message area, a Language Environment message corresponding to a user supplied condition token. The caller can later retrieve the message to modify or to write as output.

Parameter

Description

cond_token

A 16-byte condition token supplied by the invoker.

destination_code

A 4-byte binary integer written to 'stderr'. The only acceptable value for is 2.

fc

A 16-byte Feedback Code indicating the results of this function.

| Table 45. Feedback Codes for __le_msg_get_and_write() | | | |
|---|----------|----------------|--|
| Code | Severity | Message Number | Message Text |
| CEE000 | 0 | - - | The function completed successfully. |
| CEE0E2 | 3 | 450 | The message inserts for the condition token with message number <i>message-number</i> and facility ID <i>facility-id</i> could not be located. |
| CEE0E3 | 3 | 451 | An invalid destination code <i>destination-code</i> was passed to routine <i>routine</i> . |
| CEE0E6 | 3 | 454 | The message number <i>message-number</i> could not be found for facility ID <i>facility-id</i> . |
| CEE0E9 | 1 | 457 | The message file destination <i>ddname</i> could not be located. |
| CEE0EA | 1 | 458 | The message repository <i>repository-name</i> could not be located. |
| CEE3CT | 3 | 3,485 | An internal message service error occurred while locating the message number within a message file. |

Table 45. Feedback Codes for __le_msg_get_and_write() (continued)

| Code | Severity | Message Number | Message Text |
|--------|----------|----------------|---|
| CEE3CU | 3 | 3,486 | An internal message service error occurred while formatting a message. |
| CEE3CV | 3 | 3,487 | An internal message service error occurred while locating a message number within the ranges specified in the repository. |

Usage notes

1. z/OS UNIX System Services consideration – In multithreaded applications, __le_msg_get_and_write() affects only the invoking thread. When multiple threads write to 'stderr' the output is interwoven by line. To group lines of output, serialize 'stderr' access (for example, by using a mutex).

Related information

- “__le_api.h – AMODE 64 C functions in Language Environment” on page 34
- “__le_msg_add_insert() – Add insert to a Language Environment message” on page 956
- “__le_msg_get() – Get a Language Environment message” on page 958
- “__le_msg_write() – Output a Language Environment message to stderr” on page 961

__le_msg_write() – Output a Language Environment message to stderr

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>

void __le_msg_write(_VSTRING * message_string,
                   _INT4 * destination_code,
                   _FEEDBACK * fc);
```

General description

Writes a user-defined Language Environment message string to 'stderr'.

Parameter

Description

message_string

A halfword-prefixed printable character string containing a message. DBCS characters must be enclosed within shift-out (0x0F) and shift-in (0x0E) characters.

Insert data cannot be placed in the message with __le_msg_write(). The halfword-prefixed message string must contain only printable characters and be a length greater than zero. Unpredictable results will occur if the byte following the halfword prefix is 0x00.

destination_code

A 4-byte binary integer written to 'stderr'. The only acceptable value is 2.

fc

A 16-byte Feedback Code indicating the results of this function.

| Table 46. Feedback Codes for __le_msg_write() | | | |
|---|----------|----------------|--|
| Code | Severity | Message Number | Message Text |
| CEE000 | 0 | - - | The function completed successfully. |
| CEE0E3 | 3 | 451 | An invalid destination code <i>destination-code</i> was passed to routine <i>routine</i> . |
| CEE0E9 | 3 | 457 | The message file destination <i>ddname</i> could not be located. |

Usage notes

1. z/OS UNIX System Services consideration – In multithreaded applications, __le_msg_write() affects only the invoking thread. When multiple threads write to 'stderr' the output is interwoven by line. To group lines of output, serialize 'stderr' access (for example, by using a mutex).

Related information

- “__le_api.h – AMODE 64 C functions in Language Environment” on page 34
- “__le_msg_add_insert() – Add insert to a Language Environment message” on page 956
- “__le_msg_get() – Get a Language Environment message” on page 958
- “__le_msg_get_and_write() – Get and output a Language Environment message” on page 960

__le_record_dump() – Record information for the active condition

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | AMODE 64 |

Format

```
#include <__le_api.h>

int __le_record_dump(int function_code,
                    void *information);
```

General description

The __le_record_dump() function records information of an active condition, so that the information can be retrieved from the condition information block (CIB) later. Use this function only during condition handling.

Parameter

Description

function_code

A fullword integer that contains the function code of the following value:

1

Record the dataset name of a dump for the active condition.

information

The information to be recorded. When the value of *function_code* is 1, the information is a halfword length-prefixed EBCDIC character string, which is expected to be the dataset name of a dump for the active condition. Language Environment will validate that the length is positive and it does not exceed 44.

Returned value

If successful, `__le_record_dump()` returns 0.

If unsuccessful, `__le_record_dump()` returns nonzero and sets `errno` to one of the following values:

Error Code**Description****EMVSERR**

No active CIB is available.

EINVAL

Incorrect parameters detected.

Usage notes

1. After the condition handling functions return control to your application, CIB that represents the condition is no longer valid, therefore the recorded information is no longer accessible.
2. If `__le_record_dump()` is called more than once for the same condition, the information of the last call is recorded.
3. This function is valid when it is called while a Language Environment exception handler is running.
4. You can use `__le_record_dump()` only in signal catchers that are driven for synchronous signals because the CIB is used for synchronous signals only.

__le_traceback() – Call chain traceback service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|-----------------------|
| Language Environment | both | z/OS V1.9 AMODE 64 |

Format

```
#include <__le_api.h>

void __le_traceback(int cmd, void* cmd_parms, _FEEDBACK *fc);
```

General description

The `__le_traceback()` function assists in tracing the call chain. It identifies the language, program unit, entry point, current location, caller's DSA, and other information from the address of a DSA for a program unit. This is essential for creating meaningful traceback messages.

Parameter**Description****cmd**

The `__le_traceback()` command to be used. The following commands can be used:

__TRACEBACK_FIELDS

Information that can be used to create a traceback message is returned in individual fields.

cmd_parms

A pointer to a structure that contains additional command specific parameters. For the command __TRACEBACK_FIELDS, this parameter must point to a __tf_parms_t.

fc

A 16-byte feedback code indicating the results of this function.

| Table 47. Feedback Codes for __le_traceback() | | | |
|---|----------|----------------|---|
| Code | Severity | Message number | Message text |
| CEE000 | 0 | - - | The service completed successfully. |
| CEE310 | 3 | 3104S | Information could not be successfully extracted for this DSA. It is likely that the dsaptr parameter does not point to an actual DSA or save area. |
| CEE316 | 2 | 3110E | The <i>cmd</i> parameter is not a valid command for __le_traceback(). |
| CEE3NS | 1 | 3836W | A statement number is not available for this DSA. DWARF data in the load module is corrupted. |
| CEE3NT | 1 | 3837W | Statement numbers are not available. The explicit DLL load of DLL CDAEQED failed with feedback code <i>fc</i> . |
| CEE3NU | 1 | 3838W | Statement numbers are not available. The explicit DLL load of DLL CDAEQDPI failed with feedback code <i>fc</i> . |
| CEE3NV | 1 | 3839W | Statement numbers are not available. The explicit DLL load of DLL CELQDSNF failed with feedback code <i>fc</i> . |
| CEE300 | 1 | 3840 | Statement numbers are not available. dllqueryfn() failed for a function in the DLL CELQDSNF. |
| CEE301 | 1 | 3841 | A statement number is not available for this DSA. An internal routine failed with return code <i>return-code</i> and reason code <i>reason-code</i> . |

The __tf_parms_s structure is defined as follows:

```
typedef struct __tf_string_s {
    size_t    __tf_bufflen;

    char*     __tf_buff;
} __tf_string_t;

typedef struct __tf_parms_s {
    /******
    /* Input
    /******
    void*     __tf_dsa_addr;
    void*     __tf_caa_addr;
    void*     __tf_call_instruction;
    /******
    /* Output related to input DSA
    /******
    void*     __tf_pu_addr;
```

```

void* __tf_entry_addr;
struct __cib* __tf_cib_addr;
uint8_t __tf_member_id;
int __tf_is_main:1;
int :23;
int :32;
__tf_string_t __tf_pu_name;
__tf_string_t __tf_entry_name;
__tf_string_t __tf_statement_id;
/*****
/* Output related to caller's DSA */
*****/
void* __tf_caller_dsa_addr;
void* __tf_caller_call_instruction;
} __tf_parms_t;

```

The following are members of the structure:

Member Description

void* __tf_dsa_addr

The address of the DSA for the current routine in the traceback. When this field is zero on input, the address of the DSA for the caller of `__le_traceback()` will be used and the address will be returned. No attempt is made to verify that the input is a DSA. Incorrect input can lead to unpredictable results.

void* __tf_caa_addr

The address of the CAA associated with the DSA. When this field is zero on input, the address of the CAA for the current thread will be used and the address will be returned. No attempt is made to verify that the input is a CAA. Incorrect input can lead to unpredictable results.

void* __tf_call_instruction

The address of the instruction that caused transfer out of the routine. This is either the address of a BASR, BRAS or BRASL instruction if transfer was made by subroutine call, or the address of the interrupted statement if transfer was caused by an exception. When multiple calls are made to `__le_traceback()` to scan the call chain, the `callers_call_instruction` (described below) returned from the previous call can be used here. If the address is not known, this field should be set to zero. When this field is zero on input and the address can be determined, it will be returned.

void* __tf_pu_addr

The address of the start of the program unit for the routine associated with the DSA is returned in this field. If the program unit address cannot be determined, this field is set to zero.

void* __tf_entry_addr

The address of the entry point into the routine associated with the DSA is returned in this field. If the entry point address cannot be determined, this parameter is set to zero.

struct __cib* __tf_cib_addr

The address of the CIB (struct `__cib`) associated with the DSA, if an exception occurred, is returned in this field. If no exception occurred, this field is set to zero. Note that if an exception caused transfer out of the routine, the state of the registers after the last instruction ran in the routine is saved in the CIB, rather than in the DSA.

uint8_t __tf_member_id

The member identifier for the routine associated with the DSA will be returned in this field. If the member ID cannot be determined, this field is set to negative one.

int __tf_is_main:1

One of two values is returned in this field: 0 (the routine associated with the DSA is not the main program) or 1 (the routine associated with the DSA is the main program).

__tf_string_t __tf_pu_name

A structure that will be used to return the name of the program unit containing the routine associated with the DSA. The structure has the following fields:

char* __tf_buff

The address of a buffer in which the program unit name will be returned. The name will be returned in the buffer as a null terminated string.

size_t __tf_bufflen

The size of the buffer

If the program unit name cannot be determined, the buffer is set to a null string. If the program unit name cannot fit within the supplied string, it is truncated. (Truncation of DBCS preserves even byte count and SI/SO pairing.) If __tf_buff is NULL or __tf_bufflen is zero, the program unit name is not returned.

__tf_string_t __tf_entry_name

A structure that will be used to return the name of the entry point into the routine associated with the DSA. The structure has the following fields:

char* __tf_buff

The address of a buffer in which the entry point name will be returned. The name will be returned in the buffer as a null terminated string.

size_t __tf_bufflen

The size of the buffer

If the entry point name cannot be determined, the buffer is set to a null string. If the entry point name cannot fit within the supplied string, it is truncated. (Truncation of DBCS preserves even byte count and SI/SO pairing.) If __tf_buff is NULL or __tf_bufflen is zero, the entry point name is not returned

__tf_string_t __tf_statement_id

A structure that will be used to return the identifier of the statement containing the instruction which caused transfer out of the routine associated with the DSA. The structure has the following fields:

char* __tf_buff

The address of a buffer in which the statement id will be returned. The statement id will be returned in the buffer as a null terminated string.

size_t __tf_bufflen

The size of the buffer

If the statement id cannot be determined, the buffer is set to a null string. If the statement id cannot fit within the supplied string, it is truncated. (Truncation of DBCS preserves even byte count and SI/SO pairing.) If __tf_buff is NULL or __tf_bufflen is zero, the statement id is not returned

void* __tf_callers_dsa_addr

The address of the DSA for the caller is returned in this field. If the address of the caller's DSA cannot be determined or is not valid (points to inaccessible storage), then this field is set to zero.

void* __tf_callers_call_instruction

The address of the instruction that caused transfer out of the caller is returned in this field. This is either the address of a BASR, BRAS or BRASL instruction if transfer was made by subroutine call, or the address of the interrupted statement if transfer was caused by an exception. If the address cannot be determined, this parameter is set to zero.

Example

```
#include <__le_api.h>
#include <stdlib.h>

int main() {
    __tf_parms_t    tbck_parms;
    char            pu_name[256];
    char            entry_name[256];
    char            statement_id[256];
    _FEEDBACK      fc;
    int             rc;

    tbck_parms.__tf_pu_name.__tf_bufflen = sizeof(pu_name);
    tbck_parms.__tf_entry_name.__tf_bufflen = sizeof(entry_name);
    tbck_parms.__tf_statement_id.__tf_bufflen = sizeof(statement_id);

    tbck_parms.__tf_pu_name.__tf_buff = pu_name;
    tbck_parms.__tf_entry_name.__tf_buff = entry_name;
    tbck_parms.__tf_statement_id.__tf_buff = statement_id;
```



```

tbck_parms.__tf_dsa_addr = 0;
tbck_parms.__tf_cca_addr = 0;
tbck_parms.__tf_call_instruction = 0;

do {
    _le_traceback(__TRACEBACK_FIELDS, &tbck_parms, &fc);

    if ( fc.tok_sev >= 2 ) {
        printf("Error: __le_traceback() failed.\n");
        break;
    }

    printf("Entry=%s Offset=%c%x Line=%s\n",
        tbck_parms.__tf_entry_name.__tf_buff,
        tbck_parms.__tf_call_instruction
        < tbck_parms.__tf_entry_addr ? '-' : '+',
        abs((int)((long)tbck_parms.__tf_call_instruction
        - (long)tbck_parms.__tf_entry_addr)),
        tbck_parms.__tf_statement_id.__tf_buff
    );

    tbck_parms.__tf_dsa_addr = tbck_parms.__tf_caller_dsa_addr;
    tbck_parms.__tf_call_instruction =
        tbck_parms.__tf_caller_call_instruction;

} while (!tbck_parms.__tf_is_main);

return 0;
}

```

Output

```

Entry=main Offset=+da Line=28
Entry=CELQINIT Offset=+134c Line=

```

Related information

- “[__le_api.h — AMODE 64 C functions in Language Environment](#)” on page 34

lfind() — Linear search routine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _XOPEN_SOURCE
#include <search.h>

void *lfind(const void *key, const void *base, size_t *nelp,
            size_t width, int (*compar)(const void *, const void *));

```

General description

The `lfind()` function is the same as a `lsearch()` except that if the entry is not found, it is not added to the table. Instead, a NULL pointer is returned.

Special behavior for C++: Because C and C++ linkage conventions are incompatible, `lfind()` cannot receive a C++ function pointer as the comparator argument. If you attempt to pass a C++ function pointer

to `lfind()`, the compiler will flag it as an error. You can pass a C or C++ function to `lfind()` by declaring it as `extern "C"`.

Returned value

If the searched-for entry is found, `lfind()` returns a pointer to it.

If not found, `lfind()` returns a NULL pointer.

No errors are defined.

Related information

- [“search.h — Searching tables” on page 58](#)
- [“bsearch\(\) — Search arrays” on page 221](#)
- [“hsearch\(\) — Search hash tables” on page 818](#)
- [“lsearch\(\) — Linear search and update” on page 1022](#)
- [“tsearch\(\) — Binary tree search” on page 1903](#)

lgamma(), lgammaf(), lgammal() — Log gamma function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE
#include <math.h>

double lgamma(double x);
extern int signgam;
int *__signgam(void);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

double lgamma(double x);
float lgammaf(float x);
long double lgammal(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float lgamma(float x);
long double lgamma(long double x);
```

General description

The `lgamma()` function computes the

$\log_e |\Gamma(x)|$

where

$\Gamma(x)$

is defined as

$$\int_0^{\infty} e^{-t} t^{(x-1)} dt$$

The sign of

$\Gamma(x)$

is returned in the external integer *signgam*. The argument *x* may not be a non-positive integer.

In a multithreaded process, each thread has its own instance of the *signgam* variable. Threads access their instances of the variable by calling the `__signgam()` function. See “[__signgam\(\) — Return signgam reference](#)” on page 1640. The `math.h` header (see “[math.h — Floating-point math functions](#)” on page 40) redefines the string “*signgam*” to an invocation of the `__signgam` function. The actual *signgam* external variable is used to store the *signgam* value for the IPT.

Note: The following table shows the viable formats for these functions. See “[IEEE binary floating-point](#)” on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| lgamma | X | X |
| lgammaf | X | X |
| lgammal | X | X |

Returned value

If successful, `lgamma()` returns the above function of its argument.

`lgamma()` will fail under the following conditions:

- If the result overflows, the function will return `HUGE_VAL` and set `errno` to `ERANGE`.
- If *x* is a non-positive integer and `_XOPEN_SOURCE` is defined, `lgamma()` returns `HUGE_VAL` and sets `errno` to `EDOM`.
- If *x* is a non-positive integer and `_ISOC99_SOURCE` is defined, `lgamma()` returns `HUGE_VAL` and sets `errno` to `ERANGE`.

Note: If both `_XOPEN_SOURCE` and `_ISOC99_SOURCE` are defined, the `_ISOC99_SOURCE` behavior will take precedence.

Special behavior for IEEE: Even when `_XOPEN_SOURCE` is defined and `_ISOC99_SOURCE` not, `lgamma()` returns `HUGE_VAL` and sets `errno` to `ERANGE`.

Example

```
/*
 * This example uses lgamma() to calculate ln(|G(x)|), where x = 42.
 */
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x=42, g_at_x;

    g_at_x = exp(lgamma(x)); /* g_at_x = 3.345253e+49 */
    printf ("The value of G(%4.2f) is %7.2e\n", x, g_at_x);
}
```

Output

```
The value of G(42.00) is 3.35e+49
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“exp\(\), expf\(\), expl\(\) — Calculate exponential function” on page 453](#)
- [“isnan\(\) — Test for NaN” on page 916](#)
- [“__signgam\(\) — Return signgam reference” on page 1640](#)

lgammad32(), lgammad64(), lgammad128() - Log gamma function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 lgammad32(_Decimal32 x);
_Decimal64 lgammad64(_Decimal64 x);
_Decimal128 lgammad128(_Decimal128 x);
_Decimal32 lgamma(_Decimal32 x); /* C++ only */
_Decimal64 lgamma(_Decimal64 x); /* C++ only */
_Decimal128 lgamma(_Decimal128 x); /* C++ only */
```

General description

The lgamma() function computes the $\log_e |\Gamma(x)|$

is defined as

$$\int_0^\infty e^{-t} t^{(x-1)} dt$$

The sign of $\Gamma(x)$

is returned in the external integer signgam. The argument x may not be a non-positive integer.

In a multithreaded process, each thread has its own instance of the *signgam* variable. Threads access their instances of the variable by calling the __signgam() function. The math.h header redefines the string *signgam* to an invocation of the __signgam function. The actual signgam external variable is used to store the signgam value for the IPT.

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, lgamma() returns the above function of its argument.

lgamma() will fail under the following conditions:

- If the result overflows, the function will return +HUGE_VAL_D32, +HUGE_VAL_D64 or +HUGE_VAL_D128 and set errno to ERANGE.
- If x is a non-positive integer, lgamma() returns +HUGE_VAL_D32, +HUGE_VAL_D64 or +HUGE_VAL_D128 and sets errno to ERANGE.

Example

CELEBL26

```
/* CELEBL26

   This exaxmple illustrates the lgammad64() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>
int main(void)
{
    _Decimal64 x, y;

    x = 42.0DD;
    y = lgammad64(x);

    printf ("lgammad64(%Df) = %Df\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“expd32\(\), expd64\(\), expd128\(\) — Calculate exponential function ” on page 454](#)
- [“isnan\(\) — Test for NaN” on page 916](#)
- [“__signgam\(\) — Return signgam reference” on page 1640](#)

__librel() — Query release level

Standards

| Table 48. Standards | | |
|------------------------|----------|--------------|
| Standards / Extensions | C or C++ | Dependencies |
| Language Environment | both | |

Format

```
#include <stdlib.h>

int __librel(void);
```

General description

The __librel() function provides the release level of the z/OS C/C++ runtime library. To use this function, you must enable the [runtime library extensions](#).

Returned value

The __librel() function returns the z/OS C/C++ runtime library release level that your application is using. The value is printed in hexadecimal format. The first byte of the value returned contains the product and version, second byte the release, and the third and fourth bytes contain the modification level.

Figure 4 on page 972 shows the format of the hexadecimal value returned by the __librel() function.

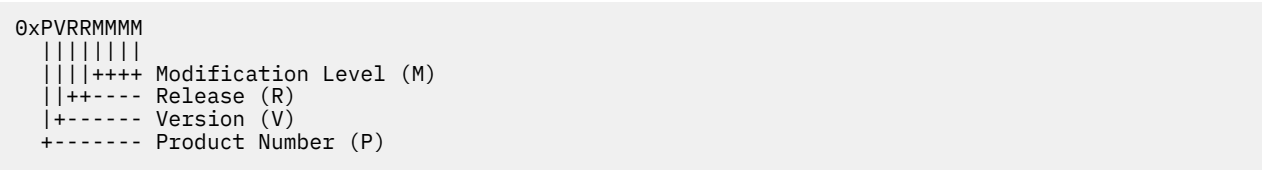


Figure 4. Format of the __librel() function return value

Table 49 on page 972 correlates library release level with the corresponding __librel() return value.

| Table 49. Library release level and value returned by the __librel() function | |
|---|--------------|
| Library release level | Return value |
| z/OS 3.2 | 0x43020000 |
| z/OS 3.1 | 0x43010000 |
| z/OS 2.5 | 0x42050000 |

Example

CELEBL04

```
/* CELEBL04

This example calls the __librel() function that returns
the library release level your program is currently
using in the following hexadecimal format 0xPVRMMMMM.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    printf("The current release of the library is: %X\n",__librel());
}
```

Output

The current release of the library is: 43020000

Related information

- [“stdlib.h — Standard library functions” on page 65](#)

link() — Create a link to a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int link(const char *oldfile, const char *newname);
```

General description

Provides an alternative pathname for the existing file, so that the file can be accessed by either the old or the new name. `link()` creates a link from the pathname *newname* to an existing file, with the pathname *oldfile*. The link can be stored in the same directory as the original file or in a completely different one.

Links are allowed to files only, not to directories.

This is a hard link, which ensures the existence of a file even after its original name has been removed.

If `link()` successfully creates the link, it increments the *link count* of the file. The link count tells how many links there are to the file. At the same time, `link()` updates the change time of the file, and the change time and modification time of the directory that contains *newname* (that is, the directory that holds the link). If `link()` fails, the link count is not incremented.

If *oldfile* names a symbolic link, `link()` creates a link that refers to the file that results from resolving the pathname contained in the symbolic link. If *newname* names a symbolic link, `link()` fails and sets `errno` to `EEXIST`.

Returned value

If successful, `link()` returns 0.

If unsuccessful, `link()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process did not have appropriate permissions to create the link. Possible reasons include no search permission on a pathname component of *oldfile* or *newname*, no write permission on the directory intended to contain the link, or no permission to access *oldfile*.

EEXIST

Either *newname* refers to a symbolic link, or a file or directory with the name *newname* already exists.

EINVAL

Either *oldfile* or *newname* is incorrect, because it contains a NULL.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links encountered during resolution of *oldfile* or *newname* is greater than `POSIX_SYMLLOOP`.

EMLINK

oldfile already has its maximum number of links. The maximum number of links to a file is given by **LINK_MAX**, which you can determine by using `pathconf()` or `fpathconf()`.

ENAMETOOLONG

oldfile or *newname* is longer than **PATH_MAX**, or a component of one of the pathnames is longer than **NAME_MAX** while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the pathname string substituted for a symbolic link in *oldfile* or *newname* exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using `pathconf()`.

ENOENT

A pathname component of *oldfile* or *newname* does not exist, or *oldfile* itself does not exist, or one of the two arguments is an empty string.

ENOSPC

The directory intended to contain the link cannot be extended to contain another entry.

ENOTDIR

A pathname component of one of the arguments is not a directory.

EPERM

oldfile is the name of a directory, and links to directories are not supported.

EROFS

Creating the link would require writing on a read-only file system.

EXDEV

oldfile and *newname* are on different file systems.

Example

```
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#include <stdlib.h>
#include <stdio.h>

main() {
    char fn[]="link.example.file";
    char ln[]="link.example.link";
    int fd;

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        close(fd);
        if (link(fn, ln) != 0) {
            perror("link() error");
            unlink(fn);
        }
        else {
            unlink(fn);
            unlink(ln);
        }
    }
}
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“rename\(\) — Rename file” on page 1434](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

linkat() — Create a link to a file relative to directory file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>          /* Definition of AT_* constants */
#include <unistd.h>

int linkat(int olddirfd, const char *oldpath, int newdirfd, const char *newpath, int flags);
```

General description

linkat() operates in the same way as link() except for the following differences.

- If the path name that is given in *oldpath* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *olddirfd* (rather than relative to the current working directory of the calling process, as is done by link() for a relative path name).
- If *oldpath* is relative and *olddirfd* is the special value AT_FDCWD, *oldpath* is interpreted relative to the current working directory of the calling process (like link()).
- If *oldpath* is absolute, *olddirfd* is ignored.
- The interpretation of *newpath* is as for *oldpath* except that a relative path name is interpreted relative to the directory referred to by the file descriptor *newdirfd*.
- The following values can be bitwise ORed in flags:

AT_EMPTY_PATH

If *oldpath* is an empty string, create a link to the file that is referenced by *olddirfd*. In this case, *olddirfd* can refer to any type of file except a directory. This generally does not work if a file has a link count of zero (files that are created with O_TMPFILE and without O_EXCL are an exception).

AT_SYMLINK_FOLLOW

By default, linkat() does not dereference *oldpath* if it is a symbolic link (like link()). The flag AT_SYMLINK_FOLLOW can be specified in *flags* to cause *oldpath* to be dereferenced if it is a symbolic link.

Returned value

If successful, linkat() returns 0.

If unsuccessful, linkat() returns -1 and sets errno to one of the following values:

Error Code

Description

EACCES

The process does not have appropriate permissions to create the link. Possible reasons include:

- No search permission on a path name component of *oldpath* or *newpath*.
- No write permission on the directory that is intended to contain the link.
- No permission to access *oldpath*.

EBADF

oldpath (or *newpath*) is relative but *olddirfd* (or *newdirfd*) is not `AT_FDCWD` or a valid file descriptor.

EEXIST

Either *newpath* refers to a symbolic link, or a file or directory with the name *newpath* exists.

EINVAL

Either *oldpath* or *newpath* is incorrect because it contains a NULL or an invalid flag value was specified in *flags*.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links that are encountered during the resolution of *oldpath* or *newpath* is greater than `POSIX_SYMLINK_MAX`.

EMLINK

oldpath has its maximum number of links. The maximum number of links to a file is given by `LINK_MAX`, which can be determined by using `pathconf()` or `fpathconf()`.

ENAMETOOLONG

oldpath or *newpath* is longer than `PATH_MAX`, or a component of one of the path names is longer than `NAME_MAX` while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the path name string that is substituted for a symbolic link in *oldfile* or *newname* exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined by using `pathconf()`.

ENOENT

- A path name component of *oldpath* or *newpath* does not exist.
- *oldpath* does not exist.
- One of the two arguments is an empty string.
- *oldpath* is a relative path name and *olddirfd* refers to a directory that is deleted.
- *newpath* is a relative path name and *newdirfd* refers to a directory that is deleted.

ENOSPC

The directory that is intended to contain the link cannot be extended to contain another entry.

ENOTDIR

- A path name component of one of the arguments is not a directory.
- *oldpath* is relative and *olddirfd* is a file descriptor that refers to a file other than a directory.
- *newpath* is relative and *newdirfd* is a file descriptor that refers to a file other than a directory.

EPERM

oldpath is the name of a directory and links to directories are not supported.

EROFS

Creating the link requires writing on a read-only file system.

EXDEV

oldpath and *newpath* are on different file systems.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

listen() — Prepare the server for incoming client requests

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int listen(int socket, int backlog);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/socket.h>

int listen(int socket, int backlog);
```

General description

The `listen()` function applies only to stream sockets. It indicates a readiness to accept client connection requests, and creates a connection request queue of length *backlog* to queue incoming connection requests. Once full, additional connection requests are rejected.

Parameter

Description

socket

The socket descriptor.

backlog

Defines the maximum length for the queue of pending connections.

The `listen()` call indicates a readiness to accept client connection requests. It transforms an active socket into a passive socket. Once called, *socket* can never be used as an active socket to initiate connection requests. Calling `listen()` is the third of four steps that a server performs to accept a connection. It is called after allocating a stream socket with `socket()`, and after binding a name to *socket* with `bind()`. It must be called before calling `accept()`.

If the backlog is less than 0, *backlog* is set to 0. If the backlog is greater than `SOMAXCONN`, as defined in **sys/socket.h**, *backlog* is set to `SOMAXCONN`.

For `AF_UNIX` sockets, this value is variable and can be set in the application. For `AF_INET` and `AF_INET6` sockets, the value cannot exceed the maximum number of connections allowed by the installed TCP/IP.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

If successful, `listen()` returns 0.

If unsuccessful, `listen()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

The *socket* parameter is not a valid socket descriptor.

EDESTADDRREQ

The socket is not bound to a local address, and the protocol does not support listening on an unbound socket.

EINVAL

An invalid argument was supplied. The socket is not named (a `bind()` has not been done), or the socket is ready to accept connections (a `listen()` has already been done). The socket is already connected.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The *socket* parameter is not a socket descriptor that supports the `listen()` call.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“socket\(\) — Create a socket” on page 1677](#)

listxattr(), llistxattr(), flistxattr() — List extended attribute names

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/xattr.h>

ssize_t listxattr(const char *path, char *list, size_t size);
ssize_t llistxattr(const char *path, char *list, size_t size);
ssize_t flistxattr(int fd, char *list, size_t size);
```

General description

Extended attributes are extensions to the normal attributes that are associated with all `inodes` in the system. They are used as `name:value` pairs that are associated with files and directories to provide more functions to a file system.

`listxattr()` retrieves the list of extended attribute names that are associated with the given path in the file system. The retrieved list is placed in a caller-allocated buffer that is pointed by *list* with size (in bytes) that is specified by *size*. If *size* is specified as zero, only the current size of the list of extended attributes is returned, and the buffer pointed by *list* remains unchanged.

`llistxattr()` is identical to `listxattr()` except that in the case of a symbolic link, the list of names of extended attributes that are associated with the link itself is retrieved by `lremovexattr()`, not the file that it refers to.

`flistxattr()` is identical to `listxattr()` except that only the open file that is referred to by *fd* is interrogated by `flistxattr()` in place of *path*.

Returned value

If successful, the size of the extended attribute name list in bytes is returned.

If unsuccessful, -1 is returned and `errno` is set to one of the following values:

Error Code

Description

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters.

ERANGE

The size of the value buffer is too small to hold the result.

ENOENT

No file is named *pathname*, or *pathname* is an empty string.

Related information

- [“sys/xattr.h — Extended attributes handling” on page 73](#)
- [“getxattr\(\), lgetxattr\(\), fgetxattr\(\) — Retrieve an extended attribute value” on page 804](#)
- [“removexattr\(\), lremovexattr\(\), fremovexattr\(\) — Remove an extended attribute” on page 1430](#)
- [“setxattr\(\), lsetxattr\(\), fsetxattr\(\) — Set an extended attribute value” on page 1591](#)

llabs() — Calculate absolute value of long long integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| z/OS UNIX C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | OS/390 V2R10 |

Format

```
#include <stdio.h>

long long llabs(long long int n);
```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

Calculates the absolute value of its long long integer argument *n*. The result is undefined when the argument is equal to `LLONG_MIN`, the smallest available long long integer (-9 223 372 036 854 775 808). The value `LLONG_MIN` is defined in the `limits.h` header file.

Returned value

Returns the absolute value of the long long integer argument *n*.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdlib.h — Standard library functions” on page 65](#)
- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“labs\(\) — Calculate long absolute value” on page 934](#)

lldiv() — Compute quotient and remainder of integral division for long long type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| z/OS UNIX C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | OS/390 V2R10 |

Format

```
#include <stdio.h>

long long lldiv(long long numer, long long denom);
```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

Calculates the quotient and remainder of the division of numerator by denominator.

Returned value

Returns a structure of type `lldiv_t`, containing both the quotient `long long quot` and the remainder `long long rem`.

If the value cannot be represented, the returned value is undefined. If *denominator* is 0, a divide by 0 exception is raised.

Example

```
/*
   This example uses the
   lldiv() function to calculate the quotients and
   remainders for a set of two dividends and two divisors.
*/
#define _LONG_LONG 1
#include <stdio.h>
#include <stdlib.h>

int main(void)
```

```

{
    long long num[2] = {45,-45};
    long long den[2] = {7,-7};
    lldiv_t ans; /* lldiv_t is a struct type containing
                  two long long int fields:
                  'quot' stores quotient; 'rem' stores remainder */

    short i,j;

    printf("Results of long division:\n");
    for (i = 0; i < 2; i++)
        for (j = 0; j < 2; j++)
        {
            ans = lldiv(num[i], den[j]);
            printf("Dividend: %6lld Divisor: %6lld", num[i], den[j]);
            printf(" Quotient: %6lld Remainder: %6lld\n", ans.quot,
                  ans.rem);
        }
}

```

Output

```

Results of long division:
Dividend:  45 Divisor:   7 Quotient:   6 Remainder:   3
Dividend:  45 Divisor:  -7 Quotient:  -6 Remainder:   3
Dividend: -45 Divisor:   7 Quotient:  -6 Remainder:  -3
Dividend: -45 Divisor:  -7 Quotient:   6 Remainder:  -3

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“stdlib.h — Standard library functions” on page 65](#)
- [“div\(\) — Calculate quotient and remainder” on page 385](#)
- [“lldiv\(\) — Compute quotient and remainder of integral division” on page 943](#)

llround(), llroundf(), llroundl() — Round to the nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```

#define _ISOC99_SOURCE
#include <math.h>

long long int llround(double x);
long long int llroundf(float x);
long long int llroundl(long double x);

```

C++ TR1 C99:

```

#define _TR1_C99
#include <math.h>

long long int llround(float x);
long long int llround(long double x);

```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

The lround() family of functions round x to the nearest integer, rounding halfway cases away from zero, regardless of the current rounding mode.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| lround | X | X |
| lroundf | X | X |
| lroundl | X | X |

Returned value

If successful, they return the rounded integer. If the correct value is positive or negative and too large to represent as a long long, a domain error will occur and an unspecified value is returned.

Example

```
/*
 * This program illustrates the use of lround() function
 *
 */
#define _ISOC99_SOURCE
#include <math.h>
#include <_Ieee754.h> /* fpc functions */
#include <stdio.h>

void main() {
    _FP_fpcreg_t    save_rmode;
    long long int   rnd2nearest;
    double          number;

    printf("Illustrates the lround() function\n\n");

    save_rmode.rmode = _RMODE_RZ;
    __fpc_sm(save_rmode.rmode); /* set rounding mode to round to zero */

    number=501.1;
    rnd2nearest = lround(number);
    printf ("lround(%.1f) = %lli\n",number, rnd2nearest);

    number=1.5;
    rnd2nearest = lround(number);
    printf ("lround(%.1f) = %lli\n",number, rnd2nearest);

    number=-2.5;
    rnd2nearest = lround(number);
    printf ("lround(%.1f) = %lli\n",number, rnd2nearest);
}

Output

Illustrates the lround() function

lround(501.1) = 501
lround(1.5) = 2
lround(-2.5) = -3
```

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“ceil\(\), ceilf\(\), ceill\(\) — Round up to integral value”](#) on page 249
- [“floor\(\), floorf\(\), floorl\(\) — Round down to integral value”](#) on page 554

- “[lrint\(\), lrintf\(\), lrintl\(\) and llrint\(\), llrintf\(\), llrintl\(\) — Round the argument to the nearest integer](#)” on page 1015
- “[lround\(\), lroundf\(\), lroundl\(\) — Round a decimal floating-point number to its nearest integer](#)” on page 1019
- “[nearbyint\(\), nearbyintf\(\), nearbyintl\(\) — Round the argument to the nearest integer](#)” on page 1137
- “[rint\(\), rintf\(\), rintl\(\) — Round to nearest integral value](#)” on page 1454
- “[round\(\), roundf\(\), roundl\(\) — Round to the nearest integer](#)” on page 1459
- “[trunc\(\), truncf\(\), trunc\(\) — Truncate an integer value](#)” on page 1899

llroundd32(), llroundd64(), llroundd128() — Round to the nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

long long int llroundd32(_Decimal32 x);
long long int llroundd64(_Decimal64 x);
long long int llroundd128(_Decimal128 x);

long long int llround(_Decimal32 x); /* C++ only */
long long int llround(_Decimal64 x); /* C++ only */
long long int llround(_Decimal128 x); /* C++ only */
```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

The `llround()` family of functions round x to the nearest integer, rounding halfway cases away from zero, regardless of the current rounding mode.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, they return the rounded integer. If the correct value is positive or negative and too large to represent as a long long, a domain error will occur and an unspecified value is returned.

Example

```
/* CELEBL21
   This example illustrates the llroundd32() function.
*/
#pragma strings(readonly)
```

```

#define __STDC_WANT_DEC_FP__
#include <fenv.h>
#include <math.h>
#include <stdio.h>

static void try_rm(int, _Decimal32);

/* pass back printable rounding mode */

static
char *rm_str(int rm)
{
    char *s = "undetermined";

    switch (rm)
    {
        case FE_DEC_TONEAREST :
            s = "FE_DEC_TONEAREST" ; break;
        case FE_DEC_TOWARDZERO :
            s = "FE_DEC_TOWARDZERO" ; break;
        case FE_DEC_UPWARD :
            s = "FE_DEC_UPWARD" ; break;
        case FE_DEC_DOWNWARD :
            s = "FE_DEC_DOWNWARD" ; break;
        case FE_DEC_TONEARESTFROMZERO :
            s = "FE_DEC_TONEARESTFROMZERO" ; break;
        case FE_DEC_TONEARESTTOWARDZERO :
            s = "FE_DEC_TONEARESTTOWARDZERO" ; break;
        case FE_DEC_AWAYFROMZERO :
            s = "FE_DEC_AWAYFROMZERO" ; break;
        case FE_DEC_PREPAREFORSHORTER :
            s = "FE_DEC_PREPAREFORSHORTER" ; break;
    }

    return s;
}

/* Try out one passed-in number with rounding mode */

static void try_rm(int rm, _Decimal32 d32)
{
    long long int ll;

    (void)fe_dec_setround(rm);

    ll = llroundd32(d32);

    printf("llroundd32(%+.2HF) = %+lld - rounding mode = %s\n",
           d32, ll, rm_str(rm));
    return;
}

int main()
{
    try_rm( FE_DEC_TONEAREST, 501.50DF);
    try_rm( FE_DEC_TOWARDZERO, 501.50DF);
    try_rm( FE_DEC_UPWARD, -501.51DF);
    try_rm( FE_DEC_DOWNWARD, -501.49DF);
    try_rm( FE_DEC_TONEARESTFROMZERO, 500.50DF);
    try_rm( FE_DEC_TONEARESTTOWARDZERO, -501.50DF);
    try_rm( FE_DEC_AWAYFROMZERO, 500.49DF);
    try_rm( FE_DEC_PREPAREFORSHORTER, 501.50DF);

    return 0;
}

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceild32\(\), ceild64\(\), ceild128\(\) — Round up to integral value” on page 250](#)
- [“floord32\(\), floord64\(\), floord128\(\) — Round down to integral value” on page 555](#)
- [“llround\(\), llroundf\(\), llroundl\(\) — Round to the nearest integer” on page 981](#)

- “[lrintd32\(\), lrintd64\(\), lrintd128\(\) and llrintd32\(\), llrintd64\(\), llrintd128\(\)](#) — Round the argument to the nearest integer” on page 1017
- “[lroundd32\(\), lroundd64\(\), lroundd128\(\)](#) — Round a floating-point number to its nearest integer” on page 1020
- “[nearbyintd32\(\), nearbyintd64\(\), nearbyintd128\(\)](#) — Round the argument to the nearest integer” on page 1139
- “[rintd32\(\), rintd64\(\), rintd128\(\)](#) — Round to nearest integral value” on page 1455
- “[roundd32\(\), roundd64\(\), roundd128\(\)](#) — Round to the nearest integer” on page 1460
- “[truncd32\(\), truncd64\(\), truncd128\(\)](#) — Truncate an integer value” on page 1900

lltoa() — Convert long long into a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

```
#define _OPEN_SYS_ITOA_EXT
#include <stdlib.h>

char * lltoa(int64_t ll, char * buffer, int radix);
```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

The `lltoa()` function converts the `int64_t ll` into a character string. The string is placed in the buffer passed, which must be large enough to hold the output. The radix values can be OCTAL, DECIMAL, or HEX. When the radix is DECIMAL, `lltoa()` produces the same result as the following statement:

```
(void) sprintf(buffer, "%lld", ll);
```

with `buffer` the returned character string. When the radix is OCTAL, `lltoa()` formats `int64_t ll` into an unsigned octal constant. When the radix is HEX, `lltoa()` formats `int64_t ll` into an unsigned hexadecimal constant. The hexadecimal value will include lower case `abcdef`, as necessary.

Returned value

String pointer (same as `buffer`) will be returned. When passed an invalid radix argument, function will return NULL and set `errno` to `EINVAL`.

Usage notes

1. This is a non-standard function. Even though the prototype given is commonly used by compilers on other platforms, there is no guarantee that this function will behave the same on all platforms, in all cases. You can use this function to help port applications from other platforms, but you should avoid using it when writing new applications, in order to ensure maximum portability.

Example

CELEBL30

```
/* CELEBL30

This example reads an int64_t and formats it to decimal, unsigned
octal, unsigned hexadecimal constants converted to a character
string.

*/

#define _OPEN_SYS_ITOA_EXT
#include <stdio.h>
#include <stdlib.h>

int main ()
{
    int64_t i;
    char buffer [sizeof(int64_t)*8+1];
    printf ("Enter a number: ");
    if (scanf ("%lld",&i) == 1) {
        lltoa (i,buffer,DECIMAL);
        printf ("decimal: %s\n",buffer);
        lltoa (i,buffer,HEX);
        printf ("hexadecimal: %s\n",buffer);
        lltoa (i,buffer,OCTAL);
        printf ("octal: %s\n",buffer);
    }
    return 0;
}
```

Output

If the input is 1234, then the output should be:

```
decimal: 1234
hexadecimal: 4d2
octal: 2322
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“itoa\(\) — Convert int into a string” on page 925](#)
- [“ltoa\(\) — Convert long into a string” on page 1030](#)
- [“ulltoa\(\) — Convert unsigned long long into a string” on page 1925](#)
- [“ultoa\(\) — Convert unsigned long into a string” on page 1927](#)
- [“utoa\(\) — Convert unsigned int into a string” on page 1958](#)

localdtconv() — Date and time formatting convention inquiry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <locale.h>

struct dtconv *localdtconv(void);
```

General description

Determines the date/time format information of the current locale.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Returned value

Returns the address of the *dtconv* structure:

```
struct dtconv {
    char *abbrev_month_names[12]; /* Abbreviated month names */
    char *month_names[12];       /* full month names */
    char *abbrev_day_names[7];   /* Abbreviated day names */
    char *day_names[7];          /* full day names */
    char *date_time_format;      /* date and time format */
    char *date_format;           /* date format */
    char *time_format;           /* time format */
    char *am_string;             /* AM string */
    char *pm_string;             /* PM string */
    char *time_format_ampm;      /* long date format */
    char *iso_std8601_2000;      /* ISO 8601:2000 std date format*/
};
```

The *dtconv* structure is an IBM extension that stores values from the LC_TIME category of the current locale. It is initialized by the `setlocale()` function and copied to the user-supplied *dtconv* when `localdtconv()` is called.

The *dtconv* structure can be overwritten by subsequent calls to `localdtconv()` and `setlocale()` with LC_ALL or LC_TIME.

Related information

- See the topic about internationalization of locales and character sets in [z/OS XL C/C++ Programming Guide](#)
- [“locale.h — Locale settings” on page 36](#)
- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“localeconv\(\) — Query numeric conventions” on page 988](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“setlocale\(\) — Set locale” on page 1547](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)
- [“time\(\), time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

localeconv() – Query numeric conventions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <locale.h>

struct lconv *localeconv(void);
```

General description

Sets the components of a structure having type `struct lconv` to values appropriate for the current locale. The structure may be overwritten by another call to `localeconv()` or by calling `setlocale()` and passing `LC_ALL`, `LC_MONETARY`, or `LC_NUMERIC`.

For a list of the elements in the `lconv` structure, see [Table 6 on page 37](#).

Pointers to strings with a value of "" indicate that the value is not available in the C locale or is of 0 length. char types with a value of `UCHAR_MAX` indicate that the value is not available in the current locale.

Returned value

Returns a pointer to the structure.

Example

CELEBL06

```
/* CELEBL06

   This example prints out the default decimal point for your locale and
   then the decimal point for the Fr_CA locale.

*/
#include <stdio.h>
#include <locale.h>

int main(void)
{
    char * string;
    struct lconv * mylocale;
    mylocale = localeconv();
    /* Display default decimal point */
    printf( "Default decimal point is a %s\n",
            mylocale->decimal_point );

    if (NULL != (string = setlocale(LC_ALL, "Fr_CA.IBM-1047" )))
    {
        mylocale = localeconv();
        /* A comma is set to be the decimal point
           when the locale is Fr_CA.IBM-1047 */
        printf( "French-speaking Canadian decimal point is a %s\n",
                mylocale->decimal_point );
    }
    else {
        printf("setlocale(LC_ALL, Fr_CA.IBM-1047) returned <NULL>\n");
    }
}
```

```
    return 0;
}
```

Output

```
Default decimal-point is a .
French-speaking Canadian decimal-point is a ,
```

Related information

- See the topic about internationalization of locales and character sets in [z/OS XL C/C++ Programming Guide](#)
- “[locale.h — Locale settings](#)” on page 36
- “[localdtconv\(\) — Date and time formatting convention inquiry](#)” on page 986
- “[localtime\(\), localtime64\(\) — Convert time and correct for local time](#)” on page 989
- “[localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time](#)” on page 991
- “[setlocale\(\) — Set locale](#)” on page 1547

localtime(), localtime64() — Convert time and correct for local time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <time.h>

struct tm *localtime(const time_t *timeval);

#define _LARGE_TIME_API
#include <time.h>

struct tm *localtime64(const time64_t *timeval);
```

Compile requirement: Use of `localtime64()` function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

The `localtime()` function converts the calendar time pointed to by `timeval` to a broken-down time expressed in local time. Calendar time is usually obtained by a call to the `time()` function.

The `localtime64()` function behaves exactly like `localtime()` except it will break down a `time64_t` value pointing to a calendar time beyond 03:14:07 UTC on January 19, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Usage notes

1. This function is sensitive to time zone information which is provided by:
 - The TZ environmental variable when POSIX(ON) and TZ is correctly defined, or by the _TZ environmental variable when POSIX(OFF) and _TZ is correctly defined.
 - The LC_TOD category of the current locale if POSIX(OFF) or TZ is not defined.

The time zone external variables tzname, timezone, and daylight declarations remain feature test protected in time.h.
2. The ctime(), localtime(), and mktime() functions now return Coordinated Universal Time (UTC) unless customized locale information is made available, which includes setting the timezone_name variable.
3. In POSIX you can supply the necessary information by using environment variables.
4. In non-POSIX applications, you can supply customized locale information by setting time zone and daylight information in LC_TOD.
5. By customizing the locale, you allow the time functions to preserve both time and date, correctly adjusting for daylight time on a given date.
6. The gmtime() and localtime() functions may use a common, statically allocated structure for the conversion. Each call to one of these functions will alter the result of the previous call.
7. Calendar time returned by the time() function begins at the epoch, which was at 00:00:00 Coordinated Universal Time (UTC), January 1, 1970.
8. The localtime() function converts calendar time (that is, seconds elapsed since the epoch) to broken-down time, expressed as local time, using time zone information provided by the TZ or _TZ environment variable or the LC_TOD category of the current locale:
 - When neither TZ nor _TZ is defined, the current locale is interrogated for time zone information. If neither TZ nor _TZ is defined and LC_TOD time zone information is not present in the current locale, a default value is applied to local time. POSIX programs simply default to Coordinated Universal Time (UTC), while non-POSIX programs establish an offset from UTC based on the setting of the system clock. For more information about customizing a time zone to work with local time, see “Customizing a time zone” in [z/OS XL C/C++ Programming Guide](#).

Returned value

Returns a pointer to a *tm* structure containing the broken-down time, expressed as a local time, and corresponding to the calendar time pointed to by *timeval*. If the calendar time cannot be converted, localtime() returns a NULL pointer. See [“time.h — Time and date” on page 75](#) for a description of the fields of the *tm* structure.

Error Code

Description

EOVERFLOW

The result cannot be represented.

Example

CELEBL07

```
/* CELEBL07

   This example queries the system clock and displays the local time.

*/
#include <time.h>
#include <stdio.h>

int main(void)
{
    struct tm *newtime;
    time_t ltime;
```



```

time(&lttime);
newtime = localtime(&lttime);
printf("The date and time is %s", asctime(newtime));
}

```

Output

This output would occur if the local time is 3:00 p.m. June 16, 2006):

```
The date and time is Fri Jun 16 15:00:00 2006
```

Related information

- See the topic about internationalization of locales and character sets in *z/OS XL C/C++ Programming Guide* for a description of LC_TOD, which is a nonstandard, IBM z/OS C/C++ proprietary locale category.
- [“locale.h — Locale settings” on page 36](#)
- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) — Date and time formatting convention inquiry” on page 986](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)
- [“time\(\), time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

localtime_r(), localtime64_r() — Convert time value to broken-down local time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 Language Environment | both | OS/390 V2R8 |

Format

```

#define _XOPEN_SOURCE 500
#include <time.h>

struct tm *localtime_r(const time_t *__restrict__ clock,
                      struct tm *__restrict__ result);

```

```

#define _XOPEN_SOURCE 500
#define _XPLATFORM_SOURCE
#include <time.h>

```

```
struct tm *localtime_r(const time_t *__restrict__ clock, struct tm *__restrict__ result);
```

```
#define _LARGE_TIME_API
#include <time.h>
```

```
struct tm *localtime64_r(const time64_t *__restrict__ clock,
                        struct tm *__restrict__ result);
```

Compile requirement: Use of `localtime64_r()` function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

The `localtime_r()` function converts the calendar time pointed to by `clock` into a broken-down time that is stored in the structure to which `result` points. The `localtime_r()` function also returns a pointer to that same structure.

Unlike `localtime()`, the reentrant version is not required to set `tzname`.

The `localtime64_r()` function behaves exactly like `localtime_r()` except it will break down a `time64_t` value pointing to a calendar time beyond 03:14:07 Coordinated Universal Time on January 19, 2038 with a limit of 23:59:59 Coordinated Universal Time on December 31, 9999.

Special behavior for `_XPLATFORM_SOURCE`: When `_XPLATFORM_SOURCE` is defined, the structure `tm` includes `tm_gmtoff` and `tm_zone`. The values are available after `localtime_r()` is called.

Returned value

If successful, `localtime_r()` returns a pointer to the structure pointed to by the argument `result`.

If an error is detected, `localtime_r()` returns a null pointer and set `errno` to indicate the error.

Error Code

Description

EOVERFLOW

The result cannot be represented.

Related information

- See the topic about internationalization of locales and character sets in [z/OS XL C/C++ Programming Guide](#)
- [“locale.h — Locale settings” on page 36](#)
- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) — Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)
- [“time\(\), time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

lockf() — Record locking on files

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int lockf(int filedes, int function, off_t size);
```

General description

The `lockf()` function allows sections of a file to be locked with advisory-mode locks. Calls to `lockf()` from other processes which attempt to lock the locked file section will either return an error value or block until the section becomes unlocked. All the locks for a process are removed when the process terminates. Record locking with `lockf()` is supported for regular files.

The *filedes* argument is an open file descriptor. The file descriptor must have been opened with a write-only permission (`O_WRONLY`) or with read/write permission (`O_RDWR`) to establish a lock with this function.

The *function* argument is a control value which specifies the action to be taken. The permissible values for *function* are defined in `<unistd.h>` as follows:

| Function | Description |
|----------|---|
| F_ULOCK | unlock locked sections |
| F_LOCK | lock a section for exclusive use |
| F_TLOCK | test and lock a section for exclusive use |
| F_TEST | test a section for locks by other processes |

`F_TEST` detects if a lock by another process is present on the specified section; `F_LOCK` and `F_TLOCK` both lock a section of a file if the section is available; `F_ULOCK` removes locks from a section of the file.

The *size* argument is the number of contiguous bytes to be locked or unlocked. The section to be locked or unlocked starts at the current offset in the file and extends forward for a positive size or backward for a negative size (the preceding bytes up to but not including the current offset). If *size* is 0, the section from the current offset through the largest possible file offset is locked (that is, from the current offset through the present or any future End Of File (EOF)). An area need not be allocated to the file to be locked because locks may exist past the End Of File.

The sections locked with `F_LOCK` or `F_TLOCK` may, in whole or in part, contain or be contained by a previously locked section for the same process. When this occurs, or if adjacent locked sections would occur, the sections are combined into a single locked section. If the request would cause the number of locks to exceed a system-imposed limit, the request will fail.

`F_LOCK` and `F_TLOCK` requests differ only by the action taken if the section is not available. `F_LOCK` blocks the calling process until the section is available. `F_TLOCK` makes the function fail if the section is already locked by another process.

File locks are released on first close by the locking process of any file descriptor for the file.

`F_ULOCK` requests may release (wholly or in part) one or more locked sections controlled by the process. Locked sections will be unlocked starting at the current file offset through *size* bytes or to the End Of File (EOF) if *size* is (`off_t`)0. When all of a locked section is not released (that is, when the beginning or end of the area to be unlocked falls within a locked section), the remaining portions of that section are still

locked by the process. Releasing the center portion of a locked section will cause the remaining locked beginning and end portions to become two separate locked sections. If the request would cause the number of locks in the system to exceed a system-imposed limit, the request will fail.

A potential for deadlock occurs if a process controlling a locked section is blocked by accessing another process's locked section. If the system detects that a deadlock would occur, `lockf()` will fail with an EDEADLK error.

Locks obtained by `lockf()` are controlled by the same facility controlling locks obtained by `fcntl()`.

The interaction between `fcntl()` and `lockf()` locks is unspecified.

Blocking on a section is interrupted by any signal.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `lockf()` returns 0.

If unsuccessful, existing locks are not changed, `lockf()` returns -1, and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|-------------------------|--|
| EACCES or EAGAIN | The <i>function</i> argument is <code>F_TLOCK</code> or <code>F_TEST</code> and the section is already locked by another process |
| EBADF | The <i>filedes</i> argument is not a valid open file descriptor; or <i>function</i> is <code>F_LOCK</code> or <code>F_TLOCK</code> and <i>filedes</i> is not a valid file descriptor open for writing. |
| EDEADLK | The <i>function</i> argument is <code>F_LOCK</code> and a deadlock is detected. |
| EINTR | A signal was caught during execution of the function. |
| E_OVERFLOW | The offset of the first, or if size is not 0 then the last, byte in the requested section cannot be represented correctly in an object of type <code>off_t</code> . |

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

log(), logf(), logl() – Calculate natural logarithm

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double log(double x);
float log(float x);           /* C++ only */
long double log(long double x); /* C++ only */
float logf(float x);
long double logl(long double x);
```

General description

Calculates the natural logarithm (base e) of x, for x greater than 0.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

Returned value

Returns the computed value.

If x is negative, the function sets errno to EDOM and returns -HUGE_VAL. If x is 0.0, the function returns -HUGE_VAL and sets errno to ERANGE. If the correct value would cause an underflow, 0 is returned and the value ERANGE is stored in errno.

Special behavior for IEEE: If x greater than 0, the function returns the natural logarithm (base e) of x.

If x is negative, the function sets errno to EDOM and returns NaNQ. If x is 0.0, the function returns -HUGE_VAL and errno remains unchanged.

Note: When environment variable _EDC_SUSV3 is set to 2, and if x is 0.0, the function returns -HUGE_VAL and sets errno to ERANGE.

Example

CELEBL08

```
/* CELEBL08

   This example calculates the natural logarithm of 1000.0.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x = 1000.0, y;
```

```
y = log(x);  
printf("The natural logarithm of %lf is %lf\n", x, y);  
}
```

Output

The natural logarithm of 1000.000000 is 6.907755

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“exp\(\), expf\(\), expl\(\) — Calculate exponential function” on page 453](#)
- [“log10\(\), log10f\(\), log10l\(\) — Calculate base 10 logarithm” on page 1005](#)
- [“pow\(\), powf\(\), powl\(\) — Raise to power” on page 1204](#)

logb(), logbf(), logbl() — Unbiased exponent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|-----------------------------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 for logbf(), logbl() |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1  
#include <math.h>  
  
double logb(double x);
```

C99:

```
#define _ISOC99_SOURCE  
#include <math.h>  
  
float logbf(float x);  
long double logbl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99  
#include <math.h>  
  
float logb(float x);  
long double logb(long double x);
```

General description

Returns the exponent of its argument *x*, as a signed integer value in floating-point mode. If *x* is subnormal, it is treated as a normalized number.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| logb | X | X |
| logbf | X | X |
| logbl | X | X |

Returned value

If successful, `logb()` returns the exponent of `x`.

`logb()` will fail under the following condition: If `x` is equal to 0.0, `logb()` will return `-HUGE_VAL` and set `errno` to `EDOM`.

Example

```

/*
 * This program illustrates the use of logb() function
 *
 */
#define _ISOC99_SOURCE
#include <math.h>
#include <float.h> /* Needed for FLT_RADIX */
#include <stdio.h>

void main() {

    int i;
    union {
        double number;
        unsigned char  uchars [sizeof(double)];
    } dblval;
    double logbx;

    printf("Illustrates the logb() function");

    #ifdef _BFP
        printf(" (IEEE version)\n\n");
    #else
        printf(" (HFP version)\n\n");
    #endif

    /* generate the smallest possible double number */
    for (i=0; i<sizeof(double); i++)
        dblval.uchars[i] = 0;
    dblval.uchars[1] = 0x10;

    logbx = logb(dblval.number);

    printf("x = %g\n",dblval.number);
    printf("logb(x) = %f\n\n", logbx);

    printf("pow(FLT_RADIX, logb(x) ) should equal x\n");
    printf("pow(%d,%f) = %g\n",FLT_RADIX, logbx, pow(FLT_RADIX, logbx));
}

```

Output

Illustrates the logb() function (IEEE version)

x = 2.22507e-308
logb(x) = -1022.000000

pow(FLT_RADIX, logb(x)) should equal x
pow(2,-1022.000000) = 2.22507e-308

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ilogb\(\), ilogbf\(\), ilogbl\(\) — Integer unbiased exponent” on page 834](#)

logbd32(), logbd64(), logbd128() – Unbiased exponent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 logbd32(_Decimal32 x);
_Decimal64 logbd64(_Decimal64 x);
_Decimal128 logbd128(_Decimal128 x);

_Decimal32 logb(_Decimal32 x);    /* C++ only */
_Decimal64 logb(_Decimal64 x);    /* C++ only */
_Decimal128 logb(_Decimal128 x);  /* C++ only */
```

General description

Returns the unbiased exponent of its argument *x* as a signed integer value in decimal floating-point mode. For typical numbers, the value returned is the logarithm of $|x|$ rounded down (toward $-\infty$) to the nearest integer value.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, these functions return the unbiased exponent of *x* as a signed integer value in decimal floating-point mode.

These functions will fail under the following condition: If *x* is equal to 0.0, `-HUGE_VAL_D32`, `-HUGE_VAL_D64`, or `-HUGE_VAL_D128` is returned and `errno` is set to `EDOM`.

Example

```
/* CELEBL24
   This program illustrates the use of logbd32() function
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>
#include <stdlib.h>

void main()
{
    _Decimal32 x, logbx;

    printf("Illustrates the logbd32() function\n");

    /* Generate the smallest possible positive _Decimal32 number */
    x = strtod32("0000001.E-101", NULL);
    logbx = logbd32(x);
```



```

printf("x      = %Hg\n" , x      );
printf("logb(x) = %Hf\n\n", logbx);

printf("powd32(10.0, logb32(x)) should equal x\n");
printf("powd32(%Hf, %Hf) = %Hg\n",
       10.0DF, logbx, powd32(10.0DF, logbx));
}

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ilogbd32\(\), ilogbd64\(\), ilogbd128\(\) — Integer unbiased exponent” on page 835](#)
- [“logb\(\), logbf\(\), logbl\(\) — Unbiased exponent” on page 996](#)

logd32(), logd64(), logd128() — Calculate natural logarithm

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 logd32(_Decimal32 x);
_Decimal64 logd64(_Decimal64 x);
_Decimal128 logd128(_Decimal128 x);

_Decimal32 log(_Decimal32 x); /* C++ only */
_Decimal64 log(_Decimal64 x); /* C++ only */
_Decimal128 log(_Decimal128 x); /* C++ only */

```

General description

Calculates the natural logarithm (base e) of x, for x greater than 0.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If x greater than 0, the function returns the natural logarithm (base e) of x.

If x is negative, the function sets errno to EDOM and returns NaNQ.

If x is 0.0, the function returns -HUGE_VAL_D32, -HUGE_VAL_D64, or -HUGE_VAL_D128 and errno remains unchanged.

Example

```

/* CELEBL22

   This example illustrates the logd64() function.

*/

```

```
#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 x = 1000.0DD, y;

    y = logd64(x);

    printf("The natural logarithm of %Df is %Df\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“expd32\(\), expd64\(\), expd128\(\) — Calculate exponential function ” on page 454](#)
- [“log\(\), logf\(\), logl\(\) — Calculate natural logarithm” on page 995](#)
- [“log10d32\(\), log10d64\(\), log10d128\(\) — Calculate base 10 logarithm” on page 1006](#)
- [“powd32\(\), powd64\(\), powd128\(\) — Raise to power” on page 1205](#)

__login(), __login_applid() — Create a new security environment for process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R6 |

Format

```
#define _OPEN_SYS
#include <unistd.h>

int __login(int    function_code,
            int    identity_type,
            int    identity_length,
            void   *identity,
            int    pass_length,
            char   *pass,
            int    certificate_length,
            char   *certificate,
            int    option_flags);

int __login_applid(int function_code,
                  int identity_type,
                  int identity_length,
                  void *identity,
                  int pass_length,
                  char *pass,
                  int certificate_length,
                  char *certificate,
                  int option_flags,
                  const char *applid);
```

General description

The __login() function provides a way for a process to change its identity so as to be different than the address space identity and create a new security environment for the process. Once changed the process should not revert back to a previous identity and security environment. The following rules apply:

- Any single-threaded process can issue a __login to change its security environment.

- If the process is in a multiprocessing or multiple user environment and there is no task level security associated with the process, then the new security environment will be associated with the process.
- If the process is in a multiprocessing or multiple user environment and there is task level security associated with the process, then the old security environment will be replaced by the new security environment.

The `__login_applid()` function is equivalent to `__login()` with the added feature that it also allows the application identifier (APPLID) to be supplied that will be passed on to the security product to assist with authentication. This is useful, for example, in situations where a pass ticket is provided and the pass ticket was created with a USERID/APPLID combination. When applid is NULL or a pointer to NULL, no application identifier will be passed on to the security product.

The function has the following parameters:

| Parameter | Description |
|-----------|-------------|
|-----------|-------------|

| | |
|-----------------------------|---|
| <i>function_code</i> | Specifies the function. Specify <code>__LOGIN_CREATE</code> , as defined in the <code>unistd.h</code> header file, to create a process level security environment for the caller's process. |
|-----------------------------|---|

| | |
|-----------------------------|--|
| <i>identity_type</i> | Specifies the format of the user identity being provided in <i>*identity</i> . Specify <code>__LOGIN_USERID</code> , as defined in the <code>unistd.h</code> header file. The user ID identity is in the format of a 1-to-8-character userid and is passed as input. |
|-----------------------------|--|

| | |
|-------------------------------|--|
| <i>identity_length</i> | Specifies the length of the <i>identity</i> as defined by <i>identity_type</i> . |
|-------------------------------|--|

| | |
|-------------------------|--|
| <i>*identity</i> | Specifies the user identity as defined by <i>identity_type</i> . |
|-------------------------|--|

| | |
|---------------------------|---|
| <i>pass_length</i> | Specifies the length of the password or PassTicket, or the password phrase defined by <i>pass</i> . |
|---------------------------|---|

| | |
|---------------------|--|
| <i>*pass</i> | Specifies a user password or PassTicket, or a password phrase. |
|---------------------|--|

| | |
|----------------------------------|--|
| <i>certificate_length</i> | Is not used presently and must be set to zero. |
|----------------------------------|--|

| | |
|---------------------------|---|
| <i>certificate</i> | Is not used presently and must point to void. |
|---------------------------|---|

| | |
|----------------------------|---|
| <i>option_flags</i> | Specifies options used to tailor request. Must be set to 0. |
|----------------------------|---|

| | |
|----------------------|--|
| <i>applid</i> | Specifies the application identifier that will be used for authentication with the security product. |
|----------------------|--|

Usage notes

1. The intent of the `__login()` service is to provide a way for a process to change its identity so as to be different than the address space identity. The process should either terminate or select a new user ID, but should not try to revert back to the original identity. The user could issue the `__login()` again with the original user identity, but the task would retain its own security environment and not share the security environment at the address space level.
2. A security product supporting multiprocessing or multiple user environment must be installed and operational.

Returned value

If successful, `__login()` returns 0.

If unsuccessful, `__login()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EACCES

Permission is denied.

EINVAL

A parameter is not valid. For example, length of applid exceeds 8 bytes.

EMVSERR

An MVS environmental error or internal occurred.

EMVSEXPIRE

The password or PassTicket, or a password phrase for the specified resource has expired.

EMVSSAF2ERR

An error occurred in the security product. The userid has been revoked or is unable to use the application.

ENOSYS

The function is not implemented.

EPERM

The operation is not permitted. Calling process may not be authorized in BPX.DAEMON facility class.
The function is not supported in an address space where a load was done from an uncontrolled library.
A required password or PassTicket, or a password phrase was not specified.

ESRCH

The USERID cannot become an OMVS process. The userid provided is not defined to the security product or doesn't have an OMVS segment defined.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

log1p(), log1pf(), log1pl() — Natural log of x+1

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double log1p(double x);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

float log1pf(float x);
long double log1pl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float log1p(float x);
long double log1p(long double x);
```

General description

Computes

$\text{Log}_e(1.0 + x)$

The value of x must be greater than -1.0.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| log1p | X | X |
| log1pf | X | X |
| log1pl | X | X |

Returned value

If successful, log1p() returns the value of the above function of x.

log1p() will fail under the following conditions:

- If x is less than -1.0, log1p() will return -HUGE_VAL and set errno to EDOM.
- If x is equal to -1.0, log1p() will return -HUGE_VAL and set errno to ERANGE.

Special behavior for IEEE: If successful, log1p() returns the

$\text{Log}_e(1.0 + x)$

The value of x must be greater than -1.0.

log1p() will fail under the following conditions:

- If x is less than -1.0, log1p() will return NaNQ and set errno to EDOM.
- If x is equal to -1.0, log1p() will return -HUGE_VAL and errno remains unchanged.

Note: When environment variable _EDC_SUSV3 is set to 2, and if x is equal to -1.0, the function returns -HUGE_VAL and sets errno to ERANGE.

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“log\(\), logf\(\), logl\(\) — Calculate natural logarithm”](#) on page 995

log1pd32(), log1pd64(), log1pd128() — Natural log of x+1

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 log1pd32(_Decimal32 x);
_Decimal64 log1pd64(_Decimal64 x);
_Decimal128 log1pd128(_Decimal128 x);

_Decimal32 log1p(_Decimal32 x);    /* C++ only */
_Decimal64 log1p(_Decimal64 x);    /* C++ only */
_Decimal128 log1p(_Decimal128 x);  /* C++ only */
```

General description

Computes

$\text{Log}_e(1.0 + x)$

The value of x must be greater than -1.0.

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) IEEE Decimal Floating-Point for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, log1p() returns the Log (1.0 + x) The value of x must be greater than -1.0.

log1p() will fail under the following conditions:

- If x is less than -1.0, log1p() will return NaNQ and set errno to EDOM.
- If x is equal to -1.0, log1p() will return -HUGE_VAL_D32, -HUGE_VAL_D64 or -HUGE_VAL_D128 and errno remains unchanged.

Example

```
/* CELEBL27

   This exaxmple illustrates the log1pd128() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>
void main(void)
{
    _Decimal128 x, y;

    x = 23.2DL;
    y = log1pd128(x);

    printf("log1pd128( %Ddf ) = %Ddf\n", x , y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“logd32\(\), logd64\(\), logd128\(\) — Calculate natural logarithm” on page 999](#)

log10(), log10f(), log10l() – Calculate base 10 logarithm

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double log10(double x);
float log10(float x);           /* C++ only */
long double log10(long double x); /* C++ only */
float log10f(float x);
long double log10l(long double x);
```

General description

Calculates the base 10 logarithm of the positive value of x .

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

Returns the computed value.

If x is negative, the function sets `errno` to `EDOM` and returns `-HUGE_VAL`. If x is 0, the function returns `-HUGE_VAL`, and sets `errno` to `ERANGE`. If the correct value would cause an underflow, 0 is returned and the value `ERANGE` is stored in `errno`.

Special behavior for IEEE: If successful, the function returns the base 10 logarithm of the positive value of x .

If x is negative, the function sets `errno` to `EDOM` and returns `NaNQ`. If x is 0, the function returns `-HUGE_VAL` and `errno` remains unchanged.

Note: When environment variable `_EDC_SUSV3` is set to 2, and if x is 0, the function returns `-HUGE_VAL` and sets `errno` to `ERANGE`.

Example

CELEBL09

```
/* CELEBL09
   This example calculates the base 10 logarithm of 1000.0.
*/
#include <math.h>
#include <stdio.h>

int main(void)
{
```

```
double x = 1000.0, y;

y = log10(x);

printf("The base 10 logarithm of %lf is %lf\n", x, y);
}
```

Output

```
The base 10 logarithm of 1000.000000 is 3.000000
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“exp\(\), expf\(\), expl\(\) — Calculate exponential function” on page 453](#)
- [“log\(\), logf\(\), logl\(\) — Calculate natural logarithm” on page 995](#)
- [“pow\(\), powf\(\), powl\(\) — Raise to power” on page 1204](#)

log10d32(), log10d64(), log10d128() — Calculate base 10 logarithm

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 log10d32(_Decimal32 x);
_Decimal64 log10d64(_Decimal64 x);
_Decimal128 log10d128(_Decimal128 x);

_Decimal32 log10(_Decimal32 x); /* C++ only */
_Decimal64 log10(_Decimal64 x); /* C++ only */
_Decimal128 log10(_Decimal128 x); /* C++ only */
```

General description

Calculates the base 10 logarithm of the positive value of *x*.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, the function returns the base 10 logarithm of the positive value of *x*.

If *x* is negative, the function sets *errno* to *EDOM* and returns NaNQ.

If *x* is 0, the function returns *-HUGE_VAL_D32*, *-HUGE_VAL_D64*, or *-HUGE_VAL_D128* and *errno* remains unchanged.

Example

```

/* CELEBL23

   This example illustrates the log10d128() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x = 1000.0DL, y;

    y = log10d128(x);

    printf("The base 10 logarithm of %DDf is %DDf\n", x, y);
}

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“expd32\(\), expd64\(\), expd128\(\) — Calculate exponential function ” on page 454](#)
- [“logd32\(\), logd64\(\), logd128\(\) — Calculate natural logarithm” on page 999](#)
- [“log10\(\), log10f\(\), log10l\(\) — Calculate base 10 logarithm” on page 1005](#)
- [“powd32\(\), powd64\(\), powd128\(\) — Raise to power” on page 1205](#)

log2(), log2f(), log2l() — Calculate the base-2 logarithm

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R5 |

Format

```

#define _ISOC99_SOURCE
#include <math.h>

double log2(double x);
float log2f(float x);
long double log2l(long double x);

```

C++ TR1 C99:

```

#define _TR1_C99
#include <math.h>

float log2(float x);
long double log2(long double x);

```

General description

The log2 functions compute the base-2 logarithm of x.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| log2 | X | X |
| log2f | X | X |
| log2l | X | X |

Returned value

The log2 functions return log2 x.
A domain error occurs if x is less than zero. A range error may occur if x is zero.

Special behavior for IEEE: If x is equal to 0, a pole error will occur and errno remains unchanged.

When environment variable _EDC_SUSV3 is set to 2, and if x is equal to 0, the function returns -HUGE_VAL and sets errno to ERANGE.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

log2d32(), log2d64(), log2d128() — Calculate the base-2 logarithm

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 log2d32(_Decimal32 x);
_Decimal64 log2d64(_Decimal64 x);
_Decimal128 log2d128(_Decimal128 x);

_Decimal32 log2(_Decimal32 x); /* C++ only */
_Decimal64 log2(_Decimal64 x); /* C++ only */
_Decimal128 log2(_Decimal128 x); /* C++ only */
```

General description

The log2() functions compute the base-2 logarithm of x.

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) IEEE Decimal Floating-Point for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

The log2 functions return log2 x.
A domain error occurs if x is less than zero.
A range error may occur if x is zero.

Example

```
/* CELEBL28

   This exaxmple illustrates the log2d32() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>
void main(void)
{
    _Decimal32 x, y;

    x = 85.7DF;
    y = log2d32(x);

    printf("log2d32( %Hf ) = %Hf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)

longjmp() — Restore stack environment

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 C11 Single UNIX Specification, Version 3 | both | |

Format

```
#include <setjmp.h>

__noreturn__ void longjmp(jmp_buf env, int value);
```

General description

Restores a stack environment previously saved in *env* by `setjmp()`. The `setjmp()` and `longjmp()` functions provide a way to perform a nonlocal goto. They are often used in signal handlers.

A call to `setjmp()` causes the current stack environment to be saved in *env*. A subsequent call to `longjmp()` restores the saved environment, and returns control to a point in the program corresponding to the `setjmp()` call. Execution resumes as if the `setjmp()` call had just returned the given *value* of the value argument. All variables that are accessible to the function that receives control contain the values they had when `longjmp()` was called. The values of register variables are unpredictable. Nonvolatile *auto* variables that are changed between calls to `setjmp()` and `longjmp()` are also unpredictable.

Note: Ensure that the function that calls `setjmp()` does not return before you call the corresponding `longjmp()` function. Calling `longjmp()` after the function calling `setjmp()` returns causes unpredictable program behavior.

The *value* argument passed to `longjmp()` must be nonzero. If you give a 0 argument for *value*, `longjmp()` substitutes a 1 in its place.

Notes:

1. If `longjmp()` is used to jump back into an XPLink routine, any `alloca()` requests issued by the XPLink routine after the earlier `setjmp()` (or `_setjmp()`, `sigsetjmp()`, `getcontext()`, and so on) was called and before `longjmp()` is called are backed out. All storage obtained by these `alloca()` requests is freed before the XPLink routine is resumed.
2. If `longjmp()` is used to jump back into a non-XPLink routine, `alloca()` requests made after `setjmp()` (and so on) and before `longjmp()` are not backed out.

Special behavior for POSIX: In a POSIX program, the signal mask is *not* saved. Thus, to save and restore a stack environment that includes the current signal mask, use `sigsetjmp()` and `siglongjmp()` instead of `setjmp()` and `longjmp()`. The `sigsetjmp()`—`siglongjmp()` pair, the `setjmp()`—`longjmp()` pair, the `_setjmp()`—`_longjmp()` pair, and the `getcontext()`—`setcontext()` pair cannot be intermixed. A stack environment saved by `setjmp()` can be restored only by `longjmp()`.

Special behavior for C++: If `setjmp()` and `longjmp()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. Additionally, if any automatic objects would be destroyed by a thrown exception transferring control to another (destination) point in the program, then a call to `longjmp()` at the throw point that transfers control to the same (destination) point has undefined behavior. The use of `setjmp()` and `longjmp()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Special behavior for XPG4.2: In a program that was compiled with the feature test macro, `_XOPEN_SOURCE_EXTENDED`, defined, another pair of functions, `_setjmp()`—`_longjmp()` are available. These functions are, on this implementation, functionally identical to `setjmp()`—`longjmp()`. Therefore it is possible, but not recommended, to intermix the `setjmp()`—`longjmp()` pair with the `_setjmp()`—`_longjmp()` pair.

Special behavior for XPLINK-compiled C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the Release 10 or later C compilers that are to run with Language Environment Release 10 or later libraries and use the **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** types must not be compiled with C headers from Language Environment 2.9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Release 10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Release 10 and later headers define a shorter **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area. The Language Environment headers before Release 10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

`longjmp()` does not use the normal function call and return mechanisms; it returns no values.

Example

This example provides for saving the stack environment at this statement: `if(setjmp(mark) != 0) ...`

When the system first performs the `if` statement, it saves the environment in *mark* and sets the condition to FALSE because `setjmp()` returns a 0 when it saves the environment. The program prints the message: `setjmp has been called`

The subsequent call to function *p* tests for a local error condition, which can cause it to perform the `longjmp()` function. Then, control returns to the original `setjmp()` function using the environment saved in *mark*. This time the condition is TRUE because -1 is the returned value from the `longjmp()` function. The example then performs the statements in the block and prints: `longjmp has been called`

It then performs the *recover* function and leaves the program.

```
/* Illustration of longjmp(). */
#include <stdio.h>
#include <setjmp.h>

jmp_buf mark;

void p(void);
void recover(void);

int main(void)
{
    if (setjmp(mark) != 0)
    {
        printf("longjmp has been called\n");
        recover();
        exit(1);
    }
    printf("setjmp has been called\n");
    :
    p();
    :
}

void p(void)
{
    int error = 0;
    :
    error = 9;
    :
    if (error != 0)
        longjmp(mark, -1);
    :
}

void recover(void)
{
    :
}
```

Related information

- [“setjmp.h — Manipulate program state” on page 58](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“setjmp\(\) — Preserve stack environment” on page 1542](#)
- [“_setjmp\(\) — Set jump point for a nonlocal goto” on page 1544](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

_longjmp() — Nonlocal goto

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <setjmp.h>

void _longjmp(jmp_buf env, int value);
```

General description

The `_longjmp()` function restores a stack environment previously saved in *env* by `_setjmp()`. The `_setjmp()` and `_longjmp()` functions provide a way to perform a nonlocal *goto*. They are often used in signal handlers.

A call to `_setjmp()` causes the current stack environment to be saved in *env*.

A subsequent call to `_longjmp()` restores the saved environment and returns control to a point in the program corresponding to the `_setjmp()` call. Execution resumes as if the `_setjmp()` call had just returned the given *value* of the value argument. All variables that are accessible to the function that receives control contain the values they had when `_longjmp()` was called. The values of register variables are unpredictable. Nonvolatile *auto* variables that are changed between calls to `_setjmp()` and `_longjmp()` are also unpredictable.

The X/Open standard states that `_longjmp()` and `_setjmp()` are functionally identical to `longjmp()` and `setjmp()`, respectively, with the addition restriction that `_longjmp()` and `_setjmp()` do not manipulate the signal mask. However, on this implementation `longjmp()` and `setjmp()` do not manipulate the signal mask. So on this implementation `_longjmp()` and `_setjmp()` are literally identical to `longjmp()` and `setjmp()`, respectively.

To save and restore a stack environment, including the current signal mask, use `sigsetjmp()` and `siglongjmp()` instead of `_setjmp()` and `_longjmp()`, or `setjmp()` and `longjmp()`.

The `_setjmp()`—`_longjmp()` pair, the `setjmp()`—`longjmp()` pair, the `sigsetjmp()`—`siglongjmp()` pair, and the `getcontext()`—`setcontext()` pair cannot be intermixed. A stack environment saved by `_setjmp()` can be restored only by `_longjmp()`.

Notes:

1. However, on this implementation, since the `_setjmp()`—`_longjmp()` pair are functionally identical to the `setjmp()`—`longjmp()` pair it is possible to intermix them, but it is not recommended.
2. Ensure that the function that calls `_setjmp()` does not return before you call the corresponding `_longjmp()` function. Calling `_longjmp()` after the function calling `_setjmp()` returns causes unpredictable program behavior.
3. If `_longjmp()` is used to jump back into an XPLink routine, any `alloca()` requests issued by the XPLink routine after the earlier `_setjmp()` (or `setjmp()`, `sigsetjmp()`, `getcontext()` and so on) was called and before `_longjmp()` is called are backed out. All storage obtained by these `alloca()` requests is freed before the XPLink routine is resumed.
4. If `_longjmp()` is used to jump back into a non-XPLink routine, `alloca()` requests made after `_setjmp()` (and so on) and before `_longjmp()` are not backed out.

The *value* argument passed to `_longjmp()` must be nonzero. If you give a zero argument for *value*, `_longjmp()` substitutes a 1 in its place.

env

An address for a `jmp_buf` structure

value

The return value from `_setjmp()`

Special behavior for C++: If `_setjmp()` and `_longjmp()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. Additionally, if any automatic objects would be destroyed by a thrown exception transferring control to another (destination) point in the program, then a call to `_longjmp()` at the throw point that transfers control to the same (destination) point has undefined behavior. The use of `_setjmp()` and `_longjmp()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Special behavior for XPLINK-compiled C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the Release 10 or later C compilers that are to run with Language Environment Release 10 or later libraries and use the **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** types must not be compiled with C headers from Language Environment 2.9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Release 10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Release 10 and later headers define a shorter **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area. The Language Environment headers before Release 10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

`_longjmp()` does not use the normal function call and return mechanisms; it returns no values. When `_longjmp()` completes, program execution continues as if the corresponding invocation of `_setjmp()` had just returned the value specified by *value*.

Related information

- [“setjmp.h — Manipulate program state” on page 58](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“setjmp\(\) — Preserve stack environment” on page 1542](#)
- [“_setjmp\(\) — Set jump point for a nonlocal goto” on page 1544](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

lrand48() — Pseudo-random number generator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

long int lrand48(void);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrand48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The functions drand48() and erand48() return nonnegative, double-precision, floating-point values, uniformly distributed over the interval [0.0,1.0).

The functions lrand48() and nrand48() return nonnegative, long integers, uniformly distributed over the interval [0,2**31).

The functions mrand48() and jrand48() return signed long integers, uniformly distributed over the interval [-2**31,2**31).

The lrand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \quad n \geq 0$$

The initial values of X, a, and c are:

```
X(0) = 1
a    = 5deece66d (base 16)
c    = b          (base 16)
```

C/370 provides storage to save the most recent 48-bit integer value of the sequence, X(i). This storage is shared by the drand48(), lrand48() and mrand48() functions. The value, X(n), in this storage may be reinitialized by calling the lcong48(), seed48() or srand48() function. Likewise, the values of a and c, may be changed by calling the lcong48() function. Thereafter, whenever the seed48() or srand48() function is called to change X(n), the initial values of a and c are also reestablished.

Special behavior for z/OS UNIX Services: You can make the lrand48() function and other functions in the drand48 family thread-specific by setting the environment variable _RAND48 to the value THREAD before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested, and the lrand48() function is called from thread t, the lrand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(t,i), for the thread t. The sequence of values for a thread is generated according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t)) \bmod (2^{**}48) \quad n \geq 0$$

The initial values of X(t), a(t) and c(t) for the thread t are:

```
X(t,0) = 1
a(t)   = 5deece66d (base 16)
c(t)   = b          (base 16)
```

C/370 provides storage which is specific to the thread t to save the most recent 48-bit integer value of the sequence, X(t,i), generated by the drand48(), lrand48() or mrand48() function. The value, X(t,n), in this storage may be reinitialized by calling the lcong48(), seed48() or srand48() function from the thread t. Likewise, the values of a(t) and c(t) for thread t may be changed by calling the lcong48() function from the thread. Thereafter, whenever the seed48() or srand48() function is called from the thread t to change X(t,n), the initial values of a(t) and c(t) are also reestablished.

Returned value

lrand48() transforms the generated 48-bit value, $X(n+1)$, to a nonnegative, long integer value on the interval $[0, 2^{31})$ and returns this transformed value.

Special behavior for z/OS UNIX Services: If thread-specific behavior is requested for the drand48 family and lrand48() is called on thread t , lrand48() transforms the generated 48-bit value, $X(t, n+1)$, to a nonnegative, long integer value on the interval $[0, 2^{31})$ and returns this transformed value.

Related information

- “stdlib.h — Standard library functions” on page 65
- “drand48() — Pseudo-random number generator” on page 403
- “erand48() — Pseudo-random number generator” on page 430
- “jrand48() — Pseudo-random number generator” on page 927
- “lcong48() — Pseudo-random number initializer” on page 939
- “mrand48() — Pseudo-random number generator” on page 1108
- “nrand48() — Pseudo-random number generator” on page 1153
- “seed48() — Pseudo-random number initializer” on page 1470
- “srand48() — Pseudo-random number initializer” on page 1705

lrint(), lrintf(), lrintl() and llrint(), llrintf(), llrintl() — Round the argument to the nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

long int lrint(double x);
long int lrintf(float x);
long int lrintl(long double x);

long long int llrint(double x);
long long int llrintf(float x);
long long int llrintl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

long int lrint(float x);
long int lrint(long double x);
long long int llrint(float x);
long long int llrint(long double x);
```

Compile requirement: The llrint() family of functions requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

The lrint() and llrint() families of functions round their argument to the nearest integer value according to the current rounding mode. If the rounded value is outside the range of the return type, the numeric result is unspecified. A range error may occur if the magnitude of x is too large.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| lrint | X | X |
| lrintf | X | X |
| lrintl | X | X |
| llrint | X | X |
| llrintf | X | X |
| llrintl | X | X |

Returned value

If successful, they return the rounded integer value. If the correct value is positive or negative and too large to represent as a long (lrint() family) or long long (llrint() family), a domain error will occur and an unspecified value is returned.

Example

```

/*
 * This program illustrates the use of lrint() function
 *
 * Note: To get the output shown in this book , this program
 *       should be compiled using IEEE floating point representation
 *
 */
#define _ISOC99_SOURCE
#include <math.h>
#include <stdio.h>
#include <_Ieee754.h> /* save/get fpc functions */

char *RoundStr (_FP_rmode_t rm_type) {
    char *RndStr="undetermined";
    switch (rm_type) {
        case (_RMODE_RN):
            RndStr="round to nearest";
            break;
        case (_RMODE_RZ):
            RndStr="round toward zero";
            break;
        case (_RMODE_RP):
            RndStr="round toward +infinity ";
            break;
        case (_RMODE_RM):
            RndStr="round toward -infinity ";
            break;
    }
    return (RndStr);
}

void main() {
    _FP_fpcreg_t save_rmode, current_rmode;
    long int      rnd2nearest;
    double        number=500.99;

    printf("Illustrates the lrint() function\n");
    __fpc_rd(&current_rmode); /* get current rounding mode */

    rnd2nearest = lrint(number);
    printf ("When rounding direction is %s:\n lrint(%.2f) = %li\n",

```

```

        RoundStr(current_rmode.rmode), number, rnd2nearest);
    save_rmode.rmode = _RMODE_RZ;
    __fpc_sm(save_rmode.rmode); /* set rounding mode to round to zero */

    rnd2nearest = lrint(number);
    printf ("When rounding direction is %s:\n lrint(%.2f) = %li\n",
           RoundStr(save_rmode.rmode), number, rnd2nearest);
}

```

Output

Illustrates the lrint() function
 When rounding direction is round to nearest:
 lrint(500.99) = 501
 When rounding direction is round toward zero:
 lrint(500.99) = 500

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceil\(\), ceilf\(\), ceill\(\) — Round up to integral value” on page 249](#)
- [“floor\(\), floorf\(\), floorl\(\) — Round down to integral value” on page 554](#)
- [“llround\(\), llroundf\(\), llroundl\(\) — Round to the nearest integer” on page 981](#)
- [“lround\(\), lroundf\(\), lroundl\(\) — Round a decimal floating-point number to its nearest integer” on page 1019](#)
- [“nearbyint\(\), nearbyintf\(\), nearbyintl\(\) — Round the argument to the nearest integer” on page 1137](#)
- [“rint\(\), rintf\(\), rintl\(\) — Round to nearest integral value” on page 1454](#)
- [“round\(\), roundf\(\), roundl\(\) — Round to the nearest integer” on page 1459](#)
- [“trunc\(\), truncf\(\), trunc\(\) — Truncate an integer value” on page 1899](#)

lrintd32(), lrintd64(), lrintd128() and llrintd32(), llrintd64(), llrintd128() — Round the argument to the nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <math.h>

long int lrintd32(_Decimal32 x);
long int lrintd64(_Decimal64 x);
long int lrintd128(_Decimal128 x);

long int lrint(_Decimal32 x); /* C++ only */
long int lrint(_Decimal64 x); /* C++ only */
long int lrint(_Decimal128 x); /* C++ only */

long long int llrintd32(_Decimal32 x);
long long int llrintd64(_Decimal64 x);
long long int llrintd128(_Decimal128 x);

long long int llrint(_Decimal32 x); /* C++ only */
long long int llrint(_Decimal64 x); /* C++ only */
long long int llrint(_Decimal128 x); /* C++ only */

```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

The lrint() and llrint() families of functions round their argument to the nearest integer value according to the current rounding mode. If the rounded value is outside the range of the return type, the numeric result is unspecified. A range error may occur if the magnitude of x is too large.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, they return the rounded integer value. If the correct value is positive or negative and too large to represent as a long (lrint() family) or long long (llrint() family), a domain error will occur and an unspecified value is returned.

Example

```
/* CELEBL20

   This example illustrates the lrintd64() and llrintd128() functions.
*/

#pragma strings(readonly)

#define __STDC_WANT_DEC_FP__
#include <fenv.h>
#include <math.h>
#include <stdio.h>

static void try_rm(int);
/* pass back printable rounding mode */

static
char *rm_str(int rm)
{
    char *s = "undetermined";

    switch (rm)
    {
        case FE_DEC_TONEAREST :
            s = "FE_DEC_TONEAREST" ; break;
        case FE_DEC_TOWARDZERO :
            s = "FE_DEC_TOWARDZERO" ; break;
        case FE_DEC_UPWARD :
            s = "FE_DEC_UPWARD" ; break;
        case FE_DEC_DOWNWARD :
            s = "FE_DEC_DOWNWARD" ; break;
        case FE_DEC_TONEARESTFROMZERO :
            s = "FE_DEC_TONEARESTFROMZERO" ; break;
        case FE_DEC_TONEARESTTOWARDZERO :
            s = "FE_DEC_TONEARESTTOWARDZERO" ; break;
        case FE_DEC_AWAYFROMZERO :
            s = "FE_DEC_AWAYFROMZERO" ; break;
        case FE_DEC_PREPAREFORSHORTER :
            s = "FE_DEC_PREPAREFORSHORTER" ; break;
    }

    return s;
}

/* Try out one passed-in number with rounding mode */

static void try_rm(int rm)
{
    long int l;
    long long int ll;
    _Decimal64 d64 = 500.01DD;
    _Decimal128 d128 = 500.99DL;
```

```

(void)fe_dec_setround(rm);

l = lrintd64( d64 );
ll = llrintd128(d128);

printf(" lrintd64( %.2DF) = %ld - rounding mode = %s\n",
      d64 , l, rm_str(rm)
);
printf(" llrintd128(%.2DDF) = %lld - rounding mode = %s\n",
      d128, ll, rm_str(rm)
);

return;
}

int main()
{
    try_rm( FE_DEC_TONEAREST          );
    try_rm( FE_DEC_TOWARDZERO         );
    try_rm( FE_DEC_UPWARD             );
    try_rm( FE_DEC_DOWNWARD           );
    try_rm( FE_DEC_TONEARESTFROMZERO  );
    try_rm( FE_DEC_TONEARESTTOWARDZERO );
    try_rm( FE_DEC_AWAYFROMZERO       );
    try_rm( FE_DEC_PREPAREFORSHORTER  );

    return 0;
}

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceild32\(\), ceild64\(\), ceild128\(\) — Round up to integral value” on page 250](#)
- [“floord32\(\), floord64\(\), floord128\(\) — Round down to integral value” on page 555](#)
- [“llroundd32\(\), llroundd64\(\), llroundd128\(\) — Round to the nearest integer” on page 983](#)
- [“lroundd32\(\), lroundd64\(\), lroundd128\(\) — Round a floating-point number to its nearest integer” on page 1020](#)
- [“lrint\(\), lrintf\(\), lrintl\(\) and llrint\(\), llrintf\(\), llrintl\(\) — Round the argument to the nearest integer” on page 1015](#)
- [“nearbyintd32\(\), nearbyintd64\(\), nearbyintd128\(\) — Round the argument to the nearest integer” on page 1139](#)
- [“rintd32\(\), rintd64\(\), rintd128\(\) — Round to nearest integral value” on page 1455](#)
- [“roundd32\(\), roundd64\(\), roundd128\(\) — Round to the nearest integer” on page 1460](#)
- [“truncd32\(\), truncd64\(\), truncd128\(\) — Truncate an integer value” on page 1900](#)

lround(), lroundf(), lroundl() — Round a decimal floating-point number to its nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R5 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

long int lround(double x);
long int lroundf(float x);
long int lroundl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

long lround(float x);
long lround(long double x);
```

General description

The lround functions round x to the nearest integer value, rounding halfway cases away from zero, regardless of the current rounding mode.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| lround | X | X |
| lroundf | X | X |
| lroundl | X | X |

Returned value

The lround functions return the rounded integer value of x .

If the rounded value is outside the range of the return type, the numeric result is unspecified. A range error may occur if the magnitude of x is too large.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

lroundd32(), lroundd64(), lroundd128() — Round a floating-point number to its nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

long int lroundd32(_Decimal32 x);
long int lroundd64(_Decimal64 x);
long int lroundd128(_Decimal128 x);

long int lround(_Decimal32 x);    /* C++ only */
```

```
long int lround(_Decimal64 x);    /* C++ only */
long int lround(_Decimal128 x);  /* C++ only */
```

General description

The lround functions round x to the nearest integer value, rounding halfway cases away from zero, regardless of the current rounding mode.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The lround functions return the rounded integer value of x .

If the rounded value is outside the range of the return type, the numeric result is unspecified. A range error may occur if the magnitude of x is too large.

Example

```
/* CELEBL21

   This example illustrates the llroundd32() function.
*/

#pragma strings(readonly)

#define __STDC_WANT_DEC_FP__
#include <fenv.h>
#include <math.h>
#include <stdio.h>

static void try_rm(int, _Decimal32);

/* pass back printable rounding mode */

static
char *rm_str(int rm)
{
    char *s = "undetermined";

    switch (rm)
    {
        case FE_DEC_TONEAREST :
            s = "FE_DEC_TONEAREST" ; break;
        case FE_DEC_TOWARDZERO :
            s = "FE_DEC_TOWARDZERO" ; break;
        case FE_DEC_UPWARD :
            s = "FE_DEC_UPWARD" ; break;
        case FE_DEC_DOWNWARD :
            s = "FE_DEC_DOWNWARD" ; break;
        case FE_DEC_TONEARESTFROMZERO :
            s = "FE_DEC_TONEARESTFROMZERO" ; break;
        case FE_DEC_TONEARESTTOWARDZERO :
            s = "FE_DEC_TONEARESTTOWARDZERO" ; break;
        case FE_DEC_AWAYFROMZERO :
            s = "FE_DEC_AWAYFROMZERO" ; break;
        case FE_DEC_PREPAREFORSHORTER :
            s = "FE_DEC_PREPAREFORSHORTER" ; break;
    }

    return s;
}

/* Try out one passed-in number with rounding mode */

static void try_rm(int rm, _Decimal32 d32)
```

```
{
    long long int ll;

    (void)fe_dec_setround(rm);

    ll = llroundd32(d32);

    printf("llroundd32(%+.2HF) = %+lld - rounding mode = %s\n",
          d32 , ll, rm_str(rm)
    );
    return;
}

int main()
{
    try_rm( FE_DEC_TONEAREST      , 501.50DF);
    try_rm( FE_DEC_TOWARDZERO     , 501.50DF);
    try_rm( FE_DEC_UPWARD         , -501.51DF);
    try_rm( FE_DEC_DOWNWARD       , -501.49DF);
    try_rm( FE_DEC_TONEARESTFROMZERO , 500.50DF);
    try_rm( FE_DEC_TONEARESTTOWARDZERO, -501.50DF);
    try_rm( FE_DEC_AWAYFROMZERO    , 500.49DF);
    try_rm( FE_DEC_PREPAREFORSHORTER , 501.50DF);

    return 0;
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“lround\(\), lroundf\(\), lroundl\(\) — Round a decimal floating-point number to its nearest integer” on page 1019](#)

lsearch() — Linear search and update

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <search.h>

void *lsearch(const void *key, void *base, size_t *nelp,
              size_t width,
              int (*compar)(const void *, const void *));
```

General description

The lsearch() function is a linear search routine. It returns a pointer into a table indicating where an entry may be found. If the entry does not occur, it is added at the end of the table. The *key* argument points to the entry to be sought in the table. The *base* argument points to the first element in the table. The *width* argument is the size of an element in bytes. The *nelp* argument points to an integer containing the current number of elements in the table. The integer to which *nelp* points is incremented if the entry is added to the table. The *compar* argument points to a comparison function which the user must supply (strcmp(), for example). It is called with two arguments that point to the elements being compared. The function must return 0 if the elements are equal and nonzero otherwise.

Special behavior for C++: Because C and C++ linkage conventions are incompatible, `lsearch()` cannot receive a C++ function pointer as the comparator argument. If you attempt to pass a C++ function pointer to `lsearch()`, the compiler will flag it as an error. You can pass a C or C++ function to `lsearch()` by declaring it as `extern "C"`.

Returned value

If the searched for entry is found, `lsearch()` returns a pointer to it.

If not found, `lsearch()` returns a pointer to the newly added element. A NULL pointer is returned in case of error.

No errors are defined.

Related information

- [“bsearch\(\) — Search arrays” on page 221](#)
- [“hsearch\(\) — Search hash tables” on page 818](#)
- [“lfind\(\) — Linear search routine” on page 967](#)
- [“tsearch\(\) — Binary tree search” on page 1903](#)

lseek() — Change the offset of a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

off_t lseek(int fil-des, off_t offset, int pos);
```

General description

Changes the current file offset to a new position in a z/OS UNIX file. The new position is the given byte *offset* from the position specified by *pos*. After you have used `lseek()` to seek to a new location, the next I/O operation on the file begins at that location.

`lseek()` lets you specify new file offsets past the current end of the file. If data is written at such a point, read operations in the gap between this data and the old end of the file will return bytes containing zeros. (In other words, the gap is assumed to be filled with zeros.)

Seeking past the end of a file, however, does not automatically extend the length of the file. There must be a write operation before the file is actually extended.

Special behavior for POSIX C: For character special files, `lseek()` sets the file offset to the specified value. z/OS UNIX services ignore the file offset value during the read/write processing to character special files.

int *fil-des*;

The file whose current file offset you want to change.

off_t offset;

The amount (positive or negative) the byte offset is to be changed. The sign indicates whether the offset is to be moved forward (positive) or backward (negative).

int pos;

One of the following symbols (defined in the `unistd.h` header file):

SEEK_SET

The start of the file

SEEK_CUR

The current file offset in the file

SEEK_END

The end of the file

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `lseek()` returns the new file offset, measured in bytes from the beginning of the file.

If unsuccessful, `lseek()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EBADF**

fildev is not a valid open file descriptor.

EINVAL

pos contained something other than one of the three options, or the combination of the *pos* values would have placed the file offset before the beginning of the file.

EOVERFLOW

The resulting file offset would be a value which cannot be represented correctly in an object of type `off_t`.

ESPIPE

fildev is associated with a pipe or FIFO special file.

Example

This fragment positions a file (that has at least 10 bytes) to an offset of 10 bytes before the end of the file.

```
lseek(fildev, -10, SEEK_END);
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fseek\(\) — Change file position” on page 638](#)
- [“fsetpos\(\) — Set file position” on page 647](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)

- “[sigaction\(\)](#) — Examine or change a signal action” on page 1605
- “[write\(\)](#) — Write data on a file or socket” on page 2070

lstat(), lstat64() — Get status of file or symbolic link

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| z/OS UNIX XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

lstat:

```
#define _POSIX1_SOURCE 2
#include <sys/stat.h>

int lstat(const char *__restrict__ pathname, struct stat *__restrict__ buf);
```

lstat64:

```
#define _LARGE_TIME_API
#define _POSIX1_SOURCE 2
#include <sys/stat.h>

int lstat64(const char *__restrict__ pathname, struct stat64 *__restrict__ info);
```

Compile requirement: Use of the `lstat64` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

Gets status information about a specified file that is pointed to by the *pathname* argument and places it in the area of memory pointed to by the *buf* argument. You do not need permissions on the file itself, but you must have search permission on all directory components of the *pathname*.

If the named file is a symbolic link, `lstat()` returns information about the symbolic link itself.

The `lstat64()` function behaves exactly like `lstat()` except `lstat64()` uses structure `stat64` instead of `struct stat` to support time beyond 03:14:07 UTC on January 19, 2038.

The information is returned in the following `stat` and `stat64` structures, defined in the `sys/stat.h` header file.

Table 50. Values Returned in `stat` and `stat64` Structures

| Value for <code>stat</code> | Value for <code>stat64</code> | Description |
|-------------------------------|-------------------------------|---|
| <code>mode_t st_mode</code> | <code>mode_t st_mode</code> | A bit string indicating the permissions and privileges of the Symbols are defined in the <code>sys/stat.h</code> header file to refer to bits in a <code>mode_t</code> value; these symbols are listed in “ chmod() — Change the mode of a file or directory ” on page 274. |
| <code>ino_t st_ino</code> | <code>ino_t st_ino</code> | The serial number of the file. |
| <code>dev_t st_dev</code> | <code>dev_t st_dev</code> | The numeric ID of the device containing the file. |
| <code>nlink_t st_nlink</code> | <code>nlink_t st_nlink</code> | The number of links to the file. |

Table 50. Values Returned in stat and stat64 Structures (continued)

| Value for stat | Value for stat64 | Description |
|-----------------|-------------------|--|
| uid_t st_uid | uid_t st_uid | The numeric user ID (UID) of the file's owner. |
| gid_t st_gid | gid_t st_gid | The numeric group ID (GID) of the file's group. |
| off_t st_size | long long st_size | For regular files, the file's size in bytes. For other kinds of files, the value of this field is unspecified. |
| time_t st_atime | time64_t st_atime | The most recent time the file was accessed. |
| time_t st_ctime | time64_t st_ctime | The most recent time the status of the file was changed. |
| time_t st_mtime | time64_t st_mtime | The most recent time the contents of the file were changed. |

Values for `time_t` and `time64_t` are given in terms of seconds that have elapsed since epoch.

If the named file is a symbolic link, `lstat()` updates the time-related fields before putting information in the `stat` structure.

You can examine properties of a `mode_t` value from the `st_mode` field by using a collection of macros defined in the `sys/modes.h` header file. If *mode* is a `mode_t` value, and *genvalue* is an unsigned `int` value from the `stat` structure, then:

S_ISBLK(*mode*)

Is nonzero for block special files.

S_ISCHR(*mode*)

Is nonzero for character special files.

S_ISDIR(*mode*)

Is nonzero for directories.

S_ISEXTL(*mode*,*genvalue*)

Is nonzero for external links.

S_ISFIFO(*mode*)

Is nonzero for pipes and FIFO special files.

S_ISLNK(*mode*)

Is nonzero for symbolic links.

S_ISREG(*mode*)

Is nonzero for regular files.

S_ISSOCK(*mode*)

Is nonzero for sockets.

If `lstat()` successfully determines all this information, it stores it in the area indicated by the *buf* argument.

Large file support for z/OS UNIX files: `lstat64()` automatically supports large z/OS UNIX files for both AMODE 31 and AMODE 64 C/C++ applications, which means there is no need for `_LARGE_FILES` feature test macro to be defined. As for `lstat()`, the automatic support is only for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the long long data type support enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable `lstat()` to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `lstat()` returns 0.

If unsuccessful, `lstat()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EACCES

The process does not have search permission on some component of the *pathname* prefix.

EINVAL

buf contains a NULL.

EIO

Added for XPG4.2: An I/O error occurred while reading from the file system.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links encountered during resolution of the *pathname* argument is greater than POSIX_SYMLINK.

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters or some component of *pathname* is longer than **NAME_MAX** characters while **_POSIX_NO_TRUNC** is in effect. For symbolic links, the length of the *pathname* string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined through `pathconf()`.

ENOENT

There is no file named *pathname*, or *pathname* is an empty string.

ENOTDIR

A component of the *pathname* prefix is not a directory.

EOVERFLOW

The file size in bytes or the number of blocks allocated to the file or the file serial number cannot be represented correctly in the structure pointed to by *buf*.

Note: Starting with z/OS V1.9, environment variable `_EDC_EOVERFLOW` can be used to control behavior of `lstat()` with respect to detecting an EOVERFLOW condition for z/OS UNIX files. By default, `lstat()` will not set EOVERFLOW when the file size can not be represented correctly in structure pointed to by *buf*. When `_EDC_EOVERFLOW` is set to YES, `lstat()` will check for an overflow condition.

Example

CELEBL12

```
/* CELEBL12

   This example provides status information for a file.

*/
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/types.h>
#include <sys/stat.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>
#include <time.h>

main() {
    char fn[]="temp.file", ln[]="temp.link";
    struct stat info;
    int fd;

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        close(fd);
        if (link(fn, ln) != 0)
            perror("link() error");
        else {
            if (lstat(ln, &info) != 0)
                perror("lstat() error");
            else {
                puts("lstat() returned:");
                printf("  inode:   %d\n", (int) info.st_ino);
            }
        }
    }
}
```

```

        printf(" dev id:   %d\n",   (int) info.st_dev);
        printf(" mode:    %08x\n",   info.st_mode);
        printf(" links:   %d\n",   info.st_nlink);
        printf(" uid:     %d\n",   (int) info.st_uid);
        printf(" gid:     %d\n",   (int) info.st_gid);
        printf("created:  %s",      ctime(&info.st_createtime));
    }
    unlink(ln);
}
    unlink(fn);
}
}

```

Output

```

lstat() returned:
inode:   3022
dev id:   1
mode:    03000080
links:    2
uid:      25
gid:      500
created:  Fri Jun 16 15:00:00 2006

```

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“extlink_np\(\) — Create an external symbolic link” on page 461](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fstat\(\), fstat64\(\) — Get status information about a file” on page 649](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“mkfifo\(\) — Make a FIFO special file” on page 1075](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readlink\(\) — Read the value of a symbolic link” on page 1390](#)
- [“remove\(\) — Delete file” on page 1429](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)
- [“utime\(\), utime64\(\) — Set file access and modification times” on page 1952](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

l64a() — Convert long to base 64 string representation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

char *l64a(long value);
```

General description

The `l64a()` function converts a long integer into its corresponding base 64 character representation. In this notation, long integers are represented by up to 6 characters, each character representing a digit in base 64 notation. Under AMODE 64, the lower order 32 bits of *value* are used for conversion. The following characters are used to represent digits:

Character

Digit represented

·
0
/
1
0-9
2-11
A-Z
12-37
a-z
38-63

Returned value

`l64a()` returns a pointer to the base 64 representation of *value*. If *value* is zero, `l64a()` returns a pointer to a NULL string.

`l64a()` returns a pointer to a static buffer, which will be overwritten by subsequent calls. Buffers are allocated on a per-thread basis.

There are no `errno` values defined.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“a64l\(\) — Convert base 64 string representation to long integer” on page 209](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)

ltoa() – Convert long into a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

```
#define _OPEN_SYS_ITOA_EXT
#include <stdlib.h>

char * ltoa(long l, char * buffer, int radix);
```

General description

The ltoa() function converts the long *l* into a character string. The string is placed in the buffer passed, which must be large enough to hold the output. The radix values can be OCTAL, DECIMAL, or HEX. When the radix is DECIMAL, ltoa() produces the same result as the following statement:

```
(void) sprintf(buffer, "%ld", l);
```

with buffer the returned character string. When the radix is OCTAL, ltoa() formats long *l* into an unsigned octal constant. When the radix is HEX, ltoa() formats long *l* into an unsigned hexadecimal constant. The hexadecimal value will include lower case abcdef, as necessary

Usage note

This is a non-standard function. Even though the prototype given is commonly used by compilers on other platforms, there is no guarantee that this function will behave the same on all platforms, in all cases. You can use this function to help port applications from other platforms, but you should avoid using it when writing new applications, in order to ensure maximum portability.

Returned value

String pointer (same as buffer) will be returned. When passed an invalid radix argument, function will return NULL and set errno to EINVAL.

Example

CELEBL29

```
/* CELEBL29

   This example reads a long int and formats it to decimal, unsigned
   octal, unsigned hexadecimal constants converted to a character
   string.

*/

#define _OPEN_SYS_ITOA_EXT
#include <stdio.h>
#include <stdlib.h>

int main ()
{
    long i;
    char buffer [sizeof(long)*8+1];
    printf ("Enter a number: ");
    if (scanf ("%ld",&i) == 1) {
        ltoa (i,buffer,DECIMAL);
        printf ("decimal: %s\n",buffer);
        ltoa (i,buffer,HEX);
```



```

    printf ("hexadecimal: %s\n",buffer);
    ltoa (i,buffer,OCTAL);
    printf ("octal: %s\n",buffer);
}
return 0;
}

```

Output

If the input is 1234, then the output should be:

```

decimal: 1234
hexadecimal: 4d2
octal: 2322

```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“itoa\(\) — Convert int into a string” on page 925](#)
- [“lltoa\(\) — Convert long long into a string” on page 985](#)
- [“ulltoa\(\) — Convert unsigned long long into a string” on page 1925](#)
- [“ultoa\(\) — Convert unsigned long into a string” on page 1927](#)
- [“utoa\(\) — Convert unsigned int into a string” on page 1958](#)

lutimes() — Change file access and modification times

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#define _XPLATFORM_SOURCE 1

#include <sys/time.h>

int lutimes(const char *path, const struct timeval times[2]);

```

General description

The `lutimes()` function changes the access and modification times of a file that is pointed to by the *path* argument to the value of the *times* argument. `lutimes()` behaves the same as `utimes()`, except that when *path* refers to a symbolic link, the link is not dereferenced; instead, the timestamps of the symbolic link are changed.

The *times* argument is an array of two `timeval` structures. The first array member represents the date and time of the last access, and the second member represents the date and time of the last modification. The times in the `timeval` structure are measured in seconds and microseconds since the Epoch, but the actual times that are stored with the file are rounded to the nearest second. The `timeval` members are:

tv_sec

Seconds since 1 January 1970 (Coordinated Universal Time)

tv_usec

Microseconds

If the *times* argument is a NULL pointer, the access and modification times of the file are set to the current time.

Returned value

If successful, `lutimes()` returns 0.
If unsuccessful, `lutimes()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EACCES
The process does not have search permission on some components of the *path* prefix; or all of the following are true:

- *times* is NULL.
- The effective user ID of the process does not match the owner of the file.
- The process does not have write permission on the file.
- The process does not have appropriate privileges.

ELOOP
A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLINK` symbolic links (defined in the `limits.h` header file) are detected in the resolution of *path*.

ENAMETOOLONG
path is longer than `PATH_MAX` characters or some components of *path* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the path name string that is substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined by using `pathconf()`.

ENOTDIR
Some components of the *path* prefix are not a directory.

ENOTENT
No file is named *path*, or the *path* argument is an empty string.

EPERM
times is not NULL. The effective user ID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.

EROFS
path is on a read-only file system.

Related information

- [“sys/time.h – Time types” on page 71](#)
- [“utime\(\), utime64\(\) – Set file access and modification times” on page 1952](#)
- [“utimes\(\), utimes64\(\) – Set file access and modification times” on page 1956](#)
- [“futimes\(\) – Change file access and modification times” on page 670](#)

makecontext() – Modify user context

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ucontext.h>

void makecontext(ucontext_t *ucp, void (*func)(), int argc, ...);
```

General description

The `makecontext()` function modifies the context specified by *ucp*, which has been initialized using `getcontext()`. When this context is resumed using `setcontext()` or `swapcontext()`, program execution continues by calling *func()*, passing it the arguments that follow *argc* in the `makecontext()` call.

The value of *argc* must match the number of integer arguments passed to *func()*, otherwise the behavior is undefined.

The **`uc_link`** member of **`ucontext_t`** is used to determine the context that will be resumed when the context being modified by `makecontext()` returns. If the **`uc_link`** member is not equal to 0, the process continues as if after a call to `setcontext()` with the context pointed to by the **`uc_link`** member. If the **`uc_link`** member is equal to 0, the process exits as if `exit()` were called. The **`uc_link`** member should be initialized before the call to `makecontext()`.

This function is supported only in a POSIX program.

This function is not supported in an AMODE 31 XPLINK environment (for example, one which is in AMODE 31 and in which either the `main()` function was compiled with the XPLINK option, or the XPLINK(ON) runtime option was specified).

The **`<ucontext.h>`** header file defines the **`ucontext_t`** type as a structure that includes the following members:

| | | |
|-------------------------|--------------------------|--|
| <code>mcontext_t</code> | <code>uc_mcontext</code> | A machine-specific representation of the saved context. |
| <code>ucontext_t</code> | <code>*uc_link</code> | Pointer to the context that will be resumed when this context returns. |
| <code>sigset_t</code> | <code>uc_sigmask</code> | The set of signals that are blocked when this context is active. |
| <code>stack_t</code> | <code>uc_stack</code> | The stack used by this context. |

Special behavior for C++

Because C and C++ linkage conventions are incompatible, `makecontext()` cannot receive C++ function pointers. If you attempt to pass a C++ function pointer to `makecontext()`, the compiler will flag it as an error. To use the C++ `makecontext()` function, you must ensure that all functions registered for `makecontext()` have C linkage by declaring them as `extern "C"`. For example:

```
C: void func(int, int);
:
: makecontext(&context, func, 2, arg1, arg2);

C++: extern "C" void func();
:
: makecontext(&context, func, 2, arg1, arg2);
```

AMODE 64 considerations

Storage for the stack must be above the 2GB bar. It may not be storage acquired with the `__malloc24()` or `__malloc31()` functions. The stack must be big enough to allow for the creation of a 1M guard page (aligned on a 1M boundary).

The environment variable `_EDC_CONTEXT_GUARD` can be used to control when the stack is guarded and unguarded. For details on the `_EDC_CONTEXT_GUARD` environment variable, see the "Using Environment Variables" chapter in [z/OS XL C/C++ Programming Guide](#).

Returned value

makecontext() returns no values.

If unsuccessful, makecontext() sets errno to one of the following values:

Error Code

Description

EINVAL

The context being modified is using an alternate stack, and the target function entry point is not a valid Language Environment or C entry point.

The *argc* argument specifies a value less than 0.

ENOMEM

The *ucp* argument does not have enough stack left to complete the operation. Or more than 15 arguments are passed to the target function, and there is not enough storage to hold all of the arguments.

Note: If the target function is in a DLL that has not yet been loaded, then makecontext() cannot determine the size requirement and assumes that the size required is MINSIGSTKSZ. Therefore, in this case, the stack must be at least the size indicated by MINSIGSTKSZ. If the size required by the target function is more than MINSIGSTKSZ, then you must load the DLL before invoking makecontext().

Example

This example creates a context in main with the getcontext() statement, then modifies the context to have its own stack and to invoke the function *func*. It invokes the function with the setcontext() statement. Since the **uc_link** member is set to 0, the process exits when the function returns.

```
/* This example shows the usage of makecontext(). */

#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>
#include <stdio.h>
#include <ucontext.h>
#include <errno.h>

#ifdef _LP64
#define STACK_SIZE 2097152+16384 /* large enough value for AMODE 64 */
#else
#define STACK_SIZE 16384 /* AMODE 31 addressing */
#endif

void func(int);

ucontext_t context, *cp = &context;

int main(void) {
    int value = 1;

    getcontext(cp);
    context.uc_link = 0;
    if ((context.uc_stack.ss_sp = (char *) malloc(STACK_SIZE)) != NULL) {
        context.uc_stack.ss_size = STACK_SIZE;
        context.uc_stack.ss_flags = 0;
        errno = 0;
        makecontext(cp, func, 1, value);
        if (errno != 0) {
            perror("Error reported by makecontext()");
            return -1; /* Error occurred exit */
        }
    }
    else {
        perror("not enough storage for stack");
        abort();
    }
    printf("context has been built\n");
    setcontext(cp);
    perror("returned from setcontext");
    abort();
}
```

```

}

void func(int arg) {

    printf("function called with value %d\n",arg);
    printf("process will exit when function returns\n");
    return;

}

```

Output

```

context has been built
function called with value 1
process will exit when function returns

```

Related information

- [“ucontext.h — Context related functions” on page 76](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

malloc() — Reserve storage block

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <stdlib.h>

void *malloc(size_t size);

```

General description

Reserves a block of storage of *size* bytes. Unlike the `calloc()` function, the content of the storage allocated is indeterminate. The storage to which the returned value points is always aligned for storage of any type of object. Under IBM z/OS C only, if 4K alignment is required, use the `__4kmalc()` function. (This function is available to C applications in stand-alone System Productivity Facility (SPF) applications.) The library functions specific to the System Programming C (SPC) environment are described in [z/OS XL C/C++ Programming Guide](#).

Special behavior for C++: The C++ keywords `new` and `delete` are not interoperable with `aligned_alloc()`, `calloc()`, `free()`, `malloc()`, `posix_memalign()`, or `realloc()`.

Note: To use the `aligned_alloc()` function, compile the source code with [C11 standard based compilation](#).

Returned value

If successful, malloc() returns a pointer to the reserved space. The storage space to which the returned value points is always suitably aligned for storage of any type of object.

If not enough storage is available, or if size was specified as 0, malloc() returns NULL. If malloc() returns NULL because there is not enough storage or the requested size is 0, it sets errno to one of the following values:

Error Code

Description

ENOMEM

Insufficient memory is available

Example

CELEBM01

```
/* CELEBM01

This example prompts you for the number of array entries you
want and then reserves enough space in storage for the entries.
If &malloc. was successful, the example assigns values
to the entries and prints out each entry; otherwise, it prints
out an error.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    long * array;      /* start of the array */
    long * index;      /* index variable */
    int i;             /* index variable */
    int num;           /* number of entries of the array */

    printf( "Enter the size of the array\n" );
    scanf( "%i", &num );

    /* allocate num entries */
    if ( (index = array = (long *)malloc( num * sizeof( long ))) != NULL )
    {
        for ( i = 0; i < num; ++i )          /* put values in array */
            *index++ = i;                    /* using pointer notation */

        for ( i = 0; i < num; ++i )          /* print the array out */
            printf( "array[ %i ] = %i\n", i, array[i] );
    }
    else { /* malloc error */
        printf( "Out of storage\n" );
        abort();
    }
}
```

Output

```
Enter the size of the array
array[ 0 ] = 0
array[ 1 ] = 1
array[ 2 ] = 2
array[ 3 ] = 3
array[ 4 ] = 4
```

Related information

- See the topic about using the system programming C facilities in [z/OS XL C/C++ Programming Guide](#)
- “stdlib.h — Standard library functions” on page 65
- “aligned_alloc() — Allocating aligned memory blocks” on page 157

- [“calloc\(\) — Reserve and initialize storage” on page 232](#)
- [“free\(\) — Free a block of storage” on page 620](#)
- [“__malloc24\(\) — Allocate 24-bit storage” on page 1037](#)
- [“__malloc31\(\) — Allocate 31-bit storage” on page 1038](#)
- [“posix_memalign\(\) — Reserve aligned storage block” on page 1201](#)
- [“realloc\(\) — Change reserved storage block size” on page 1395](#)

__malloc24() — Allocate 24-bit storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | AMODE 64 |

Format

```
#include <stdlib.h>

void *__malloc24(size_t size);
```

General description

Reserves a block of storage of *size* bytes from "below-the-line" storage (that is, below 16 MB).

Returned value

If successful, __malloc24() returns a pointer to the reserved space. The storage space to which the returned value points is always suitably aligned for storage of any type of object.

If not enough storage is available, or if *size* was specified as 0, __malloc24() returns NULL. If __malloc24() returns NULL because there is not enough storage, it sets errno to one of the following values:

Error Code

Description

ENOMEM

Insufficient memory is available

Related information

- See the topic about using the system programming C facilities in [z/OS XL C/C++ Programming Guide](#).
- [“stdlib.h — Standard library functions” on page 65](#)
- [“calloc\(\) — Reserve and initialize storage” on page 232](#)
- [“free\(\) — Free a block of storage” on page 620](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“__malloc31\(\) — Allocate 31-bit storage” on page 1038](#)
- [“realloc\(\) — Change reserved storage block size” on page 1395](#)

__malloc31() – Allocate 31-bit storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | AMODE 64 |

Format

```
#include <stdlib.h>

void *__malloc31(size_t size);
```

General description

Reserves a block of storage of *size* bytes from "below-the-bar" storage (that is, below 2 GB).

Returned value

If successful, __malloc31() returns a pointer to the reserved space. The storage space to which the returned value points is always suitably aligned for storage of any type of object.

If not enough storage is available, or if *size* was specified as 0, __malloc31() returns NULL. If __malloc31() returns NULL because there is not enough storage, it sets *errno* to one of the following values:

Error Code

Description

ENOMEM

Insufficient memory is available

Related information

- “Using the System Programming C Facilities” in [z/OS XL C/C++ Programming Guide](#)
- “[stdlib.h – Standard library functions](#)” on page 65
- “[calloc\(\) – Reserve and initialize storage](#)” on page 232
- “[free\(\) – Free a block of storage](#)” on page 620
- “[malloc\(\) – Reserve storage block](#)” on page 1035
- “[__malloc24\(\) – Allocate 24-bit storage](#)” on page 1037
- “[realloc\(\) – Change reserved storage block size](#)” on page 1395

__map_init() – Designate a storage area for mapping blocks

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------------------|
| | both | POSIX(ON) OS/390 V2R9 |

Format

```
#define _OPEN_SYS_MAP_EXTENTION
#include <sys/mman.h>

int __map_init(struct _Mmg_init *parmlist);
```

General description

The `__map_init()` function allocates a map area in the private area of the calling address space. This map area is propagated to child address spaces on fork, which is the only way that multiple processes can share a map area. The application can connect and disconnect blocks of storage in the map area, providing a very fast way to connect up to persistent memory. The `__map_init()` function is meant to be used by applications which need more shared memory or mmap storage than will fit in the address space.

The application should set the following values in the `_Mmg_init` structure:

Element

Description

`_Mmg_numblks`

Set to the number of blocks to be contained in the map area.

`_Mmg_megsperblk`

Set to the size in megabytes of each block in the map area.

`_Mmg_token`

Set to an 8 character map token when successful. This map token should be saved and must be used as a parameter on calls to the `__map_service()` function calls.

`_Mmg_res01a`

Reserved, set to 0.

`_Mmg_res01b`

Reserved, set to 0.

`_Mmg_areaaddr`

As input, set to 0 if you want the address assigned or set to the address of storage where you want the map to begin. As output, this field contains the actual address of the map area.

Usage notes

- It is intended that the application call the `__map_init()` service once to create the map area.
- The application then issues fork to create child processes which will inherit a map area initialized to the hidden state.
- The initial process or the child (and grandchildren) process can then use the `__map_service` to connect and disconnect blocks of storage which are persistent until explicitly deleted.
- When the process which created the initial map area terminates, all further activity against the map blocks is terminated. The map blocks are then deleted when the last child process with an active map area terminates.
- There is no explicit call to delete the map area. This is unlike shared memory or other IPC constructs.

Returned value

If successful, `__map_init()` returns NULL.

If unsuccessful, `__map_init()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EEXIST

An attempt was made to create more than one map for the process.

EFAULT

The *parmlist* (*_Mmg_init* structure) has an argument that is not accessible to the caller.

EINVAL

One of the following occurred:

- The number of blocks (*_Mmg_numblks*) was zero or negative.
- The number of megabytes per block (*_Mmg_Megsperblk*) was zero or negative.
- A reserved field contained nonzero data.
- The specified address (*_Mmg_areaaddr*) is not on a megabyte multiple.

EMVSSAF2ERR

An error occurred in the security product. Use the *__errno2()* function to retrieve the reason code to determine the exact reason the error occurred.

ENOMEM

The requested storage at location *_Mmg_areaaddr* or the size requested could not be obtained. The storage is either not available or your Region size is too small to contain the map area. Or, there is insufficient free virtual storage in the address space to satisfy the request.

EPERM

The user is not authorized to use the *__map_init()* function. Callers must be permitted to the BPX.MAP FACILITY class profile to use this service.

Related information

- [“sys/mman.h — Memory management” on page 69](#)
- [“__map_service\(\) — Set memory mapping service” on page 1040](#)

__map_service() — Set memory mapping service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------------------|
| | both | POSIX(ON) OS/390 V2R9 |

Format

```
#define _OPEN_SYS_MAP_EXTENTION
#include <sys/mman.h>

int __map_service(struct _Mmg_service *parmlist, int count, *_Map_token_t);
```

General description

The *__map_service()* function is used to manipulate the map area created by the *__map_init()* function. The supported functions are defined under *_Mmg_servicetype* below.

Before calling the *__map_service()* service, the application should set values in the *_Mmg_service* structure as follows:

Element

Description

_Mmg_servicetype

Set the type of service being requested for each memory block defined in the array.

Request

Description

_Mmg_newblock

Set for an allocation of a new data block in the mapped area.

_Mmg_conn

Set to request that a data block be connected at the requested location in the map area.

_Mmg_disconn

Set to disconnect a data block from the map area.

_Mmg_free

Set to free the storage backing a data block.

_Mmg_cntl

Set to change the read or write permission settings for a data block.

_Mmg_serviceIflag

Used for `_Mmg_cntl` to indicate read or write and all other bits set to zero. For `_Mmg_disconn` to indicate if the backing storage is to be freed after disconnect. For `_Mmg_newblock` the option of `_Mmg_NoConn` can be set on to bypass the connect to the map area block. The token returned will have to be saved and used for connect services on a later call to make the block accessible. For all other `_Mmg_serviceItype` requests, set all the bits to zero.

_Mmg_serviceOflag

Used for status of the request. When the request has been successfully processed all the bits are set to zero. When processing an list of requests and a failure occurs in `_Mmg_Reqlfail` is set on and further processing on the list is aborted. `_Mmg_servicetype` requests, set all the bits to zero.

_Mmg_token

This is returned as output for a `_Mmg_newblock` request and is used as input for `_Mmg_conn`, and `_Mmg_free`. It is ignored for `_Mmg_disconn` and `_Mmg_cntl`.

_Mmg_res0b

Reserved, set to 0.

_Mmg_blkaddr

For `_Mmg_newblock` and `_Mmg_conn` this is input. It should be set to an address within the map area (on a block multiple) where you want to allocate a block or 0. If 0 is specified, the first available block in the map area is used. On output, this field contains the address within the map area that was assigned to the data block. For `_Mmg_disconn` it is input only and contains the address of the map block to be disconnected. For `_Mmg_cntl` this field is required and specifies the block to be use for the `_Mmg_cntl` option. For `_Mmg_free`, `_Mmg_cntl` and `_Mmg_newblock`, when the option of `_Mmg_NoConn` is set on, this field is ignored.

With *count* reflecting the number of `_Mmg_service` structures included in the array structure supplied on *parmlist* parameter. With *count* a positive integer in the range of 1-1000.

With *_Map_token_t* the 8 character token retrieved from the `_Mmg_token` field in a `_Mmg_service` structure that returned successful from a `__map_init()` function call.

Usage notes

- The `__map_init` and the `__map_service` functions are intended to be used in the following manner:
 - The initial process calls `__map_init` to create a map area large enough for the biggest expected usage.
 - The initial process forks worker processes which inherit the map area at the same virtual address. By having the map area at the same virtual address, storage blocks can be connected to the same block in map areas of different worker processes and pointers can be used to point to data in this or other blocks. This assumes they are always connected at the same location in the map area.
 - As worker processes perform their tasks, they can request new blocks of storage to be created in the map area. Each block has a token associated with it. This token allows other worker processes to connect to the same block. In this respect, the map area acts like shared memory.
 - The worker processes can connect as many blocks to their map area as will fit.

- When the worker process has no further need for a data block, it can disconnect it from the map area. After a delete request for a block, this block is actually freed when the last worker process disconnects for this block.
- When a worker process is completely done with a data block, the storage can be freed. This data is actually freed when the last worker process disconnects from that block.
- Using these services, the application could create multiple gigabytes of storage, of which only certain blocks are mapped into the worker processes at a given time.
- This service is designed to perform the storage connects and disconnects very fast. No data movement occurs.
- Storage blocks are initially connected in write mode. When a block is in write mode, all worker processes which have the block connected, have the block in write mode. If the block access is changed to read-only, then all worker processes which have the block connected, have the block in read-only mode.
- If the initial process or a worker process forks, then the child process inherits a map area initialized to the hidden state.
- Any areas within the map area which do not have a block connected are in the hidden state. Any reference to storage in the hidden state will trigger a SIGSEGV signal.

Returned value

If successful, `__map_service()` returns 0.

If unsuccessful, `__map_service()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EEXIST

A request was made to perform a service on a block but a map is not currently active in the process.

EFAULT

The *parmlist* (`_Mmg_service` structure) argument addresses either could not be accessed or was in read-only storage and could not be updated.

EINVAL

For one of the following reasons:

The block address provided is either not in the map area or it is not on a map block boundary.

A request was made to connect to a block or free the backing storage for a block but the token provided does not match that of any allocated block in the backing store.

A request was made to disconnect from a block but the block is not currently in the map area for this process.

A newblock or connect request was specified for a map area block that is already in use.

A request was made to connect to a block in the backing store that is currently marked to be freed. The connect is not permitted.

The *count* value was not a positive integer in the range of 1-1000.

ENOMEM

A request to create a new block or connect to an existing block was made but there are no unused blocks in the map area to satisfy the request.

Related information

- [“sys/mman.h — Memory management” on page 69](#)
- [“__map_init\(\) — Designate a storage area for mapping blocks” on page 1038](#)

maxcoll() — Return maximum collating element

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <collate.h>

collel_t maxcoll(void);
```

General description

Returns the largest possible value of a collating element in the current locale.

Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“cclass\(\) — Return characters in a character class” on page 243](#)
- [“collequiv\(\) — Return a list of equivalent collating elements” on page 300](#)
- [“collorder\(\) — Return list of collating elements” on page 301](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“colltostr\(\) — Return a string for a collating element” on page 304](#)
- [“getmccoll\(\) — Get next collating element from string” on page 736](#)
- [“getwmccoll\(\) — Get next collating element from wide string” on page 803](#)
- [“ismccollet\(\) — Identify a multicharacter collating element” on page 915](#)
- [“strtcoll\(\) — Return collating element for string” on page 1757](#)

maxdesc() — Get socket numbers to extend beyond the default range

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/types.h>
#include <sys/socket.h>

int maxdesc(int *totdesc, int *inetdesc);
```

General description

Bulk mode sockets are not supported. Do not use this function.

Returned value

If successful, `maxdesc()` returns 0.

If unsuccessful, `maxdesc()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EALREADY

Your program called `maxdesc()` after creating a socket, after a call to `setibmssockopt()`, or after a previous call to `maxdesc()`.

EFAULT

Using the `totdesc` parameter as specified results in an attempt to access storage outside of the caller's address space, or storage not modifiable by the caller.

ENOMEM

Your address space has insufficient storage.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“getstablesz\(\) — Get the socket table size” on page 787](#)
- [“getrlimit\(\) — Get current or maximum resource consumption” on page 767](#)

mblen() — Calculate length of multibyte character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

int mblen(const char *string, size_t n);
```

General description

Determines the length in bytes of the multibyte character pointed to by *string*. A maximum of *n* bytes is examined.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. Changing the `LC_CTYPE` category invalidates the internal shift state: undefined results can occur.

If the current locale supports EBCDIC DBCS characters, then the shift state is updated where applicable. The length returned may be up to 4 (for the shift-out character, 2-byte code, and the shift-in character). If *string* is a NULL pointer, this function resets itself to the initial state.

The function maintains the internal shift state that is altered by subsequent calls.

Returned value

If *string* is NULL, `mblen()` returns:

- Nonzero when DBCS-host code (EBCDIC systems) is used
- Nonzero if multibyte encodings are state-dependent
- Zero otherwise

If *string* is not NULL, `mblen()` returns:

- Zero if *string* points to the NULL character
- The number of bytes comprising the multibyte character
- The value -1 if *string* does not point to a valid multibyte character

Example

```
#include <locale.h>
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    char *mbs = "a"
                "\x0E" /* shift out */
                "\x44\x66" /* <j0158> */
                "\x44\x76" /* <j0159> */
                "\x42\x4e" /* <j0160> */
                "\x0F" /* shift in */
                "b";

    char *loc = setlocale(LC_ALL, "JA_JP.IBM-939");
    int n;

    if (!loc) /* setlocale() failure */
    {
        exit(8);
    }

    printf("We're in the %s locale.\n", loc);

    n = mblen(NULL, MB_CUR_MAX);
    /* n is nonzero, indicating state-dependent encoding; mblen() has */
    /* forced the internal shift state to "initial". */
    /* ===== */
    printf("n = mblen(NULL, MB_CUR_MAX); ==> n = %s\n",
           n ? "NONZERO" : "ZERO");

    n = mblen(mbs, MB_CUR_MAX);
    /* ===== */
    /* n is 1, 'a' is a multibyte character of length 1, internal */
    /* shift state remains at "initial". */
    /* ===== */
    printf("n = mblen(mbs, MB_CUR_MAX); ==> n = %d\n", n);

    n = mblen(mbs + 1, MB_CUR_MAX);
    /* ===== */
    /* n is 3, 'shift out' plus two byte character '<j0158>'. The */
    /* internal state changes to "shift out". */
    /* ===== */
    printf("n = mblen(mbs + 1, MB_CUR_MAX); ==> n = %d\n", n);

    n = mblen(mbs + 4, MB_CUR_MAX);
    /* ===== */
    /* n is 2, two byte character '<j0159>'. The internal shift */
    /* state remains "shift out". */
    /* ===== */
    printf("n = mblen(mbs + 4, MB_CUR_MAX); ==> n = %d\n", n);

    n = mblen(mbs + 6, MB_CUR_MAX);
    /* ===== */
    /* n is 3, two byte character '<j0160>' plus 'shift in'. The */
    /* internal shift state returns to "initial". */
    /* ===== */
    printf("n = mblen(mbs + 6, MB_CUR_MAX); ==> n = %d\n", n);
}
```

```

    n = mblen(mbs + 9, MB_CUR_MAX);
    /*****
    /* n is 1, 'b' is a multibyte character of length 1, internal
    /* shift state remains at "initial".
    /*****/
    printf("n = mblen(mbs + 9, MB_CUR_MAX); ==> n = %d\n", n);

    n = mblen(mbs + 10, MB_CUR_MAX);
    /*****
    /* n is 0 (end of multibyte character string).
    /*****/
    printf("n = mblen(mbs + 10, MB_CUR_MAX); ==> n = %d\n", n);

    return 0;
}
```

Output

```

We're in the JA_JP.IBM-939 locale.
n = mblen(NULL, MB_CUR_MAX); ==> n = NONZERO
n = mblen(mbs, MB_CUR_MAX); ==> n = 1
n = mblen(mbs + 1, MB_CUR_MAX); ==> n = 3
n = mblen(mbs + 4, MB_CUR_MAX); ==> n = 2
n = mblen(mbs + 6, MB_CUR_MAX); ==> n = 3
n = mblen(mbs + 9, MB_CUR_MAX); ==> n = 1
n = mblen(mbs + 10, MB_CUR_MAX); ==> n = 0
```

Related information

- The topic describing internationalization of locales and character sets in [z/OS XL C/C++ Programming Guide](#)
- [“locale.h — Locale settings” on page 36](#)
- [“stdlib.h — Standard library functions” on page 65](#)
- [“mbrlen\(\) — Calculate length of multibyte character” on page 1046](#)
- [“mbrtowc\(\) — Convert a multibyte character to a wide character” on page 1052](#)
- [“mbsrtowcs\(\) — Convert a multibyte string to a wide-character string” on page 1056](#)
- [“mbstowcs\(\) — Convert multibyte characters to wide characters” on page 1058](#)
- [“mbtowc\(\) — Convert multibyte character to wide character” on page 1059](#)
- [“setlocale\(\) — Set locale” on page 1547](#)
- [“strlen\(\) — Determine string length” on page 1740](#)
- [“wrtomb\(\) — Convert a wide character to a multibyte character” on page 1988](#)
- [“wcslen\(\) — Calculate length of wide-character string” on page 2000](#)
- [“wcsrtombs\(\) — Convert wide-character string to multibyte string” on page 2009](#)
- [“wctomb\(\) — Convert wide character to multibyte character” on page 2040](#)

mbrlen() — Calculate length of multibyte character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XP4

```
#include <wchar.h>

size_t mbrlen(const char * __restrict__s, size_t n, mbstate_t * __restrict__ps);
```

XP4

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

size_t mbrlen(const char *s, size_t n, mbstate_t *ps);
```

General description

Calculates the number of bytes required to return to the initial shift state. This is equivalent to

```
mbrtowc((wchar_t *)0, s, n, ps != NULL ? ps : &internal);
```

where `&internal` is the address of the internal `mbstate_t` object for the `mbrlen()` function.

`mbrlen()` is a restartable version of `mblen()`. That is, shift state information is passed as one of the arguments, and is updated on exit. With `mbrlen()`, you can switch from one multibyte string to another, provided that you have kept the shift-state information.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Special behavior for XP4

If you define any feature test macro specifying XP4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `mbrlen()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XP4 and other feature test macros.

Returned value

If `s` is a NULL pointer, `mbrlen()` resets the shift state to the initial shift state and returns 0.

If `s` is not a NULL pointer, `mbrlen()` returns the first of the following that applies.

0

If the next `n` or fewer bytes complete the valid multibyte character that corresponds to the NULL wide character.

positive

If the next `n` or fewer bytes complete the valid multibyte character; the value returned is the number of bytes that complete the multibyte character.

-2

If the next `n` bytes form an incomplete (but potentially valid) multibyte character, and all `n` bytes have been processed; it is unspecified whether this can occur when the value of `n` is less than that of the `MB_CUR_MAX` macro.

Note: When a -2 value is returned, and `n` is at least `MB_CUR_MAX`, the string would contain redundant shift-out and shift-in characters. To continue processing the multibyte string, increment the pointer by the value `n`, and call the `mbrtowc()` function.

-1

If an encoding error occurs (when the next `n` or fewer bytes do not contribute to the complete and valid multibyte character), the value of the macro `EILSEQ` is stored in `errno`, but the conversion state remains unchanged.

Example

CELEBM03

```
/* CELEBM03 */
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>

int main(void)
{
    char      mbs[5] = "a";    /* string containing the multibyte char */
    mbstate_t ss      = 0;    /* set shift state to the initial state */
    int       length;

    /* Determine the length in bytes of a multibyte character pointed */
    /* to by mbs.                                                    */

    length = mbrlen(mbs, MB_CUR_MAX, &ss);

    printf("    length: %d \n", length);
    printf("    mbs: \"%s\" \n", mbs);
    printf("MB_CUR_MAX: %d \n", MB_CUR_MAX);
    printf("    ss: %d \n", ss);
}
```

Output

```
    length: 1
    mbs: "a"
MB_CUR_MAX: 4
    ss: 0
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “locale.h – Locale settings” on page 36
- “wchar.h – ISO/C Multibyte Support extensions” on page 79
- “mbrlen() – Calculate length of multibyte character” on page 1044
- “mbrtowc() – Convert a multibyte character to a wide character” on page 1052
- “mbsrtowcs() – Convert a multibyte string to a wide-character string” on page 1056
- “mbtowc() – Convert multibyte character to wide character” on page 1059
- “setlocale() – Set locale” on page 1547
- “wctomb() – Convert a wide character to a multibyte character” on page 1988
- “wcsrtombs() – Convert wide-character string to multibyte string” on page 2009

mbrtoc16() – Convert a multibyte character to a char16_t character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C Amendment C11 | both | z/OS V2R1 |

Format

```
#include <uchar.h>
```

```
size_t mbrtoc16(char16_t * restrict pc16,
               const char * restrict s,
               size_t n,
               mbstate_t * restrict ps);
```

General description

The `mbrtoc16()` function converts a multibyte character to a wide character of type `char16_t`, and returns the number of bytes of the multibyte character.

If `s` is not a null pointer, the `mbrtoc16()` function inspects at most `n` bytes beginning with the byte pointed to by `s` to determine the number of bytes needed to complete the next multibyte character (including any shift sequences). If the function determines that the next multibyte character is complete and valid, it determines the values of the corresponding wide characters and then, if `pc16` is not a null pointer, stores the value of the first (or only) such character in the object pointed to by `pc16`. Subsequent calls will store successive wide characters without consuming any additional input until all the characters have been stored. If the corresponding wide character is the null wide character, the resulting state described is the initial conversion state.

If `s` is a null pointer, the `mbrtoc16()` function is equivalent to the call `mbrtoc16(NULL, "", 1, ps)`. In this case, the values of the parameters `pc16` and `n` are ignored.

If `ps` is a null pointer, `mbrtoc16()` uses its own internal object to track the shift state. Otherwise `*ps` must be a valid `mbstate_t` object. An `mbstate_t` object `*ps` can be initialized to the initial state by assigning 0 to it, or by calling `mbrtoc16(NULL, NULL, 0, ps)`.

Usage notes

1. To use the `mbrtoc16()` function, compile the source code with [C11 standard based compilation](#).
2. The `mbrtoc16()` function only supports the CCSIDs that are provided by Unicode Services.
3. The result of converting multiple string alternately in one thread by using multiple `mbstate_t` objects (including the internal one) is undefined.

Returned value

The `mbrtoc16()` function returns the first of the following that applies (given the current conversion state):

0

If the next `n` or fewer bytes complete the multibyte character that corresponds to the null wide character (which is the value stored).

between 1 and `n` inclusive

If the next `n` or fewer bytes complete a valid multibyte character (which is the value stored); the value returned is the number of bytes that complete the multibyte character.

-3

If the next character resulting from a previous call has been stored (no byte from the input has been consumed by this call).

-2

If the next `n` bytes contribute to an incomplete (but potentially valid) multibyte character, and all `n` bytes have been processed (no value is stored). When `n` has at least the value of the `MB_CUR_MAX` macro, this case can only occur if `s` points to a sequence of redundant shift sequence (for implementations with state-dependent encodings).

-1

If an encoding error occurs (when the next `n` or fewer bytes do not contribute to a complete and valid multibyte character). The value of the macro `EILSEQ` is stored in `errno`, and the conversion state is unspecified.

Example

```
#include <stdio.h>
#include <stdlib.h>
#include <uchar.h>

int main(void)
{
    char16_t c16;
    char mbs[] = "a" ; /* string containing the multibyte character */
    mbstate_t ss = 0 ; /* set shift state to the initial state */
    int length = 0 ;

    /* Determine the length of the multibyte character pointed to by */
    /* mbs. Store the multibyte character in the char16_t object */
    /* called c16. */

    length = mbrtoc16(&c16, mbs, MB_CUR_MAX, &ss);
    if (length < 0) {
        /* -2 and -3 return value could not happen during converting the 'a' */
        perror("mbrtoc16() fails to convert");
        exit(-1);
    }

    printf(" mbs: \"%s\" \n", mbs);
    printf(" length: %d \n", length);
    printf(" c16: 0x%04hx \n", c16);
}
```

Output:

```
mbs:"a"
length: 1
c16: 0x0061
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “uchar.h – Extended character data types” on page 76
- “setlocale() – Set locale” on page 1547
- “c16rtomb() – Convert a char16_t character to a multibyte character” on page 224
- “mbrtoc32() – Convert a multibyte character to a char32_t character” on page 1050

mbrtoc32() – Convert a multibyte character to a char32_t character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C Amendment C11 | both | z/OS V2R1 |

Format

```
#include <uchar.h>

size_t mbrtoc32(char32_t * restrict pc32,
                const char * restrict s,
                size_t n,
                mbstate_t * restrict ps);
```

General description

The `mbrtoc32()` function converts a multibyte character to a wide character of type `char32_t`, and returns the number of bytes of the multibyte character.

If `s` is not a null pointer, the `mbrtoc32()` function inspects at most `n` bytes beginning with the byte pointed to by `s` to determine the number of bytes needed to complete the next multibyte character (including any shift sequences). If the function determines that the next multibyte character is complete and valid, it determines the values of the corresponding wide characters and then, if `pc32` is not a null pointer, stores the value of the first (or only) such character in the object pointed to by `pc32`. Subsequent calls will store successive wide characters without consuming any additional input until all the characters have been stored. If the corresponding wide character is the null wide character, the resulting state described is the initial conversion state.

If `s` is a null pointer, the `mbrtoc32()` function is equivalent to the call `mbrtoc32(NULL, "", 1, ps)`. In this case, the values of the parameters `pc32` and `n` are ignored.

If `ps` is a null pointer, `mbrtoc32()` uses its own internal object to track the shift state. Otherwise `*ps` must be a valid `mbstate_t` object. An `mbstate_t` object `*ps` can be initialized to the initial state by assigning 0 to it, or by calling `mbrtoc32(NULL, NULL, 0, ps)`.

Usage notes

1. To use the `mbrtoc32()` function, compile the source code with [C11 standard based compilation](#).
2. The `mbrtoc32()` function only supports the CCSIDs that are provided by Unicode Services.
3. The result of converting multiple string alternately in one thread by using multiple `mbstate_t` objects (including the internal one) is undefined.

Returned value

The `mbrtoc32()` function returns the first of the following that applies (given the current conversion state):

0

If the next `n` or fewer bytes complete the multibyte character that corresponds to the null wide character (which is the value stored).

between 1 and `n` inclusive

If the next `n` or fewer bytes complete a valid multibyte character (which is the value stored); the value returned is the number of bytes that complete the multibyte character.

-3

If the next character resulting from a previous call has been stored (no byte from the input has been consumed by this call).

-2

If the next `n` bytes contribute to an incomplete (but potentially valid) multibyte character, and all `n` bytes have been processed (no value is stored). When `n` has at least the value of the `MB_CUR_MAX` macro, this case can only occur if `s` points to a sequence of redundant shift sequence (for implementations with state-dependent encodings).

-1

If an encoding error occurs (when the next `n` or fewer bytes do not contribute to a complete and valid multibyte character). The value of the macro `EILSEQ` is stored in `errno`, and the conversion state is unspecified.

Example

```
#include <stdio.h>
#include <stdlib.h>
#include <uchar.h>
```

```
int main(void)
{
    char32_t c32;
    char mbs[] = "a" ; /* string containing the multibyte character */
    mbstate_t ss = 0 ; /* set shift state to the initial state */
    int length = 0 ;

    /* Determine the length of the multibyte character pointed to by */
    /* mbs. Store the multibyte character in the char32_t object */
    /* called c32. */

    length = mbrtoc32(&c32, mbs, MB_CUR_MAX, &ss);
    if (length < 0) {
        /* -2 and -3 return value could not happen during converting the 'a' */
        perror("mbrtoc32() fails to convert");
        exit(-1);
    }

    printf(" mbs: \"%s\" \n", mbs);
    printf(" length: %d \n", length);
    printf(" c32: 0x%08x \n", c32);
}
```

Output:

```
mbs:"a"
length: 1
c32: 0x00000061
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “uchar.h — Extended character data types” on page 76
- “setlocale() — Set locale” on page 1547
- “c32rtomb() — Convert a char32_t character to a multibyte character” on page 226
- “mbrtoc16() — Convert a multibyte character to a char16_t character” on page 1048

mbrtowc() — Convert a multibyte character to a wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XPg4

```
#include <wchar.h>

size_t mbrtowc(wchar_t * __restrict__ pwc, const char * __restrict__ s,
               size_t n, mbstate_t * __restrict__ ps);
```

XPg4

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

size_t mbrtowc(wchar_t *pwc, const char *s, size_t n, mbstate_t *ps);
```

General description

The `mbrtowc()` function is equivalent to `mbrtowc(NULL, "", 1, ps)`.

If `s` is a NULL pointer, the `mbrtowc()` function ignores the `n` and the `pwc`, and resets the shift state, pointed to by `ps`, to the initial shift state.

If `s` is not a NULL pointer, `mbrtowc()` inspects at most `n` bytes, beginning with the byte pointed to by `s`, and the shift state pointed to by `ps`, and determines the number of bytes that is needed to complete the valid multibyte character.

When the multibyte character is completed, `mbrtowc()` determines the value of the corresponding wide character and stores it in the object pointed to by `pwc`, so long as `pwc` is not a NULL pointer. Finally, `mbrtowc()` stores the actual shift state in the object pointed to by `ps`. If `ps` is a NULL pointer, `mbrtowc()` uses its own internal object to track the shift state.

`mbrtowc()` is a restartable version of `mbtowc()`. That is, shift-state information is passed as one of the arguments and is updated on exit. With `mbrtowc()`, you can switch from one multibyte string to another, provided that you have kept the shift-state information.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results may occur.

Special behavior for XPG4

If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `mbrtowc()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

If `s` is a NULL pointer, `mbrtowc()` resets the shift state to the initial shift state and returns 0.

If `s` is not a NULL pointer, `mbrtowc()` returns one of the following, in the order shown:

0

If the next `n` or fewer bytes complete the valid multibyte character that corresponds to the NULL wide character.

positive integer

If the next `n` or fewer bytes complete the valid multibyte character; the value returned is the number of bytes that complete the multibyte character.

-2

If the next `n` bytes form an incomplete (but potentially valid) multibyte character, and all `n` bytes have been processed. It is unspecified whether this can occur when the value of `n` is less than that of the `MB_CUR_MAX` macro.

Note: When a -2 value is returned, and `n` is at least `MB_CUR_MAX`, the string would contain redundant shift-out and shift-in characters. To continue processing the multibyte string, increment the pointer by the value `n`, and call the `mbrtowc()` function.

-1

If an encoding error occurs (when the next `n` or fewer bytes do not contribute to the complete and valid multibyte character). The value of the macro `EILSEQ` is stored in `errno`, but the conversion state is unchanged.

Example

CELEBM04

```
/* CELEBM04 */
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>
```

```
int main(void)
{
    wchar_t    wc;
    char       mbs[5] = "a";    /* string containing the multibyte char */
    mbstate_t  ss = 0;          /* set shift state to the initial state */
    int        length;

    /* Determine the length of the multibyte character pointed to by
    /* mbs. Store the multibyte character in the wchar_t object
    /* called wc.
    /*
    length = mbrtowc(&wc, mbs, MB_CUR_MAX, &ss);

    printf("    length: %d \n", length);
    printf("    wc: %lc \n", wc);
    printf("    mbs: \"%s\" \n", mbs);
    printf("MB_CUR_MAX: %d \n", MB_CUR_MAX);
    printf("    ss: %d \n", ss);
}
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “locale.h — Locale settings” on page 36
- “wchar.h — ISO/C Multibyte Support extensions” on page 79
- “mblen() — Calculate length of multibyte character” on page 1044
- “mbrlen() — Calculate length of multibyte character” on page 1046
- “mbsrtowcs() — Convert a multibyte string to a wide-character string” on page 1056
- “setlocale() — Set locale” on page 1547
- “wrtomb() — Convert a wide character to a multibyte character” on page 1988
- “wcsrtombs() — Convert wide-character string to multibyte string” on page 2009

mbsinit() — Test state object for initial state

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XP G4

```
#include <wchar.h>

int mbsinit(const mbstate_t *ps);
```

XP G4

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

int mbsinit(const mbstate_t *ps);
```


General description

If *ps* is not a NULL pointer the mbsinit() function determines whether the pointer to mbstate_t object describes an initial conversion state.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Special behavior for XPG4

If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the wchar header, then you must also define the _MSE_PROTOS feature test macro to make the declaration of the mbsinit() function in the wchar header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

If *ps* is a NULL pointer or if the pointed-to object describes an initial conversion state, mbsinit() returns nonzero.

Otherwise, mbsinit() returns 0.

Example

CELEBM05

```
/* CELEBM05

   This example checks the conversion state to see if it is in the
   initial state.

*/
#include "stdio.h"
#include "wchar.h"
#include "stdlib.h"

main() {
    char    *string = "ABC";
    mbstate_t state = 0;
    wchar_t  wc;
    int      rc;

    rc = mbrtowc(&wc, string, MB_CUR_MAX, &state);
    if (mbsinit(&state))
        printf("In initial conversion state\n");
}
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “locale.h — Locale settings” on page 36
- “wchar.h — ISO/C Multibyte Support extensions” on page 79
- “mbrlen() — Calculate length of multibyte character” on page 1046
- “mbrtowc() — Convert a multibyte character to a wide character” on page 1052
- “mbsrtowcs() — Convert a multibyte string to a wide-character string” on page 1056
- “setlocale() — Set locale” on page 1547
- “wrtomb() — Convert a wide character to a multibyte character” on page 1988
- “wcsrtombs() — Convert wide-character string to multibyte string” on page 2009

mbsrtowcs() — Convert a multibyte string to a wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XP4

```
#include <wchar.h>

size_t mbsrtowcs(wchar_t *dst, const char **src, size_t len, mbstate_t *ps);
```

XP4

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

size_t mbsrtowcs(wchar_t *dst, const char **src, size_t len, mbstate_t *ps);
```

General description

Converts a sequence of multibyte characters that begins in the conversion state described by *ps* from the array indirectly pointed to by *src*. It converts this sequence into a sequence of corresponding wide characters, that, if *dst* is not a NULL pointer, are then stored into the array pointed to by *dst*. Conversion continues up to and including a terminating NULL character, and the terminating NULL wide character is also stored. Conversion stops earlier in two cases: (1) when a sequence of bytes is reached that does not form a valid multibyte character, or (2) if *dst* is not a NULL pointer, when *len* codes have been stored into the array pointed to by *dst*. Each conversion takes place as if by a call to the `mbtowc()` function.

If *dst* is not a NULL pointer, the pointer object pointed to by *src* is assigned either a NULL pointer (if conversion stopped because a terminating NULL character was reached) or the address just past the last multibyte character converted. If conversion stopped because a terminating NULL character was reached, the resulting state is the initial state.

`mbsrtowcs()` is a restartable version of `mbstowcs()`. That is, shift-state information is passed as one of the arguments and is updated on exit. With `mbsrtowcs()`, you can switch from one multibyte string to another, provided that you have kept the shift-state information.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Special behavior for XP4

If you define any feature test macro specifying XP4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `mbsrtowcs()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XP4 and other feature test macros.

Returned value

If successful, `mbsrtowcs()` returns the number of multibyte characters converted, not including the terminating NULL character, if any.

If the *dst* argument is a null pointer, the *len* argument is ignored and `mbsrtowcs()` returns the required size in wide characters for the destination string.

If the input string contains an invalid multibyte character, `mbsrtowcs()` returns `(size_t)-1` and sets `errno` to one of the following values:

Error Code

Description

EILSEQ

Encoding error (the conversion state is undefined).

Example

CELEBM06

```
/* CELEBM06 */
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>

#define SIZE 10

int main(void)
{
    wchar_t wcs[SIZE];
    char mbs[SIZE]="abcd"; /* string containing the multibyte char */
    char *ptr = mbs; /* pointer to the mbs string */
    int length;

    /* Determine the length of the multibyte string pointed to by */
    /* mbs. Store the multibyte characters in the wchar_t array */
    /* pointed to by wcs. */

    length = mbsrtowcs(wcs, (const char**)&ptr, SIZE, NULL);
    wcs[length] = L'\0';

    printf("    length: %d \n", length);
    printf("    wcs: \"%ls\" \n", wcs);
    printf("    mbs: \"%s\" \n", mbs);
    printf("    &mbs: %p \n", mbs);
    printf("    &ptr: %p \n", ptr);
}
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “`locale.h` — Locale settings” on page 36
- “`wchar.h` — ISO/C Multibyte Support extensions” on page 79
- “`mblen()` — Calculate length of multibyte character” on page 1044
- “`mbrlen()` — Calculate length of multibyte character” on page 1046
- “`mbrtowc()` — Convert a multibyte character to a wide character” on page 1052
- “`mbstowcs()` — Convert multibyte characters to wide characters” on page 1058
- “`setlocale()` — Set locale” on page 1547
- “`wcrtomb()` — Convert a wide character to a multibyte character” on page 1988
- “`wcsrtombs()` — Convert wide-character string to multibyte string” on page 2009

mbstowcs() – Convert multibyte characters to wide characters

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

size_t mbstowcs(wchar_t * __restrict__pwc, const char* __restrict__ string, size_t n);
```

General description

Determines the length of the sequence of the multibyte characters that start in the initial shift state and that are pointed to by *string*. It then converts each of the multibyte characters to a `wchar_t`, and stores no more than *n* codes in the array pointed to by *pwc*. The conversion stops if either an invalid multibyte sequence is encountered or if *n* codes have been converted.

Processing continues up to and including the terminating NULL character, and characters that follow it are not processed. The terminating NULL character is converted into a code with the value 0.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

If *pwc* is a NULL pointer, `mbstowcs()` will return the length required to convert the entire array regardless of the value of *n*, but no values are stored.

Returned value

If successful, `mbstowcs()` returns the number of *pwc* array elements modified (or required if *pwc* is NULL) , not counting the terminating 0 code (the `wchar_t` 0 code). Note that, if the return value is *n*, the resulting *wchar_t* array will *not* be NULL-terminated.

If an invalid multibyte character is encountered, `mbstowcs()` returns `(size_t)-1`.

Example

CELEBM07

```
/* CELEBM07

   This example uses &mbstowcs. to convert a multibyte character
   string to a wide character string.

*/
#include <stdio.h>
#include <stdlib.h>

int main()
{
    char      mbsin[8] = "\x50\x0e\x42\xf1\x0f\x50\x00";
    wchar_t   wcsout[5];
    size_t    wcssize;

    printf("mbsin is 0x%.2x 0x%.2x 0x%.2x 0x%.2x 0x%.2x 0x%.2x 0x%.2x\n",
```

```
    mbsin[0], mbsin[1], mbsin[2],
    mbsin[3], mbsin[4], mbsin[5],
    mbsin[6]);

    wcssize = mbstowcs(wcsout, mbsin, 5);

    printf("mbstowcs(wcsout, mbsin, 5); returned %d\n", wcssize);

    printf("wcsout is 0x%.4x 0x%.4x 0x%.4x 0x%.4x\n",
           wcsout[0], wcsout[1],
           wcsout[2], wcsout[3]);
}
```

Output

```
mbsin is 0x50 0x0e 0x42 0xf1 0x0f 0x50 0x00
mbstowcs(wcsout, mbsin, 5); returned 3
wcsout is 0x0050 0x42f1 0x0050 0x0000
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “[locale.h — Locale settings](#)” on page 36
- “[stdlib.h — Standard library functions](#)” on page 65
- “[mblen\(\) — Calculate length of multibyte character](#)” on page 1044
- “[mbsrtowcs\(\) — Convert a multibyte string to a wide-character string](#)” on page 1056
- “[mbtowc\(\) — Convert multibyte character to wide character](#)” on page 1059
- “[setlocale\(\) — Set locale](#)” on page 1547
- “[wcslen\(\) — Calculate length of wide-character string](#)” on page 2000
- “[wcstombs\(\) — Convert wide-character string to multibyte character string](#)” on page 2028

mbtowc() — Convert multibyte character to wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

int mbtowc(wchar_t * __restrict__pwc, const char* __restrict__string, size_t n);
```

General description

Converts a multibyte character to a wide character and returns the number of bytes of the multibyte character. It first determines the length of the multibyte character pointed to by *string*. It then converts the multibyte character to the corresponding wide character and places the wide character in the location pointed to by *pwc*, if *pwc* is not a NULL pointer. A maximum of *n* bytes is examined.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Returned value

If *string* is NULL, mbtowc() returns:

- Nonzero if the multibyte encoding in the current locale (LC_CTYPE) is shift-dependent.
- 0 otherwise.
- The current shift state is set to the initial state.

Otherwise if *string* is not NULL, mbtowc() returns:

- The number of bytes comprising the converted multibyte character, if *n* or fewer bytes form a valid multibyte character.
- 0 if *string* points to the NULL character.
- -1 if *string* does not point to a valid multibyte character, and the next *n* bytes do not form a valid multibyte character.

If the current locale supports EBCDIC DBCS characters, the shift state is updated where applicable. The length returned may be up to 4 characters long (for the shift-out character, 2-byte code, and the shift-in character).

After the function is placed into its initial state, it interprets multibyte characters—pointed to by *string*—accordingly. During the processing of shift-dependent encoded characters, you cannot stop processing one string, then move temporarily to processing another string, and return to the first, because the state would be valid for the second string, not the place where you stopped in the first string.

Example

```
/* This example uses mbtowc() to convert a multibyte character into a wide
   character.
   */
#include <stdio.h>
#include <stdlib.h>

int temp;
char string [6];
wchar_t arr[6];

int main(void)
{ /* Set string to point to a multibyte character. */
  :
    temp = mbtowc(arr, string, MB_CUR_MAX);
    printf("wide-character string: %ls",arr);
  }
```

Related information

- “Internationalization: Locales and Character Sets” in [z/OS XL C/C++ Programming Guide](#)
- “locale.h — Locale settings” on page 36
- “stdlib.h — Standard library functions” on page 65
- “mblen() — Calculate length of multibyte character” on page 1044
- “mbrtowc() — Convert a multibyte character to a wide character” on page 1052
- “mbstowcs() — Convert multibyte characters to wide characters” on page 1058
- “setlocale() — Set locale” on page 1547
- “wcslen() — Calculate length of wide-character string” on page 2000
- “wctomb() — Convert wide character to multibyte character” on page 2040

m_create_layout() – Create and initialize a layout object (bidi data)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C XPG4 C99 | both | z/OS V1R2 |

Format

```
#include <sys/layout.h>

LayoutObject m_create_layout(const AttrObject attrobj, const char *modifier);
```

General description

The `m_create_layout()` function is part of the support for handling of bidirectional (Bidi) conversion of data between Visual (MVS) and Implicit (z/OS UNIX) formats. Initial support is for Arabic and Hebrew data.

The `m_create_layout()` function creates a `LayoutObject` associated with the locale identified by *attrobj*. The `LayoutObject` is an opaque object containing all the data and methods necessary to perform the layout operations on context-dependent or directional characters of the locale identified by the *attrobj*.

The memory for the `LayoutObject` is allocated by `m_create_layout()`. The `LayoutObject` created has default layout values. If the *modifier* argument is not NULL, the layout values specified by the *modifier* will overwrite the default layout values associated with the locale. Also, internal states maintained by the layout transformation function across transformations are set to their initial values.

The *attrobj* argument is or may be an amalgam of many opaque objects. A locale object is just one example of the type of object that can be attached to an attribute object. The *attrobj* argument specifies a name that is usually associated with a locale category. If *attrobj* is NULL, the `LayoutObject` created is associated with the current locale as set by the `setlocale()` function.

The *modifier* argument can be used to announce a set of layout values when the `LayoutObject` is created.

A `LayoutObject` created by `m_create_layout()` is deleted by calling the `m_destroy_layout()` function.

For a detailed description of bidirectional layout transformation, see *Bidirectional Language Support in z/OS XL C/C++ Programming Guide*.

Returned value

If successful, `m_create_layout()` returns a `LayoutObject` for use in subsequent calls to `m_*_layout()` functions.

If unsuccessful, `m_create_layout()` returns `(LayoutObject)0` and sets `errno` to one of the following values:

Error Code

Description

EBADF

The attribute object is invalid or the locale associated with the attribute object is not available.

EINVAL

The modifier string has a syntax error or it contains unknown layout values.

ENOMEM

Insufficient storage space is available.

Related information

- [“sys/layout.h — Bidirectional conversion of data between Visual and Implicit formats” on page 69](#)
- [“m_destroy_layout\(\) — Destroy a layout object \(bidi data\)” on page 1062](#)
- [“m_getvalues_layout\(\) — Query layout values of a layout object \(bidi data\)” on page 1070](#)
- [“m_setvalues_layout\(\) — Set layout values of a layout object \(bidi data\)” on page 1109](#)
- [“m_transform_layout\(\) — Layout transformation for character strings \(bidi data\)” on page 1124](#)
- [“m_wtransform_layout\(\) — Layout transformation for wide-character strings \(bidi data\)” on page 1130](#)
- [“setlocale\(\) — Set locale” on page 1547](#)

m_destroy_layout() — Destroy a layout object (bidi data)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C XPG4 C99 | both | z/OS V1R2 |

Format

```
#include <sys/layout.h>

int m_destroy_layout(const LayoutObject layoutobject);
```

General description

The `m_destroy_layout()` function is part of the support for handling of bidirectional (Bidi) conversion of data between Visual (MVS) and Implicit (z/OS UNIX) formats. Initial support is for Arabic and Hebrew data.

The `m_destroy_layout()` function destroys a `LayoutObject` by deallocating the layout object and all the associated resources previously allocated by the `m_create_layout()` function.

Returned value

If successful, `m_destroy_layout()` returns 0.

If unsuccessful, `m_destroy_layout()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EFAULT

Errors occurred while processing the request.

Related information

- [“sys/layout.h — Bidirectional conversion of data between Visual and Implicit formats” on page 69](#)
- [“m_destroy_layout\(\) — Destroy a layout object \(bidi data\)” on page 1062](#)
- [“m_getvalues_layout\(\) — Query layout values of a layout object \(bidi data\)” on page 1070](#)
- [“m_setvalues_layout\(\) — Set layout values of a layout object \(bidi data\)” on page 1109](#)
- [“m_transform_layout\(\) — Layout transformation for character strings \(bidi data\)” on page 1124](#)
- [“m_wtransform_layout\(\) — Layout transformation for wide-character strings \(bidi data\)” on page 1130](#)

memccpy() – Copy bytes in memory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <string.h>

void *memccpy(void *__restrict__ s1, const void *__restrict__ s2, int c, size_t n);
```

General description

The `memccpy()` function copies bytes from memory area `s2` into memory area `s1`, stopping after the first occurrence of byte `c` (converted to an unsigned char) is copied, or after `n` bytes are copied, whichever comes first.

Returned value

If successful, `memccpy()` returns a pointer to the byte after the copy of `c` in `s1`.

If `c` was not found in the first `n` bytes of `s2`, `memccpy()` returns a NULL pointer.

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memchr\(\) – Search buffer” on page 1063](#)
- [“memcmp\(\) – Compare bytes” on page 1065](#)
- [“memcpy\(\) – Copy buffer” on page 1066](#)
- [“memmove\(\) – Move buffer” on page 1067](#)
- [“memset\(\) – Set buffer to value” on page 1069](#)
- [“strchr\(\) – Search for character” on page 1720](#)

memchr() – Search buffer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

void *memchr(const void *buf, int c, size_t count);
```

General description

The `memchr()` built-in function searches the first *count* bytes pointed to by *buf* for the first occurrence of *c* converted to an unsigned character. The search continues until it finds *c* or examines *count* bytes.

Returned value

If successful, `memchr()` returns a pointer to the location of *c* in *buf*.

If *c* is not within the first *count* bytes of *buf*, `memchr()` returns NULL.

Example

CELEBM11

```
/* CELEBM11

   This example finds the first occurrence of "x" in
   the string that you provide.
   If it is found, the string that starts with that character is
   printed.
   If you compile this code as MYPROG, then it could be invoked
   like this, with exactly one parameter:
       MYPROG skixing

*/
#include <stdio.h>
#include <string.h>

int main(int argc, char ** argv)
{
    char * result;

    if ( argc != 2 )
        printf( "Usage: %s string\n", argv[0] );
    else
    {
        if ((result = (char *)memchr( argv[1], 'x', strlen(argv[1])) ) != NULL)
            printf( "The string starting with x is %s\n", result );
        else
            printf( "The letter x cannot be found in the string\n" );
    }
}
```

Output

```
The string starting with x is xing
```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memcpy\(\) – Copy bytes in memory” on page 1063](#)
- [“memcmp\(\) – Compare bytes” on page 1065](#)
- [“memcpy\(\) – Copy buffer” on page 1066](#)
- [“memmove\(\) – Move buffer” on page 1067](#)
- [“memset\(\) – Set buffer to value” on page 1069](#)
- [“strchr\(\) – Search for character” on page 1720](#)

memcmp() – Compare bytes

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

int memcmp(const void *buf1, const void *buf2, size_t count);
```

General description

The `memcmp()` built-in function compares the first *count* bytes of *buf1* and *buf2*.

The relation is determined by the sign of the difference between the values of the leftmost first pair of bytes that differ. The values depend on EBCDIC encoding. This function is *not* locale sensitive.

Returned value

Indicates the relationship between *buf1* and *buf2* as follows:

Value

Meaning

< 0

The contents of the buffer pointed to by *buf1* less than the contents of the buffer pointed to by *buf2*

= 0

The contents of the buffer pointed to by *buf1* identical to the contents of the buffer pointed to by *buf2*

> 0

The contents of the buffer pointed to by *buf1* greater than the contents of the buffer pointed to by *buf2*

Example

CELEBM12

```
/* CELEBM12

   This example compares first and second arguments passed to
   main to determine which, if either, is greater.

*/
#include <stdio.h>
#include <string.h>

int main(int argc, char ** argv)
{
    int len;
    int result;

    if ( argc != 3 )
    {
        printf( "Usage: %s string1 string2\n", argv[0] );
    }
    else
```

```

{
    /* Determine the length to be used for comparison */
    if (strlen( argv[1] ) < strlen( argv[2] ))
        len = strlen( argv[1] );
    else
        len = strlen( argv[2] );

    result = memcmp( argv[1], argv[2], len );

    printf( "When the first %i characters are compared,\n", len );
    if ( result == 0 )
        printf( "\"%s\" is identical to \"%s\"\n", argv[1], argv[2] );
    else if ( result < 0 )
        printf( "\"%s\" is less than \"%s\"\n", argv[1], argv[2] );
    else
        printf( "\"%s\" is greater than \"%s\"\n", argv[1], argv[2] );
}
}
```

Output

If the program is passed the arguments *firststring* and *secondstring*, you would obtain following:

```

When the first 11 characters are compared,
"firststring" is less than "secondstring"
```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memccpy\(\) – Copy bytes in memory” on page 1063](#)
- [“memchr\(\) – Search buffer” on page 1063](#)
- [“memcpy\(\) – Copy buffer” on page 1066](#)
- [“memmove\(\) – Move buffer” on page 1067](#)
- [“memset\(\) – Set buffer to value” on page 1069](#)
- [“strcmp\(\) – Compare strings” on page 1722](#)

memcpy() – Copy buffer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <string.h>

void *memcpy(void * __restrict__dest, const void * __restrict__src, size_t count);
```

General description

The memcpy() built-in function copies *count* bytes from the object pointed to by *src* to the object pointed to by *dest*. See [“Built-in functions” on page 96](#) for information about the use of built-in functions. For memcpy(), the source characters may be overlaid if copying takes place between objects that overlap. Use the memmove() function to allow copying between objects that overlap.

Returned value

`memcpy()` returns the value of *dest*.

Example

CELEBM13

```
/* CELEBM13

   This example copies the contents of source to target.

   */
#include <string.h>
#include <stdio.h>

#define MAX_LEN 80

char source[ MAX_LEN ] = "This is the source string";
char target[ MAX_LEN ] = "This is the target string";

int main(void)
{
    printf( "Before memcpy, target is \"%s\\n\", target );
    memcpy( target, source, sizeof(source));
    printf( "After memcpy, target becomes \"%s\\n\", target );
}
```

Output

```
Before memcpy, target is "This is the target string"
After memcpy, target becomes "This is the source string"
```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memcpy\(\) – Copy bytes in memory” on page 1063](#)
- [“memchr\(\) – Search buffer” on page 1063](#)
- [“memcmp\(\) – Compare bytes” on page 1065](#)
- [“memmove\(\) – Move buffer” on page 1067](#)
- [“memset\(\) – Set buffer to value” on page 1069](#)
- [“strcpy\(\) – Copy string” on page 1725](#)

memmove() – Move buffer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

void *memmove(void *dest, const void *src, size_t count);
```

General description

Copies *count* bytes from the object pointed to by *src* to the object pointed to by *dest*. The `memmove()` function allows copying between possibly overlapping objects as if the *count* bytes of the object pointed to by *src* must first be copied into a temporary array before being copied to the object pointed to by *dest*.

Returned value

`memmove()` returns the value of *dest*.

Example

CELEBM14

```
/* CELEBM14

   This example copies the word shiny from position target + 2
   to position target + 8.

*/
#include <string.h>
#include <stdio.h>
#define SIZE    21

char target[SIZE] = "a shiny white sphere";

int main( void )
{
    char * p = target + 8; /* p points at the starting character
                           of the word we want to replace */
    char * source = target + 2; /* start of "shiny" */

    printf( "Before memmove, target is \"%s\"\n", target );
    memmove( p, source, 5 );
    printf( "After memmove, target becomes \"%s\"\n", target );
}
```

Output

```
Before memmove, target is "a shiny white sphere"
After memmove, target becomes "a shiny shiny sphere"
```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memcpy\(\) – Copy bytes in memory” on page 1063](#)
- [“memchr\(\) – Search buffer” on page 1063](#)
- [“memcmp\(\) – Compare bytes” on page 1065](#)
- [“memcpy\(\) – Copy buffer” on page 1066](#)
- [“memset\(\) – Set buffer to value” on page 1069](#)
- [“strcpy\(\) – Copy string” on page 1725](#)

memset() — Set buffer to value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

void *memset(void *dest, int c, size_t count);
```

General description

The `memset()` built-in function sets the first *count* bytes of *dest* to the value *c* converted to an unsigned int.

Returned value

`memset()` returns the value of *dest*.

Example

CELEBM15

```
/* CELEBM15

   This example sets 10 bytes of the buffer to "A" and
   the next 10 bytes to "B".

*/
#include <string.h>
#include <stdio.h>
#define BUF_SIZE 20
#define HALF_BUF_SIZE BUF_SIZE/2

int main(void)
{
    char buffer[BUF_SIZE + 1];
    char *string;

    memset(buffer, 0, sizeof(buffer));
    string = (char *)memset(buffer, 'A', HALF_BUF_SIZE);
    printf("\nBuffer contents: %s\n", string);
    memset(buffer+HALF_BUF_SIZE, 'B', HALF_BUF_SIZE);
    printf("\nBuffer contents: %s\n", buffer);
}
```

Output

```
Buffer contents: AAAAAAAAAA
Buffer contents: AAAAAAAAAABBBBBBBBBB
```

Related information

- [“string.h — String manipulation functions” on page 66](#)

- [“memcpy\(\) — Copy bytes in memory” on page 1063](#)
- [“memchr\(\) — Search buffer” on page 1063](#)
- [“memcmp\(\) — Compare bytes” on page 1065](#)
- [“memcpy\(\) — Copy buffer” on page 1066](#)
- [“memmove\(\) — Move buffer” on page 1067](#)

m_getvalues_layout() — Query layout values of a layout object (bidi data)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C XPG4 C99 | both | z/OS V1R2 |

Format

```
#include <sys/layout.h>

int m_getvalues_layout(const LayoutObject layout_object, LayoutValues values,
                      int *index_returned);
```

General description

The `m_getvalues_layout()` function is part of the support for handling of bidirectional (Bidi) conversion of data between Visual (MVS) and Implicit (z/OS UNIX) formats. Initial support is for Arabic and Hebrew data.

The `m_getvalues_layout()` function is used to query the current setting of layout values within a `LayoutObject`. The `layout_object` argument specifies a `LayoutObject` returned by the `m_create_layout()` function. The `values` argument specifies the list of layout values which are to be queried.

Each value element of a `LayoutValueRec` must point to a location where the layout value is stored. For example, if a layout value is of type `T`, the argument must be of type `T*`. The values are queried from the `LayoutObject` and represent its current state.

If the layout value name has **QueryValueSize** OR-ed to it, instead of the value of the layout value, only its size is returned. This option can be used by the caller to determine the amount of memory needed to be allocated for the layout values queried.

It is the user's responsibility to manage the space allocation for the layout values queried.

For a detailed description of bidirectional layout transformation, see [Bidirectional Language Support in z/OS XL C/C++ Programming Guide](#).

Returned value

If successful, `m_getvalues_layout()` returns 0.

If any value cannot be queried, `m_getvalues_layout()` stores into `index_returned` the (zero-based) index of the value causing the error. It returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EINVAL

The layout value specified by `index_returned` is unknown or its value is invalid or the argument `layout_object` is invalid.

Related information

- [“sys/layout.h — Bidirectional conversion of data between Visual and Implicit formats” on page 69](#)
- [“m_create_layout\(\) — Create and initialize a layout object \(bidi data\)” on page 1061](#)
- [“m_destroy_layout\(\) — Destroy a layout object \(bidi data\)” on page 1062](#)
- [“m_setvalues_layout\(\) — Set layout values of a layout object \(bidi data\)” on page 1109](#)
- [“m_transform_layout\(\) — Layout transformation for character strings \(bidi data\)” on page 1124](#)
- [“m_wtransform_layout\(\) — Layout transformation for wide-character strings \(bidi data\)” on page 1130](#)

mkdir() — Make a directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/stat.h>

int mkdir(const char *pathname, mode_t mode);
```

General description

Creates a new, empty directory, *pathname*. The file permission bits in *mode* are modified by the file creation mask of the process, and then used to set the file permission bits of the directory being created. For more information on the file creation mask, see [“umask\(\) — Set and retrieve file creation mask” on page 1929](#).

The *mode* argument is created with one of the flags defined in the `sys/stat.h` header file. Any mode flags that are not defined will be turned off, and the function will be allowed to proceed.

Flag**Description****S_IRGRP**

Read permission for the file's group.

S_IROTH

Read permission for users other than the file owner.

S_IRUSR

Read permission for the file owner.

S_IRWXG

Read, write, and search or execute permission for the file's group. `S_IRWXG` is the bitwise inclusive OR of `S_IRGRP`, `S_IWGRP`, and `S_IXGRP`.

S_IRWXO

Read, write, and search or execute permission for users other than the file owner. S_IRWXO is the bitwise inclusive OR of S_IROTH, S_IWOTH, and S_IXOTH.

S_IRWXU

Read, write, and search, or execute, for the file owner; S_IRWXU is the bitwise inclusive OR of S_IRUSR, S_IWUSR, and S_IXUSR.

S_ISGID

Privilege to set group ID (GID) for execution. When this file is run through an exec function, the effective group ID of the process is set to the group ID of the file. The process then has the same authority as the file owner, rather than the authority of the actual invoker.

S_ISUID

Privilege to set the user ID (UID) for execution. When this file is run through an exec function, the effective user ID of the process is set to the owner of the file. The process then has the same authority as the file owner, rather than the authority of the actual invoker.

S_ISVTX

Indicates shared text. Keep loaded as an executable file in storage.

S_IWGRP

Write permission for the file's group.

S_IWOTH

Write permission for users other than the file owner.

S_IWUSR

Write permission for the file owner.

S_IXGRP

Search permission (for a directory) or execute permission (for a file) for the file's group.

S_IXOTH

Search permission for a directory, or execute permission for a file, for users other than the file owner.

S_IXUSR

Search permission (for a directory) or execute permission (for a file) for the file owner.

The owner ID of the new directory is set to the effective user ID of the process. The group ID of the new directory is set to the group ID of the owning directory.

mkdir() sets the access, change, and modification times for the new directory. It also sets the change and modification times for the directory that contains the new directory.

If *pathname* names a symbolic link, mkdir() fails.

Returned value

If successful, mkdir() returns 0.

If unsuccessful, mkdir() does not create a directory, returns -1, and sets errno to one of the following values:

Error Code**Description****EACCES**

The process did not have search permission on some component of *pathname*, or did not have write permission on the parent directory of the directory to be created.

EEXIST

Either the named file refers to a symbolic link, or there is already a file or directory with the given *pathname*.

ELOOP

A loop exists in symbolic links. This error is issued if more than POSIX_SYMLINK_MAX (defined in the limits.h header file) symbolic links are detected in the resolution of *pathname*.

EMLINK

The link count of the parent directory has already reached LINK_MAX (defined in the limits.h header file).

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters or some component of *pathname* is longer than **NAME_MAX** characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the pathname string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using pathconf().

ENOENT

Some component of *pathname* does not exist, or *pathname* is an empty string.

ENOSPC

The file system does not have enough space to contain a new directory, or the parent directory cannot be extended.

ENOTDIR

A component of the *pathname* prefix is not a directory.

EROFS

The parent directory of the directory to be created is on a read-only file system.

Example**CELEBM16**

```
/* CELEBM16

   The following example creates a new directory.

*/
#define _POSIX_SOURCE
#include <sys/stat.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    char new_dir[]="new_dir";

    if (mkdir(new_dir, S_IRWXU|S_IRGRP|S_IXGRP) != 0)
        perror("mkdir() error");
    else if (chdir(new_dir) != 0)
        perror("first chdir() error");
    else if (chdir("..") != 0)
        perror("second chdir() error");
    else if (rmdir(new_dir) != 0)
        perror("rmdir() error");
    else
        puts("success!");
}
```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“chdir\(\) — Change the working directory” on page 270](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“umask\(\) — Set and retrieve file creation mask” on page 1929](#)

mkdirat() — Make a directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>
#include <sys/stat.h>

int mkdirat(int dirfd, const char *pathname, mode_t mode);
```

General description

mkdirat() is equivalent to mkdir() except for the following cases:

- If *pathname* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by mkdir() for a relative path name).
- If *pathname* is relative and *dirfd* is the special value AT_FDCWD, *pathname* is interpreted relative to the current working directory of the calling process (like mkdir()).
- If *pathname* is absolute, *dirfd* is ignored.

Returned value

If successful, mkdirat() returns 0.

If unsuccessful, mkdirat() returns -1 and sets errno to one of the following values:

Error Code

Description

EACCES

The process does not have search permission on some component of *pathname* or does not have write permission on the parent directory of the file or directory to be created.

EBADF

pathname is relative but *dirfd* is not AT_FDCWD or a valid file descriptor.

EEXIST

Either the named file refers to a symbolic link, or there is a file or directory with the given *pathname*.

EFBIG

A request to create a directory is prohibited because the file size limit for the process is set to 0.

ELOOP

A loop exists in symbolic links. This error is issued if more than POSIX_SYMLOOP (defined in the limits.h header file) symbolic links are detected in the resolution of *pathname*.

EMLINK

The link count of the parent directory reaches the maximum number that is defined for the system.

ENAMETOOLONG

pathname is longer than PATH_MAX characters or some component of *pathname* is longer than NAME_MAX characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the *pathname* string that is substituted for a symbolic link exceeds PATH_MAX. The PATH_MAX and NAME_MAX values can be determined by using pathconf().

ENOENT

The named file does not exist, or *pathname* is a relative path name and *dirfd* refers to a directory that is deleted.

ENOSPC

The file system does not have enough space to contain a new file or directory, or the parent directory cannot be extended.

ENOTDIR

A component of the path prefix is not a directory, or *pathname* is relative and *dirfd* is a file descriptor that refers to a file other than a directory.

EROFS

The parent directory of the file or directory to be created is on a read-only file system.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“mkdirat\(\) — Make a directory” on page 1074](#)

mkfifo() — Make a FIFO special file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/stat.h>

int mkfifo(const char *pathname, mode_t mode);
```

General description

Sets the access, change, and modification times for the new file. It also sets the change and modification times for the directory that contains the new file.

mkfifo() creates a new FIFO special file, *pathname*. The file permission bits in *mode* are changed by the file creation mask of the process, and then used to set the file permission bits of the FIFO file being created. If *pathname* contains a symbolic link, mkfifo() fails. For more information on the file creation mask, see [“umask\(\) — Set and retrieve file creation mask” on page 1929](#); for information about the file permission bits, see [“chmod\(\) — Change the mode of a file or directory” on page 274](#).

The owner ID of the FIFO file is set to the effective user ID of the process. The group ID of the FIFO file is set to the group ID of the owning directory. *pathname* cannot end in a symbolic link.

Returned value

If successful, mkfifo() returns 0.

If unsuccessful, mkfifo() does not create a FIFO file, returns -1, and sets errno to one of the following values:

Error Code Description

EACCES

The process does not have search permission on some component of *pathname*, or does not have write permission on the parent directory of the file to be created.

EEXIST

Either the named file refers to a symbolic link, or there is already a file or directory with the given *pathname*.

EINTR

A signal is received while this open is blocked waiting for an `open()` for read (if `O_WRONLY` was specified) or for an `open()` for write (if `O_RDONLY` was specified).

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLLOOP` (defined in the `limits.h` header file) symbolic links are detected in the resolution of *pathname*.

EMLINK

The link count of the parent directory has already reached the maximum defined for the system.

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters or some component of *pathname* is longer than **NAME_MAX** characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the *pathname* string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using `pathconf()`.

ENOENT

Some component of *pathname* does not exist, or *pathname* is an empty string.

ENOSPC

The file system does not have enough space to contain a new file, or the parent directory cannot be extended.

ENOTDIR

A component of the *pathname* prefix is not a directory.

EROFS

The parent directory of the FIFO file is on a read-only file system.

Example

CELEBM17

```
/* CELEBM17

   This example uses mkfifo() to create a FIFO specail file named
   temp.fifo and then writes and reads from the file before closing it.

*/
#define _POSIX_SOURCE
#include <sys/stat.h>
#include <unistd.h>
#include <fcntl.h>
#include <stdio.h>

main() {
    char fn[]="temp.fifo";
    char out[20]="FIFO's are fun!", in[20];
    int rfd, wfd;

    if (mkfifo(fn, S_IRWXU) != 0)
        perror("mkfifo() error");
    else {
        if ((rfd = open(fn, O_RDONLY|O_NONBLOCK)) < 0)
            perror("open() error for read end");
        else {
            if ((wfd = open(fn, O_WRONLY)) < 0)
                perror("open() error for write end");
            else {
                if (write(wfd, out, strlen(out)+1) == -1)
                    perror("write() error");
            }
        }
    }
}
```

```

        else if (read(rfd, in, sizeof(in)) == -1)
            perror("read() error");
        else printf("read '%s' from the FIFO\n", in);
        close(wfd);
    }
    close(rfd);
}
unlink(fn);
}
}

```

Output

```
read 'FIFO's are fun!' from the FIFO
```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“umask\(\) — Set and retrieve file creation mask” on page 1929](#)

mkfifoat() — Make a FIFO special file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```

#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>
#include <sys/stat.h>

int mkfifoat(int dirfd, const char *pathname, mode_t mode);

```

General description

`mkfifoat()` is equivalent to `mkfifo()` except in the case where *pathname* specifies a relative path. In this case the newly created FIFO is created relative to the directory that is associated with the file descriptor *dirfd* instead of the current working directory. If `mkfifoat()` is passed the special value `AT_FDCWD` in the *dirfd* parameter, the current working directory is used and the behavior is identical to a call to `mkfifo()`.

Returned value

If successful, `mkfifoat()` returns 0.

If unsuccessful, `mkfifoat()` returns -1, and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have search permission on some component of *pathname*, or does not have write permission on the parent directory of the file to be created.

EBADF

pathname is relative but *dirfd* is not `AT_FDCWD` or a valid file descriptor.

EEXIST

Either the named file refers to a symbolic link, or there is a file or directory with the given *pathname*.

EFBIG

A request to create a directory is prohibited because the file size limit for the process is set to 0.

EINVAL

The file type that is specified in the *mode* parameter is not valid.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLINK` (defined in the `limits.h` header file) symbolic links are detected in the resolution of *pathname*.

EMLINK

The link count of the parent directory reaches the maximum number that is defined for the system.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the *pathname* string that is substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined by using `pathconf()`.

ENOENT

The named file does not exist, or *pathname* is a relative path name and *dirfd* refers to a directory that is deleted.

ENOSPC

The file system does not have enough space to contain a new file or directory, or the parent directory cannot be extended.

ENOTDIR

A component of the path prefix is not a directory, or *pathname* is relative and *dirfd* is a file descriptor that refers to a file other than a directory.

EROFS

The parent directory of the file or directory to be created is on a read-only file system.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“mkfifo\(\) — Make a FIFO special file” on page 1075](#)

mknod() — Make a directory or file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 z/OS UNIX | both | |

Format

_OPEN_SYS

```
#define _OPEN_SYS
#include <sys/stat.h>

int mknod(const char *path, mode_t mode, rdev_t dev_identifier);
```

_XOPEN_SOURCE_EXTENDED 1

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/stat.h>

int mknod(const char *path, mode_t mode, dev_t dev_identifier);
```

General description

Creates a new directory, regular file, character special file, or FIFO special file (named pipe), with the pathname specified in the *path* argument.

The first byte of the *mode* argument determines the file type of the file:

S_IFCHR

Character special file

S_IFFIFO

FIFO special file

S_IFREG

Regular file

S_IFDIR

Directory file

The file permission bits of the new file are initialized with the remaining bits in *mode* and changed by the file creation mask of the process. For more information on these symbols, refer to [“chmod\(\) — Change the mode of a file or directory”](#) on page 274.

dev_identifier applies only to a character special file. It is ignored for the other file types. *dev_identifier* contains a value representing the device major and device minor numbers. The major number is contained in the high-order 16 bits; it identifies a device driver supporting a class of devices, such as interactive terminals. The minor number is contained in the low-order 16 bits of *dev_identifier*; it identifies a specific device within the class referred to by the device major number. With z/OS UNIX services, the device major numbers are:

- 1** Manager pseudoterminal
- 2** Subsidiary pseudoterminal
- 3** /dev/tty
- 4** /dev/null
- 5** /dev/fdn
- 6** Sockets
- 7** OCSRTY
- 8** OCSADMIN

9

"/dev/console"

Device major numbers 1,2 and 7: The device minor numbers range between 0 and one less than the maximum number of pseudoterminal pairs defined by the installation.

Device major numbers 3,4,6,8 and 9: The device minor number is ignored.

Device major number 5: The device minor number value represents the file descriptor to be referred to. For example, device minor 0 refers to file descriptor 0.

When it completes successfully, `mknod()` marks for update the following fields of the file: `st_atime`, `st_ctime`, and `st_mtime`. It also marks for update the `st_ctime` and `st_mtime` fields of the directory that contains the new file.

Returned value

If successful, `mknod()` returns 0.

If unsuccessful, `mknod()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Search permission is denied on a component of *path*, or write permission is denied on the parent directory of the file to be created.

EEXIST

A file by that name already exists.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLLOOP` (defined in the `limits.h` header file) symbolic links are detected in the resolution of *path*.

EMLINK

The link count of the parent directory has already reached the maximum defined for the system.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters, or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the pathname string substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined through `pathconf()`.

ENOENT

A component of *path* was not found, or no *path* was specified.

ENOSPC

The file system does not have enough space to contain a new directory, or the parent directory cannot be extended.

ENOTDIR

A component of *path* is not a directory

EPERM

Added for XPG4.2: The invoking process does not have appropriate privileges and the file type is not FIFO-special.

EROFS

The file named in *path* cannot be created, because it would reside on a read-only file system.

Example

CELEBM18

```
/* CELEBM18 */
#include <sys/stat.h>
#include <unistd.h>
#include <stdio.h>
```

```

#define main 0x00010000

main() {
    char fn[]="char  ec";

    if (mknod(fn, S_IFCHR|S_IRUSR|S_IWUSR, main|0x0001) != 0)
        perror("mknod() error");
    else if (unlink(fn) != 0)
        perror("unlink() error");
}

```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“mkfifo\(\) — Make a FIFO special file” on page 1075](#)
- [“open\(\) — Open a file” on page 1157](#)

mknodat() — Make a directory or file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```

#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>
#include <sys/stat.h>

int mknodat(int dirfd, const char *pathname, mode_t mode, dev_t dev);

```

General description

`mknodat()` is equivalent to `mknod()` except for the following cases:

- If *pathname* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by `mknod()` for a relative path name).
- If *pathname* is relative and *dirfd* is the special value `AT_FDCWD`, *pathname* is interpreted relative to the current working directory of the calling process (like `mknod()`).
- If *pathname* is absolute, *dirfd* is ignored.

Returned value

If successful, `mknodat()` returns 0.

If unsuccessful, `mknodat()` returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EACCES

The process does not have search permission on some component of *pathname* or does not have write permission on the parent directory of the file or directory to be created.

EBADF

pathname is relative but *dirfd* is not `AT_FDCWD` or a valid file descriptor.

EEXIST

Either the named file refers to a symbolic link, or there is a file or directory with the given *pathname*.

EFBIG

A request to create a directory is prohibited because the file size limit for the process is set to 0.

EINVAL

The file type that is specified in the *mode* parameter is not valid.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLINK` (defined in the `limits.h` header file) symbolic links are detected in the resolution of *pathname*.

EMLINK

The link count of the parent directory reaches the maximum number that is defined for the system.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the *pathname* string that is substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined by using `pathconf()`.

ENOENT

The named file does not exist, or *pathname* is a relative path name and *dirfd* refers to a directory that is deleted.

ENOSPC

The file system does not have enough space to contain a new directory or directory, or the parent directory cannot be extended.

ENOTDIR

A component of the path prefix is not a directory, or *pathname* is relative and *dirfd* is a file descriptor that refers to a file other than a directory.

EPERM

The invoking process does not have appropriate privileges and the file type is not FIFO-special. The operation is not permitted. The requested operation requires a superuser authority.

EROFS

The parent directory of the file or directory to be created is on a read-only file system.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“mknod\(\) — Make a directory or file” on page 1078](#)

mkstemp() — Make a unique filename

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

int mkstemp(char *template);
```

General description

The `mkstemp()` function replaces the contents of the string pointed to by *template* with a unique file name, and returns a file descriptor for the file open for reading and writing. The function thus prevents any possible race condition between testing whether the file exists and opening it for use. The string in *template* should look like a file name with six trailing 'X's; `mkstemp()` replaces each 'X' with a character from the portable file name character set. The characters are chosen such that the resulting name does not duplicate the name of an existing file. This function is supported only in a POSIX program.

Returned value

If successful, `mkstemp()` returns an open file descriptor.

If no suitable file could be created, `mkstemp()` returns -1.

There are no `errno` values defined.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“mktemp\(\) — Make a unique file name” on page 1083](#)

mktemp() — Make a unique file name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

char *mktemp(char *template);
```

General description

The `mktemp()` function replaces the contents of the string pointed by *template* by a unique file name and returns *template*. The application must initialize *template* to be a file name with six trailing 'X's; `mktemp()` replaces each 'X' with a single-byte character from the portable file name character set.

This function is supported only in a POSIX program.

Note: The `mktemp()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `mkstemp()` function is preferred for portability and greater reliability.

Returned value

If successful, mktime() returns a pointer to *template*.
If a unique name cannot be created, mktime() sets *template* to a NULL string.
There are no errno values defined.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“mkstemp\(\) — Make a unique filename” on page 1082](#)

mktime(), mktime64() — Convert local time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <time.h>

time_t mktime(struct tm *tm_ptr);

#define _LARGE_TIME_API
#include <time.h>

time64_t mktime64 (struct tm *tm_ptr);
```

Compile requirement: Use of mktime64() function requires the long long data type. For more information on how to make long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The mktime() function converts broken-down time, expressed as a local time, in the tm structure (described in [Table 16 on page 76](#)) pointed to by *tm_ptr*, to calendar time. Calendar time is the number of seconds since epoch, which was at 00:00:00 Coordinated Universal Time (UTC), January 1, 1970.

The values of the structure members passed to the mktime() function are not restricted to the ranges described in [“time.h — Time and date” on page 75](#). For values that are outside the specified range, the mktime() function will use date arithmetic to adjust the values to produce a valid date and time (see [“Example” on page 1086](#)). The values of *tm_wday* and *tm_yday* are ignored and are assigned their correct values on return.

On the successful completion of the function, all the members of the structure pointed to by *time* are set to represent the specified time since the Epoch with their values forced into the ranges described in [“time.h — Time and date” on page 75](#). The value of *tm_wday* is set after the values of *tm_mon* and *tm_year* are determined. The output value of *tm_isdst* is determined by the mktime() function, independent of the value presented as input to the mktime() function.

If an application uses the `localtime()` function to determine local time, the `localtime()` function will determine if daylight savings applies (assuming DST information is available) and will correctly set the `tm_isdst` flag. If the application wants to determine seconds from Epoch corresponding to a `tm` structure returned by the `localtime()` function, it should not modify the `tm_isdst` flag set by the `localtime()` function.

If an application sets `tm_isdst` to 0 before calling the `mktime()` function, it is asserting that daylight savings does not apply to the input values of the `tm` structure, regardless of the system DST start and end dates. Likewise, if the application has set a value for `tm_isdst` to be greater than 0, it is asserting that the time represented by the `tm` structure has been shifted for daylight savings. Therefore, the `mktime()` function unshifts the time in determining seconds since Epoch.

Setting `tm_isdst` to -1 indicates the `mktime()` function will determine whether daylight savings time applies. If yes, the `mktime()` function returns `tm_isdst` greater than 0. If not, it returns `tm_isdst` of 0 unless DST information is not available on the system, in which case `tm_isdst` of -1 is returned.

Your time zone might not be using DST, perhaps because the `TZ` environment variable does not specify a daylight savings time name or perhaps because `DSTNAME` is unspecified in the current `LC_TOD` locale category. In such a case, if you code `tm_isdst=1` and call the `mktime()` function, `(time_t)-1` is returned to indicate an error.

The `mktime64()` function behaves exactly like the `mktime()` function except it will support a structured date beyond 00:00:00 UTC January 1, 2038 with a limit of 23:59:59 UTC on December 31, 9999.

Returned value

If successful, the `mktime()` function returns a `time_t` representing seconds since the Epoch. The number of seconds corresponds to the broken-down time, expressed as local time, based on the user-supplied `tm` structure pointed to by `tm_ptr`.

If the `mktime()` function cannot convert the broken-down time to a calendar time, it returns `(time_t)-1` to indicate an error, such as time before January 1, 1970 (UTC).

Error Code

Description

EOVERFLOW

The result cannot be represented.

Usage notes

1. The `ctime()`, `localtime()`, and `mktime()` functions now return Coordinated Universal Time (UTC) unless customized locale information is made available, which includes setting the `timezone_name` variable.
2. Applications working with local time may define time zone information by using the `TZ` (POSIX) or `_TZ` (non-POSIX) environment variable or by customizing the `LC_TOD` category of the locale in use.
3. When neither `TZ` nor `_TZ` is defined, the current locale is interrogated for time zone information. If neither `TZ` nor `_TZ` is defined and `LC_TOD` time zone information is not present in the current locale, a default value is applied to local time. POSIX programs simply default to Coordinated Universal Time (UTC), while non-POSIX programs establish an offset from UTC based on the setting of the system clock. For more information about customizing a time zone to work with local time, see “Customizing a time zone” in [z/OS XL C/C++ Programming Guide](#).
4. The `mktime()` functions fails when a result overflows the `time_t` object used to return the number of seconds elapsed from the time in `tm_ptr` back to the start of the standard epoch. In 31-bit, the last year that `mktime()` supports is 2037. In 64-bit, the `time_t` grows from 4 bytes to 8 bytes in length, so that `mktime()` can accommodate dates further into the future. The upper bound in 64-bit is set to the year 9999.

Example

CELEBM19

```
/* CELEBM19

   This example prints the day of the week that is 40 days and
   16 hours from the current date.

*/
#include <stdio.h>
#include <time.h>

char *wday[] = { "Sunday", "Monday", "Tuesday", "Wednesday",
                 "Thursday", "Friday", "Saturday" };

int main(void)
{
    time_t t1, t3;
    struct tm *t2;

    t1 = time(NULL);
    t2 = localtime(&t1);
    t2 -> tm_mday += 40;
    t2 -> tm_hour += 16;
    t3 = mktime(t2);

    printf("40 days and 16 hours from now, it will be a %s \n",
           wday[t2 -> tm_wday]);
}
```

Output

40 days and 16 hours from now, it will be a Sunday

Related information

- [“time.h – Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) – Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) – Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) – Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) – Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) – Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) – Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) – Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) – Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) – Convert time value to broken-down local time” on page 991](#)
- [“strftime\(\) – Convert to formatted time” on page 1735](#)
- [“time\(\),time64\(\) – Determine current UTC time” on page 1865](#)
- [“tzset\(\) – Set the time zone” on page 1918](#)

__mlockall() – Lock the address space of a process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SOURCE_EXTENDED 2
#include <sys/mman.h>

int __mlockall(int flags);
```

General description

The function `__mlockall()` causes all of the pages mapped by the address space of a process to be memory resident until unlocked or until the process exits or execs another process image. The *flags* argument determines whether the pages are to be locked or unlocked.

Flags

Meaning

`_BPX_NONSWAP`

Lock the current pages mapped for this address space.

`_BPX_SWAP`

Unlock the current pages previously locked.

Returned value

If successful, `__mlockall()` returns 0.

If unsuccessful, `__mlockall()` returns -1 and no change is made to the memory state of the address space.

Note: This function will return a `EINVAL` with an `errno2()` of 09300be if the kernel is not available.

Related information

- [“sys/mman.h — Memory management” on page 69](#)

mmap() — Map pages of memory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 z/OS UNIX | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/mman.h>

void *mmap(void *addr, size_t len, int prot, int flags, int fildes, off_t off);
```

General description

The `mmap()` function establishes a mapping between an address space of a process (for *len* bytes) and a file that is associated with the file descriptor *fildes* at offset *off* for *len* bytes. The format of the call is as follows:

```
pa=mmap(addr, len, prot, flags, fildes, off);
```

The value of *pa* is an unspecified function of the argument *addr* and values of *flags*, further described below. A successful `mmap()` call returns *pa* as its results. The address ranges covered by [*pa*, *pa + len*] and [*off*, *off + len*] must be legitimate for the possible (not necessarily current) address space of a process and the file, respectively.

If the size of the mapped file changes after the call to `mmap()`, the effect of references to portions of the mapped region that correspond to added or removed portions of the file is unspecified.

The *prot* argument determines whether read, write, execute, or some combinations of accesses are permitted to the pages being mapped. The protection options are defined in `<sys/mman.h>`:

PROT_READ

Page can be read.

PROT_WRITE

Page can be written.

PROT_EXEC

Page can be executed.

PROT_NONE

Page cannot be accessed.

Implementations need not enforce all combinations of access permissions. However, write are permitted only when `PROT_WRITE` has been set.

The *flags* argument provides other information about the handling of the mapped pages. The options are defined in `<sys/mman.h>`:

MAP_SHARED

Share changes.

MAP_PRIVATE

Changes are private.

MAP_FIXED

Interpret *addr* exactly.

__MAP_MEGA

Map in megabyte increments.

__MAP_64

Map storage above the 2-gigabyte addressing range.

MAP_ANONYMOUS

The mapping is not backed by any file and the memory contents are initialized to zero. When `MAP_ANONYMOUS` is set, the *fil*des argument must be -1 and the *off* argument must be zero. `MAP_ANONYMOUS` can be used with any of the other `Map_type` options.

MAP_ANON

Synonym for `MAP_ANONYMOUS`.

The `MAP_PRIVATE` and `MAP_SHARED` flags control the visibility of write references to the memory region. Exactly one of these flags must be specified. The mapping type is retained across a *fork*.

If `MAP_SHARED` is set in *flags*, write references to the memory region by the calling process might change the file and are visible in all `MAP_SHARED` mappings of the same portion of the file by any process.

If `MAP_PRIVATE` is set in *flags*, write references to the memory region by the calling process do not change the file and are not visible to any process in other mappings of the same portion of the file.

All changes to the mapped data made by processes that have mapped the memory region using `MAP_SHARED` are shared and are visible to all other processes that have mapped the same file-offset range.

When `MAP_FIXED` is set in the *flags* argument, the implementation is informed that the value of *pa* must be *addr*, exactly. If `MAP_FIXED` is set, `mmap()` might return `(void*) -1` and set `errno` to `EINVAL`. If a `MAP_FIXED` request is successful, the mapping that is established that is by `mmap()` replaces any previous mappings for the process's pages in the range [*pa*, *pa + len*].

When `MAP_FIXED` is not set, the implementation uses *addr* in an unspecified manner to arrive to *pa*. The *pa* so chosen will be an area of the address space, which the implementation deems suitable for a mapping of *len* bytes to the file. All implementation interprets an *addr* value of 0 as granting the implementation complete freedom in selecting *pa*, subject to constraints described below. A nonzero value of *addr* is taken to be a suggestion of a process address near which the mapping should be placed. When the implementation selects a value for *pa*, it never places a mapping at address 0, nor does it replace any extant mapping, nor map into dynamic memory allocation areas.

The *off* argument is constrained to be aligned and sized according to the value returned by `sysconf()` when passed `_SC_PAGESIZE` or `_SC_PAGE_SIZE`. When `MAP_FIXED` is specified, the argument *addr* must also meet these constraints. The implementation performs mapping operations over whole pages. Thus, while the argument *len* need not meet a size or alignment constraint, the implementation includes, in any mapping operation, any partial page specified by the range [*pa*, *pa* + *len*].

The implementation always zero-fills any partial page at the end of a memory region. Further, the implementation never writes out any modified portions of the last page of a file that are beyond the end of the mapped portion of the file. If the mapping established by `mmap()` extends into pages beyond the page containing the last byte of the file, an application references to any of the pages in the mapping that are beyond the last page results in the delivery of a `SIGBUS` or `SIGSEGV` signal.

The `mmap()` function adds an extra reference to the file associated with the file descriptor *fd* is not removed by a subsequent `close()` on that file descriptor. This reference is removed when there are not more mappings to the file.

The `st_atime` field of the mapped file might be marked for update at any time between the `mmap()` call and the corresponding `munmap()` call. The initial read or write reference to a mapped region causes the file's `st_atime` field to be marked for update if it has not already been marked for update.

The `st_ctime` and `st_mtime` fields of a file that is mapped with `MAP_SHARED` and `PROT_WRITE`, will be marked for update at *st*ime point in the interval between a write reference to the mapped region and the next call to `msync()` with `MS_ASYNC` or `MS_SYNC` for that portion of the file by any process. If there is no such call, these fields might be marked for update at any time after a write reference if the underlying file is modified as a result.

If a memory-mapped region is not unmapped before the process terminates, process termination will not automatically write out to disk any modified data in the mapped region. Modified private data in a `MAP_PRIVATE` region will be discarded. If the map region is `MAP_SHARED`, the modified data continue to reside in the cache (if the same file-offset range is being shared) and might ultimately be written out to disk by another process that uses the `msync()` service. However, if no other processes map the same file-offset range as `MAP_SHARED`, the modified data is discarded.

There might be implementation-dependent limits on the number of memory regions that can be mapped (per process or per system). If such a limit is imposed, whether the number of memory regions that can be mapped by a process is decreased by the use of `shmat()` is implementation-dependent.

Specification of the `__MAP_MEGA` option results in the system allocating storage to map the file in megabyte increments. This option should only be used for large files. Any file over half a megabyte in size will likely achieve better performance by using this option. When using this option, `mmaps` and `munmaps` are in megabyte ranges on megabyte boundaries.

When `__MAP_MEGA` is specified, all changes to the mapped data are shared. Modifications to the mapped data are visible to all other processes that map the same file-offset range. That is, `__MAP_MEGA` behaves much like `MAP_SHARED`. `__MAP_MEGA` is mutually exclusive with `MAP_PRIVATE` and `MAP_SHARED`. Specification of `__MAP_MEGA` with either `MAP_PRIVATE` or `MAP_SHARED` will result in the request failing with `errno` set to `EINVAL`.

The `__MAP_MEGA` option might be specified with `MAP_FIXED`.

Map_address parameter: If the map address is not zero and `__MAP_MEGA` has been specified, then for non `MAP_FIXED` requests, the kernel attempts to create the mapping at the `map_address`, truncated to the nearest megabyte boundary. If unsuccessful, it proceeds as if a `map_address` of zero were specified. For `MAP_FIXED` requests, the value of `map_address` must be multiples of the segment size (megabyte multiples). If not, the `mmap` request fails with `errno` set to `EINVAL`.

Map_length parameter: When `__MAP_MEGA` is specified, mapping operations are performed over whole segments (megabyte chunks). If the length is not a multiple of the segment size, the entire trailing portion of the last segment will also be mapped into the user storage.

File_descriptor: The file descriptor identifies the file being mapped. If an attempt is made to map a file that is already mapped but was mapped with a different specification of `__MAP_MEGA`, then the current request fails with `errno` set to `EINVAL-MMapTypeMismatch`. That is, at any point in time a file might be mapped with the `__MAP_MEGA` option or without the `__MAP_MEGA` option but not both ways at the same time.

For a `__MAP_MEGA` mapping, if this is the first map to the file represented by the specified file descriptor then whether the file was opened for read or for write will determine what protection options might be specified for the file by this `mmap` and any future `mmaps` and `mprotects`, by this or any other process mapping to the same file. If the file was opened for read but not write, then only `PROT_READ`, `PROT_EXEC` or `PROT_NONE` are allowed. If the file was opened for write, then any of the protection options will be allowed. Only regular files might be mapped. Note also that remote files accessed through NFS or DFS might not be mapped.

Protect_options: The specification that is made for `Protect_options` has a global effect when the file is mapped with the `__MAP_MEGA` option. The `Protect_option` specified immediately effects all processes currently mapped to the same file-offset range.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

64-bit mapping support: You can enable the 64-bit mapping support in any of the following ways:

- Set the *flags* argument to `__MAP_64`.
- Set the *addr* argument to the value above 64G.
- Set the *len* argument to the value greater than 2G.

If the first mapping of a file uses 64-bit mapping support, then all subsequent mappings of the file must also use 64-bit mapping support until there are no more mappings onto that file. If an attempt is made to map the file without using 64-bit mapping support, an `EINVAL` error is returned. This rule also applies to the 31-bit mapping support.

Usage notes

- The `mmap()` function does not support shared memory objects or typed memory objects.
- When `__MAP_64` is specified, the *addr* argument must be either 0 or a value greater than 64G; otherwise, an `EINVAL` error is returned.
- When `__MAP_64` is specified, it might be combined with `MAP_FIXED` or `MAP_SHARED` or both.
- When both `__MAP_64` and `MAP_FIXED` are specified, the first fullword of the *addr* argument must be nonzero; otherwise, an `EINVAL` error is returned.
- For non-`MAP_FIXED` requests, if *addr* specifies an address that is above 64G, the system attempts to create a mapping at the address that is specified by *addr* and the address must be on a segment boundary. If it is unsuccessful, it proceeds as if an *addr* value of zero were specified, but will attempt to create a mapping above 64G.
- When `MAP_ANONYMOUS` or `MAP_ANON` is specified, the *filides* parameter must be -1 and the *off* parameter must be 0.

Returned value

If successful, `mmap()` returns the address at which the mapping was placed.

If unsuccessful, *mmap()* returns MAP_FAILED and sets *errno* to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|-------------------|---|
| EACCESS | The <i>fildev</i> argument is not open for read, regardless of the protection that is specified, or <i>fildev</i> is not open for write and PROT_WRITE was specified for a MAP_SHARED type mapping. |
| EBADF | The <i>fildev</i> argument is not a valid open file descriptor. |
| EINVAL | The <i>addr</i> argument (if MAP_FIXED was specified) or <i>off</i> is not a multiple of the page size as returned by <i>sysconf()</i> , or are considered invalid by the implementation. The value of <i>flags</i> is invalid (neither MAP_PRIVATE nor MAP_SHARED is set). When MAP_ANONYMOUS is specified, the <i>fildev</i> parameter must be -1 and the <i>off</i> parameter must be 0. |
| EMFILE | The number of mapped regions would exceed an implementation-dependent limit (per process or per system). |
| ENODEV | The <i>fildev</i> argument refers to a file whose type is not supported by <i>mmap()</i> . |
| ENOMEM | MAP_FIXED was specified, and the range [<i>addr</i> , <i>addr</i> + range [<i>addr</i> , <i>addr</i> + <i>len</i>], rounding <i>len</i>] exceeds that allowed for the address space for a process; or if MAP_FIXED was not specified and there is insufficient room in the address space to effect the mapping. |
| ENXIO | Address in the range [<i>off</i> , <i>off</i> + <i>len</i>] are invalid for <i>fildev</i> |
| E_OVERFLOW | The file is a regular file and the value of <i>off</i> plus <i>len</i> exceeds the offset maximum that is established in the open file. Note: Starting with z/OS V1.9, environment variable _EDC_E_OVERFLOW can be used to control behavior of <i>mmap()</i> about detecting an E_OVERFLOW condition for z/OS UNIX files. By default, <i>mmap()</i> will not set E_OVERFLOW when the offset maximum is exceeded associated with <i>fildev</i> . When _EDC_E_OVERFLOW is set to YES, <i>mmap()</i> checks for an overflow condition. |

Related information

- [“sys/mman.h — Memory management” on page 69](#)
- [“exec functions” on page 442](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“lockf\(\) — Record locking on files” on page 993](#)
- [“mprotect\(\) — Set protection of memory mapping” on page 1106](#)
- [“msync\(\) — Synchronize memory with physical storage” on page 1123](#)
- [“munmap\(\) — Unmap pages of memory” on page 1127](#)
- [“shmat\(\) — Shared memory attach operation” on page 1593](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)

modf(), modff(), modfl() – Extract fractional and integral parts of floating-point value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double modf(double x, double *intptr);
float modf(float x, int *intptr);          /* C++ only */
long double modf(long double x, int *intptr); /* C++ only */
float modff(float x, int *intptr);
long double modfl(long double x, int *intptr);
```

General description

Breaks down the floating-point value *x* into fractional and integral parts. The integral part is stored as double, in the object pointed to by *intptr*. Both the fractional and integral parts are given the same sign as *x*.

Restriction: The modff() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

Returns the signed fractional portion of *x*.

Example

CELEBM20

```
/* CELEBM20

   This example breaks the floating-point number -14.876 into
   its fractional and integral components.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y, d;

    x = -14.876;
    y = modf(x, &d);

    printf("x = %lf\n", x);
    printf("Integral part = %lf\n", d);
    printf("Fractional part = %lf\n", y);
}
```

Output

```
x = -14.876000
Integral part = -14.000000
Fractional part = -0.876000
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“fmod\(\), fmodf\(\), fmodl\(\) — Calculate floating-point remainder” on page 565](#)
- [“frexp\(\), frexpf\(\), frexpl\(\) — Extract mantissa and exponent of the floating-point value” on page 624](#)
- [“ldexp\(\), ldexpf\(\), ldexpl\(\) — Multiply by a power of two” on page 940](#)

modfd32(), modfd64(), modfd128() — Extract fractional and integral parts of decimal floating-point value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 modfd32(_Decimal32 x, _Decimal32 *p);
_Decimal64 modfd64(_Decimal64 x, _Decimal64 *x);
_Decimal128 modfd128(_Decimal128 x, _Decimal128 *x);
_Decimal32 modf(_Decimal32 x, _Decimal32 *x); /* C++ only */
_Decimal64 modf(_Decimal64 x, _Decimal64 *x); /* C++ only */
_Decimal128 modf(_Decimal128 x, _Decimal128 *x); /* C++ only */
```

General description

Breaks down the decimal floating-point value *x* into fractional and integral parts. The integral part is stored in the object point to by *p*. Both the fractional and integral parts are given the same sign as *x*.

Note:

- To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
- These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The lround functions return the signed fractional portion of *x*.

If the rounded value is outside the range of the return type, the numeric result is unspecified. A range error may occur if the magnitude of *x* is too large.

Example

```
/* CELEBM24

This example illustrates the modfd128() function.

This example breaks the floating-point number -14.876 into
```

```
    its fractional and integral components.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x, y, d;

    x = -14.876DL;
    y = modfd128(x, &d);

    printf("Number          = %DDf\n", x);
    printf("Integral part   = %DDf\n", d);
    printf("Fractional part = %DDf\n", y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“frexpd32\(\), frexpd64\(\), frexpd128\(\) — Extract mantissa and exponent of the decimal floating-point value” on page 625](#)
- [“ldexpd32\(\), ldexpd64\(\), ldexpd128\(\) — Multiply by a power of ten” on page 941](#)
- [“modf\(\), modff\(\), modfl\(\) — Extract fractional and integral parts of floating-point value” on page 1092](#)

__moservices() - Memory object services

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------------|----------|--------------|
| AMODE 64 Language Environment | both | z/OS V1.10 |

Format

```
#include <stdlib.h>

int __moservices(int reqtype, size_t mopl len,
                 struct __mopl_s * mopl, void ** moorigin);
```

General description

The __moservices() function allows the caller to perform the following memory object services:

- Create a memory object that is associated with the current Language Environment enclave;
- Free a memory object that was created by using a previous __moservices() call;
- Specify a shared memory dump priority to be used when allocating shared memory.

Argument

Description

reqtype

The request type. Valid values are

__MO_GETSTOR

Use IARV64 REQUEST(GETSTOR) to create a memory object that is associated with the current Language Environment enclave.

__MO_DETACH

Use IARV64 REQUEST(DETACH) to free a memory object that was created by using __moservices().

__MO_SHMDUMPPRIORITY

Set a shared memory dump priority to be associated with shared memory segments on subsequent shmget() calls.

mopllen

The length of the passed mopl structure. If a mopl is not passed, this length must be set to zero.

mopl

Points to a structure describing additional characteristics for the request.

For __MO_GETSTOR and __MO_SHMDUMPPRIORITY requests, this structure is required.

For __MO_DETACH requests, this structure is optional.

moorigin

On __MO_GETSTOR calls, moorigin contains the origin address of the memory object upon return.

On __MO_DETACH calls, moorigin contains the origin address of the memory object to be detached.

The __mopl_s structure is defined in stdlib.h and has the following format:

```
struct __mopl_s {
    unsigned long    __moplrequestsize;
    int             __mopldumppriority;
    unsigned int     __moplgetstorflags;
    long            __moplreserved;
    int             __mopl_iarv64_rc;
    int             __mopl_iarv64_rsn;
};
```

The entire __mopl_s structure must be set to binary zeros before use. The fields are used as follows:

| | |
|---------------------------|---|
| __mopldumppriority | For __MO_GETSTOR, the desired memory object dump priority (1-99). For __MO_SHMDUMPPRIORITY, the desired shared memory dump priority (1-99). |
| __moplrequestsize | For __MO_GETSTOR, the size of the memory object to be created. The size is in 1 MB units when 4 K or 1 MB page frames are requested. The size is in 2 GB units when 2 GB page frames are requested. |

| | |
|---------------------------|---|
| __moplgetstorflags | <p>For __MO_GETSTOR, flags identifying additional characteristics for the memory object to be created. The following flags are defined:</p> <ul style="list-style-type: none"> • __MOPL_PAGEFRAMESIZE1MEG - the memory object is backed by fixed 1 MB page frames. __moservices() returns -1 with errno EMVSERR if the current hardware does not have Large Page support or if large page frames are not available on the system. • __MOPL_PAGEFRAMESIZEMAX - the memory object must be backed by fixed 1 MB page frames. If the request cannot be backed by fixed 1 MB page frames due to unavailability of large page frames, then the request is backed by 4 K page frames. When 4 K page frames are used, the request is successful, but __mopl_iarv64_rc and __mopl_iarv64_rsn contain values to indicate that the memory object is not backed by fixed 1 MB page frames. • __MOPL_PAGEFRAMESIZE_PAGEABLE1MEG - the memory object must be preferentially backed by pageable 1 MB page frames. Pageable 1 MB page frames are backed at first reference. If pageable 1 MB page frames are not available at first reference, pageable 4 K page frames are used. • __MOPL_PAGEFRAMESIZE_2G - the memory object must be backed by 2 GB page frames. __moservices() returns -1 with errno EMVSERR if the current hardware does not have Large Page support or if large page frames are not available on the system. <p>Note: If none of the previous flags are set, the memory object is backed by 4 K page frames. Also, the previous flags are mutually exclusive.</p> <ul style="list-style-type: none"> • __MOPL_EXECUTABLE - the obtained memory object is executable. • __MOPL_NONEXECUTABLE - the obtained memory object is nonexecutable. <p>Note: If neither __MOPL_EXECUTABLE nor __MOPL_NONEXECUTABLE is set, the executable attribute of the memory object obeys the current system defaults. If both __MOPL_EXECUTABLE and __MOPL_NONEXECUTABLE are set, __moservices() returns -1 with errno EINVAL.</p> |
| __mopl_iarv64_rc | The return code from the call to IARV64 |
| __mopl_iarv64_rsn | The reason code from the call to IARV64 |

Constants are available, which identify the dump priorities of memory objects that are obtained by Language Environment:

| | |
|---------------------------------|--|
| __MO_DUMP_PRIORITY_STACK | Dump priority of memory objects to be used as Language Environment stacks. Value is 5. |
| __MO_DUMP_PRIORITY_HEAP | Dump priority of memory objects to be used as Language Environment heaps. Value is 15. |

For the dump priority of memory objects obtained by other programs (such as Java), refer to the corresponding documentation for those programs.

All memory objects that are obtained by __moservices() are unguarded and count toward the address space memlimit. For more information on memory objects and the IARV64 service, see *z/OS MVS Programming: Assembler Services Guide* and the *z/OS MVS Programming: Assembler Services Reference ABE-HSP*, *z/OS MVS Programming: Assembler Services Reference IAR-XCT*.

Returned value

If successful, __moservices() returns 0.

If unsuccessful, __moservices() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

An argument to this function contained an incorrect value. Use __errno2() to obtain more detailed information on the error.

EMVSERR

A z/OS environmental or internal error occurred. Use __errno2() to obtain more detailed information on the error.

If the underlying IARV64 call is unsuccessful, and the mopl argument is specified, then __mopl_iarv64_rc and __mopl_iarv64_rsn contain the return and reason codes that are returned by IARV64.

Example

```
/* CELEBM25

   This example illustrates the __moservices() function.

   This example sets a shared memory dump priority, then
   gets and detaches a memory object.

*/

#include <stdlib.h>
#include <stdio.h>
#include <errno.h>
#include <string.h>

int main(void) {
    __mopl_t mymopl;
    int mos_rv;
    void * mymoptr;

    memset(&mymopl, 0, sizeof(__mopl_t));

    /* Set a shared memory dump priority for subsequent shmget() */
    mymopl.__mopldumppriority = 8;

    mos_rv = __moservices(__MO_SHMDUMPPRIORITY, sizeof(mymopl),
                          &mymopl, &mymoptr);

    if (mos_rv != 0) {
        perror("moservices(SHMDUMPPRIORITY) call failed");
    }

    /* Obtain a 100MB memory object whose dump priority falls
     * between the dump priorities of the Language Environment
     * stacks and heaps.
     */
    mymopl.__mopldumppriority = __MO_DUMP_PRIORITY_STACK + 5;
    mymopl.__moplrequestsize = 100;

    mos_rv = __moservices(__MO_GETSTOR, sizeof(mymopl),
                          &mymopl, &mymoptr);

    if (mos_rv == 0) {
        printf("moservices(GETSTOR) successful, MO addr: %p\n",
              mymoptr);

        /* Free the 100MB memory object.
         */
        mos_rv = __moservices(__MO_DETACH, 0, NULL, &mymoptr);

        if (mos_rv != 0) {
            perror("moservices(DETACH) call failed");
        }
    }
    else {

```

```
        perror("moservices(GETSTOR) call failed");
    }

    return 0;
}
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)

mount() — Make a file system available

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

Format 1:

```
#define _OPEN_SYS

#include <sys/stat.h>

int mount(const char *path, char *filesystem, char *filesystype, mtm_t mtm,
          int parmlen, char *parm);
```

Format 2:

```
#define _OPEN_SYS
#define _XPLATFORM_SOURCE

#include <sys/mount.h>
int mount(const char *source, const char *target, const char *filesystemtype, unsigned long
          mountflags, const void *data);
```

General description

mount() supports different input parameters and functions when it is defined under different feature test macros.

Format 1: when only _OPEN_SYS is defined

Adds a file system to z/OS UNIX file system. The same file system cannot be mounted at more than one place in the hierarchical file system.

In order to mount a file system, the caller must be an authorized program, or must be running for a user with appropriate privileges.

path

The mount point directory that the file system is to be mounted to.

filesystem

The name of the file system to be mounted; it must be unique within the system. For a HFS data set, this is a 1-to-44-character MVS data set name specified as all uppercase letters.

This name is terminated with NULL characters.

filesystype

The name for the file system that will perform the mount. This 8-character name must match the TYPE operand on a FILESYSTYPE statement in the BPXPRMxx parmlib member for the file system.

mtm

A flag field that specifies the mount mode and additional mount options:

MTM_RDONLY

Mount the file system as a read-only file system.

MTM_RDWR

Mount the file system as a read/write file system.

MTM_NOSUID

The SETUID and SETGID mode flags will be ignored for programs that reside in this file system.

MTM_SYNCHONLY

The mount must be completed synchronously or fail if it cannot.

parmlen

Length of the *parm* argument. The maximum length is 500 characters. For a HFS data set, this is not specified.

parm

A parameter passed to the physical file system that performs the mount. This parameter may not be required. The form and content of the *parm* are determined by the physical file system. A HFS data set does *not* require a *parm*.

Format 2: when both `_OPEN_SYS` and `_XPLATFORM_SOURCE` are defined

`mount()` attaches the file system that are specified by *source* (which is often a name that refers to a file system, but can also be the path name of a directory or file, or a dummy string) to the location (a directory or file) that is specified by the path name in *target*.

To mount a file system, the caller must be an authorized program, or must run for a user with appropriate privileges.

filesystemtype specifies the name for the file system that performs the mount. This 8-character name must match the TYPE operand on a FILESYSTYPE statement in the BPXPRMxx parmlib member for the file system.

data specifies a parameter that is passed to the file system that performs the mount. This parameter might not be required. The form and content of the data are determined by the file system.

A call to `mount()` performs one of a number of general types of operation, depending on the bits specified in *mountflags*. The choice of which operation to perform is determined by testing the bits set in *mountflags*, with the tests being conducted in the following order:

1. Remount an existing mount: *mountflags* includes MS_REMOUNT.
2. Create a bind mount: *mountflags* includes MS_BIND.
3. Change the propagation type of an existing mount: *mountflags* includes one of MS_PRIVATE or MS_UNBINDABLE.
4. Move an existing mount to a new location: *mountflags* includes MS_MOVE.
5. Create a new mount: *mountflags* includes none of the previous flags.

The following flags can be specified in *mountflags* to modify the behavior of `mount()`:

MS_REC

Used in conjunction with MS_BIND to create a recursive bind mount, and in conjunction with the propagation type flags to recursively change the propagation type of all of the mounts in a subtree.

MS_RDONLY

Mount the file system as a read-only file system.

MS_NOSUID

The SETUID and SETGID mode flags is ignored for programs that reside in this file system.

Remounting an existing mount

An existing mount might be remounted by specifying MS_REMOUNT in *mountflags*. This allows you to change the *mountflags* of an existing mount without having to unmount and remount the filesystem. *target* must be the same value that is specified in the initial `mount()` call.

The *source*, *filesystemtype*, and *data* arguments are ignored.

The *mountflags* argument must match the values that are used in the original `mount()` call, except for those parameters that are deliberately changed. The following *mountflags* can be changed: `MS_NOSUID` and `MS_RDONLY`.

The `MS_REMOUNT` flag can be used with `MS_BIND` to modify only the per-mount-point flags. This is useful for setting or clearing the "read-only" flag on a mount without changing the underlying file system. Specifying *mountflags* as `MS_REMOUNT | MS_BIND | MS_RDONLY` makes access through this mount-point read-only, without affecting other mounts.

Creating a bind mount

If *mountflags* includes `MS_BIND`, perform a bind mount. A bind mount makes a file or a directory subtree visible at another point within the single directory hierarchy.

The *filesystemtype* and *data* arguments are ignored.

The remaining bits (other than `MS_REC`, described below) in the *mountflags* argument are also ignored. (The bind mount has the same mount options as the underlying mount.) However, see the previous discussion of remounting, for a method of making an existing bind mount read-only.

By default, when a directory is bind mounted, only that directory is mounted; if there are any submounts under the directory tree, they are not bind mounted. If the `MS_REC` flag is also specified, then a recursive bind mount operation is performed: all submounts under the source subtree (other than unbindable mounts) are also bind mounted at the corresponding location in the target subtree.

Changing the propagation type of an existing mount

If *mountflags* includes one of `MS_PRIVATE` or `MS_UNBINDABLE`, the propagation type of an existing mount is changed. If more than one of these flags is specified, an error results.

The only other flags that can be specified while changing the propagation type is `MS_REC`.

The *source*, *filesystemtype*, and *data* arguments are ignored.

The meanings of the propagation type flags are as follows:

MS_PRIVATE

Make this mount private. Mount and unmount events do not propagate into or out of this mount.

MS_UNBINDABLE

Make this mount unbindable. This is like a private mount, and in addition this mount cannot be bind mounted. When a recursive bind mount (`mount()` with the `MS_BIND` and `MS_REC` flags) is performed on a directory subtree, any unbindable mounts within the subtree are automatically pruned (i.e., not replicated) when replicating that subtree to produce the target subtree.

By default, changing the propagation type affects only the target mount. If the `MS_REC` flag is also specified in *mountflags*, the propagation type of all mounts under target is also changed.

Moving a mount

mountflags contains the flag `MS_MOVE`, move a subtree: *source* specifies an existing mount and *target* specifies the new location to which that mount is to be relocated. The move is atomic: at no point is the subtree unmounted.

The remaining bits in the *mountflags* argument are ignored, as are the *filesystemtype* and *data* arguments.

Creating a new mount

If none of `MS_REMOUNT`, `MS_BIND`, `MS_MOVE`, `MS_PRIVATE` or `MS_UNBINDABLE` is specified in *mountflags*, `mount()` performs its default action: creating a new mount. *source* specifies the source for the new mount, and *target* specifies the directory at which to create the mount point.

The *filesystemtype* and *data* arguments are employed, and further bits might be specified in *mountflags* to modify the behavior of the call.

Returned value

If successful, `mount()` returns 0.

If the `mount()` is proceeding asynchronously, it returns 1.

If unsuccessful, `mount()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBUSY

The specified file system is unavailable.

EINVAL

A parameter was incorrectly specified.

- When only `_OPEN_SYS` is defined: verify *filesystemtype* and *mtm*.
- When both `_OPEN_SYS` and `_XPLATFORM_SOURCE` are defined: verify *filesystemtype* and *mountflags*. Another possible reason is that the mount point is the root of a file system or the file system is mounted.

EIO

An I/O error occurred.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLLOOP` (defined in the `limits.h` header file) symbolic links are detected in the resolution of the path name.

ENAMETOOLONG

When both `_OPEN_SYS` and `_XPLATFORM_SOURCE` are defined: a path name was longer than `PATH_MAX`, or some component of path name is longer than `NAME_MAX` characters.

ENOENT

- When only `_OPEN_SYS` is defined: the mount point does not exist.
- When both `_OPEN_SYS` and `_XPLATFORM_SOURCE` are defined: the specified path name cannot be found.

ENOMEM

There is not enough storage available to save the information that is required for this file system.

ENOTDIR

- When only `_OPEN_SYS` is defined: the mount point is not a directory.
- When both `_OPEN_SYS` and `_XPLATFORM_SOURCE` are defined: the target or a prefix of source is not a directory.

EPERM

Superuser authority is required to issue a mount.

Example

CELEBM21

```
/* CELEBM21

   This example adds a file system to the hierarchical
   file system.

*/
#define _OPEN_SYS
#include <sys/stat.h>
#include <stdio.h>
#include <unistd.h>

main() {
    char mount_point[]="/new_fs";
    char HFS[]="POSIX.NEW.HFS";
    char filesystem[9]="HFS    ";

    setvbuf(stdout, NULL, _IOLBF, 0);
    puts("before mount()");
    system("df -Pk");
    if (mount(mount_point, HFS, filesystem, MTM_RDWR, 0, NULL) != 0)
```

__mount

```
    perror("mount() error");
else {
    puts("After mount()");
    system("df -Pk");
    if (umount(HFS, MTM_UMOUNT) != 0)
        perror("umount() error");
}
}
```

Output

```
before mount()
Filesystem 1024-blocks      Used Available Capacity  Mounted on
POSIX.ROOT.FS  9600      8660       940       90%      /

After mount()
Filesystem 1024-blocks      Used Available Capacity  Mounted on
POSIX.NEW.HFS    200        20       180       10%    /new_fs
POSIX.ROOT.FS  9600      8660       940       90%      /
```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“sys/mount.h — File system mount and unmount” on page 69](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“umount\(\) — Remove a virtual file system” on page 1931](#)
- [“umount2\(\) — Unmount file system” on page 1934](#)
- [“w_getmntent\(\) — Get information on mounted file systems” on page 2044](#)
- [“w_statfs\(\) — Get the file system status” on page 2079](#)

__mount() — Make a file system available

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R9 |

Format

```
#define _OPEN_SYS
#include <sys/stat.h>
#include <sys/mntent.h>

int __mount(struct mnt2 *mnte, char *sysname);
```

General description

Adds a file system to the hierarchical file system. The same file system cannot be mounted at more than one place in the hierarchical file system.

In order to mount a file system, the caller must be an authorized program or must be running for a user with appropriate privileges.

Element descriptions

To mount or change the mount of a z/OS UNIX file in a sysplex, the application should set values in *mnte* as follows:

mnt2h_cbid

The mnte2 control block ID. Initialize it to "MNT2".

mnt2h_cblen

The mnt2 size. Initialize it to the size of struct mnt2.

mh2_cursor

Contains the internal cursor. This should be set to 0 initially, and must be left unchanged for subsequent calls.

mnt2h_devno

This element contains the device number, if needed.

mh_bodylen

The mnt2 size of w_mntent2. Must be initialized to the sizeof the w_mntent2 body.

rsvd

This field must be set to all zeros.

mnt2_fstype

The file system type.

mnt2_mode

File system mount mode. A flag field that specifies the mount mode and additional mount options:

mntentfsaunmount

If it is 1 after the file system is mounted, the file system will be unmounted when a system leaves the sysplex. If it is 0, then the setting of mntentfsnoautomove will be used. See mntentfsnoautomove below. This option can be changed after the file is mounted by changing this bit and setting the request bit, mntentnewauto, to 1 before calling __mount(). If changed to 0, also set mntentfsnoautomove to indicate automove or no move.

mntentfsclient

If it is 0, then the file system is a sysplex client. If it is 1, then the file system is not a sysplex client.

Note: Note that mntentfsclient is not an input parameter.

mntentfsnoautomove

If it is 0 after the file system is mounted, it can be moved automatically. If it is 1 after the file system is mounted, it will not be moved automatically. The mode can be reversed after the file is mounted (when mntentfsaunmount is 0) by changing this bit and setting the request bit, mnt2ntnewauto, to 1 before calling __mount().

Note: The setting of this bit only applies if mntentfsaunmount is 0.

mntentfsmodenosec

If it is 1, then the file system will not enforce security checks. If it is 0, then the file system will enforce security checks.

mntentfsmodeexport

If it is 0, then the file system has not been exported by DFS. If it is 1, then the file system has been exported by DFS.

mntentfsmoderonly

If it is 0, then the file system is mounted as read/write. If it is 1, then the file system is mounted as read-only.

mntentfsmodenosuid

If it is 1, then the SETUID and SETGID mode flags will be ignored for programs that reside in this file system. If it is 0 then the SETUID and SETGID mode flags will be enforced for programs that reside in this file system. This information is returned by the function but should not be changed.

mnt2_dev

Device # which stat will return for all files in this file system. Not set on input to __mount().

mnt2_parentdev

st_dev of parent file system. Not set on input to __mount().

mnt2_rootino

The ino of the mount point. Not set on input to __mount().

mnt2_status

status of the file system. The field is not an input parameter. It can be tested on output after a successful request.

mnt2_ddname

The ddname specified on mount. 1 to 8 characters are allowed.

mnt2_fstname

The name of the file system type specified by the FILESYS statement. The name for the file system that will perform the mount. This 8-character name must match the TYPE operand on a FILESYSTYPE statement in the BPXPRMxx parmlib member for the file system. 1 to 8 characters are allowed.

mnt2_fsname

The name of the file system to be mounted; it must be unique within the system. For a HFS data set, this is a 1-to-44-character MVS data set name specified as all uppercase letters. This name is terminated with NULL characters.

mnt2_pathlen

The length of mount point path.

mnt2_mountpoint

The name of the directory where the file system is mounted. 1 to 1023 characters are allowed. Also refers to the mount point directory where the file system will be mounted.

mnt2_parmoffset

Offset of mount parameter *mnt2_parmreturn* from *mnt2_fstype*. Also refers to a parameter passed to the physical file system that performs the mount. This parameter may not be required. The form and content of the parameter are determined by the physical file system. A HFS data set does not require a parameter.

mnt2_parmlen

The length of the mount parameter with size *mnt2_parmreturn*. Also refers to the length of the parameter argument. The maximum length is 1024 characters. A hierarchical file system data set does not require a parameter.

mnt2_sysname

The name of the target system. 1 to 8 characters are allowed. Changing the target system is always supplied as *sysname*. For all other calls, *sysname* must be supplied as NULL or the target name will be changed. When *sysname* is supplied, the *mnt2ntchange* flag must be set off for a mount function call, or the *mnt2ntchange* flag must be set on for a change mount function call. When you specify system on a mount it means mount this file on this system or when you specify system on a change mount it means move the file system from where it is currently mounted to this system.

mnt2_qsystem

The name of the quiesce system. 1 to 8 characters are allowed but the character(s) are padded with blanks and do not contain a NULL terminator. This field is an output only field from *getmntent()*.

mnt2_fromsys

The name of the system from which the file system has moved.

mnt2_flags

The field containing the request flags. A flag field that specifies the change for existing mounted file system:

mnt2ntnewauto

This flag instigates a change of mode which will effect the automove state depending on the value that is set for *mnt2ntfsnoautomove*. See the explanation under *mnt2ntfsnoautomove*.

mnt2ntchange

The request in this *w_mntent* is a change to existing status or mode. This flag must be set on for all change mount requests. The *w_mntent* structure needs to modify either the *mnt2ntfsname* field or the *mnt2ntmountpoint* and *mnt2ndpathlen* fields. When the request is to mount a directory, then this flag must be set to off.

mnt2_status2

The file system status extensions.

mnt2_success

This field is used to return the number of successfully moved file systems when moving a collection of file systems. It is not used in other cases.

parm_point

This field contains the mountpoint parameters to be used when mounting a file system. It is a separate field in the *mnt2* structure but contiguously allocated following the *w_mnt2* body. The *mnt2_parmoffset* field contains the offset to the start of *parm_point*.

mnt2_syslistlength

Length of system list.

mnt2_syslistoffset

Offset of system list.

mnt2_aggnamelength

Length of the aggregate name in *mnt2_aggname*. The length does not include the NULL terminating character, and is only valid if *mnt2_aggnameoffset* has a non-zero value.

mnt2_aggnameoffset

The offset of *mnt2_aggname* from *w_mntent*. If the value is zero, then no aggregate name is returned.

The *mnt3* structure can also be used in place of the *mnt2* structure. The following *mnt3* fields are equivalent to their *mnt2* counterparts, with appropriate changes to the header fields to specify the usage of the *mnt3* structure:

mnt3h_cbid

The *mnt3* control block ID. Initialize it to "MNT3".

mnt3h_cblen

The *mnt3* size. Initialize to the size of struct *mnt3*.

mh3_cursor***mh3_devno******mh_bodylen***

The *mnt3* size of *w_mntent3*. Must be initialized to the sizeof the *w_mntent3* body.

rsvd***mnt3_fstype******mnt3_mode******mnt3_dev******mnt3_parentdev******mnt3_rootino******mnt3_status******mnt3_ddname******mnt3_fsname******mnt3_pathlen******mnt3_mountpoint******mnt3_parmoffset******mnt3_parmlen******mnt3_sysname******mnt3_qsysname******mnt3_fromsys******mnt3_flags******mnt3_status2******mnt3_success***

Returned value

If successful, `__mount()` returns 0.

If the `__mount()` is proceeding asynchronously, it returns 1.

If unsuccessful, `__mount()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBUSY

The specified file system is unavailable.

EINVAL

A parameter was incorrectly specified. Verify *filesystype* and *mtm*. Another possible reason for this error is that the mount point is the root of a file system or that the file system is already mounted.

EIO

An I/O error occurred.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLLOOP` (defined in the `limits.h` header file) symbolic links are detected in the resolution of *pathname*.

ENOENT

The mount point does not exist.

ENOMEM

There is not enough storage available to save the information required for this file system.

ENOTDIR

The mount point is not a directory.

EPERM

Appropriate authority is required to issue a mount.

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“sys/mntent.h — w_getmntent\(\) function and related structures and constants” on page 69](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“umount\(\) — Remove a virtual file system” on page 1931](#)
- [“w_getmntent\(\) — Get information on mounted file systems” on page 2044](#)
- [“w_statfs\(\) — Get the file system status” on page 2079](#)

mprotect() — Set protection of memory mapping

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 z/OS UNIX | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/mman.h>
```

```
int mprotect(void *addr, size_t len, int prot);
```

General description

The `mprotect()` function changes the access protections on the mappings specified by the *len* up to the next multiple of the page size as returned by `sysconf()`, to be that specified by *prot*. Legitimate values for *prot* are the same as those permitted for `mprotect()` and are defined in `<sys/mman.h>`:

PROT_READ

page can be read

PROT_WRITE

page can be written

PROT_EXEC

page can be executed

PROT_NONE

page cannot be accessed

The range provided by the `Map_address` and `Map_length` may span regular maps as well as `__MAP_MEGA` maps. `Mprotect` affects `__MAP_MEGA` maps very differently than regular maps. The difference is in the scope of the change. When a change is made to a `__MAP_MEGA` map, the change affects all processes which are currently mapped to the same file-offset range represented by the pages within the provided range. For example, changing a file-offset range (storage pages) that is currently in use with a protection of write to a protection of read, makes the file-offset range read for all processes, not just the current one. In other words, the changes are global. On the other hand, changes to regular maps affect only the process that issues `mprotect`.

When `mprotect()` fails for reasons other than `EINVAL`, the protection on some of the pages in the range `[addr, addr + len)` may have been changed.

Returned value

If successful, `mprotect()` returns 0.

If unsuccessful, `mprotect()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The *prot* argument specifies a protection that violates the access permission the process has to the underlying memory object.

EAGAIN

The *prot* argument specifies `PROT_WRITE` over a `MAP_PRIVATE` mapping and there are insufficient memory resources to reserve for locking the private page.

EINVAL

The *addr* argument is not a multiple of the page size as returned by `sysconf()`.

ENOMEM

Addresses in the range `[addr, addr + len)` are invalid for the address space of a process, or specify one or more pages

Related information

- [“sys/mman.h — Memory management” on page 69](#)
- [“mmap\(\) — Map pages of memory” on page 1087](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)

mrnd48() – Pseudo-random number generator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

long int mrnd48(void);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrnd48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The functions drand48() and erand48() return nonnegative, double-precision, floating-point values, uniformly distributed over the interval [0.0,1.0).

The functions lrand48() and nrand48() return nonnegative, long integers, uniformly distributed over the interval [0,2**31).

The functions mrnd48() and jrand48() return signed long integers, uniformly distributed over the interval [-2**31,2**31).

The mrnd48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \qquad n \geq 0$$

The initial values of X, a, and c are:

```
X(0) = 1
a    = 5deece66d (base 16)
c    = b          (base 16)
```

C/370 provides storage to save the most recent 48-bit integer value of the sequence, X(i). This storage is shared by the drand48(), lrand48() and mrnd48() functions. The value, X(n), in this storage may be reinitialized by calling the lcong48(), seed48() or srand48() function. Likewise, the values of a and c, may be changed by calling the lcong48() function. Thereafter, whenever the seed48() or srand48() function is called to change X(n), the initial values of a and c are also reestablished.

Special behavior for z/OS UNIX services

You can make the mrnd48() function and other functions in the drand48 family thread-specific by setting the environment variable _RAND48 to the value THREAD before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested, and the mrnd48() function is called from thread t, the mrnd48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(t,i),

for the thread `t`. The sequence of values for a thread is generated according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t))\text{mod}(2^{**}48) \qquad n \geq 0$$

The initial values of `X(t)`, `a(t)` and `c(t)` for the thread `t` are:

```
X(t,0) = 1
a(t)   = 5deece66d (base 16)
c(t)   = b          (base 16)
```

`C/370` provides storage which is specific to the thread `t` to save the most recent 48-bit integer value of the sequence, `X(t,i)`, generated by the `drand48()`, `lrand48()` or `mrnd48()` function. The value, `X(t,n)`, in this storage may be reinitialized by calling the `lcong48()`, `seed48()` or `srand48()` function from the thread `t`. Likewise, the values of `a(t)` and `c(t)` for thread `t` may be changed by calling the `lcong48()` function from the thread. Thereafter, whenever the `seed48()` or `srand48()` function is called from the thread `t` to change `X(t,n)`, the initial values of `a(t)` and `c(t)` are also reestablished.

Returned value

`mrnd48()` transforms the generated 48-bit value, `X(n+1)`, to a signed long integer value on the interval `[-2**31,2**31)` and returns this transformed value.

Special behavior for z/OS UNIX Services

If thread-specific behavior is requested for the `drand48` family and the `mrnd48()` function is called on thread `t`, the `mrnd48()` function transforms the generated 48-bit value, `X(t,n+1)`, to a signed long integer value on the interval `[-2**31,2**31)` and returns this transformed value.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“drand48\(\) – Pseudo-random number generator” on page 403](#)
- [“erand48\(\) – Pseudo-random number generator” on page 430](#)
- [“jrand48\(\) – Pseudo-random number generator” on page 927](#)
- [“lcong48\(\) – Pseudo-random number initializer” on page 939](#)
- [“lrand48\(\) – Pseudo-random number generator” on page 1013](#)
- [“nrand48\(\) – Pseudo-random number generator” on page 1153](#)
- [“seed48\(\) – Pseudo-random number initializer” on page 1470](#)
- [“srand48\(\) – Pseudo-random number initializer” on page 1705](#)

m_setvalues_layout() – Set layout values of a layout object (bidi data)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C XPG4 C99 | both | z/OS V1R2 |

Format

```
#include <sys/layout.h>

int m_setvalues_layout(LayoutObject layout_object, const LayoutValues values,
                      int *index_returned);
```

General description

The `m_setvalues_layout()` function is part of the support for handling of bidirectional (Bidi) conversion of data between Visual (MVS) and Implicit (z/OS UNIX) formats. Initial support is for Arabic and Hebrew data.

The `m_setvalues_layout()` function is used to change the layout values of a `LayoutObject`. The *layout_object* argument specifies a `LayoutObject` returned by the `m_create_layout()` function. The *values* argument specifies the list of layout values which are to be changed. The values are written into the `LayoutObject` and may affect the behavior of subsequent layout functions.

Note: Some layout values do alter internal states maintained by a `LayoutObject`. The `m_setvalues_layout()` function can be implemented as a macro that evaluates the first argument twice.

Returned value

If successful, `m_setvalues_layout()` sets the requested layout values and returns 0.

If any value cannot be set, `m_setvalues_layout()` does not change any of the layout values. It stores into *index_returned* the (zero-based) index of the value causing the error. It returns -1 and sets `errno` to one of the following values:

Error Code
Description

EINVAL
The layout value specified by *index_returned* is unknown or its value is invalid or the argument *layout_object* is invalid.

Related information

- [“sys/layout.h – Bidirectional conversion of data between Visual and Implicit formats” on page 69](#)
- [“m_create_layout\(\) – Create and initialize a layout object \(bidi data\)” on page 1061](#)
- [“m_destroy_layout\(\) – Destroy a layout object \(bidi data\)” on page 1062](#)
- [“m_getvalues_layout\(\) – Query layout values of a layout object \(bidi data\)” on page 1070](#)
- [“m_transform_layout\(\) – Layout transformation for character strings \(bidi data\)” on page 1124](#)
- [“m_wtransform_layout\(\) – Layout transformation for wide-character strings \(bidi data\)” on page 1130](#)

msgctl(), msgctl64() – Message control operations

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

msgctl:

```
#define _XOPEN_SOURCE
#include <sys/msg.h>

int msgctl(int msgid, int cmd, struct msqid_ds *buf);
```

msgctl64:

```
#define _LARGE_TIME_API
#define _XOPEN_SOURCE
#include <sys/msg.h>

int msgctl64(int msgid, int cmd, struct msqid_ds64 * buf);
```

Compile requirement: Use of the `msgctl64()` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The `msgctl()` or `msgctl64()` function provides message control operations as specified by *cmd*. The following values for *cmd*, and the message control operations they specify, are (These symbolic constants are defined by the `<sys/ipc.h>` header):

IPC_STAT

Place the current value of each member of the `msqid_ds` or `msqid_ds64` data structure associated with *msgid* into the structure pointed to by *buf*. The contents of this structure are defined in `<sys/msg.h>`. This command requires read permission.

IPC_SET

Set the value of the following members of the `msqid_ds` or `msqid_ds64` data structure associated with *msgid* to the corresponding value found in the structure pointed to by *buf*:

- `msg_perm.uid`
- `msg_perm.gid`
- `msg_perm.mode`
- `msg_qbytes`

`IPC_SET` can only be executed by a process with the appropriate privileges or that has an effective user ID equal to the value of `msg_perm.cuid` or `msg_perm.uid` in the `msqid_ds` or `msqid_ds64` data structure associated with *msgid*. Only a process with appropriate privileges can raise the value of `msg_qbytes`.

IPC_RMID

Remove the message queue identifier specified by *msgid* from the system and destroy the message queue and `msqid_ds` or `msqid_ds64` data structure associated with it. **IPC_RMID** can only be executed by a process with appropriate privileges or one that has an effective user ID equal to the value of `msg_perm.cuid` or `msg_perm.uid` in the `msqid_ds` or `msqid_ds64` data structure associated with *msgid*.

The `msgctl64()` function behaves exactly like `msgctl()` except `msgctl64()` uses `struct msqid_ds64` instead of `struct msqid_ds` to support time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, `msgctl()` or `msgctl64()` returns 0.

If unsuccessful, `msgctl()` or `msgctl64()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The argument *cmd* is **IPC_STAT** and the calling process does not have read permission.

EINVAL

The value of *msgid* is not a valid message queue identifier, or the value of *cmd* is not a valid command.

EPERM

The argument *cmd* is **IPC_RMID** or **IPC_SET** and the effective user ID of the calling process is not equal to that of a process with appropriate privileges and it is not equal to the value of *msg_perm.cuid* or *msg_perm.uid* in the data structure associated with *msgid*.

Or the argument *cmd* is **IPC_SET**, an attempt is being made to increase the value of *msg_qbytes*, and the effective user ID of the calling process does not have appropriate privileges.

Related information

- [“sys/ipc.h – Interprocess communication access structure” on page 69](#)
- [“sys/msg.h – Message queue structures” on page 69](#)
- [“msgget\(\) – Get message queue” on page 1112](#)
- [“msgrcv\(\) – Message receive operation” on page 1115](#)
- [“msgsnd\(\) – Message send operations” on page 1119](#)
- [“msgxrcv\(\), msgxrcv64\(\) – Extended message receive operation” on page 1120](#)

msgget() – Get message queue

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <sys/msg.h>

int msgget(key_t key, int msgflg);
```

General description

The *msgget()* function returns the message queue identifier associated with the argument *key*.

A message queue identifier, associated message queue and data structure (see <sys/msg.h>) are created for the argument *key* if one of the following is true:

- The argument *key* is equal to **IPC_PRIVATE**
- The argument *key* does not already have a message queue identifier associated with it, and the flag **IPC_CREAT** is on in *msgflg*.

Valid values for the argument *msgflg* include any combination of the following constants defined in <sys/ipc.h> and <sys/modes.h>:

IPC_CREAT

Create a message queue if the *key* specified does not already have an associated ID. **IPC_CREAT** is ignored when **IPC_PRIVATE** is specified

IPC_EXCL

Causes the `msgget()` function to fail if the *key* specified has an associated ID. **IPC_EXCL** is ignored when **IPC_CREAT** is not specified or **IPC_PRIVATE** is specified

IPC_RCVTYPEPID

Creates a message queue that can only be read from `msgrcv()` when `MSG_TYPE` is the process ID of the invoker. This restriction does not apply if the `msgrcv()` invoker has the same effective UID as the message queue creator.

IPC_SNDTYPEPID

Creates a message queue that can only be written to `msgsnd()` when `MSG_TYPE` is the process ID of the invoker. This restriction does not apply if the `msgsnd()` invoker has the same effective UID as the message queue creator.

S_IRUSR

Permits read access when the effective user ID of the caller matches either `msg_perm.cuid` or `msg_perm.uid`

S_IWUSR

Permits write access when the effective user ID of the caller matches either `msg_perm.cuid` or `msg_perm.uid`

S_IRGRP

Permits read access when the effective group ID of the caller matches either `msg_perm.cgid` or `msg_perm.gid`

S_IWGRP

Permits write access when the effective group ID of the caller matches either `msg_perm.cgid` or `msg_perm.gid`

S_IROTH

Permits other read access

S_IWOTH

Permits other write access

When a message set associated with argument *key* already exists, setting **IPC_EXCL** and **IPC_CREAT** in argument *msgflg* will force `msgget()` to fail.

Upon creation, the `msg_ds` data structure associated with the new message queue identifier is initialized as follows:

- The fields `msg_perm.cuid`, `msg_perm.uid`, `msg_perm.cgid`, and `msg_perm.gid` are set equal to the effective user ID and effective group ID, respectively, of the calling process.
- The low-order 9 bits of `msg_perm.mode` are set equal to the low-order 9 bits of *msgflg*.
- The fields `msg_qnum`, `msg_lspid`, `msg_lrpids`, `msg_stime`, and `msg_rtime` are set to zero.
- The field `msg_ctime` is set equal to the current time.
- The field `msg_qbytes` is set equal to the system limit.

Usage notes

1. In a client/server environment, two message queues can be used. One inbound to the server created with **IPC_SNDTYPEPID** and the other outbound from the server created with **IPC_RCVTYPEPID**. This arrangement guarantees that the server knows the process ID of the client and the client is the only process that receives the server's returned message. The server may invoke `msgrcv()` with `PID=0` to see if any messages belong to process IDs that have gone away.
2. Important terms and their descriptions are explained:

Term**Descriptions****PLO**

Perform Lock Operation.

IPC_PLO1

Use PLO serialization (if available) until a select() involving this message queue is detected.

IPC_PLO2

Allow the kernel to use its best judgment with serialization (IPC_PLO1 ignored).

- Message_Flags IPC_PLO1 and IPC_PLO2 are ignored if the PLO instruction is not present on the hardware.
- Performance of the PLO instruction for serialization will vary with the msgrcv type, number of messages on the queue and the number of tasks doing msgsnd() and msgrcv(). Msgrcv() with type<0 and long message queues is expected to be a worse performer. Msgrcv() with type>0 is expected to be an equivalent or good performer. Msgrcv() with type=0 is expected to be a very good performer.
- Message queues created with *Ipc_RcvTypePID*, *Ipc_SndTypePID*, *IPC_PLO1* and *IPC_PLO2* will show these bits and may show the *IPC_PLOINUSE* bit in the S_MODE byte returned with *w_getipc*.
- Message queue PLO serialization is not compatible with select() using message queues. When msgrcv() detects a select() for a message queue, serialization will be changed to use traditional latches.
- Performance runs should be made with *IPC_PLO1* since *IPC_PLO2* may switch to latch serialization and the user would not know when.

Returned value

If successful, msgget() returns a nonnegative integer, namely a message queue identifier.

If unsuccessful, msgget() returns -1 and sets errno to one of the following values:

Error Code**Description****EACCES**

A message queue identifier exists for the argument *key*, but access permission as specified by the low-order 9 bits of *msgflg* could not be granted

EEXIST

A message queue identifier exists for the argument *key*, but both **IPC_CREAT** and **IPC_EXCL** are specified in *msgflg*

EINVAL

The value of argument *msgflg* is not currently supported

ENOENT

A message queue identifier does not exist for the argument *key* and **IPC_CREAT** is not specified.

ENOSPC

A message queue identifier is to be created but the system-imposed limit on the maximum number of allowed message queue identifiers system-wide would be exceeded.

When *msgflg* equals 0, the following applies:

- If a message queue identifier has already been created with *key* earlier, and the calling process of this msgget() has read and/or write permissions to it, then msgget() returns the associated message queue identifier.
- If a message queue identifier has already been created with *key* earlier, and the calling process of this msgget() does not have read and/or write permissions to it, then msgget() returns -1 and sets errno to EACCES.
- If a message queue identifier has not been created with *key* earlier, then msgget() returns -1 and sets errno to ENOENT.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“sys/msg.h — Message queue structures” on page 69](#)

- “[sys/types.h — typedef symbols and structures](#)” on page 71
- “[ftok\(\) — Generate an interprocess communication \(IPC\) key](#)” on page 662
- “[msgctl\(\), msgctl64\(\) — Message control operations](#)” on page 1110
- “[msgrcv\(\) — Message receive operation](#)” on page 1115
- “[msgsnd\(\) — Message send operations](#)” on page 1119
- “[msgxrcv\(\), msgxrcv64\(\) — Extended message receive operation](#)” on page 1120

msgrcv() — Message receive operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | |

Format

Non-Single UNIX Specification, Version 2

```
#define _XOPEN_SOURCE
#include <sys/msg.h>

int msgrcv(int msgid, void *msgp, size_t msgsz, long int msgtyp, int msgflg);
```

Single UNIX Specification, Version 2

```
#define _XOPEN_SOURCE 500
#include <sys/msg.h>

ssize_t msgrcv(int msgid, void *msgp, size_t msgsz, long int msgtyp, int msgflg);
```

General description

The `msgrcv()` function reads a message from the queue associated with the message queue identifier specified by `msgid` and places it in the user-defined buffer pointed to by `msgp`.

The argument `msgp` points to a user-defined buffer that must contain first a field of type `long int` that will specify the type of the message, and then a data portion that will hold the data bytes of the message. The structure below is an example of what this user-defined buffer should look like:

```
struct message {
    long int  mtype;           //Message type
    char      mtext[n];       //Message text
}
```

The structure member, `mtype`, is the received message's type as specified by the sending process. The structure member, `mtext`, is the text of the message.

The argument `msgsz` specifies the size in bytes of `mtext`. The received message is truncated to `msgsz` bytes if it is larger than `msgsz` and the **MSG_NOERROR** flag was specified in the argument `msgflg`. The truncated portion of the message is lost and no indication of the truncation is given to the calling process.

The argument `msgtyp` specifies the type of message requested, as follows:

- If `msgtyp` is equal to zero, the first message on the queue is received.

- If *msgtyp* is greater than 0, the first message of type, *msgtyp*, is received.
- If *msgtyp* is less than 0, the first message of the lowest type that is less than or equal to the absolute value of *msgtyp* is received.

The argument *msgflg* specifies the action to be taken if a message of the desired type is not on the queue. These are as follows:

- If the **IPC_NOWAIT** flag is on in *msgflg*, the calling process will return immediately with a return value of -1 and errno set to **ENOMSG**.
- If the **IPC_NOWAIT** flag is off in *msgflg* the calling process will suspend execution until one of the following occurs:
 - A message of the desired type is placed on the queue.
 - The message queue identifier, *msgid*, is removed from the system; when this occurs, errno is set to **EIDRM** and a value of -1 is returned.
 - The calling process receives a signal that is to be caught; in this case a message is not received and the calling process resumes execution. A value of -1 is returned and errno is set to **EINTR**.

If successful, the following actions are taken with respect to the data structure, *msgiq_ds*, associated with *msgid*:

1. *msg_qnum* is decremented by 1.
2. *msg_lrpId* is set equal to the process ID of the calling process.
3. *msg_rtime* is set equal to the current time.

Returned value

If successful, *msgrcv()* returns a value equal to the number of bytes actually placed into the *mtext* field of the user-defined buffer pointed to by *msgp*. A value of zero indicates that only the *mtype* field was received from the message queue.

If unsuccessful, *msgrcv()* returns -1 and sets errno to one of the following values:

Error Code Description

E2BIG

The value of *mtext* is greater than *msgsz* and the flag **MSG_NOERROR** was not specified.

EACCES

The calling process does not have read permission to the message queue associated with the message queue identifier *msgid* or the message queue was built with **IPC_RCVTYPEPID** and the **MSG_TYPE** was other than the invoker's process ID (**JRTypeNotPID**).

EIDRM

The message queue identifier, *msgid*, has been removed from the system while the caller of *msgrcv()* was waiting.

EINTR

The function *msgrcv()* was interrupted by a signal before a message could be received.

EINVAL

The value of argument *msgid* is not a valid message queue identifier or the value of *msgsz* is less than zero.

ENOMSG

The flag **IPC_NOWAIT** was specified and the message queue does not contain a message of the desired type.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“sys/msg.h — Message queue structures” on page 69](#)

- “msgctl(), msgctl64() — Message control operations” on page 1110
- “msgget() — Get message queue” on page 1112
- “msgsnd() — Message send operations” on page 1119
- “msgxrcv(), msgxrcv64() — Extended message receive operation” on page 1120

__msgrcv_timed() — Message receive operation with timeout

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R10 |

Format

```
#define _OPEN_SYS_TIMED_EXT 1
#include <time.h>
#include <sys/msg.h>

int __msgrcv_timed(int msgid, void *msgp, size_t msgsz,
                  long int msgtyp, int msgflg, struct timespec *set);
```

General description

Reads a message from the queue associated with the message queue identifier specified by *msgid* and places it in the user-defined buffer pointed to by *msgp*.

The argument *msgp* points to a user-defined buffer that must contain first a field of type long int that will specify the type of the message, and then a data portion that will hold the data bytes of the message. The structure below is an example of what this user-defined buffer should look like:

```
struct message {
    long int  mtype;           //Message type
    char      mtext[n];       //Message text
}
```

The structure member, *mtype*, is the received message's type as specified by the sending process. The structure member, *mtext*, is the text of the message.

The argument *msgsz* specifies the size in bytes of *mtext*. The received message is truncated to *msgsz* bytes if it is larger than *msgsz* and the **MSG_NOERROR** flag was specified in the argument *msgflg*. The truncated portion of the message is lost and no indication of the truncation is given to the calling process.

The argument *msgtyp* specifies the type of message requested, as follows:

- If *msgtyp* is equal to zero, the first message on the queue is received.
- If *msgtyp* is greater than 0, the first message of type, *msgtyp*, is received.
- If *msgtyp* is less than 0, the first message of the lowest type that is less than or equal to the absolute value of *msgtyp* is received.

The argument *msgflg* specifies the action to be taken if a message of the desired type is not on the queue. These are as follows:

- If the **IPC_NOWAIT** flag is on in *msgflg*, the calling process will return immediately with a return value of -1 and *errno* set to ENOMSG.
- If the **IPC_NOWAIT** flag is off in *msgflg* the calling process will suspend execution until one of the following occurs:
 - A message of the desired type is placed on the queue.

- The message queue identifier, *msgid*, is removed from the system; when this occurs, *errno* is set to *EIDRM* and a value of -1 is returned.
- The calling process receives a signal that is to be caught; in this case a message is not received and the calling process resumes execution. A value of -1 is returned and *errno* is set to *EINTR*.

The argument *set* is the *timespec* structure which contains the timeout value.

If successful, the following actions are taken with respect to the data structure, *msqid_ds*, associated with *msgid*:

1. *msg_qnum* is decremented by 1.
2. *msg_lrpid* is set equal to the process ID of the calling process.
3. *msg_rtime* is set equal to the current time.

The variable *set* gives the timeout specification.

- If the `__msgrcv_timed()` function finds that none of the messages specified by *msgid* are received, it waits for the time interval specified in the **timespec** structure referenced by *set*. If the **timespec** structure pointed to by *set* is zero-valued and if none of the messages specified by *msgid* are received, then `__msgrcv_timed()` returns immediately with *EAGAIN*. A **timespec** with the *tv_sec* field set with *INT_MAX*, as defined in `<limits.h>`, will cause the `__msgrcv_timed()` service to wait until a message is received. If *set* is the *NULL* pointer, it will be treated the same as when **timespec** structure was supplied with the *tv_sec* field set with *INT_MAX*.

Returned value

If successful, `__msgrcv_timed()` returns a value equal to the number of bytes actually placed into the *mtext* field of the user-defined buffer pointed to by *msgp*. A value of zero indicates that only the *mtype* field was received from the message queue.

If unsuccessful, `__msgrcv_timed()` returns -1 and sets *errno* to one of the following values:

Error Code Description

E2BIG

The value of *mtext* is greater than *msgsz* and the flag **MSG_NOERROR** was not specified.

EACCES

The calling process does not have read permission to the message queue associated with the message queue identifier *msgid*.

EAGAIN

The operation would result in time requested expired before any messages were received. This would result if the timeout specified expires before a message is posted.

EIDRM

The message queue identifier, *msgid*, has been removed from the system while the caller of `__msgrcv_timed()` was waiting.

EINTR

The function `__msgrcv_timed()` was interrupted by a signal before a message could be received.

EINVAL

The value of argument *msgid* is not a valid message queue identifier or the value of *msgsz* is less than zero.

ENOMSG

The flag **IPC_NOWAIT** was specified and the message queue does not contain a message of the desired type.

Related information

- [“time.h — Time and date” on page 75](#)
- [“sys/msg.h — Message queue structures” on page 69](#)

msgsnd() — Message send operations

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <sys/msg.h>

int msgsnd(int msgid, const void *msgp, size_t msgsz, int msgflg);
```

General description

The `msgsnd()` function is used to send a message to the queue associated with the message queue identifier specified by `msgid`.

The argument `msgp` points to a user-defined buffer that must contain first a field of type `long int` that will specify the type of the message, and then a data portion that will hold the data bytes of the message. The structure below is an example of what this user-defined buffer should look like:

```
struct message {
    long int  mtype;           //Message type
    char      mtext[n];       //Message text
}
```

The structure member, `mtype`, must be a nonzero positive value that can be used by the receiving process for message selection. The structure member, `mtext`, is any text of length, `msgsz`, bytes.

The argument `msgsz` specifies the size in bytes of `mtext`. When only `mtype` is to be sent with no `mtext`, `msgsz` is set to zero. The argument can range from zero to a system-imposed maximum or the maximum number of bytes allowed in the message queue.

The argument `msgflg` specifies the action to be taken if one or more of the following are true:

- Placing the message on the message queue would cause the current number of bytes on the message queue (`msg_cbytes`) to exceed the maximum number of bytes allowed on this queue, as specified in `msg_qbytes`.
- The total number of messages on the queue is equal to the system-imposed limit.

These actions are as follows:

- If the **IPC_NOWAIT** flag is on in `msgflg`, the message will not be sent and the calling process will return immediately. `msgsnd()` will return -1 and set `errno` to `EAGAIN`.
- If the **IPC_NOWAIT** flag is off in `msgflg`, the calling process will suspend execution until one of the following occurs:
 1. The condition responsible for the suspension no longer exists, in which case the message is sent.
 2. The message queue identifier, `msgid`, is removed from the system; when this occurs, `errno` is set to `EIDRM` and a value of -1 is returned.
 3. The calling process receives a signal that is to be caught; in this case a message is not sent and the calling process resumes execution. A value of -1 is returned and error is set to `EINTR`.

If successful, the following actions are taken with respect to the data structure, `msqid_ds`, associated with `msgid`:

1. `msg_qnum` is incremented by 1.
2. `msg_lspid` is set equal to the process ID of the calling process.
3. `msg_stime` is set equal to the current time.

Returned value

If successful, `msgsnd()` returns 0.

If unsuccessful, no message is sent, `msgsnd()` returns -1, and sets `errno` to one of the following values:

Error Code
Description

EACCES
The calling process does not have write permission to the message queue associated with the message queue identifier `msgid` or the message queue was built with `IPC_SNDTYPEPID` and the `MSG_TYPE` was other than the invoker's process ID (`JRTypeNotPID`).

EAGAIN
The message cannot be sent for one of the reasons cited above and `IPC_NOWAIT` was specified.

EIDRM
The message queue identifier, `msgid`, has been removed from the system while the caller of `msgsnd()` was waiting.

EINTR
The function `msgsnd()` was interrupted by a signal before a message could be sent.

EINVAL
The value of argument `msgid` is not a valid message queue identifier, or the value of `mtype` is less than 1; or the value of `msgsz` is less than zero or greater than the system-imposed limit.

ENOMEM
Not enough system storage exists to complete the `msgsnd()` function.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“sys/msg.h — Message queue structures” on page 69](#)
- [“msgctl\(\), msgctl64\(\) — Message control operations” on page 1110](#)
- [“msgget\(\) — Get message queue” on page 1112](#)
- [“msgrcv\(\) — Message receive operation” on page 1115](#)
- [“msgxrcv\(\), msgxrcv64\(\) — Extended message receive operation” on page 1120](#)

msgxrcv(), msgxrcv64() — Extended message receive operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

msgxrcv:

```
#define _OPEN_SYS_IPC_EXTENSIONS
#include <sys/msg.h>
```

```
int msgxrcv(int msgid, void *msgp, size_t msgsz, long int msgtyp, int msgflg);
```

msgxrcv64:

```
#define _LARGE_TIME_API
#define _OPEN_SYS_IPC_EXTENSIONS
#include <sys/msg.h>

int msgxrcv64(int msgid, void *msgp, size_t msgsz, long int msgtyp, int msgflg);
```

Compile requirement: Use of the `msgxrcv64()` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The `msgxrcv()` function reads an extended message from the queue associated with the message queue identifier specified by `msgid` and places it in the user-defined buffer pointed to by `msgp`.

To expose the `msgxrcv()` name, the feature test macro **_OPEN_SYS_IPC_EXTENSIONS** must be defined. Otherwise, the function's name is `__msgxrcv()`.

The argument `msgp` points to a user-defined buffer where the extended message will be received. This buffer must be defined by a data structure of the following format: .

```
struct msgxbuf {
    time_t      mtime;           // Time and date message was sent
    uid_t       muid;           // Sender's effective user ID
    gid_t       mgid;           // Sender's effective group ID
    pid_t       mpid;           // Sender's process ID
    long int     mtype;          // Message type
    char        mtext[n];       // Message text
}
```

The `msgxrcv64()` function behaves exactly like `msgxrcv()` except `msgxrcv64()` supports calendar times beyond 03:14:07 UTC on January 19, 2038. The argument `msgp` points to a user-defined buffer where the extended message will be received. This buffer must be defined by a data structure of the following format:

```
struct msgxbuf64 {
    time64_t     mtime;          // Time and date message was sent
    uid_t        muid;           // Sender's effective user ID
    gid_t        mgid;           // Sender's effective group ID
    pid_t        mpid;           // Sender's process ID
    long int      mtype;          // Message type
    char         mtext[n];       // Message text
}
```

The structure member, `mtype`, is the received message's type as specified by the sending process. The structure member, `mtext`, is the text of the message.

The argument `msgsz` specifies the size in bytes of `mtext`. The received message is truncated to `msgsz` bytes if it is larger than `msgsz` and the **MSG_NOERROR** flag was specified in the argument `msgflg`. The truncated portion of the message is lost and no indication of the truncation is given to the calling process.

The argument `msgtyp` specifies the type of message requested, as follows:

- If `msgtyp` is equal to zero, the first message on the queue is received.
- If `msgtyp` is greater than 0, the first message of type, `msgtyp`, is received.
- If `msgtyp` is less than 0, the first message of the lowest type that is less than or equal to the absolute value of `msgtyp` is received.

The argument `msgflg` specifies the action to be taken if a message of the desired type is not on the queue. These are as follows:

- If the **IPC_NOWAIT** flag is on in `msgflg`, the calling process will return immediately with a return value of -1 and `errno` set to **ENOMSG**.

- If the **IPC_NOWAIT** flag is off in *msgflg* the calling process will suspend execution until one of the following occurs:
 - A message of the desired type is placed on the queue.
 - The message queue identifier, *msgid*, is removed from the system; when this occurs, *errno* is set to **EIDRM** and a value of -1 is returned.
 - The calling process receives a signal that is to be caught; in this case a message is not received and the calling process resumes execution. A value of -1 is returned and *errno* is set to **EINTR**.

If successful, the following actions are taken with respect to the data structure, *msqid_ds*, associated with *msgid*:

1. *msg_qnum* is decremented by 1.
2. *msg_lrpid* is set equal to the process ID of the calling process.
3. *msg_rtime* is set equal to the current time.

Returned value

If successful, *msgxrcv()* or *msgxrcv64()* returns a value equal to the number of bytes actually placed into the *mtext* field of the user-defined buffer pointed to by *msgp*. A value of zero indicates that only the *mtype* field was received from the message queue.

If unsuccessful, *msgxrcv()* returns -1 and sets *errno* to one of the following values:

Error Code

Description

E2BIG

The value of *mtext* is greater than *msgsz* and the flag **MSG_NOERROR** was not specified.

EACCES

The calling process does not have read permission to the message queue associated with the message queue identifier *msgid*.

EIDRM

The message queue identifier, *msgid*, has been removed from the system while the caller of *msgxrcv()* was waiting.

EINTR

The function *msgxrcv()* was interrupted by a signal before a message could be received.

EINVAL

The value of argument *msgid* is not a valid message queue identifier or the value of *msgsz* is less than zero.

ENOMSG

The flag **IPC_NOWAIT** was specified and the message queue does not contain a message of the desired type.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“sys/msg.h — Message queue structures” on page 69](#)
- [“msgctl\(\), msgctl64\(\) — Message control operations” on page 1110](#)
- [“msgget\(\) — Get message queue” on page 1112](#)
- [“msgrcv\(\) — Message receive operation” on page 1115](#)
- [“msgsnd\(\) — Message send operations” on page 1119](#)

msync() – Synchronize memory with physical storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/mman.h>

int msync(void *addr, size_t len, int flags);
```

General description

The `msync()` function writes all modified copies of pages over the range `[addr, addr + len)` to the underlying hardware, or invalidates any copies so that further references to the pages will be obtained by the system from their permanent storage locations.

The `flags` argument is:

MS_ASYNC

Perform asynchronous writes

MS_INVALIDATE

Invalidate mappings

MS_SYNC

Perform synchronous writes

The function synchronizes the file contents to match the current contents to the memory region.

- All write references to the memory region made before the call are visible by subsequent read operations on the file.
- It is unspecified whether writes to the same portion of the file before the call are visible by read references to the memory region.
- It is unspecified whether unmodified pages in the specified range are also written to the underlying hardware.

If `flags` is `MS_ASYNC`, the function may return immediately once all write operations are scheduled; if `flags` is `MS_SYNC`, the function does not return until all write operations are completed.

`MS_INVALIDATE` synchronizes the contents of the memory region to match the current file contents.

- All writes to the mapped portion of the file made before the call are visible by subsequent read references to the mapped memory region.
- It is unspecified whether write references before the call, by any process, to memory regions mapped to the same portion of the file using `MAP_SHARED`, are visible by read references to the region.

If `msync()` causes any write to the file, then the file's `st_ctime` and `st_mtime` fields are marked for update.

Returned value

If successful, `msync()` returns 0.

If unsuccessful, `msync()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The *addr* argument is not a multiple of the page size as returned by *sysnonf*.

EIO

An I/O error occurred while reading from or writing to the file system.

ENOMEM

Some or all the addresses in the range [*addr*, *addr* + *range*] [*addr*, *addr* + *len*] are invalid for the address space of the process or pages not mapped are specified.

Related information

- [“sys/mman.h — Memory management” on page 69](#)
- [“mmap\(\) — Map pages of memory” on page 1087](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)

m_transform_layout() — Layout transformation for character strings (bidi data)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C XPG4 C99 | both | z/OS V1R2 |

Format

```
#include <sys/layout.h>

int m_transform_layout(LayoutObject layout_object,
                      const char *InpBuf,
                      const size_t InpSize,
                      void *OutBuf,
                      size_t *Outsize,
                      size_t *InpToOut,
                      size_t *OutToInp,
                      unsigned char *Property,
                      size_t *InpBufIndex);
```

General description

The *m_transform_layout()* function is part of the support for handling of bidirectional (Bidi) conversion of data between Visual (MVS) and Implicit (z/OS UNIX) formats. Initial support is for Arabic and Hebrew data.

The *m_transform_layout()* function performs layout transformations (reordering, shaping, cell determination). Alternatively, it may provide additional information needed for layout transformation, such as:

- The expected size of the transformed layout
- The nesting level of different segments in the text
- Cross references between the locations of the corresponding elements before and after the layout transformation.

Both the input text and output text are character strings. The *m_transform_layout()* function transforms the input text in *InpBuf* according to the current layout values in *layout_object*.

Any layout value whose value type is **LayoutTextDescriptor** describes the attributes of the *InpBuf* and *OutBuf* arguments. If the attributes are the same for both *InpBuf* and *OutBuf*, a NULL transformation is performed with respect to that specific layout value.

The *InpBuf* argument specifies the source text to be processed. The *InpBuf* may not be NULL, except when there is a need to reset the internal state.

The *InpSize* argument is the number of bytes within *InpBuf* to be processed by the transformation. Its value will not have changed at the return from the transformation. *InpSize* set to -1 indicates that the text in *InpBuf* is delimited by a NULL code element. If *InpSize* is not set to -1, it is possible to have some NULL elements in the input buffer. This might be used, for example, for a *one shot* transformation of several strings, separated by NULLs.

Outputs of this function may be one or more of the following, depending on the setting of the arguments:

Output Description

OutBuf

Any transformed data is stored in *OutBuf*, converted to **ShapeCharset**.

Outsize

The number of bytes in *OutBuf*.

InpToOut

A cross reference from each *InpBuf* code element to the transformed data. The cross reference relates to the data in *InpBuf*, starting with the first element that *InpBufIndex* points to (and not necessarily starting from the beginning of the *InpBuf*).

OutToInp

A cross reference to each *InpBuf* code element from the transformed data. The cross reference relates to the data in *InpBuf*, starting with the first element that *InpBufIndex* points to (and not necessarily starting from the beginning of the *InpBuf*).

Property

A weighted value that represents specific input string transformation properties with different connotations as explained below. If this argument is not a NULL pointer, it represents an array of values with the same number of elements as the source substring text before the transformation.

Each byte will contain relevant *property* information of the corresponding element in *InpBuf*, starting from the element pointed by *InpBufIndex*.

The four rightmost bits of each *property* byte will contain information for bidirectional environments (when **ActiveDirectional** is True) and they will mean **NestingLevels**. The possible value from 0 to 15 represents the nesting level of the corresponding element in the *InpBuf*, starting from the element pointed by *InpBufIndex*. If **ActiveDirectional** is False, the content of NestingLevels bits will be ignored.

The leftmost bit of each *property* byte will contain a *new cell indicator* for composed character environments. It will be a value of either 1, for an element in *InpBuf* that is transformed to the beginning of a new cell, or 0, for the *zero-length* composing character elements when these are grouped into the same presentation cell with a non-composing character. Here again, each element of *property* pertains to the elements in the *InpBuf*, starting from the element pointed by *InpBufIndex*. (Remember that this is not necessarily the beginning of *InpBuf*.)

If none of the transformation properties is required, the argument *Property* can be NULL.

The use of *property* can be enhanced in the future to pertain to other possible usage in other environments.

InpBufIndex

An offset value to the location of the transformed text. When `m_transform_layout()` is called, *InpBufIndex* contains the offset to the element in *InpBuf* that will be transformed first. (Note that this is not necessarily the first element in *InpBuf*.)

At the return from the transformation, *InpBufIndex* contains the offset to the first element in the *InpBuf* that has not been transformed. If the entire substring has been transformed successfully, *InpBufIndex* will be incremented by the amount defined by *InpSize*.

Each of these output arguments may be NULL to specify that no output is desired for the specific argument, but at least one of them should be set to non-NULL to perform any significant work.

The *layout_object* maintains a directional state that keeps track of directional changes, based on the last segment transformed. The directional state is maintained across calls to the layout transformation functions and allows stream data to be processed with the layout functions. The directional state is reset to its initial state whenever any of the layout values **TypeOfText**, **Orientation** or **ImplicitAlg** is modified by means of a call to *m_setvalues_layout()*.

The *layout_object* argument specifies a LayoutObject returned by the *m_create_layout()* function.

The *OutBuf* argument contains the transformed data. This argument can be specified as a NULL pointer to indicate that no transformed data is required. The encoding of the *OutBuf* argument depends on the **ShapeCharset** layout value defined in *layout_object*. If the **ActiveShapeEditing** layout value is not set (False), the encoding of *OutBuf* is guaranteed to be the same as the codeset of the locale associated with the LayoutObject defined by *layout_object*.

On input, the *OutSize* argument specifies the size of the output buffer in number of bytes. The output buffer should be large enough to contain the transformed result; otherwise, only a partial transformation is performed. If the **ActiveShapeEditing** layout value is set (True), the *OutBuf* should be allocated to contain at least the *InpSize* multiplied by **ShapeCharsetSize**.

OutSize

Upon return, the *OutSize* argument is updated to be the actual number of bytes placed in *OutBuf*.

When the *OutSize* argument is specified as zero, the function calculates the size of an output buffer large enough to contain the transformed text, and the result is returned in this field. The content of the buffers specified by *InpBuf* and *OutBuf*, and the value of *InpBufIndex*, remain unchanged.

If *OutSize* = NULL, the EINVAL error condition is returned.

If the *InpToOut* argument is not a NULL pointer, it points to an array of values with the same number of bytes as *InpBuf*, starting with the one pointed by *InpBufIndex* and up to the end of the substring in the buffer.

On output, the *nth* value in *InpToOut* corresponds to the *nth* byte in *InpBuf*. This value is the index (in units of bytes) in *OutBuf* that identifies the transformed **ShapeCharset** element of the *nth* byte in *InpBuf*.

In the case of multibyte encoding, for each of the bytes of a code element in the *InpBuf*, the index points to the first byte of the transformed code element in the *OutBuf*. *InpToOut* may be specified as NULL if no index array from *InpBuf* to *OutBuf* is desired.

If the *OutToInp* argument is not a NULL pointer, it points to an array of values with the same number of bytes as contained in *OutBuf*. On output, the *nth* value in *OutToInp* corresponds to the *nth* byte in *OutBuf*. This value is the index in *InpBuf*, starting with the byte pointed to by *InpBufIndex*, that identifies the logical code element of the *nth* byte in *OutBuf*.

In the case of multibyte encoding, the index will point, for each of the bytes of a transformed code element in the *OutBuf*, to the first byte of the code element in the *InpBuf*.

OutToInp may be specified as NULL if no index array from *OutBuf* to *InpBuf* is desired.

To perform shaping of a text string without reordering of code elements, the *layout_object* should be set with input and output layout value **TypeOfText** set to TEXT_VISUAL, and both in and out of **Orientation** set to the same value.

Returned value

If successful, *m_transform_layout()* returns 0.

If unsuccessful, *m_transform_layout()* returns -1 and sets *errno* to one of the following values:

Error Code Description

E2BIG

The size of *OutBuf* is not large enough to contain the entire transformed text. The input text state at the end of the uncompleted transformation is saved internally.

EBADF

The layout values are set to a meaningless combination or the layout object is not valid.

EINVAL

Transformation stopped due to an incomplete composite sequence at the end of the input buffer, or *OutSize* contains NULL.

Related information

- [“sys/layout.h — Bidirectional conversion of data between Visual and Implicit formats” on page 69](#)
- [“m_create_layout\(\) — Create and initialize a layout object \(bidi data\)” on page 1061](#)
- [“m_destroy_layout\(\) — Destroy a layout object \(bidi data\)” on page 1062](#)
- [“m_getvalues_layout\(\) — Query layout values of a layout object \(bidi data\)” on page 1070](#)
- [“m_setvalues_layout\(\) — Set layout values of a layout object \(bidi data\)” on page 1109](#)
- [“m_wtransform_layout\(\) — Layout transformation for wide-character strings \(bidi data\)” on page 1130](#)

munmap() — Unmap pages of memory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 z/OS UNIX | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/mman.h>

int munmap(void *addr, size_t len);
```

General description

The `munmap()` function removes the mappings for pages in the range `[addr, addr + len)` rounding the `len` argument up to the next multiple of the page size as returned by `sysconf()`. If `addr` is not the address of a mapping established by a prior call to `mmap()`, the behavior is undefined. After a successful call to `munmap()` and before any subsequent mapping of the unmapped pages, further references to these pages will result in the delivery of a SIGBUS or SIGSEGV signal to the process.

__MAP_MEGA mapping: The `munmap` service removes the mapping for pages in the requested range. The requested range may span multiple maps, and the maps may represent the same or different files. The pages in the range may be part of a regular mapping or may be part of a `__MAP_MEGA` mapping. When unmapping a regular mapping, entire pages are unmapped; when unmapping a `__MAP_MEGA` mapping, entire segments are unmapped.

Map_address: The value of map address must be a multiple of the page size. The specified value does not have to be the start of a mapping. However, if the value specified for `Map_address` falls within a `__MAP_MEGA` map, then the address is rounded down to a megabyte multiple so that an entire segment

__must_stay_clean

is included in the unmap operation. It is not possible to unmap a part of a segment when processing a __MAP_MEGA map.

Map_length: The length can be the size of the whole mapping, or a part of it. If the specified length is not in multiples of the page size, it will be rounded up to a page boundary. If the Map_address plus the Map_length falls within a __MAP_MEGA map, then the length is rounded up to a segment boundary, thus including the entire segment (not necessarily the entire __MAP_MEGA mapping).

Returned value

If successful, munmap() returns 0.

If unsuccessful, munmap() returns -1 and sets errno to one of the following values:

Error Code Description

EINVAL

One of the following error conditions exists:

- The *addr* argument is not a multiple of the page size as returned by *sysconf*.
- Addresses outside the valid range for the address space of a process.
- The *len* argument is 0.

Related information

- [“sys/mman.h — Memory management” on page 69](#)
- [“mmap\(\) — Map pages of memory” on page 1087](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)

__must_stay_clean() — Enable or query clean

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | Z/OS V1R8 |

Format

```
#define _OPEN_SYS
#include <unistd.h>

int __must_stay_clean(int request);
```

General description

The __must_stay_clean() function queries or enables the "must stay clean" state for a process. A process that must stay clean is prohibited from doing an exec(), spawn(), or other load of a non-program controlled executable. Only a program controlled executable can enable the must stay clean state. The must stay clean state of a process is propagated to its children created using fork or spawn. Once the must stay clean state is enabled, it cannot be changed. All processes in the address space will be forced to stay clean until they have all terminated. The query support allows a process to determine if it was created in a trusted environment. The BPX.DAEMON class profile must be defined to use the enable function.

Argument**Description****request**

Specify the value `_MSC_QUERY` to query the state. Specify the value `_MSC_ENABLE` to enable "must stay clean" for the process.

Returned value

If successful, `__must_stay_clean()` returns the current "must stay clean" state of the process. The following state values are possible:

_MSC_NOT_ENABLED

The "must stay clean" state is not enabled.

_MSC_ENABLED

The "must stay clean" state is enabled, meaning that it was set using this function, and that it will continue to be enabled even after an `exec()` that causes job step termination.

_MSC_ENABLED_COND

The "must stay clean" state is enabled conditionally, meaning that a prior call to a security service, such as `__passwd()`, implicitly enabled the must stay clean state, and that the state will be reset to "not enabled" at the next `exec()` that causes job step termination. This state value can only be returned using the query request.

If unsuccessful, `__must_stay_clean()` returns `_MSC_FAILED(-1)` and sets `errno` to one of the following values:

Error Code**Description****EINVAL**

A parameter was not valid.

EMVSERR

An MVS environmental error occurred. One possible cause is that a 'dirty' process attempted to enable the must stay clean attribute. Another cause could be that the BPX.DAEMON class profile is not defined.

EMVSSAF2ERR

An error occurred in the security product.

Example

```
/* celeb22.c */
/* This example shows how to use __must_stay_clean() to request */
/* the environment is to "stay clean" until all processes in the */
/* address space are terminated. */
/* Requirements: */
/* 1. The environment must already be clean, noting that the */
/*    program issuing the request must be program-controlled */
/* 2. BPX.DAEMON must be defined */

#define _OPEN_SYS
#include <unistd.h>
#include <errno.h>
#include <stdio.h>
#include <stdlib.h>

int main(void){
    int rc;
    rc = __must_stay_clean(_MSC_ENABLE);    /* Stay Clean! */
    if (rc == _MSC_FAILED){
        perror("could not enable must stay clean");
        printf("errno=%d errno2=%08x\n",errno,__errno2());
        exit(1);
    }
    return 0;
}
```

Related information

m_wtransform_layout() – Layout transformation for wide-character strings (bidi data)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO C XPG4 C99 | both | z/OS V1R2 |

Format

```
#include <sys/layout.h>

int m_wtransform_layout(LayoutObject layout_object,
                        const wchar_t *InpBuf,
                        const size_t InpSize,
                        void *OutBuf,
                        size_t *Outsize,
                        size_t *InpToOut,
                        size_t *OutToInp,
                        unsigned char *Property,
                        size_t *InpBufIndex);
```

General description

The `m_wtransform_layout()` function is part of the support for handling of bidirectional (Bidi) conversion of data between Visual (MVS) and Implicit (z/OS UNIX) formats. Initial support is for Arabic and Hebrew data.

The `m_wtransform_layout()` function performs layout transformations (reordering, shaping, cell determination). Alternatively, it may provide additional information needed for layout transformation, such as:

- The expected size of the transformed layout
- The nesting level of different segments in the text
- Cross references between the locations of the corresponding elements before and after the layout transformation.

Both the input text and output text are wide-character strings. The `m_wtransform_layout()` function transforms the input text in *InpBuf* according to the current layout values in *layout_object*.

Any layout value whose value type is **LayoutTextDescriptor** describes the attributes of the *InpBuf* and *OutBuf* arguments. If the attributes are the same for both *InpBuf* and *OutBuf*, a NULL transformation is performed with respect to that specific layout value.

The *InpBuf* argument specifies the source text to be processed. The *InpBuf* may not be NULL, except when there is a need to reset the internal state.

The *InpSize* argument is the number of characters within *InpBuf* to be processed by the transformation. Its value will not have changed at the return from the transformation. *InpSize* set to -1 indicates that the text in *InpBuf* is delimited by a NULL code element. If *InpSize* is not set to -1, it is possible to have some NULL elements in the input buffer. This might be used, for example, for a *one shot* transformation of several strings, separated by NULLs.

Outputs of this function may be one or more of the following, depending on the setting of the arguments:

Argument Description

OutBuf

Any transformed data is stored in *OutBuf*, converted to **ShapeCharset**.

Outsize

The number of wide characters in *OutBuf*.

InpToOut

A cross reference from each *InpBuf* code element to the transformed data. The cross reference relates to the data in *InpBuf*, starting with the first element that *InpBufIndex* points to (and not necessarily starting from the beginning of the *InpBuf*.)

OutToInp

A cross reference to each *InpBuf* code element from the transformed data. The cross reference relates to the data in *InpBuf*, starting with the first element that *InpBufIndex* points to (and not necessarily starting from the beginning of the *InpBuf*.)

Property

A weighted value that represents specific input string transformation properties with different connotations as explained below. If this argument is not a NULL pointer, it represents an array of values with the same number of elements as the source substring text before the transformation.

Each byte will contain relevant *property* information of the corresponding element in *InpBuf*, starting from the element pointed by *InpBufIndex*.

The four rightmost bits of each *property* byte will contain information for bidirectional environments (when **ActiveDirectional** is True) and they will mean **NestingLevels**. The possible value from 0 to 15 represents the nesting level of the corresponding element in the *InpBuf*, starting from the element pointed by *InpBufIndex*. If **ActiveDirectional** is False, the content of NestingLevels bits will be ignored.

The leftmost bit of each *property* byte will contain a *new cell indicator* for composed character environments. It will be a value of either 1, for an element in *InpBuf* that is transformed to the beginning of a new cell, or 0, for the *zero-length* composing character elements, when these are grouped into the same presentation cell with a non-composing character. Here again, each element of *property* pertains to the elements in the *InpBuf*, starting from the element pointed by *InpBufIndex*. (Remember that this is not necessarily the beginning of *InpBuf*.)

If none of the transformation properties is required, the argument *Property* can be NULL.

The use of *property* can be enhanced in the future to pertain to other possible usage in other environments.

InpBufIndex

An offset value to the location of the transformed text. When `m_wtransform_layout()` is called, *InpBufIndex* contains the offset to the element in *InpBuf* that will be transformed first. (Note that this is not necessarily the first element in *InpBuf*.)

At the return from the transformation, *InpBufIndex* contains the offset to the first element in the *InpBuf* that has not been transformed. If the entire substring has been transformed successfully, *InpBufIndex* will be incremented by the amount defined by *InpSize*.

Each of these output arguments may be NULL to specify that no output is desired for the specific argument, but at least one of them should be set to non-NULL to perform any significant work.

In addition to the possible outputs above, the *layout_object* maintains a directional state across calls to the transform functions. The directional state is reset to its initial state whenever any of the layout values **TypeOfText**, **Orientation** or **ImplicitAlg** is modified by means of a call to `m_setvalues_layout()`.

The *layout_object* argument specifies a `LayoutObject` returned by the `m_create_layout()` function.

The *OutBuf* argument contains the transformed data. This argument can be specified as a NULL pointer to indicate that no transformed data is required. The encoding of the *OutBuf* argument

depends on the **ShapeCharset** layout value defined in *layout_object*. If the **ActiveShapeEditing** layout value is not set (False), the encoding of *OutBuf* is guaranteed to be the same as the codeset of the locale associated with the LayoutObject defined by *layout_object*.

On input, the *OutSize* argument specifies the size of the output buffer in number of wide characters. The output buffer should be large enough to contain the transformed result; otherwise, only a partial transformation is performed. If the **ActiveShapeEditing** layout value is set (True), the *OutBuf* should be allocated to contain at least the *InpSize* multiplied by **ShapeCharsetSize**.

OutSize

Upon return, the *OutSize* argument is updated to be the actual number of code elements placed in *OutBuf*.

When the *OutSize* argument is specified as zero, the function calculates the size of an output buffer large enough to contain the transformed text, and the result is returned in this field. The content of the buffers specified by *InpBuf* and *OutBuf*, and the value of *InpBufIndex*, remain unchanged.

If *OutSize* = NULL, the EINVAL error condition is returned.

If the *InpToOut* argument is not a NULL pointer, it points to an array of values with the same number of wide characters as *InpBuf*, starting with the one pointed by *InpBufIndex* and up to the end of the substring in the buffer.

On output, the *nth* value in *InpToOut* corresponds to the *nth* wide character in *InpBuf*. This value is the index (in units of wide characters) in *OutBuf* that identifies the transformed **ShapeCharset** element of the *nth* wide character in *InpBuf*.

InpToOut may be specified as NULL if no index array from *InpBuf* to *OutBuf* is desired.

If the *OutToInp* argument is not a NULL pointer, it points to an array of values with the same number of wide characters as contained in *OutBuf*. On output, the *nth* value in *OutToInp* corresponds to the *nth* wide character in *OutBuf*. This value is the index in *InpBuf*, starting with the wide character pointed to by *InpBufIndex*, that identifies the logical code element of the *nth* byte in *OutBuf*.

OutToInp may be specified as NULL if no index array from *OutBuf* to *InpBuf* is desired.

To perform shaping of a text string without reordering of code elements, the *layout_object* should be set with input and output layout value **TypeOfText** set to TEXT_VISUAL, and both in and out of **Orientation** set to the same value.

Returned value

If successful, m_wtransform_layout() returns 0.

If unsuccessful, m_wtransform_layout() returns -1 and sets errno to one of the following values:

Error Code

Description

E2BIG

The size of *OutBuf* is not large enough to contain the entire transformed text. The input text state at the end of the uncompleted transformation is saved internally.

EBADF

The layout values are set to a meaningless combination or the layout object is not valid.

EINVAL

Transformation stopped due to an incomplete composite sequence at the end of the input buffer, or *OutSize* contains NULL.

Related information

- [“sys/layout.h — Bidirectional conversion of data between Visual and Implicit formats” on page 69](#)
- [“m_create_layout\(\) — Create and initialize a layout object \(bidi data\)” on page 1061](#)
- [“m_destroy_layout\(\) — Destroy a layout object \(bidi data\)” on page 1062](#)

- [“m_getvalues_layout\(\) — Query layout values of a layout object \(bidi data\)”](#) on page 1070
- [“m_setvalues_layout\(\) — Set layout values of a layout object \(bidi data\)”](#) on page 1109
- [“m_transform_layout\(\) — Layout transformation for character strings \(bidi data\)”](#) on page 1124

nan(), nanf(), nanl() — Return quiet NaN

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double nan(const char *tagp);
float nanf(const char *tagp);
long double nanl(const char *tagp);
```

General description

In the nan() family of functions, the call nan("n-char-sequence") is equivalent to strtod("NaN(n-charsequence)", (char**) NULL) and the call nan("") is equivalent to strtod("NaN()", (char**) NULL). If tagp does not point to an n-char sequence or an empty string, the call is equivalent to strtod("NaN", (char**) NULL). Calls to nanf() and nanl() are equivalent to the corresponding calls strtod() and strtold().

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| nan | X | X |
| nanf | X | X |
| nanl | X | X |

Returned value

If successful, they return a quiet NaN with content indicated by tagp.

Special behavior in hex: The nan() family of functions always return 0.

Example

```
/*
 * This program illustrates the use of the nan() function
 *
 * It calls both nan and strtod with equivalent arguments
 * and displays output of both. Output should be identical.
 */
#define _ISOC99_SOURCE
#include <stdio.h>
#include <stdlib.h> /* needed of strtod */
#include <math.h>
```

```
#define TESTVALS 5
struct {
    const char * str;
} nan_vals[] = {
/*0*/ { "0", },
/*1*/ { "1", },
/*2*/ { "something", }, /* invalid n-char seq. */
/*3*/ { "2147483647", }, /* int max */
/*4*/ { "2147483648", }, /* int max +1 */
},

strods_vals[] = {
/*0*/ { "NAN(0)", },
/*1*/ { "NAN(1)", },
/*2*/ { "NAN", },
/*3*/ { "NAN(2147483647)", },
/*4*/ { "NAN(2147483648)", },
};

void main()
{
    double outnan,
        outstrtod;
    int i;
    char *tagp = (char *)NULL;

    printf("Illustrates the nan() function\n");
    printf("Output for both nan() and strtod() should be identical.\n\n");
    for (i=0; i<TESTVALS; i++) {
        outnan = nan(nan_vals[i].str);
        outstrtod = strtod(strods_vals[i].str, &tagp);

        printf("nan(%s) returned = %g\n",nan_vals[i].str, outnan);
        printf("strtod(%s) returned = %g\n\n",strods_vals[i].str, outstrtod);
    }
}
```

Output

```
Illustrates the nan() function
Output for both nan() and strtod() should be identical.

nan(0) returned = 0
strtod(NAN(0)) returned = 0

nan(1) returned = NaNQ(1)
strtod(NAN(1)) returned = NaNQ(1)

nan(something) returned = NaNQ(1)
strtod(NAN) returned = NaNQ(1)

nan(2147483647) returned = NaNQ(2147483647)
strtod(NAN(2147483647)) returned = NaNQ(2147483647)

nan(2147483648) returned = 0
strtod(NAN(2147483648)) returned = 0
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“strtod\(\) — Convert character string to double” on page 1759](#)

nand32(), nand64(), nand128() — Return quiet NaN

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32  nand32(const char *tagp);
_Decimal64  nand64(const char *tagp);
_Decimal128 nand128(const char *tagp);
```

General description

In the `nan()` family of functions, the call `nand32("n-char-sequence")` is equivalent to `strtod32("NAN(n-charsequence)", (char**) NULL)` and the call `nand32("")` is equivalent to `strtod32("NAN()", (char**) NULL)`. If `tagp` does not point to an n-char sequence or an empty string, the call is equivalent to `strtod32("NAN", (char**) NULL)`. Calls to `nand64()` and `nand128()` are equivalent to the corresponding calls `strtod64()` and `strtod128()`.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, they return a quiet NaN with content indicated by `tagp`.

Example

```
/* CELEBN05

   This program illustrates the use of the nand32() function.

   It calls both nand32() and strtod32() with equivalent arguments
   and displays output of both. Output should be identical.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>
#include <stdlib.h>          /* needed for strtod32()          */

#define TESTVALS 5

struct
{
    const char * str;
}
nan_vals[] =
{
    /*0*/ { "0"                },
    /*1*/ { "1"                },
    /*2*/ { "something"        }, /* invalid n-char seq.          */
    /*3*/ { "999999"           }, /* max nanocode              */
    /*4*/ { "1000000"          }, /* max nanocode + 1          */
}

,
stroval_vals[] =
{
    /*0*/ { "NAN(0)"           },
    /*1*/ { "NAN(1)"           },
    /*2*/ { "NAN"              },
    /*3*/ { "NAN(999999)"      },
    /*4*/ { "NAN(1000000)"     },
};
```

```
int main(void)
{
    _Decimal32 outnan,
               outstrtod;
    int        i;

    printf("Illustrates the nand32() function\n");
    printf("Output for both nand32() and strtod32()"
           "should be identical.\n\n");

    for (i = 0; i < TESTVALS; i++)
    {
        outnan      = nand32( nan_vals[i].str      );
        outstrtod   = strtod32(strod_vals[i].str, NULL);

        printf("nand32(%s)      returned = %Hg\n"
               , nan_vals[i].str, outnan      );
        printf("strtod32(%s) returned = %Hg\n\n"
               , strod_vals[i].str, outstrtod);
    }

    return 0;
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“nan\(\), nanf\(\), nanl\(\) — Return quiet NaN” on page 1133](#)
- [“strtod32\(\), strtod64\(\), strtod128\(\) — Convert character string to decimal floating point” on page 1761](#)

nanosleep() — High-resolution sleep

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| POSIX.1-2001 | both | |
| POSIX.1-2008 | | |

Format

```
#define _XOPEN_SOURCE 500
#include <time.h>

int nanosleep(const struct timespec *req, struct timespec *rem);
```

General description

nanosleep() suspends the execution of the calling thread until one of the following conditions is met:

- At least the time that is specified in **req* elapses.
- The delivery of a signal that triggers the invocation of a handler in the calling thread.
- The delivery of a signal that terminates the process.

If the call is interrupted by a signal handler, nanosleep() returns -1, sets *errno* to EINTR, and writes the remaining time into the structure that is pointed to by *rem* unless *rem* is NULL. The value of **rem* can be used to call nanosleep() again and complete the specified pause.

The structure *timespec* is used to specify intervals of time with nanosecond precision. The value of the nanoseconds field in it must be in the range 0 to 999999999.

Compared to sleep() and usleep(), nanosleep() has the following advantages:

- It provides a higher resolution for specifying the sleep interval; POSIX.1 explicitly specifies that it does not interact with signals.
- It makes the task of resuming a sleep that is interrupted by a signal handler easier.

Returned value

On successful sleeping for the requested interval, `nanosleep()` returns 0.

If the call is interrupted by a signal handler or encounters an error, `nanosleep()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINTR

The pause is interrupted by a signal that is delivered to the thread. The remaining sleep time is written into `*rem` so that the thread can call `nanosleep()` again and continue with the pause.

EINVAL

The value in the `tv_nsec` field is not in the range 0 to 999999999 or the `tv_sec` field is not in the range 0 to 4294967295 for a 64-bit caller.

Related information

- [“time.h — Time and date” on page 75](#)
- [“sleep\(\) — Suspend execution of a thread” on page 1668](#)
- [“usleep\(\) — Suspend execution for an interval” on page 1951](#)

nearbyint(), nearbyintf(), nearbyintl() — Round the argument to the nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double nearbyint(double x);
float nearbyintf(float x);
long double nearbyintl(long double x);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float nearbyint(float x);
long double nearbyint(long double x);
```

General description

The `nearbyint()` family of functions round x to an integer value, in floating-point format, using the current rounding mode without raising the `inexact` floating-point exception.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|-------------------------|-----|------|
| <code>nearbyint</code> | X | X |
| <code>nearbyintf</code> | X | X |
| <code>nearbyinfl</code> | X | X |

Returned value

If successful, they return the rounded integer value. If the correct value causes an overflow, a range error occurs and the value, respectively, of the macro: `+-HUGE_VAL`, `+-HUGE_VALF`, or `+-HUGE_VALL` (with the same sign as x) is returned.

Example

```

/*
 * This program illustrates the use of nearbyint() function
 *
 * Note: to get the results shown in this book , this program
 *       should be compiled using IEEE floating point representation
 *
 */
#define _ISOC99_SOURCE
#include <math.h>
#include <stdio.h>
#include <_Ieee754.h> /* save/get fpc functions */

char *RoundStr (_FP_rmode_t rm_type) {
    char *RndStr="undetermined";
    switch (rm_type) {
        case (_RMODE_RN):
            RndStr="round to nearest";
            break;
        case (_RMODE_RZ):
            RndStr="round toward zero";
            break;
        case (_RMODE_RP):
            RndStr="round toward +infinity ";
            break;
        case (_RMODE_RM):
            RndStr="round toward -infinity ";
            break;
    }
    return (RndStr);
}

void main() {

    _FP_fpcreg_t save_rmode, current_rmode;
    double      rnd2nearest;
    double      number1=1.5,
               number2=-3.92;

    printf("Illustrates the nearbyint() function\n");
    __fpc_rd(&current_rmode); /* get current rounding mode */

    rnd2nearest = nearbyint(number1);
    printf ("When rounding direction is %s:\n nearbyint(%.2f) = %f\n",

```

```

        RoundStr(current_rmode.rmode), number1, rnd2nearest);
save_rmode.rmode = _RMODE_RZ;
__fpc_sm(save_rmode.rmode);    /* set rounding mode to round to zero */

rnd2nearest = nearbyint(number2);
printf ("When rounding direction is %s:\n nearbyint(%.2f) = %f\n",
        RoundStr(save_rmode.rmode), number2, rnd2nearest);
}

```

Output

Illustrates the `nearbyint()` function
 When rounding direction is round to nearest:
`nearbyint(1.50) = 2.000000`
 When rounding direction is round toward zero:
`nearbyint(-3.91) = -3.000000`

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceil\(\), ceilf\(\), ceill\(\) — Round up to integral value” on page 249](#)
- [“floor\(\), floorf\(\), floorl\(\) — Round down to integral value” on page 554](#)
- [“llround\(\), llroundf\(\), llroundl\(\) — Round to the nearest integer” on page 981](#)
- [“lrint\(\), lrintf\(\), lrintl\(\) and llrint\(\), llrintf\(\), llrintl\(\) — Round the argument to the nearest integer” on page 1015](#)
- [“lround\(\), lroundf\(\), lroundl\(\) — Round a decimal floating-point number to its nearest integer” on page 1019](#)
- [“rint\(\), rintf\(\), rintl\(\) — Round to nearest integral value” on page 1454](#)
- [“round\(\), roundf\(\), roundl\(\) — Round to the nearest integer” on page 1459](#)
- [“trunc\(\), truncf\(\), trunc\(\) — Truncate an integer value” on page 1899](#)

nearbyintd32(), nearbyintd64(), nearbyintd128() — Round the argument to the nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32  nearbyintd32(_Decimal32 x);
_Decimal64  nearbyintd64(_Decimal64 x);
_Decimal128 nearbyintd128(_Decimal128 x);
_Decimal32  nearbyint(_Decimal32 x);      /* C++ only */
_Decimal64  nearbyint(_Decimal64 x);      /* C++ only */
_Decimal128 nearbyint(_Decimal128 x);     /* C++ only */

```

General description

The `nearbyint()` family of functions round `x` to an integer value, in decimal floating-point format, using the current rounding mode without raising the inexact decimal floating-point exception.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, they return the rounded integer value. If the correct value causes an overflow, a range error occurs and the value, respectively, of the macro: \pm HUGE_VAL_D32, \pm HUGE_VAL_D64, or \pm HUGE_VAL_D128 (with the same sign as x) is returned.

Example

```
/* CELEBN06

   This example illustrates the nearbyintd64() function.
*/

#pragma strings(readonly)

#define __STDC_WANT_DEC_FP__
#include <fenv.h>
#include <math.h>
#include <stdio.h>

static void try_rm(int);
/* pass back printable rounding mode */

static
char *rm_str(int rm)
{
    char *s = "undetermined";

    switch (rm)
    {
        case FE_DEC_TONEAREST :
            s = "FE_DEC_TONEAREST" ; break;
        case FE_DEC_TOWARDZERO :
            s = "FE_DEC_TOWARDZERO" ; break;
        case FE_DEC_UPWARD :
            s = "FE_DEC_UPWARD" ; break;
        case FE_DEC_DOWNWARD :
            s = "FE_DEC_DOWNWARD" ; break;
        case FE_DEC_TONEARESTFROMZERO :
            s = "FE_DEC_TONEARESTFROMZERO" ; break;
        case FE_DEC_TONEARESTTOWARDZERO :
            s = "FE_DEC_TONEARESTTOWARDZERO" ; break;
        case FE_DEC_AWAYFROMZERO :
            s = "FE_DEC_AWAYFROMZERO" ; break;
        case FE_DEC_PREPAREFORSHORTER :
            s = "FE_DEC_PREPAREFORSHORTER" ; break;
    }

    return s;
}

/* Try out one passed-in number with rounding mode */

static void try_rm(int rm)
{
    _Decimal64 r64;
    _Decimal64 d64 = 500.99DD;

    (void)fe_dec_setround(rm);

    r64 = nearbyintd64(d64);

    printf("nearbyintd64(%.2DF) = %DG - rounding mode = %s\n",
        d64, r64, rm_str(rm)
    );

    return;
}
```

```
int main()
{
    try_im( FE_DEC_TONEAREST          );
    try_im( FE_DEC_TOWARDZERO         );
    try_im( FE_DEC_UPWARD              );
    try_im( FE_DEC_DOWNWARD           );
    try_im( FE_DEC_TONEARESTFROMZERO  );
    try_im( FE_DEC_TONEARESTTOWARDZERO);
    try_im( FE_DEC_AWAYFROMZERO       );
    try_im( FE_DEC_PREPAREFORSHORTER  );

    return 0;
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceild32\(\), ceild64\(\), ceild128\(\) — Round up to integral value” on page 250](#)
- [“floord32\(\), floord64\(\), floord128\(\) — Round down to integral value” on page 555](#)
- [“llroundd32\(\), llroundd64\(\), llroundd128\(\) — Round to the nearest integer” on page 983](#)
- [“lrintd32\(\), lrintd64\(\), lrintd128\(\) and llrintd32\(\), llrintd64\(\), llrintd128\(\) — Round the argument to the nearest integer” on page 1017](#)
- [“lroundd32\(\), lroundd64\(\), lroundd128\(\) — Round a floating-point number to its nearest integer” on page 1020](#)
- [“nearbyint\(\), nearbyintf\(\), nearbyintl\(\) — Round the argument to the nearest integer” on page 1137](#)
- [“rintd32\(\), rintd64\(\), rintd128\(\) — Round to nearest integral value” on page 1455](#)
- [“roundd32\(\), roundd64\(\), roundd128\(\) — Round to the nearest integer” on page 1460](#)
- [“truncd32\(\), truncd64\(\), truncd128\(\) — Truncate an integer value” on page 1900](#)

nextafter(), nextafterf(), nextafterl() — Next representable double float

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double nextafter(double x, double y);
```

C99:

```
#define _ISOC99_SOURCE
#include <math.h>

float nextafterf(float x, float y);
long double nextafterl(long double x, long double y);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float nextafter(float x, float y);
long double nextafter(long double x, long double y);
```

General description

The nextafter() function computes the next representable double-precision floating-point value following x in the direction of y. Thus, if y is less than x, nextafter() returns the largest representable floating-point number less than x.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|------------|-----|------|
| nextafter | X | X |
| nextafterf | X | X |
| nextafterl | X | X |

Restriction: The nextafterf() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

The nextafter() functions return the next representable value following x in the direction of y. They always succeed.

If x is finite and the correct function value overflows, a range error occurs and ±HUGE_VAL, ±HUGE_VALF, and ±HUGE_VALL (with the same sign as x) are returned as appropriate for the return type of the function.

Errno

Descirption

ERANGE

The correct value overflows.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

nextafterd32(), nextafterd64(), and nextafterd128() – Next representable decimal floating-point value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 nextafterd32(_Decimal32 x, _Decimal32 y);
_Decimal64 nextafterd64(_Decimal64 x, _Decimal64 y);
_Decimal128 nextafterd128(_Decimal128 x, _Decimal128 y);
_Decimal32 nextafter(_Decimal32 x, _Decimal32 y); /* C++ only */
```



```
_Decimal64 nextafter(_Decimal64 x, _Decimal64 y); /* C++ only */
_Decimal128 nextafter(_Decimal128 x, _Decimal128 y); /* C++ only */
```

General description

The `nextafter()` function computes the next representable decimal floating-point value following `x` in the direction of `y`. Thus, if `y` is less than `x`, `nextafter()` returns the largest representable decimal floating-point number less than `x`.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `nextafter()` functions return the next representable value following `x` in the direction of `y`.

| If... | Then... |
|---|---|
| <code>x</code> equals <code>y</code> | <code>copysign(x,y)</code> is returned. |
| <code>x</code> is less than <code>y</code> | the next representable value after <code>x</code> is returned. |
| <code>x</code> is greater than <code>y</code> | the largest representable decimal floating-point number less than <code>x</code> is returned. |
| <code>x</code> or <code>y</code> is a NaN | either <code>x</code> or <code>y</code> is returned. |

Example

```
/* CELEBN07
   This example illustrates the nextafterd128() function.
*/
#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x = 123456789.70DL, dir = 123456790.00DL, z;

    z = nextafterd128(x, dir);

    printf("The next number after %DDf in the direction %DDf\n is %DDf\n",
           x, dir, z);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“nextafter\(\), nextafterf\(\), nextafterl\(\) — Next representable double float” on page 1141](#)

nexttoward(), nexttowardf(), nexttowardl() – Calculate the next representable value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double nexttoward(double x, long double y);
float nexttowardf(float x, long double y);
long double nexttowardl(long double x, long double y);
```

C++ TR1 C99:

```
#define _TR1_C99
#include <math.h>

float nexttoward(float x, long double y);
long double nexttoward(long double x, long double y);
```

General description

The nexttoward() family of functions compute the next representable floating-point value following *x* in the direction of *y*.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|-------------|-----|------|
| nexttoward | X | X |
| nexttowardf | X | X |
| nexttowardl | X | X |

Restriction: The nexttowardf() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

If successful, they return the next representable value in the specified format after *x* in the direction of *y*.

| If... | Then... |
|-----------------------------------|---|
| <i>x</i> equals <i>y</i> | <i>y</i> (of type <i>x</i>) is returned. |
| <i>x</i> is less than <i>y</i> | the next representable value after <i>x</i> is returned. |
| <i>x</i> is greater than <i>y</i> | the largest representable floating-point number less than <i>x</i> is returned. |

| If... | Then... |
|--|---|
| x is finite and the correct function value would overflow | a range error occurs and +/-HUGE_VAL, +/-HUGE_VALF, or +/-HUGE_VALL (with the same sign as x) is returned by nexttoward(), nexttowardf() or nexttowardl() respectively. |
| x does not equal y and the correct subroutine value is subnormal, 0, or underflows | a range error occurs and either the correct function value (if representable) or 0.0 is returned. |
| x or y is a NaN | a NaN is returned. |

Example

```

/*
 * This program illustrates the use of nexttoward() function
 */
#define _ISOC99_SOURCE
#include <math.h>
#include <stdio.h>

void PrintBytes(char *str, double x)
{
    static union {
        unsigned char bytes[sizeof(double)];
        double val;
    } dbl;

    int i;
    dbl.val = x;

    printf("%s ", str);
    for (i=0; i<sizeof(double); ++i) {
        printf("%02x", dbl.bytes[i]);
    }
    printf("\n");
}

void main() {
    double    nextvalue;
    double    x=1.5;
    long double y=2.0;

    printf("Illustrates the nexttoward() function\n");

    printf("\nTest1 (x<y)    x = %f  y = %Lf\n", x, y);
    PrintBytes("x in hex =", x);
    nextvalue = nexttoward(x, y);
    printf ("nexttoward(x,y) = %f\n", nextvalue);
    PrintBytes("nexttoward(x,y) in hex =", nextvalue);

    x=1.5; y=1.0;
    printf("\nTest2 (x>y)    x = %f  y = %Lf\n", x, y);
    nextvalue = nexttoward(x, y);
    printf ("nexttoward(x,y) = %f\n", nextvalue);
    PrintBytes("nexttoward(x,y) in hex =", nextvalue);
}

```

Output

Illustrates the nexttoward() function

```

Test1 (x<y)    x = 1.500000  y = 2.000000
x in hex = 3ff8000000000000
nexttoward(x,y) = 1.500000
nexttoward(x,y) in hex = 3ff8000000000001

```

```

Test2 (x>y)    x = 1.500000  y = 1.000000
nexttoward(x,y) = 1.500000
nexttoward(x,y) in hex = 3ff7ffffffffffff

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“copysign\(\), copysignf\(\), copysignl\(\) — Copy the sign from one floating-point number to another” on page 328](#)
- [“nan\(\), nanf\(\), nanl\(\) — Return quiet NaN” on page 1133](#)
- [“nextafter\(\), nextafterf\(\), nextafterl\(\) — Next representable double float” on page 1141](#)

nexttowardd32(), nexttowardd64(), nexttowardd128() — Calculate the next representable value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 nexttowardd32(_Decimal32 x, _Decimal128 y);
_Decimal64 nexttowardd64(_Decimal64 x, _Decimal128 y);
_Decimal128 nexttowardd128(_Decimal128 x, _Decimal128 y);
_Decimal32 nexttoward(_Decimal32 x, _Decimal128 y); /*C++ only*/
_Decimal64 nexttoward(_Decimal64 x, _Decimal128 y); /*C++ only*/
_Decimal128 nexttoward(_Decimal128 x, _Decimal128 y); /*C++ only*/
```

General description

The nexttoward() family of functions compute the next representable decimal floating-point value following x in the direction of y.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, they return the next representable value in the specified format after x in the direction of y.

| If... | Then... |
|---|---|
| x equals y | y (of type x) is returned. |
| x is less than y | the next representable value after x is returned. |
| x is greater than y | the largest representable decimal floating-point number less than x is returned. |
| x is finite and the correct function value would overflow | a range error occurs and ±HUGE_VAL_D32, ±HUGE_VAL_D64, or ±HUGE_VAL_D128 (with the same sign as x) is returned by nexttowardd32(), nexttowardd64() or nexttowardd128(), respectively. |

| If... | Then... |
|--|---|
| x does not equal y and the correct subroutine value is subnormal, 0, or underflows | a range error occurs and either the correct function value (if representable) or 0.0 is returned. |
| x or y is a NaN | a NaN is returned. |

Example

```
/* CELEBN08

   This example illustrates the nexttowardd32() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

static void try_nt(_Decimal32 x, _Decimal128 y)
{
    _Decimal32 r = nexttowardd32(x, y);
    printf("nexttowardd32(%12.12HG, %12.12DDG) = % 12.12HG\n", x, y, r);
    return;
}

int main(void)
{
    try_nt( 2.000000DF, 2.00000001DL );
    try_nt(-2.000000DF, -2.00000001DL );
    try_nt( 2.000000DF, 2.00000000DL );
    try_nt( 2.000000DF, 1.99999999DL );
    try_nt(-2.000000DF, -1.99999999DL );
    try_nt( 9.999999E+96DF, 9.99999999E+96DL );
    try_nt( 1.000000E-95DF, 0.99999999E-95DL );

    return 0;
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“copysignd32\(\), copysignd64\(\), copysignd128\(\) — Copy the sign from one floating-point number to another” on page 329](#)
- [“nand32\(\), nand64\(\), nand128\(\) — Return quiet NaN” on page 1134](#)
- [“nextafterd32\(\), nextafterd64\(\), and nextafterd128\(\) — Next representable decimal floating-point value” on page 1142](#)
- [“nexttoward\(\), nexttowardf\(\), nexttowardl\(\) — Calculate the next representable value” on page 1144](#)

nftw(), nftw64() — Traverse a file tree

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

nftw:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ftw.h>

int nftw(const char *path,
        int (*fn)(const char *, const struct stat *, int, struct FTW *),
        int fd_limit, int flags);
```

nftw64:

```
#define _LARGE_TIME_API
#define _XOPEN_SOURCE_EXTENDED 1
#include <ftw.h>

int nftw64(const char *path,
           int (*fn)(const char *, const struct stat64 *, int, struct FTW *),
           int fd_limit, int flags);
```

Compile requirement: Use of the `nftw64()` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The `nftw()` function recursively descends the directory hierarchy rooted in *path*. It is similar to `ftw()` except that it takes an additional argument *flags*, which is a bitwise inclusive-OR of zero or more of the following flags:

FTW_CHDIR

If set, `nftw()` will change the current working directory to each directory as it reports files in that directory. If clear, `nftw()` will not change the current working directory.

FTW_DEPTH

If set, `nftw()` will report all files in a directory before reporting the directory itself. If clear, `nftw()` will report any directory before reporting the files in that directory.

FTW_MOUNT

If set, `nftw()` will only report files in the same file system as *path*. If clear, `nftw()` will report all files encountered during the walk.

FTW_PHYS

If set, `nftw()` performs a physical walk and does not follow symbolic links. If clear, `nftw()` will follow links instead of reporting them, and will not report the same file twice.

At each file it encounters, `nftw()` calls the user-supplied function *fn* with four arguments:

- the first argument is the path name of the object.
- the second argument is a pointer to a `stat` buffer containing information on the object.
- the third argument is an integer giving additional information. Its value is one of the following:

FTW_D

for a directory

FTW_DNR

for a directory that cannot be read

FTW_DP

for a directory whose sub-directories have been visited. (This condition will only occur if `FTW_DEPTH` is included in *flags*.)

FTW_F

for a file

FTW_NS

for an object other than a symbolic link on which `stat()` could not be successfully executed. If the object is a symbolic link, and `stat()` failed, it is unspecified whether `nftw()` passes `FTW_SL` or `FTW_NS` to the user-supplied function.

FTW_SL

for a symbolic link

FTW_SLN

for a symbolic link that does not name an existing file. (This condition will only occur if FTW_PHYS is not included in *flags*.)

- the fourth argument is a pointer to an FTW structure. The value of *base* is the offset of the object's filename in the path name passed as the first argument to *fn()*. The value of *level* indicates depth relative to the root of the walk, where the root level is 0.

The argument *fd_limit* limits the directory depth for the search. At most one file descriptor will be used for each directory level.

The *nftw64()* function behaves exactly like *nftw()* except *nftw64()* uses structure *stat64* instead of struct *stat* to support time beyond 03:14:07 UTC on January 19, 2038.

Large file support for z/OS UNIX files: *nftw64()* automatically supports large z/OS UNIX files for both AMODE 31 and AMODE 64 C/C++ applications, which means there is no need for `_LARGE_FILES` feature test macro to be defined. As for *nftw()*, the automatic support is only for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the long long data type support enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable *nftw()* to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Special behavior for C++: Because C and C++ linkage conventions are incompatible, *nftw()* cannot receive a C++ function pointer as the argument. If you attempt to pass a C++ function pointer to *nftw()*, the compiler will flag it as an error. You can pass a C or C++ function to *nftw()* by declaring it as extern "C".

Returned value

nftw() continues until the first of the following conditions occurs:

- An invocation of *fn()* returns a nonzero value, in which case *nftw()* returns that value.
- The *nftw()* function detects an error other than EACCES (see FTW_DNR and FTW_NS above), in which case *nftw()* returns -1 and sets *errno* to indicate the error.
- The tree is exhausted, in which case *nftw()* returns 0.

If unsuccessful, *nftw()* sets *errno* to one of the following values. All other *errno*s returned by *nftw()* are unchanged.

Error Code**Description****EACCES**

Search permission is denied for any component of *path* or read permission is denied for *path*, or *fn()* returns -1 and does not reset *errno*.

ELOOP

Too many symbolic links were encountered.

EMFILE

OPEN_MAX file descriptors are currently open in the calling process.

ENAMETOOLONG

One of the following error conditions exists:

- Path name resolution of a symbolic link produced an intermediate result whose length exceeds PATH_MAX.
- The length of *path* exceeds PATH_MAX, or a *pathname* component is longer than PATH_MAX.

ENFILE

Too many files are currently open in the system.

ENOENT

A component of *path* does not name an existing file or *path* is an empty string.

ENOTDIR

A component of *path* is not a directory.

The `errno` value might also be set if the function `fn` causes it to be set.

Related information

- [“ftw.h — File tree traversal constants” on page 27](#)
- [“ftw\(\), ftw64\(\) — Traverse a file tree” on page 666](#)
- [“lstat\(\), lstat64\(\) — Get status of file or symbolic link” on page 1025](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)

nice() — Change priority of a process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <unistd.h>

int nice(int increment);
```

General description

`nice()` adds the value of *increment* to the nice value of the calling process. A process's nice value is a nonnegative number for which a more positive value results in a lower CPU priority.

A maximum nice value of $2 \cdot \{NZERO\} - 1$ and a minimum value of zero are imposed by the system. Requests for values above or below these limits result in the nice value being set to the corresponding limit. Only a process with appropriate privileges can lower the nice value.

The changing of a process's nice value has the equivalent effect on a process's scheduling priority value, since they both represent the process's relative CPU priority. For example, increasing one's nice value to its maximum value of $(2 \cdot NZERO) - 1$ has the equivalent effect of setting one's scheduling priority value to its maximum value (19), and will be reflected on the `nice()`, `getpriority()`, and `setpriority()` functions.

Returned value

If successful, `nice()` return the new nice value minus (NZERO).

If unsuccessful, `nice()` returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

ENOSYS

The system does not support this function.

EPERM

The value of *increment* was negative and the calling process does not have the appropriate privileges.

Because `nice()` can return the value -1 on successful completion, it is necessary to set the external variable `errno` to 0 before a call to `nice()`. If `nice()` returns -1, then `errno` can be checked to see if an error occurred or if the value is a legitimate nice value.

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“getpriority\(\) — Get process scheduling priority” on page 756](#)
- [“setpriority\(\) — Set process scheduling priority” on page 1563](#)

nlist() — Get entries from a name list

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <nlist.h>

int nlist(const char *loadname, struct nlist *np);
```

General description

The `nlist()` function allows a program to examine the name list in the executable file named by the *loadname* parameter. It selectively extracts a list of values and places them in the array of `nlist` structures pointed to by the *np* parameter.

The name list specified by the *np* parameter consists of an array of structures containing names of variables, types and values. The list is terminated with an element that has a NULL string in the name structure member. Each variable name is looked up in the name list of the executable file. If the name is found, the type and the value of the name is copied into the `nlist` structure field. If the name is not found, both the type and value entry will be set to zero.

All entries are set to zero if the specified executable file cannot be read or it does not contain a valid name list.

Notes:

1. The only variable type that will be supported by this version of `nlist()` is external function.
2. `nlist()` will extract the offset of the external functions from *loadname*.
3. The type returned in `nlist` structure will always be 2 to indicate function if the function name is found in *loadname*.
4. *loadname* must be a linear format load module containing `main()`.
5. *loadname* cannot be a dll (dynamic link library) or a fetchable load module.

Returned value

If successful, `nlist()` returns 0. The offset and type of functions if found will be returned in the `nlist` structure.

If unsuccessful, `nlist()` returns -1.

Related information

- [“nlist.h — nlist\(\) fucntion” on page 52](#)

nl_langinfo() — Retrieve locale information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#include <langinfo.h>

char *nl_langinfo(nl_item item);
```

General description

Retrieves from the current locale the string that describes the requested information specified by *item*.
For a list of macros that define the constants used to identify the information queried in the current locale, see [Table 4 on page 32](#).

Returned value

If successful, nl_langinfo() returns a pointer to a NULL-terminated string containing information concerning the active language or cultural area. The active language or cultural area is determined by the most recent setlocale() call. The array pointed to by the returned value is modified by subsequent calls to the function. The array shall not be modified by the user's program.
If the item is not valid, nl_langinfo() returns a pointer to an empty string.

Example

CELEBN01

```
/* CELEBN01

   This example retrieves the current codeset name using the
   &nl1. function.

*/
#include "langinfo.h"
#include "locale.h"
#include "stdio.h"

main() {
    char *codeset;
    setlocale(LC_ALL, "");
    codeset = nl_langinfo(CODESET);
    printf("codeset is %s\n", codeset);
}
```

Related information

- [“langinfo.h —Macros for date and time” on page 32](#)
- [“nl_types.h — National languages” on page 52](#)

- “localdtconv() — Date and time formatting convention inquiry” on page 986
- “localeconv() — Query numeric conventions” on page 988
- “setlocale() — Set locale” on page 1547

nrand48() — Pseudo-random number generator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

long int nrand48(unsigned short int x16v[3]);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrand48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The functions drand48() and erand48() return nonnegative, double-precision, floating-point values, uniformly distributed over the interval [0.0,1.0).

The functions lrand48() and nrand48() return nonnegative, long integers, uniformly distributed over the interval [0,2**31).

The functions mrand48() and jrand48() return signed long integers, uniformly distributed over the interval [-2**31,2**31).

The nrand48() function generates the next 48-bit integer value in a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \quad n \geq 0$$

The nrand48() function uses storage provided by the argument array, x16v[3], to save the most recent 48-bit integer value in the sequence, X(i). The nrand48() function uses x16v[0] for the low-order (rightmost) 16 bits, x16v[1] for the middle-order 16 bits, and x16v[2] for the high-order 16 bits of this value.

The initial values of a, and c are:

```
a  = 5deece66d (base 16)
c  = b          (base 16)
```

The values a and c, may be changed by calling the lcong48() function. The initial values of a and c are restored if either the seed48() or srand48() function is called.

Special behavior for z/OS UNIX Services: You can make the nrand48() function and other functions in the drand48 family thread-specific by setting the environment variable _RAND48 to the value THREAD before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested and the `rand48()` function is called from thread `t`, the `rand48()` function generates the next 48-bit integer value in a sequence of 48-bit integer values, $X(t,i)$, for the thread according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t)) \bmod (2^{**}48) \qquad n \geq 0$$

The `rand48()` function uses storage provided by the argument array, `x16v[3]`, to save the most recent 48-bit integer value in the sequence, $X(t,i)$. The `rand48()` function uses `x16v[0]` for the low-order (rightmost) 16 bits, `x16v[1]` for the middle-order 16 bits, and `x16v[2]` for the high-order 16 bits of this value.

The initial values of `a(t)` and `c(t)` on the thread `t` are:

$$\begin{aligned} a(t) &= 5\text{deece66d} \quad (\text{base } 16) \\ c(t) &= b \quad (\text{base } 16) \end{aligned}$$

The values `a(t)` and `c(t)` may be changed by calling the `lcong48()` function from the thread `t`. The initial values of `a(t)` and `c(t)` are restored if either the `seed48()` or `srand48()` function is called from the thread.

Returned value

`rand48()` saves the generated 48-bit value, $X(n+1)$, in storage provided by the argument array, `x16v[3]`. `rand48()` transforms the generated 48-bit value to a nonnegative, long integer value on the interval $[0, 2^{**}31)$ and returns this transformed value.

Special behavior for z/OS UNIX Services: If thread-specific behavior is requested for the `drand48` family and `rand48()` is called on thread `t`, `rand48()` saves the generated 48-bit value, $X(t,n+1)$, in storage provided by the argument array, `x16v[3]`. `rand48()` transforms the generated 48-bit value to a nonnegative, long integer value on the interval $[0, 2^{**}31)$ and returns this transformed value.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“drand48\(\) — Pseudo-random number generator” on page 403](#)
- [“erand48\(\) — Pseudo-random number generator” on page 430](#)
- [“jrand48\(\) — Pseudo-random number generator” on page 927](#)
- [“lcong48\(\) — Pseudo-random number initializer” on page 939](#)
- [“lrand48\(\) — Pseudo-random number generator” on page 1013](#)
- [“mrand48\(\) — Pseudo-random number generator” on page 1108](#)
- [“seed48\(\) — Pseudo-random number initializer” on page 1470](#)
- [“srand48\(\) — Pseudo-random number initializer” on page 1705](#)

ntohl() — Translate a long integer into host byte order

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

XPG4.2:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>
```

```
in_addr_t ntohl(in_addr_t netlong);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <arpa/inet.h>

uint32_t ntohl(uint32_t netlong);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/inet.h>

unsigned long ntohl(unsigned long a);
```

General description

The `ntohl()` function translates a long integer from network byte order to host byte order.

Parameter

Description

a

The unsigned long integer to be put into host byte order.

in_addr_t *netlong*

Is typed to the unsigned long integer to be put into host byte order.

Notes:

1. For MVS, host byte order and network byte order are the same.
2. Since this function is implemented as a macro, you need one of the feature test macros and the `inet` header file.

Returned value

`ntohl()` returns the translated long integer.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“htonl\(\) — Translate address host to network long” on page 819](#)
- [“htons\(\) — Translate an unsigned short integer into network byte order” on page 820](#)
- [“ntohs\(\) — Translate an unsigned short integer into host byte order” on page 1155](#)

ntohs() — Translate an unsigned short integer into host byte order

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

XPG4.2:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <arpa/inet.h>

in_port_t ntohs(in_port_t netshort);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <arpa/inet.h>

uint16_t ntohs(uint16_t netshort);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <arpa/inet.h>
#include <netinet/in.h>

unsigned short ntohs(unsigned short a);
```

General description

The `ntohs()` function translates a short integer from network byte order to host byte order.

Parameter

Description

a

The unsigned short integer to be put into host byte order.

in_port_t *netshort*

Is typed to the unsigned short integer to be put into host byte order.

Notes:

1. For MVS, host byte order and network byte order are the same.
2. Since this function is implemented as a macro, you need one of the feature test macros and the `inet` header file.

Returned value

`ntohs()` returns the translated short integer.

Related information

- [“arpa/inet.h — Internet operations” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“htonl\(\) — Translate address host to network long” on page 819](#)
- [“htons\(\) — Translate an unsigned short integer into network byte order” on page 820](#)
- [“ntohl\(\) — Translate a long integer into host byte order” on page 1154](#)

open() — Open a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <fcntl.h>

int open(const char *pathname, int options, ...);
```

General description

Opens a file and returns a number called a *file descriptor*.

The *pathname* argument must be a z/OS UNIX file name. You can use this file descriptor to refer to the file in subsequent I/O operations, for example, `read()` or `write()`. Each file opened by a process gets a new file descriptor.

Restriction: Using this function with FIFOs, POSIX terminals, and character special files requires IBM z/OS C programs running POSIX(ON).

The argument *pathname* is a string giving the name of the file you want to open. The integer *options* specifies options for the open operation by taking the bitwise inclusive-OR of symbols defined in the `fcntl.h` header file. The options indicate whether the file should be accessed for reading, writing, reading and writing, and so on.

An additional argument (`. . .`) is required if the `O_CREAT` option is specified in *options*. This argument may be called the *mode* and has the `mode_t` type. It specifies file permission bits to be used when a file is created. All the file permission bits are set to the bits of *mode*, except for those set in the file-mode creation mask of the process. Here is a list of symbols that can be used for a mode.

S_IRGRP

Read permission for the file's group.

S_IROTH

Read permission for users other than the file owner.

S_IRUSR

Read permission for the file owner.

S_IRWXG

Read, write, and search or execute permission for the file's group. `S_IRWXG` is the bitwise inclusive-OR of `S_IRGRP`, `S_IWGRP`, and `S_IXGRP`.

S_IRWXO

Read, write, and search or execute permission for users other than the file owner. `S_IRWXO` is the bitwise inclusive-OR of `S_IROTH`, `S_IWOTH`, and `S_IXOTH`.

S_IRWXU

Read, write, and search, or execute, for the file owner; `S_IRWXU` is the bitwise inclusive-OR of `S_IRUSR`, `S_IWUSR`, and `S_IXUSR`.

S_ISGID

Privilege to set group ID (GID) for execution. When this file is run through an exec function, the effective group ID of the process is set to the group ID of the file, so that the process has the same authority as the file owner rather than the authority of the actual invoker.

S_ISUID

Privilege to set the user ID (UID) for execution. When this file is run through an exec function, the effective user ID of the process is set to the owner of the file, so that the process has the same authority as the file owner rather than the authority of the actual invoker.

S_ISVTX

Indicates shared text. Keep loaded as an executable file in storage.

S_IWGRP

Write permission for the file's group.

S_IWOTH

Write permission for users other than the file owner.

S_IWUSR

Write permission for the file owner.

S_IXGRP

Search permission (for a directory) or execute permission (for a file) for the file's group.

S_IXOTH

Search permission for a directory, or execute permission for a file, for users other than the file owner.

S_IXUSR

Search permission (for a directory) or execute permission (for a file) for the file owner.

Most open operations position a *file offset* (an indicator showing where the next read or write will take place in the file) at the beginning of the file; however, there are options that can change this position. One of the following must be specified in the *options* argument of the `open()` operation:

O_RDONLY

Open for reading only

O_WRONLY

Open for writing only

O_RDWR

Open for both reading and writing

One or more of the following can also be specified in *options*:

O_APPEND

Positions the file offset at the end of the file before each write operation.

O_CLOEXEC

Enable the close-on-exec flag for the new file descriptor. Specifying this flag permits a program to avoid additional `fcntl()` `F_SETFD` operations to set the `FD_CLOEXEC` flag. This flag is defined by the `_XPLATFORM_SOURCE` feature test macro.

O_CREAT

Indicates that the call to `open()` has a *mode* argument.

If the file being opened already exists `O_CREAT` has no effect except when `O_EXCL` is also specified; see `O_EXCL` following.

If the file being opened does not exist it is created. The user ID is set to the effective ID of the process, and its group ID is set to the group ID of its directory. File permission bits are set according to *mode*.

If `O_CREAT` is specified and the file did not previously exist a successful `open()` sets the access time, change time, and modification time for the file. It also updates the change time and modification time fields in the parent directory.

O_DIRECT

Try to minimize cache effects of the I/O to and from this file. This flag is defined by the `_XPLATFORM_SOURCE` feature test macro.

O_DIRECTORY

If *pathname* is not a directory, cause the open to fail. This flag is defined by the `_XPLATFORM_SOURCE` feature test macro.

O_EXCL

If both `O_EXCL` and `O_CREAT` are specified `open()` fails if the file already exists. If both `O_EXCL` and `O_CREAT` are specified and *pathname* names a symbolic link `open()` fails regardless of the contents of the symbolic link.

The check for the existence of the file and the creation of the file if it does not exist is atomic with respect to other threads executing `open()` naming the same filename in the same directory with `O_EXCL` and `O_CREAT` set.

O_NOCTTY

If *pathname* specifies a terminal `open()` does not make the terminal the controlling terminal of the process (and the session). If `O_NOCTTY` is not specified the terminal becomes the controlling terminal if the following conditions are true:

- The process is a session leader.
- There is no controlling terminal for the session.
- The terminal is not already a controlling terminal for another session.

O_NOFOLLOW

If the trailing component (i.e., base name) of *pathname* is a symbolic link, the open fails with the error `ELOOP`. This flag is defined by the `_XPLATFORM_SOURCE` feature test macro.

O_NONBLOCK

Has different meanings depending on the situation.

- When you are opening a FIFO special file with `O_RDONLY` or `O_WRONLY`:

If `O_NONBLOCK` is specified a read-only `open()` returns immediately. A write-only `open()` returns with an error if no other process has the FIFO open for reading.

If `O_NONBLOCK` is not specified a read-only `open()` blocks until another process opens the FIFO for writing. A write-only `open()` blocks until another process opens the FIFO for reading.

- When you are opening a character special file that supports a nonblocking `open()`, `O_NONBLOCK` controls whether subsequent reads and writes can block.

O_PATH

Obtain a file descriptor either to indicate a location in the file system tree or to perform operations that act at the file descriptor level. This flag is defined by the `_XPLATFORM_SOURCE` feature test macro.

O_TRUNC

If the file is successfully opened with `O_RDWR` or `O_WRONLY`, this will truncate the file to zero length if the file exists and is a regular file. The mode and owner of the file are unchanged. This option should not be used with `O_RDONLY`. `O_TRUNC` has no effect on FIFO special files or directories.

If `O_TRUNC` is specified and the file previously existed a successful `open()` updates the change time and modification time for the file.

O_SYNC

Force synchronous update. If this flag is 1 every `write()` operation on the file is written to permanent storage. That is, the file system buffers are forced to permanent storage. Also see `fsync()`.

The program is assured that all data for the file has been written to permanent storage on return from a function which performs a synchronous update,

If *pathname* refers to a STREAM file, *oflag* can be constructed from `O_NONBLOCK` OR-ed with either `O_RDONLY`, `O_WRONLY` or `O_RDWR`. Other flag values are not applicable to STREAMS devices and have no

effect on them. The value `O_NONBLOCK` affects the operation of STREAMS drivers and certain functions applied to file descriptors associated with STREAMS files. For STREAMS drivers, the implementation of `O_NONBLOCK` is device-specific.

Note: z/OS UNIX services do not supply any STREAMS devices or pseudodevices. It is impossible for `open()` to return a valid STREAMS file descriptor.

The largest value that can be represented correctly in an object of type `off_t` is established as the offset maximum in the open file description.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `open()` returns a file descriptor.

If unsuccessful, `open()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EACCES

Access is denied. Possible reasons include:

- The process does not have search permission on a component in *pathname*.
- The file exists, but the process does not have permission to open the file in the way specified by the flags.
- The file does not exist, and the process does not have write permission on the directory where the file is to be created.
- `O_TRUNC` was specified, but the process does not have write permission on the file.

EBUSY

The process attempted to open a file that is in use.

EEXIST

`O_CREAT` and `O_EXCL` were specified, and either the named file refers to a symbolic link, or the named file already exists.

EINTR

`open()` was interrupted by a signal.

EINVAL

The *options* parameter does not specify a valid combination of the `O_RDONLY`, `O_WRONLY` and `O_TRUNC` bits.

EIO

The *pathname* argument names a STREAMS file and a hang-up or error occurred during the `open()`.

EISDIR

pathname is a directory, and *options* specifies write or read/write access.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of *pathname* is greater than `POSIX_SYMLINK_MAX`.

EMFILE

The process has reached the maximum number of file descriptors it can have open.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters, or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the

pathname string substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined using `pathconf()`.

ENFILE

The system has reached the maximum number of file descriptors it can have open.

ENOENT

Typical causes:

- `O_CREAT` is not specified, and the named file does not exist.
- `O_CREAT` is specified, and either the prefix of *pathname* does not exist or the *pathname* argument is an empty string.

ENOMEM

The *pathname* argument names a STREAMS file and the system is unable to allocate resources.

ENOSPC

The directory or file system intended to hold a new file has insufficient space.

ENOSR

The *pathname* argument names a STREAMS-based file and the system is unable to allocate a STREAM.

ENOSYS

For main pseudoterminals, subsidiary initialization did not complete.

ENOTDIR

A component of *pathname* is not a directory.

ENXIO

`O_NONBLOCK` and `O_WRONLY` were specified and the named file is a FIFO, but no process has the file open for reading. For a pseudoterminal, the requested minor number exceeds the maximum number supported by the installation.

EPERM

For subsidiary pseudoterminals, permission to open is denied for one of these reasons:

- It is the first open of the subsidiary after the main pseudoterminal was opened, and the user ID associated with the two opening processes is not the same.
- There was an internal error in the security system after the main pseudoterminal was opened.
- The attempt to open the subsidiary used a different pathname than earlier opens used.

EROFS

pathname is on a read-only file system, and one or more of the options `O_WRONLY`, `O_RDWR`, `O_TRUNC`, or `O_CREAT` (if the file does not exist) was specified.

Example

The following opens an output file for appending:

```
int fd;
fd = open("outfile", O_WRONLY | O_APPEND);
```

The following statement creates a new file with read/write/execute permissions for the creating user. If the file already exists, `open()` fails.

```
fd = open("newfile", O_WRONLY | O_CREAT | O_EXCL, S_IRWXU);
```

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“close\(\) — Close a file” on page 293](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)

- [“exec functions” on page 442](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fsync\(\) — Write changes to direct-access storage” on page 655](#)
- [“lseek\(\) — Change the offset of a file” on page 1023](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“umask\(\) — Set and retrieve file creation mask” on page 1929](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

openat() — Open a file relative to a directory file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>

int openat(int dirfd, const char *pathname, int flags, ...);
```

General description

`openat()` opens a file by using the specified directory file descriptor as the starting location for the path search. It operates in the same way as `open()` except for the following differences.

- If *pathname* is absolute, *dirfd* is ignored.
- If *pathname* is relative and *dirfd* is the special value `AT_FDCWD`, *pathname* is interpreted relative to the current working directory of the calling process.
- If *pathname* is relative, it is interpreted relative to the directory referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by `open()` for a relative *pathname*).
- If *pathname* is relative and *dirfd* is not a valid file descriptor, an error (EBADF) is returned.

Returned value

If successful, `openat()` returns a new file descriptor.

If unsuccessful, `openat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Access is denied. Possible reasons include:

- The process does not have search permission on a component in *pathname*.
- The file exists, but the process does not have permission to open the file in the way specified by the flags.
- The file does not exist, and the process does not have write permission on the directory where the file is to be created.

- O_TRUNC was specified, but the process does not have write permission on the file.

EBUSY

The process attempted to open a file that is in use.

EEXIST

O_CREAT and O_EXCL were specified, and either the named file refers to a symbolic link, or the named file already exists.

EINTR

open() was interrupted by a signal.

EINVAL

The *options* parameter does not specify a valid combination of the O_RDONLY, O_WRONLY and O_TRUNC bits.

EIO

The *pathname* argument names a STREAMS file and a hang-up or error occurred during the open().

EISDIR

pathname is a directory, and *options* specifies write or read/write access.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of *pathname* is greater than POSIX_SYMLINK_MAX.

EMFILE

The process has reached the maximum number of file descriptors it can have open.

ENAMETOOLONG

pathname is longer than PATH_MAX characters, or some component of *pathname* is longer than NAME_MAX characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the pathname string substituted for a symbolic link exceeds PATH_MAX. The PATH_MAX and NAME_MAX values can be determined using pathconf().

ENFILE

The system has reached the maximum number of file descriptors it can have open.

ENOENT

Typical causes:

- O_CREAT is not specified, and the named file does not exist.
- O_CREAT is specified, and either the prefix of *pathname* does not exist or the *pathname* argument is an empty string.

ENOMEM

The *pathname* argument names a STREAMS file and the system is unable to allocate resources.

ENOSPC

The directory or file system intended to hold a new file has insufficient space.

ENOSR

The *pathname* argument names a STREAMS-based file and the system is unable to allocate a STREAM.

ENOSYS

For main pseudoterminals, subsidiary initialization did not complete.

ENOTDIR

A component of *pathname* is not a directory.

ENXIO

O_NONBLOCK and O_WRONLY were specified and the named file is a FIFO, but no process has the file open for reading. For a pseudoterminal, the requested minor number exceeds the maximum number supported by the installation.

EPERM

For subsidiary pseudoterminals, permission to open is denied for one of these reasons:

- It is the first open of the subsidiary after the main pseudoterminal was opened, and the user ID associated with the two opening processes is not the same.
- There was an internal error in the security system after the main pseudoterminal was opened.
- The attempt to open the subsidiary used a different pathname than earlier opens used.

EROFS

pathname is on a read-only file system, and one or more of the options `O_WRONLY`, `O_RDWR`, `O_TRUNC`, or `O_CREAT` (if the file does not exist) was specified.

EBADF

dirfd is not a valid file descriptor.

ENOTDIR

pathname is relative and *dirfd* is a file descriptor referring to a file other than a directory.

Related information

- [“sched.h — Manipulate and examine process execution scheduling” on page 57](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“dirfd\(\) — Get directory stream file descriptor” on page 381](#)

openat2() — Open a file with more extensions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#define POSIX_SOURCE          /* Definition of O_* and S_* constants */
#include <fcntl.h>

long openat2(int dirfd, const char *pathname, struct open_how *how, size_t size);
```

Compile requirement: This function must be used under the [extended language level](#).

General description

`openat2()` is an extension of `openat()` and provides a superset of its functions. For `openat()`, the *flags* and *mode* parameters are passed as separate integer fields, where in `openat2()` they are passed as an `open_how` structure.

`openat2()` opens the file that is specified by *pathname*. If the specified file does not exist, it might optionally be (if `O_CREAT` is specified in *how.flags*) created.

As with `openat()`, if *pathname* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *dirfd* (or the current working directory of the calling process, if *dirfd* is the special value `AT_FDCWD`). If *pathname* is absolute, *dirfd* is ignored (unless *how.resolve* contains `RESOLVE_IN_ROOT`, in which case *pathname* is resolved relative to *dirfd*).

Rather than taking a single *flags* argument, an extensible structure (*how*) is passed to allow for future extensions. The *size* argument must be specified as `sizeof(struct open_how)`.

The *how* argument specifies how *pathname* is opened and acts as a superset of the *flags* and *mode* arguments to `openat()`. This argument is a pointer to a structure of the following form:

```
struct open_how {
    uint64_t flags;        /* O_* flags */
    uint64_t mode;         /* Mode for O_CREAT */
    uint64_t resolve;      /* RESOLVE_* flags */
    /* ... */
};
```

Any future extensions to `openat2()` will be implemented as new fields that are appended to the previous structure. The fields of the `open_how` structure are as follows:

flags

Specifies the file creation and file status flags to use when opening the file. All of the `O_*` flags defined for `openat()` are valid `openat2()` flag values.

mode

Specifies the mode for the new file, with identical semantics to the *mode* argument of `openat()`.

resolve

A bit-mask of flags that modify how all components of *pathname* are resolved (a component is a substring that is delimited by '/'). The primary use case for these flags is to allow trusted programs to restrict how untrusted paths (or paths inside untrusted directories) are resolved. The full list of resolve flags is as follows:

RESOLVE_BENEATH

Do not permit the path resolution to succeed if any component of the resolution is not a descendant of the directory that is indicated by *dirfd*. This causes absolute symbolic links (and absolute values of *pathname*) to be rejected.

This flag disables magic-link resolution. Therefore, to ensure that magic links are not resolved, the caller must specify `RESOLVE_NO_MAGICLINKS`.

RESOLVE_IN_ROOT

Treat the directory that is referred to by *dirfd* as the root directory while resolving *pathname*. Absolute symbolic links are interpreted relative to *dirfd*. If a prefix component of *pathname* equates to *dirfd*, an immediately following component likewise equates to *dirfd* (just as `/. .` is traditionally equivalent to `/`). If *pathname* is an absolute path, it is also interpreted relative to *dirfd*.

The effect of this flag is as though the calling process uses `chroot()` to (temporarily) modify its root directory (to the directory that is referred to by *dirfd*). However, unlike `chroot()` (which changes the file system root permanently for a process), `RESOLVE_IN_ROOT` allows a program to restrict path resolution on a per-open basis.

This flag disables magic-link resolution. Therefore, to ensure that magic links are not resolved, the caller must specify `RESOLVE_NO_MAGICLINKS`.

RESOLVE_NO_MAGICLINKS

Disallows all magic-link resolution during path resolution.

Magic links are symbolic link-like objects that are found in `proc()`; examples include `/proc/[pid]/exe` and `/proc/[pid]/fd/*`.

Unknowingly opening magic links can be risky for some applications. Examples of such risks include the following:

- If the process opening a path name is a controlling process that has no controlling terminal (see `credentials(7)`), opening a magic link inside `/proc/[pid]/fd` that happens to refer to a terminal causes the process to acquire a controlling terminal.
- In a containerized environment, a magic link inside `/proc` might refer to an object outside the container, and thus might provide a means to escape from the container.

Because of such risks, an application might prefer to disable magic link resolution by using the `RESOLVE_NO_MAGICLINKS` flag.

If the trailing component (base name) of *pathname* is a magic link, *how.resolve* contains `RESOLVE_NO_MAGICLINKS`, and *how.flags* contains both `O_PATH` and `O_NOFOLLOW`, an `O_PATH` file descriptor that references the magic link is returned.

RESOLVE_NO_SYMLINKS

Disallows resolution of symbolic links during *pathname* resolution. This option implies `RESOLVE_NO_MAGICLINKS`.

If the trailing component (base name) of *pathname* is a symbolic link, *how.resolve* contains `RESOLVE_NO_SYMLINKS` and *how.flags* contains both `O_PATH` and `O_NOFOLLOW`, an `O_PATH` file descriptor that references the symbolic link is returned.

Note: The effect of the `RESOLVE_NO_SYMLINKS` flag, which affects the treatment of symbolic links in all the components of *pathname*, differs from the effect of the `O_NOFOLLOW` file creation flag (in *how.flags*), which affects the handling of symbolic links only in the final component of *pathname*.

Applications that employ the `RESOLVE_NO_SYMLINKS` flag are encouraged to make its use configurable (unless it is used for a specific security purpose), as symbolic links are widely used by users. Setting this flag indiscriminately (for purposes that are not related to security) for all uses of `openat2()` might result in spurious errors on previously functional systems. This might occur if, for example, a system *pathname* that is used by an application is modified (for example, in a new distribution release) so that a path name component contains a symbolic link.

RESOLVE_NO_XDEV

Disallows traversal of mount points during path resolution (including all bind mounts). *pathname* must either be on the same mount as the directory referred to by *dirfd*, or on the same mount as the current working directory if *dirfd* is specified as `AT_FDCWD`.

Applications that employ the `RESOLVE_NO_XDEV` flag are encouraged to make its use configurable (unless it is used for a specific security purpose), as bind mounts are widely used by users. Setting this flag indiscriminately (for purposes that are not related to security) for all uses of `openat2()` might result in spurious errors on previously functional systems. This might occur if, for example, a system path name that is used by an application is modified (for example, in a new distribution release) so that a path name component contains a bind mount.

RESOLVE_CACHED

Makes the open operation fail unless all path components present in the kernel's lookup cache. If any revalidation or I/O is needed to satisfy the lookup, `openat2()` fails with the error `EAGAIN`. This is useful in providing a fast path open that can be performed without resorting to thread offload, or other mechanisms that an application might use to offload slower operations.

If any bits other than those that are listed previously are set in *how.resolve*, an error is returned.

Returned value

If successful, `openat2()` returns a new file descriptor.

If unsuccessful, `openat2()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCESS

Access is denied. Possible reasons include:

- The process does not have search permission on a component in *pathname*.
- The file exists, but the process does not have permission to open the file in the way specified by the flags.
- The file does not exist, and the process does not have write permission on the directory where the file is to be created.

- O_TRUNC was specified, but the process does not have write permission on the file.

EBUSY

The process attempted to open a file that is in use.

EEXIST

O_CREAT and O_EXCL were specified, and either the named file refers to a symbolic link, or the named file already exists.

EINTR

open() was interrupted by a signal.

EINVAL

The *options* parameter does not specify a valid combination of the O_RDONLY, O_WRONLY and O_TRUNC bits.

An unknown flag or invalid value is specified in *how*, or *mode* is nonzero, but *how.flags* does not contain O_CREAT or O_TMPFILE.

EIO

The *pathname* argument names a STREAMS file and a hang-up or error occurred during the open().

EISDIR

pathname is a directory, and *options* specifies write or read/write access.

ELOOP

- A loop exists in symbolic links. This error is issued if the number of symbolic links detected in the resolution of *pathname* is greater than POSIX_SYMLINK.
- *how.resolve* contains RESOLVE_NO_SYMLINKS, and one of the path components is a symbolic link (or magic link).
- *how.resolve* contains RESOLVE_NO_MAGICLINKS, and one of the path components is a magic link.

EMFILE

The process has reached the maximum number of file descriptors it can have open.

ENAMETOOLONG

pathname is longer than PATH_MAX characters, or some component of *pathname* is longer than NAME_MAX characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the pathname string substituted for a symbolic link exceeds PATH_MAX. The PATH_MAX and NAME_MAX values can be determined using pathconf().

ENFILE

The system has reached the maximum number of file descriptors it can have open.

ENOENT

Typical causes:

- O_CREAT is not specified, and the named file does not exist.
- O_CREAT is specified, and either the prefix of *pathname* does not exist or the *pathname* argument is an empty string.

ENOMEM

The *pathname* argument names a STREAMS file and the system is unable to allocate resources.

ENOSPC

The directory or file system intended to hold a new file has insufficient space.

ENOSR

The *pathname* argument names a STREAMS-based file and the system is unable to allocate a STREAM.

ENOSYS

For main pseudoterminals, subsidiary initialization did not complete.

ENOTDIR

A component of *pathname* is not a directory.

pathname is relative and *dirfd* is a file descriptor referring to a file other than a directory.

ENXIO

O_NONBLOCK and O_WRONLY were specified and the named file is a FIFO, but no process has the file open for reading. For a pseudoterminal, the requested minor number exceeds the maximum number supported by the installation.

EPERM

For subsidiary pseudoterminals, permission to open is denied for one of these reasons:

- It is the first open of the subsidiary after the main pseudoterminal was opened, and the user ID associated with the two opening processes is not the same.
- There was an internal error in the security system after the main pseudoterminal was opened.
- The attempt to open the subsidiary used a different pathname than earlier opens used.

EROFS

pathname is on a read-only file system, and one or more of the options O_WRONLY, O_RDWR, O_TRUNC, or O_CREAT (if the file does not exist) was specified.

EBADF

dirfd is not a valid file descriptor.

E2BIG

Unsupported flag is specified in the *resolve* field.

EAGAIN

RESOLVE_CACHED is set, and the open operation cannot be performed by using only cached information. The caller must retry without RESOLVE_CACHED set in *how.resolve*.

EXDEV

- *how.resolve* contains either RESOLVE_IN_ROOT or RESOLVE_BENEATH, and an escape from the root during path resolution is detected.
- *how.resolve* contains RESOLVE_NO_XDEV, and a path component crosses a mount point.

Related information

- [“sched.h — Manipulate and examine process execution scheduling” on page 57](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“openat\(\) — Open a file relative to a directory file descriptor” on page 1162](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“dirfd\(\) — Get directory stream file descriptor” on page 381](#)

opendir() — Open a directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <dirent.h>
```

```
DIR *opendir(const char *dirname);
```

General description

Opens a directory so that it can be read with `readdir()` or `__readdir2()`. *dirname* is a string giving the name of the directory you want to open. The first `readdir()` or `__readdir2()` call reads the first entry in the directory.

Returned value

If successful, `opendir()` returns a pointer to a DIR object. This object describes the directory and is used in subsequent operations on the directory, in the same way that FILE objects are used in file I/O operations.

If unsuccessful, `opendir()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have permission to search some component of *dirname*, or it does not have read permission on the directory itself.

ELOOP

A loop exists in the symbolic links. This error is issued if more than POSIX_SYMLLOOP (defined in the limits.h header file) symbolic links are encountered during resolution of the *dirname* argument.

EMFILE

The process has too many other file descriptors already open.

ENAMETOOLONG

dirname is longer than **PATH_MAX** characters, or some component of *dirname* is longer than **NAME_MAX** characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the pathname string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using `pathconf()`.

ENFILE

The entire system has too many other file descriptors already open.

ENOENT

The directory *dirname* does not exist.

ENOMEM

There is not enough storage available to open the directory.

ENOTDIR

Some component of the *dirname* pathname is not a directory.

Example

CELEB001

```
/* CELEB001
   This example opens a directory.
*/
#define _POSIX_SOURCE
#include <dirent.h>
#include <errno.h>
#include <sys/stat.h>
#include <sys/types.h>
#undef _POSIX_SOURCE
#include <stdio.h>

void traverse(char *fn, int indent) {
    DIR *dir;
    struct dirent *entry;
    int count;
    char path[1025];
```

```

struct stat info;

for (count=0; count<indent; count++) printf(" ");
printf("%s\n", fn);

if ((dir = opendir(fn)) == NULL)
    perror("opendir() error");
else {
    while ((entry = readdir(dir)) != NULL) {
        if (entry->d_name[0] != '.') {
            strcpy(path, fn);
            strcat(path, "/");
            strcat(path, entry->d_name);
            if (stat(path, &info) != 0)
                fprintf(stderr, "stat() error on %s: %s\n", path,
                    strerror(errno));
            else if (S_ISDIR(info.st_mode))
                traverse(path, indent+1);
        }
    }
    closedir(dir);
}
}

main() {
    puts("Directory structure:");
    traverse("/etc", 0);
}

```

Output

```

Directory structure:
/etc
/etc/samples
/etc/samples/IBM
/etc/IBM

```

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“__opendir2\(\) — Open a directory” on page 1170](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)
- [“fdopendir\(\) — Opens directory associated with file descriptor” on page 502](#)
- [“fdclosedir\(\) — Closes directory associated with file descriptor” on page 494](#)

__opendir2() — Open a directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R6 |

Format

```
#define _OPEN_SYS_DIR_EXT
#include <dirent.h>

DIR *__opendir2(const char *dirname, size_t bufsize);
```

General description

Opens a directory so that it can be read with `readdir()` or `__readdir2()`. The first `readdir()` or `__readdir2()` call reads the first entry in the directory.

dirname is a string giving the name of the directory you want to open. *bufsize* is the size (in bytes) of the internal work buffer used by `readdir()` or `__readdir2()` to hold directory entries. The larger the buffer, the less overhead there will be when reading through large numbers of directory entries. This buffer will exist until the directory is closed. If the specified buffer size is too small, it is ignored. A minimum-size buffer is used instead.

`__opendir2()` is the same as `opendir()`, except that the buffer size can be specified as a parameter.

Returned value

If successful, `__opendir2()` returns a pointer to a `DIR` object. This object describes the directory and is used in subsequent operations on the directory, in the same way that `FILE` objects are used in file I/O operations.

If unsuccessful, `__opendir2()` returns a `NULL` pointer and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have permission to search some component of *dirname*, or it does not have read permission on the directory itself.

ELOOP

A loop exists in the symbolic links. This error is issued if more than `POSIX_SYMLLOOP` (defined in the `limits.h` header file) symbolic links are encountered during resolution of the *dirname* argument.

EMFILE

The process has too many other file descriptors already open.

ENAMETOOLONG

dirname is longer than `PATH_MAX` characters, or some component of *dirname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the pathname string substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined using `pathconf()`.

ENFILE

The entire system has too many other file descriptors already open.

ENOENT

The directory *dirname* does not exist.

ENOMEM

There is not enough storage available to open the directory using a buffer that is length *bufsize* bytes long.

ENOTDIR

Some component of the *dirname* pathname is not a directory.

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)

- [“sys/types.h — typedef symbols and structures”](#) on page 71
- [“closedir\(\) — Close a directory”](#) on page 296
- [“opendir\(\) — Open a directory”](#) on page 1168
- [“readdir\(\) — Read an entry from a directory”](#) on page 1385
- [“rewinddir\(\) — Reposition a directory stream to the beginning”](#) on page 1450
- [“seekdir\(\) — Set position of directory stream”](#) on page 1471
- [“telldir\(\) — Current location of directory stream”](#) on page 1854

openlog() — Open the system control log

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <syslog.h>

void openlog(const char *ident, int logopt, int facility);
```

General description

The `openlog()` function optionally opens a connection to the logging facility, and sets process attributes that affect subsequent calls to the `syslog()` function. The argument *ident* is a string that is prefixed to every message. *logopt* is a bit field indicating logging options. Current values of *logopt* are:

LOG_CONS

Write messages to the system console if they cannot be sent to the logging facility. This option is safe to use in processes that have no controlling terminal, since the `syslog()` function forks before opening the console.

LOG_NDELAY

Open the connection to the logging facility immediately. Normally the open is delayed until the first message is logged. This is useful for programs that need to manage the order in which file descriptors are allocated..

LOG_NOWAIT

Do not wait for child processes that have been forked to log messages onto the console. This option should be used by processes that enable notification of child termination using `SIGCHLD`, since the `syslog()` function may otherwise block waiting for a child whose exit status has already been collected.

LOG_ODELAY

Delay open until `syslog()` is called.

LOG_PID

Log the processID with each message. This is useful for identifying specific processes. In the message header, the processID is surrounded by square brackets. The code point values for the square brackets are taken from code page IBM-1047. The value for the left square bracket is 0xAD. The value for the right square bracket is 0xBD.

The *facility* argument encodes a default facility to be assigned to all messages that do not have an explicit facility already encoded. The initial default facility is as follows:

LOG_USER

Message generated by random processes. This is the default facility identifier if none is specified.

Returned value

openlog() returns no values.

No errors are defined.

Related information

- “[syslog.h — System error logging](#)” on page 67
- “[closelog\(\) — Close the control log](#)” on page 297
- “[setlogmask\(\) — Set the mask for the control log](#)” on page 1555
- “[syslog\(\) — Send a message to the control log](#)” on page 1798

__open_stat(), __open_stat64() — Open a file and get file status information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R6 |

Format

__open_stat:

```
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>

int __open_stat(const char *pathname, int options, mode_t mode,
                struct stat *info);
```

__open_stat64:

```
#define _LARGE_TIME_API
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>

int __open_stat64(const char *pathname, int options, mode_t mode,
                  struct stat64 *info);
```

Compile requirement: Use of the __open_stat64() function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

Opens a file and returns a number called a *file descriptor*. __open_stat() also returns information about the opened file. __open_stat() is a combination of open() and fstat().

The __open_stat64() function behaves exactly like __open_stat() except __open_stat64() uses structure stat64 instead of struct stat to support time beyond 03:14:07 UTC on January 19, 2038.

The parameters are:

Parameters

Description

pathname

This parameter is a NULL-terminated character string containing the hierarchical file system (HFS) path name of the file to be opened.

pathname can begin with or without a slash.

- A path name beginning with a slash is an absolute path name. The slash refers to the root directory, and the search for the file starts at the root directory.
- A path name not beginning with a slash is a relative path name. The search for the file begins at the working directory.

See [“open\(\) — Open a file” on page 1157](#) for more information about the *pathname* parameter and the types of files that can be opened.

options

An integer containing option bits for the open operation. These options are the same as those in the *options* parameter passed to `open()`. These bits are defined in `fcntl.h`. For a list of these option bits and their meaning, see [“open\(\) — Open a file” on page 1157](#).

mode

mode is the same as the optional third parameter for `open()`, which is used when a new file is being created. For `__open_stat()`, the *mode* parameter is always required. If a new file is not being created, *mode* is ignored, and might be set to 0. When `__open_stat()` creates a file, the flag bits in *mode* specify the file permissions and other characteristics for the new file. The flag bits in *mode* are defined in `sys/modes.h`. For more information about the *mode* parameter, see [“open\(\) — Open a file” on page 1157](#).

info

The *info* parameter points to an area of memory where the system will store information about the file that is opened. This parameter is the same as the *info* parameter in `fstat()` or `stat()`. If the file is successfully opened, the system returns file status information in a `stat` structure, as defined in `sys/stat.h`. The elements of this structure are described in [“stat\(\), stat64\(\) — Get file information” on page 1706](#).

Returned value

If successful, `__open_stat()` returns a file descriptor.

If unsuccessful, `__open_stat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCESS

Access to the file was denied. One of the following errors occurred:

- The calling process does not have permission to search one of the directories specified in the *pathname* parameter.
- The calling process does not have permission to open the file in the way specified by the *options* parameter.
- The file does not exist, and the calling process does not have permission to write into files in the directory the file would have been created in.
- The truncate option was specified, but the process does not have write permission for the file.

EAGAIN

Resources were temporarily unavailable.

EBUSY

pathname specifies a main pseudoterminal that is either already in use or for which the corresponding subsidiary is open.

EEXIST

The exclusive create option was specified, but the file already exists.

Use `__errno2()` to determine the exact reason the error occurred.

EFBIG

A request to create a new file is prohibited because the file size limit for the process is set to 0.

EINTR

The `__open_stat()` operation was interrupted by a signal.

EINVAL

The *options* parameter does not specify a valid combination of the `O_RDONLY`, `O_WRONLY` and `O_TRUNC` bits, or the file type specified in the *mode* parameter is not valid.

Use `__errno2()` to determine the exact reason the error occurred.

EISDIR

The file specified by *pathname* is a directory and the *options* parameter specifies write or read/write access.

Use `__errno2()` to determine the exact reason the error occurred.

ELOOP

A loop exists in symbolic links encountered during resolution of the *pathname* parameter. This error is issued if more than 8 symbolic links are detected in the resolution of *pathname*.

EMFILE

The process has reached the maximum number of file descriptors it can have open.

ENAMETOOLONG

pathname is longer than 1023 characters, or a component of *pathname* is longer than 255 characters. (The system does not support filename truncation.)

ENODEV

Typical causes of this error are:

- An attempt was made to open a character special file for a device not supported by the system.
- An attempt was made to open a character special file for a device that is not yet initialized.

Use `__errno2()` to determine the exact reason the error occurred.

ENOENT

Typical causes of this error are:

- The request did not specify that the file was to be created, but the file named by *pathname* was not found.
- The request asked for the file to be created, but some component of *pathname* was not found, or the *pathname* parameter was blank.

Use `__errno2()` to determine the exact reason the error occurred.

ENOSPC

The directory or file system intended to hold a new file has insufficient space.

ENOTDIR

A component of *pathname* is not a directory.

ENXIO

The `__open_stat()` request specified write-only and non-block for a FIFO special file, but no process has the file open for reading. For pseudo terminals, this `errno` can mean that the minor number associated with *pathname* is too big.

EPERM

The caller is not permitted to open the specified subsidiary pseudoterminal or the corresponding main is not yet open. `EPERM` is also returned if the subsidiary is closed with `HUPCL` set and an attempt is made to reopen it.

EROFS

The *pathname* parameter names a file on a read-only file system, but options that would allow the file to be altered were specified: write-only, read/write, truncate, or `--` for a new file `-- create`.

Use `__errno2()` to determine the exact reason the error occurred.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“close\(\) — Close a file” on page 293](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“fstat\(\), fstat64\(\) — Get status information about a file” on page 649](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“umask\(\) — Set and retrieve file creation mask” on page 1929](#)
- [“open\(\) — Open a file” on page 1157](#)

__osname() — Get true operating system name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | OS/390 V2R10 |

Format

```
#define _POSIX_SOURCE
#include <sys/utsname.h>

int __osname(struct utsname *name);
```

General description

The `__osname()` function retrieves information identifying the true operating system you are running on. The argument *name* points to a memory area where a structure describing the true operating system the process is running on can be stored.

The information about the true operating system is returned in a `utsname` structure, which has the following elements:

char *sysname;

The true name of the implementation of the operating system.

char *nodename;

The node name of this particular machine. The node name is set by the `SYSNAME sysparm` (specified at IPL), and usually differentiates machines running at a single location.

char *release;

The true current release level of the implementation.

char *version;

The true current version level of the release.

char *machine;

The name of the hardware type the system is running on.

Each of the `utsname` structure elements is a normal C string, terminated with a NULL character.

The values returned by the `__osname()` function are not intended to be used for comparison purposes in order to determine a level of functionality provided by the operating system. This is because the version and release values are not guaranteed to be equal to or greater than the previous implementation.

[Table 51 on page 1177](#) lists the true operating system information returned by the `__osname()` function.

Table 51. Operating system information returned by the `__osname()` function

| Operating system | Sysname | Release | Version |
|------------------|---------|---------|---------|
| z/OS 3.2 | z/OS | 02.00 | 03 |
| z/OS 3.1 | z/OS | 01.00 | 03 |
| z/OS 2.5 | z/OS | 05.00 | 02 |

Returned value

If successful, the `__osname()` function returns a non-negative value.

If unsuccessful, the `__osname()` function returns -1 and an `errno` might be set to indicate the reason for the failure.

Example

CELEB002

```

/*
 * This example gets information about the system you are running on.
 */
#define _POSIX_SOURCE
#include <sys/utsname.h>
#include <stdio.h>
main() {
    struct utsname uts;
    if (__osname(&uts) < 0)
        perror("__osname() error");
    else {
        printf("Sysname: %s\n", uts.sysname);
        printf("Nodename: %s\n", uts.nodename);
        printf("Release: %s\n", uts.release);
        printf("Version: %s\n", uts.version);
        printf("Machine: %s\n", uts.machine);
    }
}

```

Output

```

Sysname:  z/OS
Nodename: SY1
Release:  02.00
Version:  03
Machine:  8561

```

Related information

- [“sys/utsname.h — Operating system name” on page 73](#)
- [“uname\(\) — Display current operating system name” on page 1935](#)

`__passwd()`, `__passwd_applid()` — Verify or change user password

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <pwd.h>
```

```
int __passwd(const char *username, const char *oldpass, const char *newpass);
int __passwd_applid(const char *username, const char *oldpass,
                   const char *newpass, const char *applid);
```

General description

The `__passwd()` function verifies or changes the *username* password or the password phrase. The *username* is a NULL-terminated character string of 1 to 8 bytes. The *oldpass* is the current password or password phrase for user *username*, and is a NULL-terminated character string of a password or a password phrase. When *newpass* is NULL, then *oldpass* represents the password or password phrase to be verified, and no password or password phrase change is performed. Otherwise, *newpass* is a NULL-terminated character string of a password or a password phrase. Other installation-dependent restrictions on passwords or password phrases may apply, both in terms of length and content. Length restrictions may be imposed by the security product.

The `__passwd_applid()` function is equivalent to `__passwd()` with the added feature that it also allows the application identifier (APPLID) to be supplied that will be passed on to the security product to assist with authentication. When *applid* is NULL or a pointer to NULL, no application identifier will be passed on to the security product.

The function has the following parameters:

| | |
|------------------|--------------------|
| Parameter | Description |
|------------------|--------------------|

applid

Specifies the application identifier that will be used for authentication with the security product.

If the BPX.DAEMON facility class profile is defined, then all modules within the address space must be loaded from a controlled library. This includes all modules in the application and runtime libraries. See also "Checking Which Module is not Defined to Program Control" in [z/OS UNIX System Services Planning](#).

Returned value

If successful, `__passwd()` returns 0. When *newpass* is NULL, the password or the password phrase has been verified. When *newpass* is not NULL, the new password or password phrase has been set.

If a user specifies password for *oldpass* and new password phrase for *newpass* or password phrase for *oldpass* and new password for *newpass*, then `__passwd()` returns -1 and sets *errno* to EMVSPASSWORD and the current password or password phrase is not changed.

If unsuccessful, `__passwd()` returns -1 and sets *errno* to one of the following values:

| | |
|-------------------|--------------------|
| Error Code | Description |
|-------------------|--------------------|

EACCES

The *oldpass* is not authorized.

EINVAL

The *username*, *oldpass*, *newpass*, or *applid* argument is invalid.

EMVSERR

The specified function is not supported in an address space where a load was done from an uncontrolled library.

EMVSEXPIRE

The *oldpass* has expired and no *newpass* has been provided.

EMVSPASSWORD

The *newpass* is not valid, or does not meet the installation-exit requirements.

EMVSSAF2ERR

Internal processing error.

EMVSSAFEXTRERR

An internal SAF/RACF extract error has occurred. A possible reason is that the *username* access has been revoked. *errno2* contains the BPX1PWD reason code. For more information, see [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

ESRCH

The *username* provided is not defined to the security product or does not have an OMVS segment defined.

For more information, refer to [z/OS UNIX System Services Messages and Codes](#) and [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

Related information

- [“pwd.h — Access user database through password structure” on page 56](#)
- [“endpwent\(\) — User database functions” on page 423](#)
- [“getpass\(\) — Read a string of characters without echo” on page 749](#)

pathconf() — Determine configurable path name variables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1a XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

long pathconf(const char *pathname, int varcode);
```

General description

Lets an application determine the value of a configuration variable, *varcode*, associated with a particular file or directory, *pathname*.

The *varcode* argument may be any one of the following symbols, defined in the *unistd.h* header file, each standing for a configuration variable:

_PC_LINK_MAX

Represents LINK_MAX, the maximum number of links the file can have. If *pathname* is a directory, *pathconf()* returns the maximum number of links that can be established to the directory itself.

_PC_MAX_CANON

Represents MAX_CANON, the maximum number of bytes in a terminal canonical input line. *pathname* must refer to a character special file for a terminal.

_PC_MAX_INPUT

Represents MAX_INPUT, the maximum number of bytes for which space is available in a terminal input queue. That is, it refers to the maximum number of bytes that a portable application can have the user enter before the application actually reads the input. *pathname* must refer to a character special file for a terminal.

_PC_NAME_MAX

Represents NAME_MAX, the maximum number of characters in a file name (not including any terminating NULL at the end if the file name is stored as a string). This symbol refers only to the file name itself, that is, the last component of the file's path name. pathconf() returns the maximum length of file names.

_PC_PATH_MAX

Represents PATH_MAX, the maximum number of characters in a complete path name (not including any terminating NULL at the end if the path name is stored as a string). pathconf() returns the maximum length of a relative path name.

_PC_PIPE_BUF

Represents PIPE_BUF, the maximum number of bytes that can be written “atomically” to a pipe. If more than this number of bytes is written to a pipe, the operation may take more than one physical write operation and physical read operation to read the data on the other end of the pipe. If *pathname* is a FIFO special file, pathconf() returns the value for the file itself. If *pathname* is a directory, pathconf() returns the value for any FIFOs that exist or that can be created under the directory. If *pathname* is any other kind of file, an errno of EINVAL will be returned, indicating an invalid path name was specified.

_PC_CHOWN_RESTRICTED

Represents _POSIX_CHOWN_RESTRICTED defined in the unistd.h header file, and restricts use of chown() to a process with appropriate privileges. It also changes the group ID of a file to the effective group ID of the process or to one of its supplementary group IDs. If *pathname* is a directory, pathconf() returns the value for any kind of file under the directory, but not for subdirectories of the directory.

_PC_NO_TRUNC

Represents _POSIX_NO_TRUNC defined in the unistd.h header file, and generates an error if a file name is longer than NAME_MAX. If *pathname* refers to a directory, the value returned by pathconf() applies to all files under that directory.

_PC_VDISABLE

Represents _POSIX_VDISABLE defined in the unistd.h header file. This symbol indicates that terminal special characters can be disabled using this character value, if it is defined; see the callable service tcsetattr() for details. *pathname* must refer to a character special file for a terminal.

_PC_ACL

Returns 1 if an access control mechanism is supported by the security product.

_PC_ACL_ENTRIES_MAX

Returns the maximum number of ACL entries in an ACL for a file or directory that supports ACLs.

Returned value

If successful, pathconf() return the value of the variable requested in *varcode*.

If unsuccessful, pathconf() returns -1. If a particular variable has no limit, such as PATH_MAX, pathconf() returns -1 but does not change errno.

If pathconf() cannot determine an appropriate value, it sets errno to one of the following values:

Error Code**Description****EACCES**

The process does not have search permission on some component of the *pathname*.

EINVAL

varcode is not a valid variable code, or the given variable cannot be associated with the specified file.

- If *varcode* refers to MAX_CANON, MAX_INPUT, or _POSIX_VDISABLE, and *pathname* does not refer to a character special file, pathconf() returns -1 and sets errno to EINVAL.
- If *varcode* refers to NAME_MAX, PATH_MAX, or POSIX_NO_TRUNC, and *pathname* does not refer to a directory, pathconf() returns the requested information.

- If *varcode* refers to PC_PIPE_BUF and *pathname* refers to a pipe or a FIFO, the value returned applies to the referenced object itself. If *pathname* refers to a directory, the value returned applies to any FIFOs that exist or can be created within the directory. If *pathname* refers to any other type of file, the function sets *errno* to EINVAL.

ELOOP

A loop exists in symbolic links. This error is issued if more than POSIX_SYMLINKS symbolic links are detected in the resolution of *pathname*.

ENAMETOOLONG

pathname is longer than PATH_MAX characters, or some component of *pathname* is longer than NAME_MAX while _POSIX_NO_TRUNC is in effect.

For symbolic links, the length of the path name string substituted for a symbolic link exceeds PATH_MAX.

ENOENT

There is no file named *pathname*, or the *pathname* argument is an empty string.

ENOTDIR

Some component of the *pathname* is not a directory.

Example**CELEBP01**

```
/* CELEBP01

   This example determines the maximum number of characters in a file name.

*/
#define _POSIX_SOURCE
#include <errno.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    long result;

    errno = 0;
    puts("examining NAME_MAX limit for root filesystem");
    if ((result = pathconf("/", _PC_NAME_MAX)) == -1)
        if (errno == 0)
            puts("There is no limit to NAME_MAX.");
        else perror("pathconf() error");
    else
        printf("NAME_MAX is %ld\n", result);
}
```

Output:

```
examining NAME_MAX limit for root file system
NAME_MAX is 255
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“fpathconf\(\) — Determine configurable path name variables” on page 587](#)

pause() — Suspend a process pending a signal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 POSIX.4a XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int pause(void);
```

General description

Suspends execution of the calling thread. The thread does not resume execution until a signal is delivered, executing a signal handler or ending the thread. Some signals can be blocked by the process's *thread*. See [“sigprocmask\(\) — Examine or change a thread”](#) on page 1643 for details.

If an incoming unblocked signal ends the thread, `pause()` never returns to the caller. If an incoming signal is handled by a signal handler, `pause()` returns after the signal handler returns.

Returned value

If `pause()` returns, it always returns -1 and sets `errno` to `EINTR`, indicating that a signal was received and handled successfully.

Example

CELEBP02

```
/* CELEBP02

   This example suspends execution and determines the
   current time.

*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <signal.h>
#include <stdio.h>
#include <time.h>

void catcher(int signum) {
    puts("inside catcher...");
}

void timestamp() {
    time_t t;
    time(&t);
    printf("the time is %s", ctime(&t));
}

main() {
    struct sigaction sigact;

    sigemptyset(&sigact.sa_mask);
    sigact.sa_flags = 0;
    sigact.sa_handler = catcher;
    sigaction(SIGALRM, &sigact, NULL);
```



```

alarm(10);
printf("before pause... ");
timestamp();
pause();
printf("after pause... ");
timestamp();
}

```

Output:

```

before pause... the time is Fri Jun 16 09:42:29 2006
inside catcher...

after pause... the time is Fri Jun 16 09:42:39 2006

```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)

pclose() — Close a pipe stream to or from a process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```

#define _XOPEN_SOURCE
#include <stdio.h>

int pclose(FILE *stream);

```

General description

The `pclose()` function closes a stream that was opened by `popen()`, waits for the command specified as an argument in `popen()` to terminate, and returns the status of the process that was running the shell command. However, if a call caused the termination status to be unavailable to `pclose()`, then `pclose()` returns `-1` with `errno` set to `ECHILD` to report this situation; this can happen if the application calls one of the following functions:

- `wait()`
- `waitid()`
- `waitpid()` with a *pid* argument less than or equal to the process ID of the shell command

perror

- any other function that could do one of the above

In any case, `pclose()` will not return before the child process created by `popen()` has terminated.

If the shell command cannot be executed, the child termination status returned by `pclose()` will be as if the shell command terminated using `exit(127)` or `_exit(127)`.

The `pclose()` function will not affect the termination status of any child of the calling process other than the one created by `popen()` for the associated stream.

If the argument *stream* to `pclose()` is not a pointer to a stream created by `popen()`, the termination status returned will be -1.

Threading Behavior: The `pclose()` function can be executed from any thread within the parent process.

Returned value

If successful, `pclose()` returns the termination status of the shell command.

If unsuccessful, `pclose()` returns -1 and sets `errno` to one of the following values:

Error Code Description

ECHILD

The status of the child process could not be obtained.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“popen\(\) — Initiate a pipe stream to or from a process” on page 1200](#)
- [“waitpid\(\) — Wait for a specific child process to end” on page 1981](#)

perror() — Print error message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

void perror(const char *string);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

void perror_unlocked(const char *string);
```

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdio.h>
```

```
void perror(const char *string);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <stdio.h>

void perror(const char *string);
```

General description

Prints an error message to `stderr`. If *string* is not NULL and it does not point to a NULL character, the *string* pointed to by *string* is printed to the standard error stream, followed by a colon and a space. The message associated with the value in `errno` is then printed followed with the `errno2` value in parenthesis and a newline character. The content of the message is the same as the content of a string returned by `strerror()` with the argument `errno`.

The `perror()` string shown as: EDC5121I Invalid argument. (`errno2=0x0C0F8402`).

To produce accurate results, you should ensure that `perror()` is called immediately after a library function returns with an error; otherwise, subsequent calls may alter the `errno` value.

If the error is associated with the `stderr` file, a call to `perror()` is not valid.

There is an environment variable `_EDC_ADD_ERRNO2`, which when set to 0, will remove the append of the current `errno2` value at the end of the `perror()` string shown.

The `perror()` function will not change the orientation of the `stderr` stream.

`perror_unlocked()` is functionally equivalent to `perror()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

`perror()` returns no values.

Example

CELEBP03

```
/* CELEBP03

This example tries to open a stream.
If the fopen() function fails, the example prints a message and ends
the program.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    FILE *fh;

    if ((fh = fopen("myfile.dat", "r")) == NULL)
    {
        perror("Could not open data file");
        abort();
    }
}
```

The following example tries to open a stream socket. If the socket fails, the example prints a message and ends the program.

```
#include <stdio.h>
#include <stdlib.h>
```

__pid_affinity

```
#include <sys/socket>

int main(void)
{
    int s;

    if ((s = socket (AF_INET,SOCK_STREAM,0)) <0)
    {
        perror("Could not open socket");
        exit(-1);
    }
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“strerror\(\) — Get pointer to runtime error message” on page 1729](#)

__pid_affinity() — Add or delete process affinity

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R6 |

Format

```
#define _OPEN_SYS
#include <unistd.h>

int __pid_affinity(int    function_code,
                  pid_t   target_pid,
                  pid_t   signal_pid,
                  int      signal);
```

General description

The `__pid_affinity()` function adds or deletes an entry in a process's affinity list. When a process terminates, each process in its affinity list is notified (sent a signal) of the termination. The `__pid_affinity()` function provides the ability to dynamically create or break an association between two processes that is similar to the notification mechanism between parent and child processes without the processes being related.

The *function_code* can be set to one of the following symbolics, as defined in the `unistd.h` header file:

__PAF_ADD_PID

Add the process and signal specified by *signal_pid* and *signal* to the affinity list of the process specified by *target_pid*.

__PAF_DELETE_PID

Delete the process and signal specified by *signal_pid* and *signal* from the affinity list of the process specified by *target_pid*.

The *target_pid* identifies the process whose affinity list will be altered.

The *signal_pid* identifies the process that upon termination of the *target_pid* will be sent *signal* signal.

The *signal* identifies the signal that the *signal_pid* process will receive when the *target_pid* process terminates.

Usage notes

1. Either the *Target_Pid* or *Signal_Pid* must contain the PID of the caller's process.

2. The __pid affinity service is limited to adding and deleting entries in the caller's affinity list, or adding and deleting entries that contain the caller's PID (*Signal_Pid*) in other processes affinity list.
3. When the PAF_DELETE_PID# function is specified the *Signal* is ignored. It is not validated and may contain any value.
4. An entry is only deleted (PAF_DELETE_PID# specified) when the *Signal_Pid* matches an entry in the *Target_Pid* process's affinity list.
5. Entries with duplicate PIDs are not allowed in an affinity list. If adding an entry (PAF_ADD_PID# specified) and an entry with a PID that matches the *Signal_Pid* is found the entry is reused. This may result in the loss of a specific signal.
6. No permission is required when adding the caller's PID to another process's affinity list. All processes have permission to send a signal to themselves (raise()).
7. The PIDs specified by the *Target_Pid* and *Signal_Pid* parameters must be greater than 1. Specifying a PID equal to or less than 1 will result in a error.

Returned value

If successful, __pid_affinity() returns 0.

If unsuccessful, __pid_affinity() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

One or more of the following conditions were detected:

- The value specified by *Function_code* is not supported.
- The value specified by *Signal* is not a supported signal.
- *Target_Pid* does not contain a value greater than 1.
- *Signal_Pid* does not contain a value greater than 1.
- The *Signal_Pid* or *Target_Pid* does not specify the caller PID.

EMVSERR

A MVS environmental or internal error has occurred.

EMVSSAF2ERR

An internal SAF/RACF error has occurred.

EPERM

The caller does not have permission to send the signal to the *Signal_Pid* process.

ESRCH

One or more of the following conditions were detected:

- No process corresponding to *Target_Pid* was found.
- No process corresponding to *Signal_Pid* was found.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)

pipe() — Create an unnamed pipe

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int pipe(int fdinfo[2]);
```

General description

Creates a *pipe*, an I/O channel that a process can use to communicate with another process (in the same process or another process), or in some cases with itself. Data is written into one end of the pipe and read from the other. *fdinfo*[2] points to a memory area where *pipe*() can store two file descriptors. *pipe*() stores a file descriptor for the input end of the pipe in *fdinfo*[1], and stores a file descriptor for the output end of the pipe in *fdinfo*[0]. Thus, processes can read from *fdinfo*[0] and write to *fdinfo*[1]. Data written to *fdinfo*[1] is read from *fdinfo*[0] on a first-in-first-out (FIFO) basis.

When *pipe*() creates a pipe, the *O_NONBLOCK* and *FD_CLOEXEC* flags are turned off on both ends of the pipe. You can turn these flags on with *fcntl*(). See “[fcntl\(\) — Control open file descriptors](#)” on page 483 for details.

If *pipe*() successfully creates a pipe, it updates the access, change, and modification times for the pipe.

It is unspecified whether *fdinfo*[0] is also open for writing and whether *fdinfo*[1] is also open for reading. z/OS UNIX pipes are not STREAMS-based.

Returned value

If successful, *pipe*() returns 0.

If unsuccessful, *pipe*() returns -1 and sets *errno* to one of the following values:

Error Code

Description

EMFILE

Opening the pipe would exceed the limit on the number of file descriptors the process can have open. This limit is given by *OPEN_MAX*, defined in the *limits.h* header file.

ENFILE

Opening the pipe would exceed the number of files that the system can have open simultaneously.

ENOMEM

Opening the pipe requires more space than is available.

Example

CELEBP04

```
/* CELEBP04
   This example creates an I/O channel.
```

The output shows the data written into one end and read from the other.

```

*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <stdio.h>

void reverse(char *s) {
    char *first, *last, temp;

    first = s;
    last = s+strlen(s)-1;
    while (first != last) {
        temp = *first;
        *(first++) = *last;
        *(last--) = temp;
    }
}

main() {
    char original[]="This is the original string";
    char buf[80];
    int p1[2], p2[2];

    if (pipe(p1) != 0)
        perror("first pipe() failed");
    else if (pipe(p2) != 0)
        perror("second pipe() failed");
    else if (fork() == 0) {
        close(p1[1]);
        close(p2[0]);
        if (read(p1[0], buf, sizeof(buf)) == -1)
            perror("read() error in parent");
        else {
            reverse(buf);
            if (write(p2[1], buf, strlen(buf)+1) == -1)
                perror("write() error in child");
        }
        exit(0);
    }
    else {
        close(p1[0]);
        close(p2[1]);
        printf("parent is writing '%s' to pipe 1\n", original);
        if (write(p1[1], original, strlen(original)+1) == -1)
            perror("write() error in parent");
        else if (read(p2[0], buf, sizeof(buf)) == -1)
            perror("read() error in parent");
        else printf("parent read '%s' from pipe 2\n", buf);
    }
}

```

Output:

```

parent is writing 'This is the original string' to pipe 1
parent read 'gnirts lanigiro eht si sihT' from pipe 2

```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“close\(\) — Close a file” on page 293](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

pipe2() – Create a pipe

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#define _POSIX_SOURCE          /* Definition of 0_* constants */
#include <fcntl.h>              /* Definition of 0_* constants */
#include <unistd.h>

int pipe2(int pipefd[2], int flags);
```

General description

`pipe2()` creates a pipe, which is a unidirectional data channel that can be used for interprocess communication. The array *pipefd* is used to return two file descriptors that refer to the ends of the pipe. *pipefd*[0] refers to the read end of the pipe. *pipefd*[1] refers to the write end of the pipe. Data that is written to the write end of the pipe is buffered by the kernel until it is read from the read end of the pipe.

If *flags* is 0, `pipe2()` is the same as `pipe()`. The following values can be bitwise ORed in *flags* to obtain different behavior:

O_CLOEXEC

Set the close-on-exec (FD_CLOEXEC) flag on the two new file descriptors.

O_DIRECT

Create a pipe that performs I/O in "packet" mode. Each write to the pipe is dealt with as a separate packet. Read one packet at a time from the pipe.

Notes:

- The maximum number of bytes that can be written atomically when writing to a pipe can be determined by using `pathconf()`.
- If a read specifies a buffer size that is smaller than the next packet, the requested number of bytes are read, and the excess bytes in the packet are discarded. Specifying a buffer size of PIPE_BUF are sufficient to read the largest possible packets.
- Zero-length packets are not supported. (A read that specifies a buffer size of zero is a no-op, and returns 0.)

O_NONBLOCK

Set the O_NONBLOCK file status flag on the open file descriptions that are referred to by the new file descriptors. Using this flag saves extra calls to `fcntl()` to achieve the same result.

Returned value

If successful, `pipe2()` returns 0.

If unsuccessful, `pipe2()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EFAULT

pipefd is invalid.

EINVAL

Invalid value in *flags*.

EMFILE

The process reaches the maximum number of file descriptors that it can have open.

ENFILE

The maximum number of file descriptors that can be open is reached.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“close\(\) — Close a file” on page 293](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)

pivot_root() — Change root mount

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <unistd.h>

int pivot_root(const char *new_root, const char *put_old);
```

General description

`pivot_root()` changes the root mount in the mount namespace of the calling process. It moves the root mount to the directory `put_old` and makes `new_root` the new root mount. The caller must be an authorized program or must run for a user with appropriate privileges.

`pivot_root()` changes the root directory and the current working directory of each process or thread in the same mount namespace to `new_root` if they point to the old root directory. `pivot_root()` does not change the caller's current working directory (unless it is on the old root directory), and thus it must be followed by a `chdir("/")` call.

Restriction:

- `new_root` and `put_old` must be directories.
- `new_root` and `put_old` must not be on the same mount as the current root.
- `put_old` must be at or underneath `new_root`; that is, adding some nonnegative number of `"/.."` prefixes to the path name that is pointed to by `put_old` must yield the same directory as `new_root`.
- `new_root` must be a path to a mount point but can't be `"/"`. A path that is not a mount point can be converted into one by bind mounting the path onto itself.
- The current root directory must be a mount point.

Returned value

If successful, `pivot_root()` returns 0.

If unsuccessful, `pivot_root()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EBUSY
new_root or put_old is on the current root mount.

EINVAL

- new_root is not a mount point.
- put_old is not at or underneath new_root.
- The current root directory is not a mount point.

ENOTDIR
new_root or put_old is not a directory.

EPERM
The calling process has no authority.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“chdir\(\) — Change the working directory” on page 270](#)
- [“chroot\(\) — Change root directory” on page 281](#)
- [“mount\(\) — Make a file system available” on page 1098](#)

__poe() — Port of entry information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

```
#define _OPEN_SYS
#include <sys/socket.h>

int __poe(__poe_t *poe);
```

General description

The __poe() function allows the application to specify what port of entry (POE) information the system should use in determining various levels of permission checking. The attributes for the port of entry are used by services that perform user ID security authorization (examples are: setuid(), __login(), __passwd()).

Argument poe is the address of a __poe_t structure which is used to control the port of entry operation. The __poe_t structure is defined in <sys/socket.h>. For proper behavior the user should ensure that this structure has been initialized to zeros before it is populated. The elements of the __poe_t structure are as follows:

__poe_options

Port of entry options. There are scope and action options. The combination defines the behavior of the function.

The scope option values are:

_POE_SCOPE_THREAD
 _POE_SCOPE_PROCESS
 _POE_SCOPE_SOCKET

Scope options _POE_SCOPE_THREAD, _POE_SCOPE_PROCESS, and _POE_SCOPE_SOCKET are mutually exclusive. One must be specified.

Note: As of z/OS V1R12, scope options _POE_THREAD and _POE_PROCESS have been deprecated and replaced with new names. The old names remain for compatibility and must be used when the target operating system release is prior to z/OS V1R12.

The action option values are:

_POE_ACTION_READ
 _POE_ACTION_WRITE
 _POE_ACTION_SETGET

Action options _POE_ACTION_READ, _POE_ACTION_WRITE, and _POE_ACTION_SETGET are mutually exclusive. These are optional.

__poe_entry_type

Port of entry type. The types are:

_POE_SOCKET

Entry is a file descriptor for a socket.

_POE_FILE

Entry is a file descriptor for a non-socket file. Supported file types are character special, FIFO, regular, symbolic link, and directory.

__poe_entry_len

Port of entry length. The lengths are:

_POE_SOCKET_LEN

Length of a file descriptor for a socket.

_POE_FILE_LEN

Length of a file descriptor for a non-socket file.

__poe_entry_ptr

Address of port of entry.

__poe_poeattr

Port of entry attributes. This element is an IocPoeAttr structure as defined in <termios.h>.

The following table summarizes the port of entry operation according to scope and action:

| Options | | POE Data | | Description |
|---------|--------|-------------------------------|--|--|
| Scope | Action | Source | Destination | |
| Socket | Read | Socket or file descriptor | POE data in struct __poe_cb_s | POE data is extracted from the file/socket descriptor supplied by the caller and returned to the caller via the struct __poe_cb_s. |
| | Write | n/a | n/a | Request fails with EINVAL |
| | SetGet | n/a | n/a | Request fails with EINVAL |
| | None | n/a | n/a | Request fails with EINVAL |
| Process | Read | Process level (OAPB) | POE data in struct __poe_cb_s | Process level POE data is copied from the OAPB and is returned to the caller via the struct __poe_cb_s. |
| | Write | POE data in struct __poe_cb_s | Process level (OAPB) | POE data received from the caller via the struct __poe_cb_s is copied to the process level POE data in the OAPB. |
| | SetGet | Socket or file descriptor | Process level (OAPB) and POE data in struct __poe_cb_s | POE data is extracted from the file/socket descriptor supplied by the caller. The data is copied to the process level POE data in the OAPB and returned to the caller via the struct __poe_cb_s. |
| | None | Socket or file descriptor | Process level (OAPB) | POE data is extracted from the file/socket descriptor supplied by the caller and copied to the process level POE data in the OAPB. |

| Options | | POE Data | | Description |
|---------|--------|-------------------------------|---|---|
| Scope | Action | Source | Destination | |
| Thread | Read | Thread level (OTCB) | POE data in struct __poe_cb_s | Thread level POE data copied from the OTCB is returned to the caller via the struct __poe_cb_s. |
| | Write | POE data in struct __poe_cb_s | Thread level (OTCB) | POE data received from the caller via the struct __poe_cb_s is copied to the thread level POE data in the OTCB. |
| | SetGet | Socket or file descriptor | Thread level (OTCB) and POE data in struct __poe_cb_s | POE data is extracted from the file/socket descriptor supplied by the caller. The data is copied to the thread level POE data in the OTCB and returned to the caller via the struct __poe_cb_s. |
| | None | Socket or file descriptor | Thread level (OTCB) | POE data is extracted from the file/socket descriptor supplied by the caller and copied to the thread level POE data in the OTCB. |

The ability to register port of entry is a privileged operation. An installation has two ways of allowing an application to use this service:

1. For the highest level of security, the installation defines the BPX.POE FACILITY class profile. For an application to use this service the user ID it runs under must be given read access to this profile. See [z/OS UNIX System Services Planning](#) for more information on setting up this profile.
2. For a lower security arrangement, you can assign the user ID under which the application is run a UID of 0 so that it operates as a superuser.

For more detailed information on the usage of this function see [z/OS Planning for Multilevel Security and the Common Criteria](#) and [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

Returned value

If successful, __poe() returns 0.

If unsuccessful, __poe() returns -1 and sets errno to one of the following values:

EINVAL

The __poe_cb_t structure is not correct. Use __errno2() for more details.

EPERM

The calling process does not have the appropriate privileges to read or write the POE attributes.

EFAULT

A bad address was received. Either the *poeebp* parameter or the *__poe_entry_ptr* field in the *__poeb_t* structure is not a valid address.

Related information

- “[sys/socket.h — Sockets definitions](#)” on page 70
- *__poe()* (BPX1POE, BPX4POE) -- Port of entry information” in [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

poll() — Monitor activity on file descriptors and message queues

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**Sockets:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <poll.h>

int poll(struct pollfd fds[], nfds_t nmsgsfds, int timeout);
```

Message queues and sockets:

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _OPEN_MSGQ_EXT
#include <sys/types.h>
#include <sys/time.h>
#include <sys/msg.h>
#include <poll.h>

int poll(void *listptr, nmsgsfds_t nmsgsfds, int timeout);
```

_OPEN_MSGQ_EXT must be defined if message queues are to be monitored.

General description

The *poll()* function provides applications with a mechanism for multiplexing input/output over the following set of file descriptors:

- regular files
- terminal and pseudoterminal devices
- STREAMS-based files
- sockets
- message queues.
- FIFOs
- pipes

For each member of the array(s) pointed to by *listptr*, *poll()* examines the given file descriptor or message queue for the event(s) specified in the member. The number of *pollmsg* structures and the number

of pollfd structures in the arrays are specified by *nmsgsfds*. The poll() function identifies those file descriptors on which an application can read or write data, or on which an error event has occurred.

listptr

A pointer to an array of pollfd structures, pollmsg structures, or to a pollist structure. Each structure specifies a file descriptor or message queue identifier and the events of interest for this file or message queue. The type of parameter to pass depends on whether you want to monitor file and socket descriptors, message queue identifiers, or both. To monitor socket descriptors only, set the high-order halfword of *nmsgsfds* to 0, the low-order halfword to the number of pollfd structures to be provided, and pass a pointer to an array of pollfd structures. To monitor message queues only, set the low-order halfword of *nmsgsfds* to 0, the high-order halfword to the number of pollmsg structures to be provided, and pass a pointer to an array of pollmsg structures. To monitor both, set *nmsgsfds* as described below, and pass a pointer to a pollist structure. If a pollist structure is to be used, a structure similar to the following should be defined in a user program. The pollfd structure must precede the pollmsg structure.

```
struct pollist {
    struct pollfd fds[3];
    struct pollmsg msgids[2];
} list;
```

nmsgsfds

The number of pollmsg structures and the number of pollfd structures pointed to by *listptr*.

This parameter is divided into two parts. The first half (the high-order 16 bits) gives the number of pollmsg structures containing message queue identifiers. This number must not exceed the value 32767. The second half (the low-order 16 bits) gives the number of pollfd structures containing file descriptors to check. If either half of the *nmsgsfds* parameter is equal to a value of 0, the corresponding pollmsg structures or pollfd structures is assumed not to be present.

timeout

The amount of time, in milliseconds, to wait for an event to occur.

If none of the defined events have occurred on any selected descriptor, poll() waits at least *timeout* milliseconds for an event to occur on any of the selected descriptors. If the value of *timeout* is 0, poll() returns immediately. If the value of *timeout* is -1, poll() blocks until a requested event occurs or until the call is interrupted.

The above processing also applies to message queues.

Each pollfd or pollmsg structure contains the following fields:

- fd/msgid - open file descriptor or message queue identifier
- events - requested events
- revents - returned events

The events and revents fields are bitmasks constructed by OR-ing a combination of the following event flags:

POLLERR

An error or exceptional condition has occurred. This flag is only valid in the revents bitmask; it is ignored in the events bitmask.

POLLHUP

The device has been disconnected. This event and POLLOUT are mutually exclusive, a stream can never be writable if a hang-up has occurred. However, this event and POLLIN, POLLRDNORM, POLLRDBAND or POLLPRI are not mutually exclusive. This flag is only valid in the revents bitmask. It is ignored in the events member.

POLLIN

Same as POLLRDNORM

POLLNVAL

The specified fd/msgid value is invalid. This flag is only valid in the revents bitmask; it is ignored in the events bitmask.

POLLOUT

Same as POLLWRNORM

POLLPRI

Out-of-band data may be received without blocking.

POLLRDBAND

Data from a nonzero priority band may be read without blocking. For STREAMS, this flag is set in revents even if the message is of zero length.

POLLRDNORM

Normal data may be read without blocking.

POLLWRBAND

Priority data (priority band greater than 0) may be written.

POLLWRNORM

Normal data may be written without blocking.

Note: Poll bits are supported as follows.

Regular Files

Always poll() true for reading and writing. This means that all poll() read and write bits are supported. They will never return with POLLERR or POLLHUP.

FIFOs / PIPEs

Do not have the concept of out-of-band data or priority band data. They support POLLIN, POLLRDNORM, POLLOUT, and POLLWRNORM. They ignore POLLPRI, POLLRDBAND, and POLLWRBAND. They never return POLLERR.

TTYs / OCS

Same support as FIFOs and PIPEs, except that TTYs may return POLLERR.

Sockets

Have the concept of out-of-band data. They support POLLIN, POLLRDNORM, POLLOUT, POLLWRNORM, and POLLPRI for out-of-band data. They ignore POLLRDBAND and POLLWRBAND. They may return POLLERR, and never return POLLHUP.

If the value of fd/msgid is less than 0, events is ignored and revents is set to 0 in that entry on return from poll().

In each pollfd structure, poll() clears the revents member except that where the application requested a report on a condition by setting one of the bits of events listed above, poll() sets the corresponding bit in revents if the requested condition is true. In addition, poll() sets the **POLLERR** flag in revents if the condition is true, even if the application did not set the corresponding bit in events.

The poll() function is not affected by the **O_NONBLOCK** flag.

A file descriptor for a socket that is listening for connections will indicate that it is ready for reading, once connections are available. A file descriptor for a socket that is connecting asynchronously will indicate that it is ready for writing, once a connection has been established.

The following macros are provided to manipulate the *nmsgsfds* parameter and the return value from poll():

Macro**Description****_SET_FDS_MSGS(*nmsgsfds*, *nmsgs*, *nfds*)**

Sets the high-order halfword of *nmsgsfds* to *nmsgs*, and sets the low-order halfword of *nmsgsfds* to *nfds*.

_NFDS(*n*)

If the return value *n* from poll() is nonnegative, returns the number of socket descriptors that meet the read, write, and exception criteria.

_NMSGs(*n*)

If the return value *n* from poll() is nonnegative, returns the number of message queues that meet the read, write, and exception criteria.

Returned value

If successful, `poll()` returns a nonnegative value.

A positive value indicates the total number of events that were found to be ready among the message queues and the total number of events that were found to be ready among the file descriptors. The return value is similar to `nmsgsfds` in that the high-order 16 bits of the return value give the number associated with message queues, and the low-order 16 bits give the number associated with file descriptors. Should the number associated with message queues be greater than 32767, only 32767 will be reported. This is to ensure that the return value does not appear to be negative. Should the number associated with file descriptors be greater than 65535, only 65535 will be reported.

If the call timed out and no file descriptors have been selected, `poll()` returns 0.

If unsuccessful, `poll()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAGAIN

The allocation of internal data structures failed, but a subsequent request may succeed.

EINTR

A signal was caught during `poll()`.

EINVAL

One of the parameters specified a value that was not correct. Consult the reason code to determine the exact reason the error occurred. The following reason codes can accompany this return code.

- JRWAITFOREVER
- JRINVALIDDNFDS
- JRNOFDSTOOMANYQIDS

EIO

One of the descriptors in the select mask has become inoperative and it is being repeatedly included in a select even though other operations against this descriptor have been failing with EIO. A socket descriptor, for example, can become inoperative if TCP/IP is shut down. A failure from select can not tell you which descriptor has failed so generally select will succeed and these descriptors will be reported to you as being ready for whatever event they were being selected for. Subsequently when the descriptor is used on a receive or other operation you will receive the EIO failure and can react to the problem with the individual descriptor. In general you would `close()` the descriptor and remove it from the next select mask. If the individual descriptor's failing return code is ignored though and an inoperative descriptor is repeatedly selected on and used, even though each time it is used that call fails with EIO, eventually the select call itself will fail with EIO.

Related information

- [“poll.h — poll\(\) function” on page 53](#)
- [“sys/msg.h — Message queue structures” on page 69](#)
- [“sys/time.h — Time types” on page 71](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“listen\(\) — Prepare the server for incoming client requests” on page 977](#)
- [“msgctl\(\), msgctl64\(\) — Message control operations” on page 1110](#)
- [“msgget\(\) — Get message queue” on page 1112](#)
- [“msgrcv\(\) — Message receive operation” on page 1115](#)
- [“msgsnd\(\) — Message send operations” on page 1119](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)

- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

popen() — Initiate a pipe stream to or from a process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE
#include <stdio.h>

FILE *popen(const char *command, const char *mode);
```

General description

The `popen()` function executes the command specified by the string *command*. It creates a pipe between the calling program and the executed command, and returns a pointer to a stream that can be used to either read from or write to the pipe.

The environment of the executed command will be as if a child process were created within the `popen()` call using `fork()`, and the child invoked the `sh` utility using the call:

```
exec1("/bin/sh", "sh", "-c", command, (char *)0);
```

The `popen()` function ensures that any streams from previous `popen()` calls that remain open in the parent process are closed in the child process.

The *mode* argument to `popen()` is a string that specifies I/O mode:

1. If *mode* is **r**, file descriptor **STDOUT_FILENO** will be the writable end of the pipe when the child process is started. The file descriptor *fileno(stream)* in the calling process, where *stream* is the stream pointer returned by `popen()`, will be the readable end of the pipe.
2. If *mode* is **w**, file descriptor **STDIN_FILENO** will be the readable end of the pipe when the child process is started. The file descriptor *fileno(stream)* in the calling process, where *stream* is the stream pointer returned by `popen()`, will be the writable end of the pipe.
3. If *mode* is any other value, a NULL pointer is returned and `errno` is set to `EINVAL`.

After `popen()`, both the parent and the child process will be capable of executing independently before either terminates.

Because open files are shared, a mode *r* command can be used as an input filter and a mode *w* command as an output filter.

Buffered reading before opening an input filter (that is, before `popen()`) may leave the standard input of that filter mispositioned. Similar problems with an output filter may be prevented by buffer flushing with `fflush()`.

A stream opened with `popen()` should be closed by `pclose()`.

The behavior of `popen()` is specified for values of *mode* of *r* and *w*. *mode* values of *rb* and *wb* are supported but are not portable.

If the shell command cannot be executed, the child termination status returned by `pclose()` will be as if the shell command terminated using `exit(127)` or `_exit(127)`.

If the application calls `waitpid()` with a *pid* argument greater than 0, and it still has a stream that was created with `popen()` open, it must ensure that *pid* does not refer to the process started by `popen()`

The stream returned by `popen()` will be designated as byte-oriented.

Special behavior for file tagging and conversion: When the FILETAG(AUTOTAG) runtime option is specified, the pipe opened for communication between the parent and child process by `popen()` will be tagged with the writer's program CCSID upon first I/O. For example, if `popen(some_command, "r")` were specified, then the stream returned by the `popen()` would be tagged in the child process' program CCSID.

Returned value

If successful, `popen()` returns a pointer to an open stream that can be used to read or write to a pipe.

If unsuccessful, `popen()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The *mode* argument is invalid.

`popen()` may also set `errno` values as described by `spawn()`, `fork()`, or `pipe()`.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fflush\(\) — Write buffer to file” on page 530](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“pclose\(\) — Close a pipe stream to or from a process” on page 1183](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“system\(\) — Execute a command” on page 1800](#)

posix_memalign() — Reserve aligned storage block

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _UNIX03_SOURCE
#include <stdlib.h>

int posix_memalign(void **memptr, size_t alignment, size_t size);
```

General description

The `posix_memalign()` function reserves a block of storage and returns a pointer to the reserved storage in *memptr*. The alignment of the storage is specified by *alignment*, whose value must be a

power of two and a multiple of `sizeof(void *)`. The size of the storage is specified by *size*. If successful completion, the value pointed to by *memptr* must be a multiple of *alignment*.

This function is supported only in a POSIX program.

Special behavior for C++ : The C++ keywords `new` and `delete` are not interoperable with `aligned_alloc()`, `calloc()`, `free()`, `malloc()`, `posix_memalign()`, or `realloc()`.

Returned value

If successful, `posix_memalign()` returns 0; otherwise, it returns an error number and the contents of *memptr* must either be left unmodified or be set to a null pointer.

If *size* was specified to 0, `posix_memalign()` returns zero and sets *memptr* to a null pointer.

Error Code

Description

EINVAL

The value of the alignment parameter is not a power of two or a multiple of `sizeof(void *)`.

ENOMEM

There is insufficient memory available with the requested alignment.

Example

```
#define _UNIX03_SOURCE
#include <stdio.h>
#include <stdlib.h>
#include <errno.h>

int main(void)
{
    void *p;
    size_t alignment,size;
    int ret;

    ret = 0;
    alignment = 32;
    size = 64;
    ret = posix_memalign(&p,alignment,size);
    if(!ret){
        printf("Address of aligned storage is %p\n",p);
        return 0;
    }
    else{
        printf("posix_memalign() failed with errno = %d\n",errno);
        return -1;
    }
}
```

Output:

```
Address of aligned storage is 22C7ED20
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“aligned_alloc\(\) — Allocating aligned memory blocks” on page 157](#)
- [“calloc\(\) — Reserve and initialize storage” on page 232](#)
- [“free\(\) — Free a block of storage” on page 620](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“__malloc24\(\) — Allocate 24-bit storage” on page 1037](#)
- [“__malloc31\(\) — Allocate 31-bit storage” on page 1038](#)
- [“realloc\(\) — Change reserved storage block size” on page 1395](#)

posix_openpt() — Open a pseudo-terminal device

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1.9 |

Format

```
#define _XOPEN_SOURCE 600
#include <stdlib.h>
#include <fcntl.h>

int posix_openpt(int oflag);
```

General description

The `posix_openpt()` function establishes a connection between a main device for a pseudo-terminal and a file descriptor. The file descriptor is used by other I/O functions that refer to that pseudo-terminal.

The file status flags and file access modes of the open file description are set according to the value of `oflag`.

Values for `oflag` are constructed by a bitwise-inclusive OR of flags from the following list, defined in `<fcntl.h>`:

O_RDWR

Open for reading and writing.

O_NOCTTY

If set `posix_openpt()` will not cause the terminal device to become the controlling terminal for the process.

The behavior of other values for the `oflag` argument is unspecified.

Argument

Description

oflag

The value of the file status flags and file access modes of the open file description.

Returned value

Upon successful completion, the `posix_openpt()` function opens a main pseudo-terminal device and returns a non-negative integer representing the lowest numbered unused file descriptor. Otherwise, -1 is returned and `errno` set to indicate the error.

Error Code

Description

EMFILE

{OPEN_MAX} file descriptors are currently open in the calling process.

ENFILE

The maximum allowable number of files is currently open in the system.

EINVAL

The value of `oflag` is not valid.

EAGAIN

Out of pseudo-terminal resources.

Example

CELEBP71

```
/* CELEBP71

This example demonstrates how to use posix_openpt() to open a
main psuedo-terminal device.

Expected output:
The main psuedo-terminal id is [first available descriptor]

*/
#define _XOPEN_SOURCE 600
#include <stdlib.h>
#include <fcntl.h>
#include <stdio.h>

void main() {
    int fd;

    fd = posix_openpt(O_RDWR | O_NOCTTY);
    if (fd == -1)
        perror("Error opening a terminal.\n");
    else
        printf("The main psuedo-terminal id is %d\n",fd);
}
```

pow(), powf(), powl() – Raise to power

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double pow(double x, double y);
double pow(double x, int y);           /* C++ only */
float pow(float x, int y);             /* C++ only */
float pow(float x, float y);           /* C++ only */
long double pow(long double x, int y); /* C++ only */
long double pow(long double x, long double y); /* C++ only */
float powf(float x, float y);
long double powl(long double x, long double y);
```

General description

The pow(), powf(), and powl() functions calculate the value of x to the power of y.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See “IEEE binary floating-point” on page 97 for more information about IEEE Binary Floating-Point.

Restriction: The powf() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

If successful, the `pow()`, `powf()`, and `powl()` functions return the value of x to the power of y .

If y is 0, the function returns 1.

If x is negative and y is non-integral, the function sets `errno` to `EDOM` and returns `-HUGE_VAL`. If the correct value is outside the range of representable values, $\pm\text{HUGE_VAL}$ is returned according to the sign of the value, and the value of `ERANGE` is stored in `errno`.

Special behavior for IEEE: If x is negative or 0, then the y parameter must be an integer. If y is 0, the function returns 1.0 for all x parameters.

If an overflow occurs, the function returns `HUGE_VAL` and sets `errno` to `ERANGE`.

If both x and y are negative, the function returns `NaNQ` and sets `errno` to `EDOM`.

If x is 0 and y is negative, the function returns `HUGE_VAL` and does not modify `errno`, but `powf` sets `errno` to `ERANGE`.

Note: When environment variable `_EDC_SUSV3` is set to 2, and if x is 0 and y is negative, the function returns `-HUGE_VAL` and sets `errno` to `ERANGE`.

Example

CELEBP05

```
/* CELEBP05

   This example calculates the value of 2**3.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y, z;

    x = 2.0;
    y = 3.0;
    z = pow(x,y);

    printf("%lf to the power of %lf is %lf\n", x, y, z);
}
```

Output:

```
2.000000 to the power of 3.000000 is 8.000000
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“exp\(\), expf\(\), expl\(\) — Calculate exponential function” on page 453](#)
- [“log\(\), logf\(\), logl\(\) — Calculate natural logarithm” on page 995](#)
- [“log10\(\), log10f\(\), log10l\(\) — Calculate base 10 logarithm” on page 1005](#)

[powd32\(\), powd64\(\), powd128\(\) — Raise to power](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 powd32(_Decimal32 x, _Decimal32 y);
_Decimal64 powd64(_Decimal64 x, _Decimal64 y);
_Decimal128 powd128(_Decimal128 x, _Decimal128 y);

_Decimal32 pow(_Decimal32 x, _Decimal32 y); /* C++ only */
_Decimal64 pow(_Decimal64 x, _Decimal64 y); /* C++ only */
_Decimal128 pow(_Decimal128 x, _Decimal128 y); /* C++ only */
```

General description

The powd32(), powd64(), and powd128() functions calculate the value of x to the power of y .

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, the powd32(), powd64(), and powd128() functions return the value of x to the power of y .

If x is negative or 0, then the y parameter must be an integer. If y is 0, the function returns 1.0 for all x parameters.

If an overflow occurs, the function returns HUGE_VAL_D32, HUGE_VAL_D64, or HUGE_VAL_D128 and sets `errno` to `ERANGE`.

If x is negative and y is not an integer, the function returns NaNQ and sets `errno` to `EDOM`.

If x is 0 and y is negative, the function returns HUGE_VAL_D32, HUGE_VAL_D64, or HUGE_VAL_D128 but does not modify `errno`.

Example

```
/* CELEBP59

   This example illustrates the powd64() function
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 x, y, z;

    x = 2.0DD;
    y = 3.0DD;
    z = powd64(x, y);

    printf("%Df to the power of %Df is %Df\n", x, y, z);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“expd32\(\), expd64\(\), expd128\(\) — Calculate exponential function ” on page 454](#)
- [“logd32\(\), logd64\(\), logd128\(\) — Calculate natural logarithm” on page 999](#)

- [“log10d32\(\), log10d64\(\), log10d128\(\) — Calculate base 10 logarithm”](#) on page 1006
- [“pow\(\), powf\(\), powl\(\) — Raise to power”](#) on page 1204

__pow_i() — Raise to a power (R**I)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | z/OS V1R7 |

Format

```
#include <math.h>

double __pow_i(double x, int y);
```

General description

The `__pow_i()` function calculates the value of x to the power of y and is a C interface to the Language Environment Math Service CEESDXPI. Information about the Language Environment math service CEESDXPI can be found in the following publications:

- [z/OS Language Environment Programming Guide](#)
- [z/OS Language Environment Programming Reference](#)
- [z/OS Language Environment Concepts Guide](#)

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------------------|-----|------|
| <code>__pow_i</code> | X | X |

Returned value

If successful, `__pow_i()` returns the value of x to the power of y .

| If... | Then... |
|------------------------------------|--|
| x is not equal to 0 and y is 0 | 1 is returned. |
| x is 0 and y is positive | 0 is returned. |
| x and y are 0 | 0 is returned and <code>errno</code> is set to <code>EDOM</code> . |
| x is 0 and y is negative | $\pm\text{HUGE_VAL}$ is returned and <code>errno</code> is set to <code>EDOM</code> . |
| x and y cause an overflow | <code>HUGE_VAL</code> is returned. |

Related information

- [“__pow_ii\(\) — Raise to a power \(I**I\)”](#) on page 1208

__pow_ii() – Raise to a power (I**I)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | z/OS V1R7 |

Format

```
#include <math.h>

int __pow_ii(int x, int y);
```

General description

The __pow_ii() function calculates the value of x to the power of y and is a C interface to the LE Math Service CEESIXPI. Information about the LE Math Service CEESIXPI can be found in the following publications:

- [z/OS Language Environment Programming Guide](#)
- [z/OS Language Environment Programming Reference](#)
- [z/OS Language Environment Concepts Guide](#)

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| __pow_ii | X | X |

Returned value

If successful, __pow_ii() returns the value of x to the power of y.

| If... | Then... |
|---|---|
| x is not equal to 0 and y is 0 | 1 is returned. |
| x is 0 and y is positive | 0 is returned. |
| x is 0 and y is negative | INT_MAX is returned and errno is set to EDOM. |
| x and y are 0 | 0 is returned and errno is set to EDOM. |
| x is 1 and y is negative | 1 is returned. |
| x is -1 and y is negative | ±1 is returned. |
| x is greater than 1 and y is negative | 0 is returned and errno is set to EDOM. |
| x is less than -1 and y is negative | 0 is returned and errno is set to EDOM. |
| The values of x and y cause an overflow and x is less than 0 or y is odd. | errno is set to ERANGE and the function returns INT_MIN |
| The values of x and y cause an overflow and x is greater than 0 or y is even. | errno is set to ERANGE and the function returns INT_MAX |

Related information

- “`__pow_i()` — Raise to a power (R^{**I})” on page 1207

prctl() — Operate on a process or thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/prctl.h>
```

```
int prctl(int option, unsigned long arg2, unsigned long arg3, unsigned long arg4, unsigned long arg5);
```

General description

`prctl()` manipulates various aspects of the behavior of a calling thread or process.

`prctl()` is called with a first argument that describes what to do (with values that are defined in `<sys/prctl.h>`), and further arguments that depend on the first one. The first argument can be:

PR_SET_CHILD_SUBREAPER

If `arg2` is nonzero, set the "child subreaper" attribute of the calling process; if `arg2` is zero, unset the attribute.

When a process becomes orphaned (that is, its immediate parent terminates), that process is reparented to the nearest living ancestor subreaper. Then, calls to `getppid()` in the orphaned process return the PID of the subreaper process, and when the orphan terminates, it is the subreaper process that receives a `SIGCHLD` signal. The setting of the "child subreaper" attribute is not inherited by the children that are created by `fork()` and `clone()`. The setting is preserved across `execve()`.

Establishing a subreaper process is useful in session management frameworks where a hierarchical group of processes is managed by a subreaper process, which needs to be informed when one of the processes (for example, a double-forked daemon) terminates (so that it can restart that process).

PR_GET_CHILD_SUBREAPER

Return the "child subreaper" setting of the caller in the location that is pointed to by `(int *) arg2`.

PR_SET_DUMPABLE

Set the state of the "dumpable" attribute, which determines whether core dumps are produced for the calling process upon delivery of a signal whose default behavior is to produce a core dump. `arg2` must be either 0 (process is not dumpable) or 1 (process is dumpable). Normally, the "dumpable" attribute is set to 1. However, it is reset to value 0 in the following circumstances:

- The process's effective user or group ID is changed.
- The process's file system user or group ID is changed.
- The process calls `execve()` to execute a set-user-ID or set-group-ID program, resulting in a change of either the effective user ID or the effective group ID.

As a security measure, the ownership is made `root:root` if the process's "dumpable" attribute is set to a value other than 1.

PR_GET_DUMPABLE

Return the current state of the calling process's dumpable attribute as the function result.

PR_SET_NAME

Set the name of the calling thread by using the value in the location that is pointed to by (char *) *arg2*. The name can be a null-terminated string with the max length of 16 characters. If the length of the string, including the terminating null byte, exceeds 16 bytes, the string is truncated.

PR_GET_NAME

Return the name of the calling thread in the buffer that is pointed to by (char *) *arg2*. The name can be a string with the max length of 16 characters. The returned string is null-terminated if it is shorter than that.

PR_SET_NO_NEW_PRIVS

Set the calling thread's no_new_privs attribute to the value in *arg2*. With no_new_privs set to 1, `execve()` promises not to grant privileges to do anything that cannot be done without the `execve()` call. Once set, the no_new_privs attribute cannot be unset. The setting of this attribute is inherited by the children that are created by `fork()` and `clone()` and preserved across `execve()`.

PR_GET_NO_NEW_PRIVS

Return the value of the no_new_privs attribute for the calling thread as the function result. A value of 0 indicates the regular `execve(2)` behavior. A value of 1 indicates `execve()` operates in the privilege-restricting mode.

PR_SET_PDEATHSIG

Set the parent-death signal of the calling process to *arg2* (0 to clear). This is the signal that the calling process gets when its parent dies.



Warning: The "parent" in this case is considered to be the thread that created this process. The signal is sent when that thread terminates (for example, by calling `pthread_exit()`), rather than after all of the threads in the parent process terminate. The parent-death signal is sent upon subsequent termination of the parent thread and also upon termination of each subreaper process to which the caller is then reparented. If the parent thread and all ancestor subreapers are terminated by the time of the `PR_SET_PDEATHSIG` operation, no parent-death signal is sent to the caller.

The parent-death signal setting is cleared for the child of a `fork()`. It is also cleared when executing a set-user-ID or set-group-ID binary; otherwise, this value is preserved across `execve()`. The parent-death signal setting is also cleared upon changes to any of the following thread credentials: effective user ID, effective group ID, file system user ID, or file system group ID.

PR_GET_PDEATHSIG

Return the current value of the parent process death signal in the location that is pointed to by (int *) *arg2*.

Returned value

If successful, `PR_GET_DUMPABLE` and `PR_GET_NO_NEW_PRIVS` return the nonnegative values that are described previously. All other option values return 0.

If unsuccessful, `prctl()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EFAULT**

arg2 is an invalid address.

EINVAL

option is `PR_SET_PDEATHSIG` or `PR_GET_Name` and *arg2* is not a valid signal number.

Related information

- [“sys/prctl.h — Operations on a process or thread” on page 69](#)

prlimit() — Get or set the hard and soft resource limits of a specified process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _XPLATFORM_SOURCE
#include <sys/resource.h>

int prlimit(pid_t pid, int resource, const struct rlimit *new_limit, struct rlimit *old_limit);
```

General description

`prlimit()` gets or sets resource limits for the specified process. A resource limit is a pair of values; one specifies the current (soft) limit and the other the maximum (hard) limit.

The *pid* argument specifies the process whose resource limits are to be set or retrieved. If *pid* is equal to 0, the resource limits are set or retrieved for the calling process.

The caller must have either of the following privileges for changing other process resource limit:

- The caller has superuser level authority.
- The real, effective, and saved set user IDs of the target process match the real user ID of the caller and the real, effective, and saved set group IDs of the target process must match the real group ID of the caller.

The soft limit might be modified to any value that is less than or equal to the hard limit. For certain resource values (RLIMIT_CPU, RLIMIT_NOFILE, RLIMIT_AS), the soft limit cannot be set lower than the existing usage.

The hard limit might be lowered to any value that is greater than or equal to the soft limit. The hard limit can be raised only by a process that has superuser authority. Both the soft limit and hard limit can be changed by a `prlimit()` call.

The value of RLIM_INFINITY that is defined in `<sys/resource.h>` is considered to be larger than any other limit value. If a call to `prlimit()` returns RLIM_INFINITY for a resource, it means that the implementation does not enforce limits on that resource. Specifying RLIM_INFINITY as any resource limit values on a successful call to `prlimit()` inhibits enforcement of that resource limit.

The *resource* argument specifies which resource to set the hard and/or soft limits for. The valid values of *resource* are:

RLIMIT_AS

The maximum address space size for the process in bytes. If the limit is exceeded, `malloc()` and `mmap()` fail with an `errno` of ENOMEM. Automatic stack growth fails.

RLIMIT_CORE

The maximum size of a dump of memory in bytes that is allowed for the process. A value of 0 prevents file creation. Dump file creation stops at this limit.

RLIMIT_CPU

The maximum amount of CPU time in seconds that is allowed for the process. If the limit is exceeded, a SIGXCPU signal is sent to the process, and the process is granted a small CPU time extension to allow for signal generation and delivery. If the extension is used up, the process is terminated with a SIGKILL signal. An attempt to set the CPU limit lower than that already used results in an EINVAL `errno`.

RLIMIT_DATA

The maximum size of the break value for the process in bytes. This resource has a hard and soft limit value of RLIM_INFINITY. A call to `prlimit()` to set this resource to any value other than RLIM_INFINITY fails with an `errno` of EINVAL.

RLIMIT_FSIZE

The maximum file size in bytes that is allowed for the process. A value of 0 prevents file creation. If the size is exceeded, a SIGXFSZ signal is sent to the process. If the process is blocking, catching, or ignoring SIGXFSZ, continued attempts to increase the size of a file beyond the limit fail with an `errno` of EFBIG.

RLIMIT_MEMLIMIT

The maximum amount of usable storage above the 2-gigabyte bar (in 1-megabyte segments) that can be allocated. Any attempt to extend the usable amount of virtual storage above the 2-gigabyte bar fails.

RLIMIT_NOFILE

The maximum number of open file descriptors that is allowed for the process. This number is one greater than the maximum value that might be assigned to a new descriptor. That is, it is one-based. Any function that attempts to create a new file descriptor beyond the limit fails with an EMFILE `errno`. An attempt to set the open file descriptors limit lower than that already used results in an EINVAL `errno`.

Restriction: This value cannot exceed 524288.

RLIMIT_STACK

The maximum size of the stack for a process in bytes. In z/OS UNIX System Services, the stack is a per-thread resource. This resource has a hard and soft limit value of RLIM_INFINITY. A call to `prlimit()` to set this resource to any value other than RLIM_INFINITY fails with an `errno` of EINVAL.

The *rlp* argument points to a `rlimit` structure. This structure contains the following members:

rlim_cur

The current (soft) limit

rlim_max

The maximum (hard) limit

- If the *new_limit* argument is not NULL, the `rlimit` structure to which it points is used to set new values for the soft and hard limits for *resource*.
- If the *old_limit* argument is not NULL, a successful call to `prlimit()` places the previous soft and hard limits for *resource* in the `rlimit` structure that is pointed to by *old_limit*.
- If the *new_limit* and *old_limit* arguments are all NULL, no operation are taken.
- If both the *new_limit* and *old_limit* arguments are not NULL, get operation is performed first.

The resource limit values are propagated across `exec` and `fork`.

Special behavior for z/OS UNIX System Services:

An exception exists for `exec` processing in daemon support. If a daemon process withvokes `exec` after it invokes `setuid()`, the RLIMIT_CPU, RLIMIT_AS, RLIMIT_CORE, RLIMIT_FSIZE, and RLIMIT_NOFILE limit values are set based on the limit values that are specified in the kernel parmlib member BPXPRMxx.

For processes that are not the only process within an address space, the RLIMIT_CPU and RLIMIT_AS limits are shared with all the processes within the address space. For RLIMIT_CPU, when the soft limit is exceeded, action is taken on the first process within the address space. If the action is termination, all processes within the address space are terminated.

In addition to the RLIMIT_CORE limit values, the dump file defaults are set by SYSMDUMP defaults. Refer to [z/OS MVS Initialization and Tuning Reference](#) for information on setting up SYSMDUMP defaults by using the IEADMR00 parmlib member.

Dumps of memory are taken in 4160-byte increments. Therefore, RLIMIT_CORE values affect the size of memory dumps in 4160-byte increments. For example, if the RLIMIT_CORE soft limit value is 4000, the

dump contains no data. If the RLIMIT_CORE soft limit value is 8000, the maximum size of a memory dump is 4160 bytes.

When setting RLIMIT_NOFILE, the hard limit cannot exceed the system-defined limit of 524288.

Returned value

If successful, `prlimit()` returns 0.

If unsuccessful, `prlimit()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EINVAL

An invalid resource is specified, or the soft limit to set exceeds the hard limit to set, the soft limit to set is below the current usage, or the resource does not allow any value other than RLIM_INFINITY.

EMVSSAF2ERR

A Security product internal error occurs. See the `Reason_code` parameter for the exact reason for the error.

EPERM

The limit that is specified to `prlimit()` raises the maximum limit value, and the calling process does not have appropriate privileges.

Related information

- [“getrlimit\(\) — Get current or maximum resource consumption” on page 767](#)
- [“setrlimit\(\) — Control maximum resource consumption” on page 1568](#)

pread() — Read from a file or socket without file pointer change

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R10 |

Format

```
#define _XOPEN_SOURCE 500
#include <unistd.h>

ssize_t pread(int fildev, void *buf, size_t nbyte, off_t offset);
```

General description

The `pread()` function performs the same action as `read()`, except that it reads from a given position in the file without changing the file pointer.

The first three arguments to `pread()` are the same as `read()`, with the addition of a fourth argument *offset* for the desired position inside the file.

An error result is returned for any attempt to perform a `pread()` on a file that is incapable of a seek action.

For regular files, no data transfer will occur past the offset maximum established in the open file description associated with *fildev*.

Returned value

If successful, `pread()` returns a non-negative integer indicating the number of bytes actually read.

If unsuccessful, `pread()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAGAIN

`O_NONBLOCK` is set to 1, but data was not available for reading.

EBADF

fildev is not a valid file or socket descriptor.

ECONNRESET

A connection was forcibly closed by a peer.

EFAULT

Using the *buf* and *nbyte* parameters would result in an attempt to access memory outside the caller's address space.

EINTR

`pread()` was interrupted by a signal that was caught before any data was available.

EINVAL

nbyte contains a value that is less than 0, or the request is invalid or not supported, or the STREAM or multiplexer referenced by *fildev* is linked (directly or indirectly) downstream from a multiplexer.

The *offset* argument is invalid. The value is negative.

EIO

The process is in a background process group and is attempting to read from its controlling terminal, and either the process is ignoring or blocking the SIGTTIN signal or the process group of the process is orphaned. For sockets, an I/O error occurred.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOTCONN

A receive was attempted on a connection-oriented socket that is not connected.

ENXIO

A request was outside the capabilities of the device.

EOVERFLOW

The file is a regular file and an attempt was made to read or write at or beyond the offset maximum associated with the file.

ESPIPE

fildev is associated with a pipe or FIFO.

ETIMEDOUT

The connection timed out during connection establishment, or due to a transmission timeout on active connection.

EWOULDBLOCK

socket is in nonblocking mode and data is not available to read, or the `SO_RCVTIMEO` timeout value was reached before data was available.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“pwrite\(\) — Write data on a file or socket without file pointer change” on page 1366](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)

printf() — Format and write data

The information for this function is included in [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data”](#) on page 593.

pselect() - Monitor activity on files or sockets and message queues

The information for this function is included in [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues”](#) on page 1472.

psignal() — Print signal description

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <signal.h>

void psignal(int sig, const char *s);
```

General description

`psignal()` displays a message on `stderr`, which consists of the string `s`, a colon, a space, a string that describes the signal number `sig`, and a trailing newline. If the string `s` is `NULL` or empty, the colon and space are omitted. If `sig` is invalid, the message that is displayed indicates an unknown signal.

`psignal()` does not change the orientation of the `stderr` stream.

`psignal_unlocked()` is functionally equivalent to `psignal()` with the exception that it is not thread-safe. `psignal_unlocked()` can safely be used in a multithreaded application only when it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

`psignal()` returns no values.

Error Code

Description

No errors are defined.

Related information

- [“signal.h — Exception handling”](#) on page 58

pthread_atfork() - Register fork handlers

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_atfork(void (*prepare)(void), void (*parent)(void),
void (*child)(void));
```

General description

The *pthread_atfork()* function registers fork handlers to be called before and after *fork()*, in the context of the thread that called *fork()*. Fork handler functions may be named for execution at the following three points in thread processing:

- The *prepare* handler is called before *fork()* processing commences.
- The *parent* handler is called after *fork()* processing completes in the parent process.
- The *child* handler is called after *fork()* processing completes in the child process.

If any argument to *pthread_atfork()* is NULL, the call does not register a handler to be invoked at the point corresponding to that argument.

The order of calls to *pthread_atfork()* is significant. The *parent* and *child* fork handlers are called in the order in which they were established by calls to *pthread_atfork()*. The *prepare* fork handlers are called in the opposite order.

The intended purpose of *pthread_atfork()* is to provide a mechanism for maintaining the consistency of mutex locks between parent and child processes. The handlers are expected to be straightforward programs, designed simply to manage the synchronization variables and must return to ensure that all registered handlers are called. Historically, the prepare handler acquired needed mutex locks, and the parent and child handlers released them. Unfortunately, this usage is not practical on the z/OS platform and is not guaranteed to be portable in the current UNIX standards. When the parent process is multi-threaded (invoked *pthread_create()* at least once), the child process can only safely call async-signal-safe functions before it invokes an *exec()* family function. This restriction was added to the POSIX.1 standard in 1996. Because functions such as *pthread_mutex_lock()* and *pthread_mutex_unlock()* are not async-signal-safe, unpredictable results may occur if they are used in a child handler.

Special behavior for IBM z/OS C: The C Library *pthread_atfork()* function has the following restrictions:

- Any fork handler registered by a fetched module that has been released is removed from the list at the time of release. See [“fetch\(\) — Get a load module”](#) on page 516, [“fetchep\(\) — Share writable static”](#) on page 526, and [“release\(\) — Delete a load module”](#) on page 1424 for details about fetching and releasing modules.
- Any handler registered in an explicitly loaded DLL (using *dllload()* or *dlopen()*) that has been freed (using *dllfree()* or *dlclose()*) is removed from the list, except when the DLL has also been implicitly loaded.
- Use of non-C subroutines or functions as fork handlers will result in undefined behavior.

Special behavior for IBM z/OS C/C++:

- All of the behaviors listed under "Special Behavior for IBM z/OS C."
- The *pthread_atfork()* function cannot receive C++ function pointers compiled as 31-bit non-XPLINK objects, because C and C++ linkage conventions are incompatible in that environment. If you attempt

to pass a C++ function pointer to `pthread_atfork()`, the compiler will flag it as an error. In C++, you must ensure that all handlers registered for use by `pthread_atfork()` have C linkage by declaring them as `extern "C"`.

Returned value

If successful, `pthread_atfork()` returns zero; otherwise, it returns an error number.

Error Code

Description

ENOMEM

Insufficient table space exists to record the fork handler addresses.

Example

CELEBP60

```
/* CELEBP60 */
/* Example using SUSv3 pthread_atfork() interface */

#define _UNIX03_THREADS 1

#include <pthread.h>
#include <stdio.h>
#include <unistd.h>
#include <fcntl.h>
#include <sys/types.h>
#include <sys/wait.h>
#include <stdlib.h>
#include <errno.h>

char fn_c[] = "childq.out";
char fn_p[] = "parentside.out";
int fd_c;
int fd_p;

void prep1(void) {
    char buff[80] = "prep1\n";
    write(4,buff,sizeof(buff));
}

void prep2(void) {
    char buff[80] = "prep2\n";
    write(4,buff,sizeof(buff));
}

void prep3(void) {
    char buff[80] = "prep3\n";
    write(4,buff,sizeof(buff));
}

void parent1(void) {
    char buff[80] = "parent1\n";
    write(4,buff,sizeof(buff));
}

void parent2(void) {
    char buff[80] = "parent2\n";
    write(4,buff,sizeof(buff));
}

void parent3(void) {
    char buff[80] = "parent3\n";
    write(4,buff,sizeof(buff));
}

void child1(void) {
    char buff[80] = "child1\n";
    write(3,buff,sizeof(buff));
}

void child2(void) {
    char buff[80] = "child2\n";
```

```

    write(3, buff, sizeof(buff));
}

void child3(void) {
    char buff[80] = "child3\n";
    write(3, buff, sizeof(buff));
}

void *thread1(void *arg) {
    printf("Thread1: Hello from the thread.\n");
}

int main(void)
{
    pthread_t thid;
    int rc, ret;
    pid_t pid;
    int status;
    char header[30] = "Called Child Handlers\n";

    if (pthread_create(&thid, NULL, thread1, NULL) != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    if (pthread_join(thid, NULL) != 0) {
        perror("pthread_join() error");
        exit(5);
    } else {
        printf("IPT: pthread_join success! Thread 1 should be finished now.\n");
        printf("IPT: Prepare to fork!!!\n");
    }

    /*-----*/
    /*| Start atfork handler calls in parent */
    /*-----*/
    /* Register call 1 */
    rc = pthread_atfork(&prep1, &parent2, &child3);
    if (rc != 0) {
        perror("IPT: pthread_atfork() error [Call #1]");
        printf(" rc= %d, errno: %d, ejr: %08x\n", rc, errno, __errno2());
    }

    /* Register call 2 */
    rc = pthread_atfork(&prep2, &parent3, &child1);
    if (rc != 0) {
        perror("IPT: pthread_atfork() error [Call #2]");
        printf(" rc= %d, errno: %d, ejr: %08x\n", rc, errno, __errno2());
    }

    /* Register call 3 */
    rc = pthread_atfork(&prep3, &parent1, NULL);
    if (rc != 0) {
        perror("IPT: pthread_atfork() error [Call #3]");
        printf(" rc= %d, errno: %d, ejr: %08x\n", rc, errno, __errno2());
    }

    /* Create output files to expose the execution of fork handlers. */
    if ((fd_c = creat(fn_c, S_IWUSR)) < 0)
        perror("creat() error");
    else
        printf("Created %s and assigned fd= %d\n", fn_c, fd_c);
    if ((ret = write(fd_c, header, 30)) == -1)
        perror("write() error");
    else
        printf("Write() wrote %d bytes in %s\n", ret, fn_c);

    if ((fd_p = creat(fn_p, S_IWUSR)) < 0)
        perror("creat() error");
    else
        printf("Created %s and assigned fd= %d\n", fn_p, fd_p);
    if ((ret = write(fd_p, header, 30)) == -1)
        perror("write() error");
    else
        printf("Write() wrote %d bytes in %s\n", ret, fn_p);
}

```

```
pid = fork();

if (pid < 0)
    perror("IPT: fork() error");
else {
    if (pid == 0) {
        printf("Child: I am the child!\n");
        printf("Child: My PID= %d, parent= %d\n", (int)getpid(),
            (int)getppid());
        exit(0);
    } else {
        printf("Parent: I am the parent!\n");
        printf("Parent: My PID= %d, child PID= %d\n", (int)getpid(), (int)pid);

        if (wait(&status) == -1)
            perror("Parent: wait() error");
        else if (WIFEXITED(status))
            printf("Child exited with status: %d\n", WEXITSTATUS(status));
        else
            printf("Child did not exit successfully\n");

        close(fd_c);
        close(fd_p);
    }
}
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“atexit\(\) — Register program termination function” on page 197](#)

pthread_attr_destroy() — Destroy the thread attributes object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_attr_destroy(pthread_attr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_destroy(pthread_attr_t *attr);
```

General description

Removes the definition of the thread attributes object. An error results if a thread attributes object is used after it has been destroyed.

attr is a pointer to a thread attribute object initialized by pthread_attr_init().

You can use a thread attribute object to manage the characteristics of threads in your application. It defines the set of values to be used for the thread during its creation. By establishing a thread attribute object, you can create many threads with the same set of characteristics, without defining those characteristics for each thread. You can define more than one thread attribute object.

If a thread attribute object is shared between threads, the application must provide the necessary synchronization because a thread attribute object is defined in the application's storage.

Returned value

If successful, pthread_attr_destroy() returns 0.

If unsuccessful, pthread_attr_destroy() returns -1.

There are no documented errno values. Use perror() or strerror() to determine the cause of the error.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_attr_destroy() returns an error number to indicate the error.

Example

CELEBP06

```
/* CELEBP06 */
#define _OPEN_THREADS
#include <stdio.h>
#include <pthread.h>

void *thread1(void *arg) {
    pthread_exit(NULL);
}

int main()
{
    pthread_t      thid;
    pthread_attr_t attr;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    if (pthread_create(&thid, &attr, thread1, NULL) == -1) {
        perror("error in pthread_create");
        exit(2);
    }

    if (pthread_detach(&thid) == -1) {
        perror("error in pthread_detach");
        exit(4);
    }

    if (pthread_attr_destroy(&attr) == -1) {
        perror("error in pthread_attr_destroy");
        exit(5);
    }
    exit(0);
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)

- “pthread_create() — Create a thread” on page 1274

pthread_attr_getdetachstate() — Get the detach state attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_attr_getdetachstate(pthread_attr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_attr_getdetachstate(const pthread_attr_t *attr,
                               int *detachstate);
```

General description

Returns the current value of the detachstate attribute for the thread attribute object, *attr*, that is created by pthread_attr_init(). The detachstate attribute values are:

0

Undetached. An undetached thread will keep its resources after termination.

1

Detached. A detached thread will have its resources automatically freed by the system at termination. Thus, you cannot get the thread's termination status (or wait for the thread to terminate) by using pthread_join().

You can use a thread attribute object to manage the characteristics of threads in your application. It defines the set of values to be used for the thread during its creation. By establishing a thread attribute object, you can create many threads with the same set of characteristics, without defining those characteristics for each thread. You can define more than one thread attribute object.

Returned value

If successful, pthread_attr_getdetachstate() returns the detachstate (0 or 1).

If unsuccessful, pthread_attr_getdetachstate() returns -1.

There are no documented errno values. Use perror() or strerror() to determine the cause of the error.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_attr_getdetachstate() returns an error number to indicate the error.

Example

CELEBP07

```
/* CELEBP07 */
#define _OPEN_THREADS
#include <stdio.h>
#include <pthread.h>
```

```

int main()
{
    pthread_attr_t attr;
    char          typ[12];

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    switch(pthread_attr_getdetachstate(&attr)) {
        default:
            perror("error in pthread_attr_getdetachstate()");
            exit(2);
        case 0:
            strcpy(typ, "undetached");
            break;
        case 1:
            strcpy(typ, "detached");
    }
    printf("The detach state is %s.\n", typ);

    if (pthread_attr_destroy(&attr) == -1) {
        perror("error in pthread_attr_destroy");
        exit(2);
    }
    exit(0);
}

```

CELEBP61

```

/* CELEBP61 */
/* Example using SUSv3 pthread_attr_getdetachstate() interface */

#define _UNIX03_THREADS 1
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <pthread.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int          rc, newstate, foundstate;
    char          state[12];

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    newstate = PTHREAD_CREATE_DETACHED;
    pthread_attr_setdetachstate(&attr, newstate);

    rc = pthread_attr_getdetachstate(&attr, &foundstate);
    switch(foundstate) {
        case PTHREAD_CREATE_JOINABLE:
            strcpy(state, "joinable");
            break;
        case PTHREAD_CREATE_DETACHED:
            strcpy(state, "detached");
            break;
        default:
            printf("pthread_attr_getdetachstate returned: %d\n", rc);
            printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
            exit(2);
    }

    printf("Threads created with this attribute object are %s.\n", state);

    if (pthread_attr_destroy(&attr) == -1) {
        perror("error in pthread_attr_destroy");
        exit(3);
    }

    exit(0);
}

```


Related information

- “pthread.h — Thread interfaces” on page 53
- “pthread_attr_init() — Initialize a thread attribute object” on page 1233
- “pthread_attr_setdetachstate() — Set the detach state attribute” on page 1234
- “pthread_create() — Create a thread” on page 1274

pthread_attr_getguardsize() - Get guardsize attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_getguardsize(const pthread_attr_t *__restrict__ attr,
                             size_t ** __restrict__ guardsize);
```

General description

pthread_attr_getguardsize() gets the guardsize attribute from *attr* and stores it into *guardsize*.

attr is a pointer to a thread attribute object initialized by *pthread_attr_init()*.

The retrieved guardsize always matches the size stored by *pthread_attr_setguardsize()*, despite internal adjustments for rounding to multiples of the PAGESIZE system variable.

Returned value

If successful, *pthread_attr_getguardsize()* returns 0; otherwise it returns an error number.

Error Number

Description

EINVAL

The value specified by *attr* does not refer to an initialized thread attribute object.

Example

```
/* CELEBP62 */
/* Example using SUSv3 pthread_attr_getguardsize() interface */

#define _XOPEN_SOURCE 600

#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <limits.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int rc;
    size_t guardsize;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
```

```

    exit(1);
}

printf("Set guardsize to value of PAGESIZE.\n");
rc = pthread_attr_setguardsize(&attr, PAGESIZE);
if (rc != 0) {
    printf("pthread_attr_setguardsize returned: %d\n", rc);
    printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
    exit(2);
} else {
    printf("Set guardsize is %d\n", PAGESIZE);
}

rc = pthread_attr_getguardsize(&attr, &guardsize);
if (rc != 0) {
    printf("pthread_attr_getguardsize returned: %d\n", rc);
    printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
    exit(3);
} else {
    printf("Retrieved guardsize is %d\n", guardsize);
}

rc = pthread_attr_destroy(&attr);
if (rc != 0) {
    perror("error in pthread_attr_destroy");
    exit(4);
}

exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_setguardsize\(\) - Set guardsize attribute” on page 1236](#)
- [“pthread_attr_destroy\(\) — Destroy the thread attributes object” on page 1219](#)
- "Thread stack attributes" in the *z/OS XL C/C++ Programming Guide*

pthread_attr_getschedparam() - Get scheduling parameter attributes

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```

#define _UNIX03_THREADS
#include <pthread.h>
#include <sched.h>

int pthread_attr_getschedparam(const pthread_attr_t *__restrict__ attr,
                               struct sched_param *__restrict__ param);

```

General description

pthread_attr_getschedparam() gets the scheduling priority attribute from *attr* and stores it into *param*. *attr* is a pointer to a thread attribute object initialized by *pthread_attr_init()*.

param points to a user-defined scheduling parameter object into which pthread_attr_getschedparam() copies the thread scheduling priority attribute.

Returned value

If successful, pthread_attr_getschedparam() returns 0; otherwise it returns an error number.

Error Number

Description

EINVAL

The value specified by attr does not refer to an initialized thread attribute object.

Example

```
/* CELEBP63 */
/* Example using SUSv3 pthread_attr_getschedparam() interface */

#define _UNIX03_THREADS 1
#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int rc;
    struct sched_param param;

    param.sched_priority = 999;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    rc = pthread_attr_setschedparam(&attr, &param);
    if (rc != 0) {
        printf("pthread_attr_setschedparam returned: %d\n", rc);
        printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
        exit(2);
    } else {
        printf("Set schedpriority to %d\n", param.sched_priority);
    }

    param.sched_priority = 0;

    rc = pthread_attr_getschedparam(&attr, &param);
    if (rc != 0) {
        printf("pthread_attr_getschedparam returned: %d\n", rc);
        printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
        exit(3);
    } else {
        printf("Retrieved schedpriority of %d\n", param.sched_priority);
    }

    rc = pthread_attr_destroy(&attr);
    if (rc != 0) {
        perror("error in pthread_attr_destroy");
        exit(4);
    }

    exit(0);
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_setschedparam\(\) - Set scheduling parameter attributes” on page 1238](#)
- [“pthread_attr_destroy\(\) — Destroy the thread attributes object” on page 1219](#)

pthread_attr_getstack() - Get stack attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_getstack(const pthread_attr_t *__restrict__ attr,
    void ** __restrict__ addr, size_t * __restrict__ size);
```

General description

The *pthread_attr_getstack()* function gets both the base (lowest addressable) storage address and size of the initial stack segment from a thread attribute structure and stores them into *addr* and *size* respectively.

attr is a pointer to a thread attribute object initialized by *pthread_attr_init()*.

addr is a pointer to the user-defined location where this function will place the base address of the initial stack segment.

size points to the user-defined location where this function will store the size of the initial stack segment.

Note: An XPLINK application uses two stacks, an upward-growing stack and a downward-growing stack. The "size" argument refers to the size of the downward-growing stack.

Returned value

If successful, *pthread_attr_getstack()* returns 0; otherwise it returns an error number.

Error Number

Description

EINVAL

The value specified by *attr* does not refer to an initialized thread attribute object.

Example

```
/* CELEBP69 */
/* Example using SUSv3 pthread_attr_getstack() interface */

#define _UNIX03_THREADS 1

#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <limits.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int rc;

    void *mystack;
    size_t mystacksize = 2 * PTHREAD_STACK_MIN;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }
}
```

```

/* Get a big enough stack and align it on 4K boundary. */
mystack = malloc(PTHREAD_STACK_MIN * 3);
if (mystack != NULL) {
    printf("Using PTHREAD_STACK_MIN to align stackaddr %x.\n", mystack);
    mystack = (void *)((((long)mystack + (PTHREAD_STACK_MIN - 1)) /
        PTHREAD_STACK_MIN) * PTHREAD_STACK_MIN);
} else {
    perror("Unable to acquire storage.");
    exit(2);
}

printf("Setting stackaddr to %x\n", mystack);
printf("Setting stacksize to %x\n", mystacksize);
rc = pthread_attr_setstack(&attr, mystack, mystacksize);
if (rc != 0) {
    printf("pthread_attr_setstack returned: %d\n", rc);
    printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
    exit(3);
} else {
    printf("Set stackaddr to %x\n", mystack);
    printf("Set stacksize to %x\n", mystacksize);
}

rc = pthread_attr_destroy(&attr);
if (rc != 0) {
    perror("error in pthread_attr_destroy");
    printf("Returned: %d, Error: %d\n", rc, errno);
    printf("Errno_Jr: %x\n", __errno2());
    exit(4);
}

exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_setstack\(\) - Set stack attribute” on page 1239](#)
- [“pthread_attr_destroy\(\) — Destroy the thread attributes object” on page 1219](#)
- "Thread stack attributes" in the [z/OS XL C/C++ Programming Guide](#)

pthread_attr_getstackaddr() - Get stackaddr attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```

#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_getstackaddr(const pthread_attr_t *__restrict__ attr,
    void ** __restrict__ addr);

```

General description

The `pthread_attr_getstackaddr()` function gets the `stackaddr` attribute from `attr` and stores it into `addr`. The `stackaddr` attribute holds the storage location of the created thread's initial stack segment.

`attr` is a pointer to a thread attribute object initialized by `pthread_attr_init()`.

Note: The `pthread_attr_getstackaddr()` function is provided for historical reasons and is marked obsolescent in the Single UNIX Specification, Version 3 (SUSv3). New applications should use the newer function `pthread_attr_getstack()`, which provides functionality compatible with the SUSv3 standard.

Returned value

If successful, `pthread_attr_getstackaddr()` returns 0; otherwise it returns an error number.

Error Number

Description

EINVAL

The value specified by `attr` does not refer to an initialized thread attribute object.

Example

```
/* CELEBP64 */
/* Example using SUSv3 pthread_attr_getstackaddr() interface */

#define _UNIX03_THREADS 1

#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <limits.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int rc;
    void *stackaddr;
    void *mystack;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    /* Get a big enough stack and align it on 4K boundary. */
    mystack = malloc(PTHREAD_STACK_MIN * 2);
    if (mystack != NULL) {
        printf("Using PTHREAD_STACK_MIN to align stackaddr %x.\n", mystack);
        mystack = (void *)((((long)mystack + (PTHREAD_STACK_MIN - 1)) /
                               PTHREAD_STACK_MIN) * PTHREAD_STACK_MIN);
    } else {
        perror("Unable to acquire storage.");
        exit(2);
    }

    printf("Setting stackaddr to %x\n", mystack);
    rc = pthread_attr_setstackaddr(&attr, mystack);
    if (rc != 0) {
        printf("pthread_attr_setstackaddr returned: %d\n", rc);
        printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
        exit(3);
    } else {
        printf("Set stackaddr to %x\n", mystack);
    }

    rc = pthread_attr_getstackaddr(&attr, &stackaddr);
    if (rc != 0) {
        printf("pthread_attr_getstackaddr returned: %d\n", rc);
        printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
        exit(4);
    } else {
        printf("Retrieved stackaddr is %x\n", stackaddr);
    }

    rc = pthread_attr_destroy(&attr);
    if (rc != 0) {
        perror("error in pthread_attr_destroy");
        printf("Returned: %d, Error: %d\n", rc, errno);
        printf("Errno_Jr: %x\n", __errno2());
        exit(5);
    }
}
```

```
    exit(0);
}
```

Related information

- “pthread.h — Thread interfaces” on page 53
- “pthread_attr_init() — Initialize a thread attribute object” on page 1233
- “pthread_attr_setstackaddr() - Set stackaddr attribute” on page 1241
- “pthread_attr_destroy() — Destroy the thread attributes object” on page 1219
- “Thread stack attributes” in the *z/OS XL C/C++ Programming Guide*

pthread_attr_getstacksize() — Get the thread attribute stacksize object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_attr_getstacksize(pthread_attr_t *attr, size_t *stacksize);
```

SUSV3

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_attr_getstacksize(const pthread_attr_t * __restrict__ attr,
                             size_t * __restrict__ stacksize);
```

General description

Gets the value, in bytes, of the `stacksize` attribute for the thread attribute object, `attr`, that is created by `pthread_attr_init()`. This function returns the value in the variable pointed to by `stacksize`.

You can use a thread attribute object to manage the characteristics of threads in your application. It defines the set of values to be used for the thread during its creation. By establishing a thread attribute object, you can create many threads with the same set of characteristics, without defining those characteristics for each thread. You can define more than one thread attribute object.

Note: An XPLINK application uses two stacks, an upward-growing stack and a downward-growing stack. The “stacksize” refers to the size of the downward-growing stack.

Returned value

If successful, `pthread_attr_getstacksize()` returns 0 and stores the `stacksize` attribute value in `stacksize`.

If unsuccessful, `pthread_attr_getstacksize()` returns -1.

There are no documented `errno` values. Use `perror()` or `strerror()` to determine the cause of the error.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_attr_getstacksize() returns an error number to indicate the error.

Example

CELEBP08

```
/* CELEBP08 */
#define _OPEN_THREADS
#include <stdio.h>
#include <pthread.h>

int main()
{
    pthread_attr_t attr;
    size_t size;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    if (pthread_attr_getstacksize(&attr, &size) == -1) {
        perror("error in pthread_attr_getstackstate()");
        exit(2);
    }
    printf("The stack size is %d.\n", (int) size);

    if (pthread_attr_destroy(&attr) == -1) {
        perror("error in pthread_attr_destroy");
        exit(2);
    }
    exit(0);
}
```

Output:

The stack size is 524288.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_setstacksize\(\) — Set the stacksize attribute object” on page 1243](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)

pthread_attr_getsynctype_np() — Get thread sync type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_SYS
#include <pthread.h>

int pthread_attr_getsynctype_np(pthread_attr_t *attr);
```


General description

The `pthread_attr_getsynctype_np` function returns the current synctype setting of the *attr* thread attribute object.

The *synctype* can be set to one of the following symbolics, as defined in the `pthread.h` header file:

__PTATSYNCHRONOUS

Can only create as many threads as TCBs available (or as many threads are available, depending on which number is smaller).

__PTATASYNCHRONOUS

Allows threads to be queued, that is, can create more threads than TCBs are available up to limit of how many threads are available. The queued threads will be released as TCBs become available.

Returned value

If successful, `pthread_attr_getsynctype_np()` returns the synctype value of the thread attribute object.

If unsuccessful, `pthread_attr_getsynctype_np()` returns -1.

There are no documented `errno` values. Use `perror()` or `strerror()` to determine cause of the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_setsynctype_np\(\) — Set thread sync type” on page 1245](#)

pthread_attr_getweight_np() — Get weight of thread attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_attr_getweight_np(pthread_attr_t *attr);
```

General description

Obtains the current weight of the thread setting of the thread attributes object, *attr*. The symbols for weight are defined in the `pthread.h` include file. The following weights are supported:

__MEDIUM_WEIGHT

The executing task can be reused when the thread exits.

__HEAVY_WEIGHT

When this exits, the associated MVS task can no longer request threads to process.

You can use a thread attribute object to manage the characteristics of threads in your application. It defines the set of values to be used for the thread during its creation. By establishing a thread

attribute object, you can create many threads with the same set of characteristics, without defining those characteristics for each and every thread. You can define more than one thread attribute object.

Returned value

If successful, `pthread_attr_getweight_np()` returns the value of the weight of the thread attribute.

If unsuccessful, `pthread_attr_getweight_np()` returns -1.

There are no documented `errno` values. Use `perror()` or `strerror()` to determine the cause of the error.

Example

CELEBP09

```
/* CELEBP08 */
#define _OPEN_THREADS
#define _OPEN_SYS          /* Needed to identify __HEAVY_WEIGHT AND
                           __MEDIUM_WEIGHT */
#include <stdio.h>
#include <pthread.h>

int main()
{
    pthread_attr_t attr;
    char          weight[12];

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    switch(pthread_attr_getweight_np(&attr)) {
        default:
            perror("error in pthread_attr_getweight_np()");
            exit(2);
        case __HEAVY_WEIGHT:
            strcpy(weight, "heavy");
            break;
        case __MEDIUM_WEIGHT:
            strcpy(weight, "medium");
    }
    printf("The thread weight is %s.\n", weight);

    if (pthread_attr_destroy(&attr) == -1) {
        perror("error in pthread_attr_destroy");
        exit(2);
    }
    exit(0);
}
```

Output:

```
The thread weight is heavy.
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_setweight_np\(\) — Set weight of thread attribute object” on page 1246](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)

pthread_attr_init() – Initialize a thread attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_attr_init(pthread_attr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_init(pthread_attr_t *attr);
```

General description

Initializes *attr* with the default thread attributes, whose defaults are:

stacksize

Inherited from the STACK runtime option

detachstate

Undetached

synch

Synchronous

weight

Heavy

Using a thread attribute object, you can manage the characteristics of threads in your application. It defines the set of values to be used for the thread during its creation. By establishing a thread attribute object, you can create many threads with the same set of characteristics, without defining those characteristics for each thread. You can define more than one thread attribute object. All threads are of equal priority.

If a thread attribute object is shared between threads, the application must provide the necessary synchronization because a thread attribute object is defined in the application's storage.

Note: An XPLINK application uses two stacks, an upward-growing stack and a downward-growing stack. "stacksize" always refers to the size of the upward-growing stack. The size of the downward-growing stack is inherited from the THREADSTACK runtime option.

Returned value

If successful, pthread_attr_init() returns 0.

If unsuccessful, pthread_attr_init() returns -1 and sets errno to one of the following values:

Error Code

Description

ENOMEM

Not enough memory is available to create the thread attribute object.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_attr_init() returns an error number to indicate the error.

Example

CELEBP10

```
/* CELEBP10 */
#define _OPEN_THREADS
#include <stdio.h>
#include <pthread.h>

void *thread1(void *arg)
{
    printf("hello from the thread\n");
    pthread_exit(NULL);
}

int main()
{
    int rc, stat;
    pthread_attr_t attr;
    pthread_t thid;

    rc = pthread_attr_init(&attr);
    if (rc == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    rc = pthread_create(&thid, &attr, thread1, NULL);
    if (rc == -1) {
        perror("error in pthread_create");
        exit(2);
    }

    rc = pthread_join(thid, (void *)&stat);
    exit(0);
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_destroy\(\) — Destroy the thread attributes object” on page 1219](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)

pthread_attr_setdetachstate() — Set the detach state attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_attr_setdetachstate(pthread_attr_t *attr, int *detachstate);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_attr_setdetachstate(pthread_attr_t *attr, int detachstate);
```

General description

Alters the current *detachstate* setting of a thread attributes object, which can be set to *PTHREAD_CREATE_JOINABLE* or *PTHREAD_CREATE_DETACHED*.

0

Causes all the threads created with *attr* to be in an undetached state. An undetached thread will keep its resources after termination.

1

Causes all the threads created with *attr* to be in a detached state. A detached thread will have its resources automatically freed by the system at termination. Thus, you cannot get the thread's termination status, or wait for the thread to terminate by using `pthread_join()`.

You can use a thread attribute object to manage the characteristics of threads in your application. It defines the set of values to be used for the thread during its creation. By establishing a thread attribute object, you can create many threads with the same set of characteristics, without defining those characteristics for each thread. You can define more than one thread attribute object.

Returned value

If successful, `pthread_attr_setdetachstate()` returns 0.

If unsuccessful, `pthread_attr_setdetachstate()` returns -1.

Error Code

Description

EINVAL

The value of *detachstate* was not valid or the value specified by *attr* does not refer to an initialized thread attribute object.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_attr_setdetachstate()` returns an error number to indicate the error.

Example**CELEBP11**

```
/* CELEBP11 */
#define _OPEN_THREADS
#include <stdio.h>
#include <pthread.h>

void **stat;
void *thread1(void *arg)
{
    printf("hello from the thread\n");
    pthread_exit((void *)0);
}

int main()
{
    int          ds, rc;
    size_t       s1;
    pthread_attr_t attr;
    pthread_t     thid;

    rc = pthread_attr_init(&attr);
    if (rc == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }
}
```

```

ds = 0;
rc = pthread_attr_setdetachstate(&attr, &ds);
if (rc == -1) {
    perror("error in pthread_attr_setdetachstate");
    exit(2);
}

rc = pthread_create(&thid, &attr, thread1, NULL);
if (rc == -1) {
    perror("error in pthread_create");
    exit(3);
}

rc = pthread_join(thid, stat);
exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_getdetachstate\(\) — Get the detach state attribute” on page 1221](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)

pthread_attr_setguardsize() - Set guardsize attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```

#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_setguardsize(pthread_attr_t *attr, size_t guardsize);

```

General description

pthread_attr_setguardsize() sets the guardsize attribute in *attr* using the value of *guardsize*.

attr is a pointer to a thread attribute object initialized by *pthread_attr_init()*.

This function stores the guardsize attribute in the thread attribute object for subsequent calls to *pthread_attr_getguardsize()*, but no further action is taken. The guardsize attribute is ignored during thread creation.

Note:

The Single UNIX Specification, Version 3 expects a guard area of at least *guardsize* bytes, but permits the rounding of *guardsize* to a multiple of the system variable, *PAGESIZE*. Stack management in z/OS UNIX sets a guard area of *PAGESIZE* in 31-bit applications and of (*PAGESIZE* * *PAGESIZE*) bytes in AMODE64. These values are the default for the guard size attribute. Requests for larger guard areas will fail with *EINVAL*.

A zero *guardsize* requests that no guard area be provided. However, z/OS UNIX stack management requires a guard area. Therefore, this request cannot be satisfied, although *pthread_attr_setguardsize()* will tolerate a *guardsize* of zero.

Returned value

If successful, `pthread_attr_setguardsize()` returns 0; otherwise, it returns an error number.

Error Code

Description

EINVAL

The parameter *guardsize* is not valid or the value specified by *attr* does not refer to an initialized thread attribute object.

Example

```
/* CELEBP66 */
/* Example using SUSv3 pthread_attr_setguardsize() interface */

#define _XOPEN_SOURCE 600

#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <limits.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int rc;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    printf("Set guardsize to value of PAGESIZE.\n");
    rc = pthread_attr_setguardsize(&attr, PAGESIZE);
    if (rc != 0) {
        printf("pthread_attr_setguardsize returned: %d\n", rc);
        printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
        exit(2);
    } else {
        printf("Set guardsize is %d\n", PAGESIZE);
    }

    rc = pthread_attr_destroy(&attr);
    if (rc != 0) {
        perror("error in pthread_attr_destroy");
        exit(3);
    }

    exit(0);
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_destroy\(\) — Destroy the thread attributes object” on page 1219](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_getguardsize\(\) - Get guardsize attribute” on page 1223](#)
- "Thread stack attributes" in the [z/OS XL C/C++ Programming Guide](#).

pthread_attr_setschedparam() - Set scheduling parameter attributes

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```
#define _UNIX03_THREADS
#include <pthread.h>
#include <sched.h>

int pthread_attr_setschedparam(pthread_attr_t *__restrict__ attr,
                               const struct sched_param *__restrict__ param);
```

General description

pthread_attr_setschedparam() sets the scheduling priority attribute in *attr* using the value from *param*.

attr is a pointer to a thread attribute object initialized by *pthread_attr_init()*.

param points to a user-defined scheduling parameter object used by *pthread_attr_setschedparam()* as the source of the thread scheduling priority attribute to set in *attr*. The scheduling priority member of a *sched_param* structure is declared as an int.

If successful, the *sched_priority* from *param* is available for subsequent calls to the *pthread_getschedparam()* function. However, z/OS UNIX takes no other action based on the value of the scheduling priority stored in *attr*.

Returned value

If successful, *pthread_attr_setschedparam()* returns 0; otherwise, it returns an error number.

Error Code

Description

EINVAL

The value specified by *attr* does not refer to an initialized thread attribute object.

Example

```
/* CELEBP67 */
/* Example using SUSv3 pthread_attr_setschedparam() interface */

#define _UNIX03_THREADS 1
#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int rc;
    struct sched_param param;

    param.sched_priority = 999;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }
```



```

rc = pthread_attr_setschedparam(&attr, &param);
if (rc != 0) {
    printf("pthread_attr_setschedparam returned: %d\n", rc);
    printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
    exit(2);
} else {
    printf("Set schedpriority to %d\n", param.sched_priority);
}

rc = pthread_attr_destroy(&attr);
if (rc != 0) {
    perror("error in pthread_attr_destroy");
    exit(3);
}

exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“sched.h — Manipulate and examine process execution scheduling” on page 57](#)
- [“pthread_attr_destroy\(\) — Destroy the thread attributes object” on page 1219](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_getschedparam\(\) - Get scheduling parameter attributes” on page 1224](#)

pthread_attr_setstack() - Set stack attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```

#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_setstack(pthread_attr_t *attr, void *addr, size_t size);

```

General description

The *pthread_attr_setstack()* function sets the *stackaddr* and *stacksize* attributes in *attr* from the values of *addr* and *size* respectively.

When a thread is created, the *stackaddr* attribute locates the base (lowest addressable byte) of the created thread's initial stack segment. The *stacksize* attribute is the size, in bytes, of the initial stack segment allocated for the thread.

attr is a pointer to a thread attribute object initialized by *pthread_attr_init()*.

addr is the memory location to use for the initial stack segment and must be aligned appropriately to be used as a stack. For 31-bit applications, stack alignment is on a 4K boundary; in AMODE64, the alignment is on a one megabyte boundary.

size must be at least as large as *PTHREAD_STACK_MIN*. This constant is defined in the *<limits.h>* header.

The minimum stacksize in 31-bit is 4096 (4K) and in 64-bit 1048576 (1M). In addition, the system will allocate an equivalent-sized guardpage. There is no specified maximum stacksize. If more storage

is requested than the system can satisfy at pthread creation, then pthread_create() will fail and return EINVAL.

Usage notes

1. An XPLINK application uses two stacks, an upward-growing stack and a downward-growing stack. The "size" argument refers to the size of the downward-growing stack.
2. The Language Environment storage report tolerates but does not maintain statistics on application-managed stacks. Also, the runtime storage option, suboption for dsa initialization does not support application-managed stacks.

Returned value

If successful, *pthread_attr_setstack()* returns 0; otherwise, it returns an error number.

Error Code

Description

EINVAL

Can be one of the following error conditions:

- size is less than PTHREAD_STACK_MIN
- addr does not have proper alignment to be used as a stack
- (addr + size) lacks proper alignment
- attr does not refer to an initialized thread attribute object.

Example

```
/* CELEBP65 */
/* Example using SUSv3 pthread_attr_setstack() interface */

#define _UNIX03_THREADS 1

#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <limits.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int rc;

    void * stackaddr;
    void * mystack;

    size_t stacksize;
    size_t mystacksize = 2 * PTHREAD_STACK_MIN;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    /* Get a big enough stack and align it on 4K boundary. */
    mystack = malloc(PTHREAD_STACK_MIN * 3);
    if (mystack != NULL) {
        printf("Using PTHREAD_STACK_MIN to align stackaddr %x.\n", mystack);
        mystack = (void *)((((long)mystack + (PTHREAD_STACK_MIN - 1)) /
                           PTHREAD_STACK_MIN) * PTHREAD_STACK_MIN);
    } else {
        perror("Unable to acquire storage.");
        exit(2);
    }

    printf("Setting stackaddr to %x\n", mystack);
    printf("Setting stacksize to %x\n", mystacksize);
    rc = pthread_attr_setstack(&attr, mystack, mystacksize);
    if (rc != 0) {
```

```

    printf("pthread_attr_setstack returned: %d\n", rc);
    printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
    exit(3);
} else {
    printf("Set stackaddr to %x\n", mystack);
    printf("Set stacksize to %x\n", mystacksize);
}

rc = pthread_attr_getstack(&attr, &stackaddr, &stacksize);
if (rc != 0) {
    printf("pthread_attr_getstack returned: %d\n", rc);
    printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
    exit(4);
} else {
    printf("Retrieved stackaddr is %x\n", mystack);
    printf("Retrieved stacksize is %x\n", mystacksize);
}

rc = pthread_attr_destroy(&attr);
if (rc != 0) {
    perror("error in pthread_attr_destroy");
    printf("Returned: %d, Error: %d\n", rc, errno);
    printf("Errno_Jr: %x\n", __errno2());
    exit(5);
}

exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_destroy\(\) — Destroy the thread attributes object” on page 1219](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_getstack\(\) - Get stack attribute” on page 1226](#)
- For a complete set of restrictions on *addr* and *size*, see the topic about thread stack attributes in [z/OS XL C/C++ Programming Guide](#)

pthread_attr_setstackaddr() - Set stackaddr attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 POSIX(ON) |

Format

```

#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_setstackaddr(pthread_attr_t *attr, void *addr);

```

General description

The *pthread_attr_setstackaddr()* function sets the stackaddr attribute in *attr* using the value of *addr*.

attr is a pointer to a thread attribute object initialized by *pthread_attr_init()*.

addr is the lowest addressable byte of the memory designated for use as the initial stack segment. It must have at least PTHREAD_STACK_MIN storage allocated. The PTHREAD_STACK_MIN constant is defined in <limits.h>. The *addr* value must also be aligned with the stack frame size, a multiple of 4K in 31-bit applications and one megabyte in AMODE 64.

The thread must have permission to read and write to all pages within the stack referenced by *addr*.

A stacksize is required at pthread creation. If the value is not present in the thread attribute object, the stacksize will default to PTHREAD_STACK_MIN. Subsequent calls to *pthread_attr_setstacksize()* can overwrite the stacksize prior to pthread creation.

Usage notes

1. The *pthread_attr_setstackaddr()* function is provided for historical reasons. It is marked obsolescent in the Single UNIX Specification, Version 3 (SUSv3). New applications should use the newer function *pthread_attr_setstack()*, which provides functionality compatible with the SUSv3 standard.
2. An attribute object with the stackaddr attribute set may not be used more than once, unless it is destroyed and reinitialized, or its stackaddr attribute changed. For more details, see "Thread stack attributes" in the z/OS X/L C/C++ Programming Guide.
3. An XPLINK application uses two stacks, an upward-growing stack and a downward-growing stack. The variable *addr* always refers to lowest addressable byte of the downward-growing stack.
4. The Language Environment storage report tolerates but does not maintain statistics on application-managed stacks. Also, the runtime storage option, suboption for dsa initialization does not support application-managed stacks.

Returned value

If successful, *pthread_attr_setstackaddr()* returns 0; otherwise, it returns an error number.

Error Code

Description

EINVAL

The value of *addr* does not have proper alignment to be used as a stack or the value specified by *attr* does not refer to an initialized thread attribute object.

Example

```
/* CELEBP68 */
/* Example using SUSv3 pthread_attr_setstackaddr() interface */

#define _UNIX03_THREADS 1

#include <stdio.h>
#include <stdlib.h>
#include <pthread.h>
#include <limits.h>
#include <errno.h>

int main(void)
{
    pthread_attr_t attr;
    int rc;
    void *mystack;

    if (pthread_attr_init(&attr) == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    /* Get a big enough stack and align it on 4K boundary. */
    mystack = malloc(PTHREAD_STACK_MIN * 2);
    if (mystack != NULL) {
        printf("Using PTHREAD_STACK_MIN to align stackaddr %x.\n", mystack);
        mystack = (void *)((((long)mystack + (PTHREAD_STACK_MIN - 1)) /
                           PTHREAD_STACK_MIN) * PTHREAD_STACK_MIN);
    } else {
        perror("Unable to acquire storage.");
        exit(2);
    }

    printf("Setting stackaddr to %x\n", mystack);
    rc = pthread_attr_setstackaddr(&attr, mystack);
```

```

    if (rc != 0) {
        printf("pthread_attr_setstackaddr returned: %d\n", rc);
        printf("Error: %d, Errno_Jr: %08x\n", errno, __errno2());
        exit(3);
    } else {
        printf("Set stackaddr to %x\n", mystack);
    }

    rc = pthread_attr_destroy(&attr);
    if (rc != 0) {
        perror("error in pthread_attr_destroy");
        printf("Returned: %d, Error: %d\n", rc, errno);
        printf("Errno_Jr: %x\n", __errno2());
        exit(4);
    }

    exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_destroy\(\) — Destroy the thread attributes object” on page 1219](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_getstackaddr\(\) - Get stackaddr attribute” on page 1227](#)
- "Thread stack attributes" in the [z/OS XL C/C++ Programming Guide](#)

pthread_attr_setstacksize() — Set the stacksize attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```

#define _OPEN_THREADS
#include <pthread.h>

int pthread_attr_setstacksize(pthread_attr_t *attr, size_t stacksize);

```

SUSV3:

```

#define _UNIX03_THREADS
#include <pthread.h>

int pthread_attr_setstacksize(pthread_attr_t *attr, size_t stacksize);

```

General description

Sets the stacksize, in bytes, for the thread attribute object, *attr*. *stacksize* is the initial stack size. Other stack characteristics, like stack increment size, are inherited from the STACK64/THREADSTACK64 runtime option.

You can use a thread attribute object to manage the characteristics of threads in your application. It defines the set of values to be used for the thread during its creation. By establishing a thread attribute object, you can create many threads with the same set of characteristics, without defining those characteristics for each thread. You can define more than one thread attribute object.

Usage notes

1. An XPLINK application uses two stacks, an upward-growing stack and a downward-growing stack. The "stacksize" refers to the size of the downward-growing stack.
2. When using Single UNIX Specification, Version thread support, the minimum stacksize in 31-bit is 4096 (4K) and in 64-bit 1048576 (1M). In addition, the system will allocate an equivalent-sized guardpage. There is no specified maximum stacksize. If more storage is requested than the system can satisfy at pthread creation, then pthread_create() will fail and return EINVAL.

Returned value

If successful, pthread_attr_setstacksize() returns 0.

If unsuccessful, pthread_attr_setstacksize() returns -1.

Error Code

Description

EINVAL

The value of stacksize is less than PTHREAD_STACK_MIN, or the value specified by attr does not refer to an initialized thread attribute object.

Special behavior for Single UNIX Specification, Version 3:

If unsuccessful, pthread_attr_setstacksize() returns an error number to indicate the error.

Example

CELEBP12

```
/* CELEBP12 */
#define _OPEN_THREADS
#include <stdio.h>
#include <pthread.h>

void *thread1(void *arg)
{
    printf("hello from the thread\n");
    pthread_exit(NULL);
}

int main()
{
    int          rc, stat;
    size_t       s1;
    pthread_attr_t attr;
    pthread_t     thid;

    rc = pthread_attr_init(&attr);
    if (rc == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    s1 = 4096;
    rc = pthread_attr_setstacksize(&attr, s1);
    if (rc == -1) {
        perror("error in pthread_attr_setstacksize");
        exit(2);
    }

    rc = pthread_create(&thid, &attr, thread1, NULL);
    if (rc == -1) {
        perror("error in pthread_create");
        exit(3);
    }

    rc = pthread_join(thid, (void *)&stat);
    exit(0);
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_getstacksize\(\) — Get the thread attribute stacksize object” on page 1229](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)

pthread_attr_setsynctype_np() — Set thread sync type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_SYS
#include <pthread.h>

int pthread_attr_setsynctype_np(pthread_attr_t *attr, int synctype);
```

General description

The `pthread_attr_setsynctype_np` function allows you to alter the `synctype` setting of the `attr` thread attribute object.

The `synctype` can be set to one of the following symbolics, as defined in the `pthread.h` header file:

__PTATSYNCHRONOUS

Can only create as many threads as TCBs available (or as many threads are available, depending on which number is smaller).

__PTATASYNCHRONOUS

Allows threads to be queued, that is, can create more threads than TCBs are available up to limit of how many threads are available. The queued threads will be released as TCBs become available. While threads are on the queue, they can still be affected by other pthread functions.

Returned value

If successful, `pthread_attr_setsynctype_np()` returns 0.

If unsuccessful, `pthread_attr_setsynctype_np()` returns -1.

There are no documented `errno` values. Use `perror()` or `strerror()` to determine cause of the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_getsynctype_np\(\) — Get thread sync type” on page 1230](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_attr_setweight_np\(\) — Set weight of thread attribute object” on page 1246](#)

pthread_attr_setweight_np() – Set weight of thread attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_attr_setweight_np(pthread_attr_t *attr, int threadweight);
```

General description

Alter the current weight of the thread setting of the thread attribute object, *attr*.

threadweight can be set to one of the following two symbols for the weight of the thread, as defined in the pthread.h header file.

__LIGHT_WEIGHT

Not supported.

__MEDIUM_WEIGHT

Each thread runs on a task. Upon exiting, if another thread is not queued to run, the task waits for some other thread to issue a pthread_create(), and the thread then runs on that task. The thread is assumed to cleanup all resources it used.

__HEAVY_WEIGHT

The task is attached on pthread_create() and terminates upon a pthread_exit(). Full MVS EOT resource cleanup occurs when exiting. When this exits, the associated MVS task can no longer request threads to process.

You can use a thread attribute object to manage the characteristics of threads in your application. It defines the set of values to be used for the thread during its creation. By establishing a thread attribute object, you can create many threads with the same set of characteristics, without defining those characteristics for each thread. You can define more than one thread attribute object.

Returned value

If successful, pthread_attr_setweight_np() returns 0.

If unsuccessful, pthread_attr_setweight_np() returns -1.

There are no documented errno values. Use perror() or strerror() to determine the cause of the error.

Example

CELEBP13

```
/* CELEBP13 */
#define _OPEN_THREADS
#define _OPEN_SYS /* Needed to identify __MEDIUM_WEIGHT */
#include <stdio.h>
#include <pthread.h>

void *thread1(void *arg)
{
    printf("hello from the thread\n");
```



```

    pthread_exit((void *)0);
}

int main()
{
    int          rc, stat;
    pthread_attr_t attr;
    pthread_t     thid;

    rc = pthread_attr_init(&attr);
    if (rc == -1) {
        perror("error in pthread_attr_init");
        exit(1);
    }

    rc = pthread_attr_setweight_np(&attr, __MEDIUM_WEIGHT);
    if (rc == -1) {
        perror("error in pthread_attr_setweight_np");
        exit(2);
    }

    rc = pthread_create(&thid, &attr, thread1, NULL);
    if (rc == -1) {
        perror("error in pthread_create");
        exit(3);
    }

    rc = pthread_join(thid, (void *)&stat);
    exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_getweight_np\(\) — Get weight of thread attribute object” on page 1231](#)
- [“pthread_attr_init\(\) — Initialize a thread attribute object” on page 1233](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)

pthread_cancel() — Cancel a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```

#define _OPEN_THREADS
#include <pthread.h>

int pthread_cancel(pthread_t thread);

```

SUSV3:

```

#define _UNIX03_THREADS
#include <pthread.h>

int pthread_cancel(pthread_t thread);

```

General description

Requests that a thread be canceled. The thread to be canceled controls when this cancelation request is acted on through the cancelability state and type.

The cancelability states can be:

PTHREAD_INTR_DISABLE

The thread cannot be canceled.

PTHREAD_INTR_ENABLE

The thread can be canceled, but it is subject to type.

The cancelability types can be:

PTHREAD_INTR_CONTROLLED

The thread can be canceled, but only at specific points of execution:

- When waiting on a condition variable, which is `pthread_cond_wait()` or `pthread_cond_timedwait()`
- When waiting for the end of another thread, which is `pthread_join()`
- While waiting for an asynchronous signal, which is `sigwait()`
- Testing specifically for a cancel request, which is `pthread_testintr()`
- When suspended because of POSIX functions or one of the following C standard functions: `close()`, `fcntl()`, `open()`, `pause()`, `read()`, `tcdrain()`, `tcsetattr()`, `sigsuspend()`, `sigwait()`, `sleep()`, `wait()`, or `write()`

PTHREAD_INTR_ASYNCHRONOUS

The thread can be canceled at any time.

A thread that is joined on a thread that is canceled has a status of -1 returned to it. For more information, refer to “[pthread_join\(\) — Wait for a thread to end](#)” on page 1287.

pthread_t is the data type used to uniquely identify a thread. It is returned by `pthread_create()` and used by the application in function calls that require a thread identifier.

Note: A thread in mutex wait will not be interrupted by a signal, and therefore not canceled.

Special behavior for C++: Destructors for automatic objects on the stack will be run when a thread is canceled. The stack is unwound and the destructors are run in reverse order.

Special behavior for SUSv3 : Single UNIX Standard, Version 3 defines new symbols for cancelability state and type. These are equivalent to the symbols described above and must be used when compiling in the SUSv3 namespace. The symbols for state are `PTHREAD_CANCEL_ENABLE` and `PTHREAD_CANCEL_DISABLE`. Symbols for type are `PTHREAD_CANCEL_DEFERRED` and `PTHREAD_CANCEL_ASYNCHRONOUS`.

Returned value

If successful, `pthread_cancel()` returns 0. Success indicates that the `pthread_cancel()` request has been issued. The thread to be canceled may still execute because of its interruptibility state.

If unsuccessful, `pthread_create()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The specified thread is not valid.

ESRCH

The specified thread does not refer to a currently existing thread.

Special behavior for Single UNIX Specification, Version 3:

If unsuccessful, `pthread_cancel()` returns an error number to indicate the error.

Example

CELEBP14

```
/* CELEBP14 */
#define _OPEN_THREADS
```

```

#include <errno.h>
#include <pthread.h>
#include <stdio.h>
#include <string.h>
#include <unistd.h>

int  thstatus;

void * thread(void *arg)
{
    puts("thread has started. now sleeping");
    while (1)
        sleep(1);
}

main(int argc, char *argv[])
{
    pthread_t      thid;
    void           *status;

    if ( pthread_create(&thid, NULL, thread, NULL) != 0) {
        perror("pthread_create failed");
        exit(2);
    }

    if ( pthread_cancel(thid) == -1 ) {
        perror("pthread_cancel failed");
        exit(3);
    }

    if ( pthread_join(thid, &status)== -1 ) {
        perror("pthread_join failed");
        exit(4);
    }

    if ( status == (int *)-1 )
        puts("thread was cancelled");
    else
        puts("thread was not cancelled");

    exit(0);
}

```

Output:

```

thread has started. now sleeping
thread was canceled

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_timedwait\(\), pthread_cond_timedwait64\(\) — Wait on a condition variable” on page 1259](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)
- [“pthread_exit\(\) — Exit a thread” on page 1279](#)
- [“pthread_join\(\) — Wait for a thread to end” on page 1287](#)
- [“pthread_setcancelstate\(\) — Set a thread cancelability state format” on page 1335](#)
- [“pthread_setcanceltype\(\) — Set a thread cancelability type format” on page 1336](#)
- [“pthread_setintr\(\) — Set a thread cancelability state” on page 1337](#)
- [“pthread_setintrtype\(\) — Set a thread cancelability type” on page 1339](#)
- [“pthread_testcancel\(\) — Establish a cancelation point” on page 1347](#)
- [“pthread_testintr\(\) — Establish a cancelability point” on page 1348](#)

pthread_cleanup_pop() – Remove a cleanup handler

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

void pthread_cleanup_pop(int execute);
```

General description

Removes the specified *routine* in the last executed `pthread_cleanup_push()` statement from the top of the calling thread's cleanup stack.

The *execute* parameter specifies whether the cleanup routine that is popped should be run or just discarded. If the value is nonzero, the cleanup routine is executed.

`pthread_cleanup_push()` and `pthread_cleanup_pop()` must appear in pairs in the program within the same lexical scope, or undefined behavior will result.

When the thread ends, all pushed but not yet popped cleanup routines are popped from the cleanup stack and executed in last-in-first-out (LIFO) order. This occurs when the thread:

- Calls `pthread_exit()`
- Does a return from the start routine (that gets controls as a result of a `pthread_create()`)
- Is canceled because of a `pthread_cancel()`

Returned value

`pthread_cleanup_pop()` returns no values.

This function is used as a statement.

If an error occurs while a `pthread_cleanup_pop()` statement is being processed, a termination condition is raised.

There are no documented `errno` values. Use `perror()` or `strerror()` to determine the cause of an error.

Example

CELEBP15

```
/* CELEBP15 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

int iteration;

void noise_maker(void *arg) {
    printf("hello from noise_maker in iteration %d!\n", iteration);
}

void *thread(void *arg) {
    pthread_cleanup_push(noise_maker, NULL);
    pthread_cleanup_pop(iteration == 1 ? 0 : 1);
}
```

```

main() {
    pthread_t thid;
    void * ret;

    for (iteration=1; iteration<=2; iteration++) {

        if (pthread_create(&thid, NULL, thread, NULL) != 0) {
            perror("pthread_create() error");
            exit(1);
        }

        if (pthread_join(thid, &ret) != 0){
            perror("pthread_join() error");
            exit(2);
        }
        /*
        if (pthread_detach(&thid) != 0) {
            perror("pthread_detach() error");
            exit(3);
        }
        */
    }
}

```

Output:

```
hello from noise_maker in iteration 2!
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cancel\(\) — Cancel a thread” on page 1247](#)
- [“pthread_cleanup_push\(\) — Establish a cleanup handler” on page 1251](#)
- [“pthread_exit\(\) — Exit a thread” on page 1279](#)

pthread_cleanup_push() — Establish a cleanup handler

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```

#define _OPEN_THREADS
#include <pthread.h>

void pthread_cleanup_push(void (*routine)(void *arg), void *arg);

```

General description

Pushes the specified *routine* onto the calling thread's cleanup stack. The cleanup handler is executed as a result of a `pthread_cleanup_pop()`, with a nonzero value for the *execute* parameter.

When the thread ends, all pushed but not yet popped cleanup routines are popped from the cleanup stack and executed in last-in-first-out (LIFO) order. This occurs when the thread:

- Calls `pthread_exit()`
- Does a return from the start routine
- Is canceled because of a `pthread_cancel()`

pthread_cleanup_push() and pthread_cleanup_pop() must appear in pairs and within the same lexical scope, or undefined behavior will result.

Special behavior for C++: Because C and C++ linkage conventions are incompatible, pthread_cleanup_push() cannot receive a C++ function pointer as the start routine function pointer. If you attempt to pass a C++ function pointer to pthread_cleanup_push(), the compiler will flag it as an error. You can pass a C or C++ function to pthread_cleanup_push() by declaring it as extern "C".

Returned value

pthread_cleanup_push() returns no values.

This function is used as a statement.

If an error occurs while a pthread_cleanup_push() statement is being processed, a termination condition is raised.

There are no documented errno values. Use perror() or strerror() to determine the cause of an error.

Example

CELEBP16

```
/* CELEBP16 */
#define _OPEN_THREADS

#include <pthread.h>
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>

int footprint=0;

void *thread(void *arg) {
    char *storage;

    if ((storage = (char*) malloc(80)) == NULL) {
        perror("malloc() failed");
        exit(6);
    }

    /* Plan to release storage even if thread doesn't exit normally */
    pthread_cleanup_push(free, storage);

    puts("thread has obtained storage and is waiting to be cancelled");
    footprint++;
    while (1)
        sleep(1);

    pthread_cleanup_pop(1);
}

main() {
    pthread_t thid;

    if (pthread_create(&thid, NULL, thread, NULL) != 0) {
        perror("pthread_create() error");
        exit(1);
    }

    while (footprint == 0)
        sleep(1);

    puts("IPT is cancelling thread");

    if (pthread_cancel(thid) != 0) {
        perror("pthread_cancel() error");
        exit(3);
    }

    if (pthread_join(thid, NULL) != 0) {
        perror("pthread_join() error");
        exit(4);
    }
}
```

```
}
}
```

Output:

```
thread has obtained storage and is waiting to be canceled
IPT is canceling thread
```

Related information

- “pthread.h — Thread interfaces” on page 53
- “pthread_cancel() — Cancel a thread” on page 1247
- “pthread_cleanup_pop() — Remove a cleanup handler” on page 1250
- “pthread_exit() — Exit a thread” on page 1279

pthread_cond_broadcast() — Broadcast a condition

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_cond_broadcast(pthread_cond_t *cond);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_cond_broadcast(pthread_cond_t *cond);
```

General description

Unblock all threads that are blocked on the specified condition variable, *cond*. If more than one thread is blocked, the order in which the threads are unblocked is unspecified.

pthread_cond_broadcast() has no effect if there are no threads currently blocked on *cond*.

Returned value

If successful, pthread_cond_broadcast() returns 0.

If unsuccessful, pthread_cond_broadcast() returns -1 and sets errno to one of the following values:

Error Code**Description****EINVAL**

The value specified by *cond* does not refer to an initialized condition variable.

Special behavior for Single UNIX Specification, Version 3:

If unsuccessful, pthread_cond_broadcast() returns an error number to indicate the error.

Example

CELEBP17

```
/* CELEBP17 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

main() {
    pthread_cond_t cond;

    if (pthread_cond_init(&cond, NULL) != 0) {
        perror("pthread_cond_init() error");
        exit(1);
    }

    if (pthread_cond_broadcast(&cond) != 0) {
        perror("pthread_cond_broadcast() error");
        exit(2);
    }

    if (pthread_cond_destroy(&cond) != 0) {
        perror("pthread_cond_destroy() error");
        exit(3);
    }
}
```

Related information

- [“pthread.h – Thread interfaces” on page 53](#)
- [“pthread_cond_init\(\) – Initialize a condition variable” on page 1255](#)
- [“pthread_cond_signal\(\) – Signal a condition” on page 1257](#)
- [“pthread_cond_timedwait\(\), pthread_cond_timedwait64\(\) – Wait on a condition variable” on page 1259](#)
- [“pthread_cond_wait\(\) – Wait on a condition variable” on page 1262](#)

pthread_cond_destroy() – Destroy the condition variable object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_cond_destroy(pthread_cond_t *cond);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_cond_destroy(pthread_cond_t *cond);
```

General description

Destroys the condition variable object specified by *cond*.

A condition variable object identifies a condition variable. Condition variables are used in conjunction with mutexes to protect shared resources.

Returned value

If successful, pthread_cond_destroy() returns 0.

If unsuccessful, pthread_cond_destroy() returns -1 and sets errno to one of the following values:

Error Code Description

EBUSY

An attempt was made to destroy the object referenced by *cond* while it is referenced by another thread.

EINVAL

The value specified by *cond* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_cond_destroy() returns an error number to indicate the error.

Example

CELEBP18

```

/* CELEBP18 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

main() {
    pthread_cond_t cond;

    if (pthread_cond_init(&cond, NULL) != 0) {
        perror("pthread_cond_init() error");
        exit(1);
    }

    if (pthread_cond_destroy(&cond) != 0) {
        perror("pthread_cond_destroy() error");
        exit(2);
    }
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_broadcast\(\) — Broadcast a condition” on page 1253](#)
- [“pthread_cond_init\(\) — Initialize a condition variable” on page 1255](#)
- [“pthread_cond_signal\(\) — Signal a condition” on page 1257](#)
- [“pthread_cond_timedwait\(\), pthread_cond_timedwait64\(\) — Wait on a condition variable” on page 1259](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)

pthread_cond_init() — Initialize a condition variable

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_cond_init(pthread_cond_t *cond, pthread_condattr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_cond_init(pthread_cond_t * __restrict__ cond,
                     pthread_condattr_t * __restrict__ attr);
```

General description

Initializes the condition variable referenced by *cond* with attributes referenced by *attr*. If *attr* is NULL, the default condition variable attributes are used.

Returned value

If successful, pthread_cond_init() returns 0.

If unsuccessful, pthread_cond_init() returns -1 and sets errno to one of the following values:

Error Code

Description

ENOMEM

There is not enough memory to initialize the condition variable.

EAGAIN

The system lacked the necessary resources (other than memory) to initialize another condition variable.

EBUSY

The implementation has detected an attempt to reinitialize the object referenced by cond, a previously initialized, but not yet destroyed, condition variable.

EINVAL

The value specified by attr is invalid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_cond_init() returns an error number to indicate the error.

Usage notes

The _OPEN_SYS_MUTEX_EXT feature switch can be optionally included. If the feature is set, then significantly larger pthread_cond_t objects will be defined. The feature is used for the management of mutex and condition variables in shared memory. If the feature switch is set in the define of the condition variables in shared memory, then the same feature switch must be set in the define of the mutex associated with the condition variables.

If the supplied extended pthread_cond_t object is not in shared memory, pthread_cond_init() will treat the object as a non-shared object, since it is not accessible to any other process.

If the _OPEN_SYS_MUTEX_EXT feature switch is set, a shared condition variable is tied to the specified mutex for the life of the condition variable and mutex the very first time a pthread_cond_wait() or pthread_cond_timedwait() is issued. No other mutex can be associated with the specified condition variable or vice versa until the condition variable or mutex is destroyed.

It is recommended that you define and initialize pthread_cond_t objects in the same compile unit. If you pass a pthread_cond_t object around to be initialized, make sure the initialization code has been compiled with the same _OPEN_SYS_MUTEX_EXT feature setting as the code that defines the object.

The following sequence may cause storage overlay with unpredictable results:

1. Declare or define a `pthread_cond_t` object (in shared storage) without `#define` of the `_OPEN_SYS_MUTEX_EXT` feature. The created `pthread_cond_t` object is standard size (i.e. small) without the `_OPEN_SYS_MUTEX_EXT` feature defined.
2. Pass the `pthread_cond_t` object to another code unit, which was compiled with the `_OPEN_SYS_MUTEX_EXT` feature defined, to be initialized as a shared object. The `pthread_cond_t` initialization generally involves the following steps:
 - a. `pthread_condattr_init()`
 - b. `pthread_condattr_setpshared()`. This step sets the attribute of the `pthread_cond_t` as `PTHREAD_PROCESS_SHARED` and designates the object to be of extended size.
 - c. `pthread_cond_init()`. This step initializes the passed-in (small) `pthread_cond_t` object as if it is an extended object, causing storage overlay.

Example

CELEBP19

```

/* CELEBP19 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

main() {
    pthread_cond_t cond;

    if (pthread_cond_init(&cond, NULL) != 0) {
        perror("pthread_cond_init() error");
        exit(1);
    }

    if (pthread_cond_destroy(&cond) != 0) {
        perror("pthread_cond_destroy() error");
        exit(2);
    }
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_condattr_init\(\) — Initialize a condition attribute object” on page 1268](#)
- [“pthread_cond_broadcast\(\) — Broadcast a condition” on page 1253](#)
- [“pthread_cond_signal\(\) — Signal a condition” on page 1257](#)
- [“pthread_cond_timedwait\(\), pthread_cond_timedwait64\(\) — Wait on a condition variable” on page 1259](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)

pthread_cond_signal() — Signal a condition

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```

#define _OPEN_THREADS
#include <pthread.h>

```

```
int pthread_cond_signal(pthread_cond_t *cond);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_cond_signal(pthread_cond_t *cond);
```

General description

Unblock at least one thread that is blocked on the specified condition variable, *cond*. If more than one thread is blocked, the order in which the threads are unblocked is unspecified.

pthread_cond_signal() will have no effect if there are no threads currently blocked on *cond*.

Returned value

If successful, pthread_cond_signal() returns 0.

If unsuccessful, pthread_cond_signal() returns -1 and sets errno to one of the following values:

Error Code**Description****EINVAL**

The value specified by *cond* does not refer to an initialized condition variable.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_cond_signal() returns an error number to indicate the error.

Example**CELEBP20**

```
/* CELEBP20 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

main() {
    pthread_cond_t cond;

    if (pthread_cond_init(&cond, NULL) != 0) {
        perror("pthread_cond_init() error");
        exit(1);
    }

    if (pthread_cond_signal(&cond) != 0) {
        perror("pthread_cond_broadcast() error");
        exit(2);
    }

    if (pthread_cond_destroy(&cond) != 0) {
        perror("pthread_cond_destroy() error");
        exit(3);
    }
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_broadcast\(\) — Broadcast a condition” on page 1253](#)
- [“pthread_cond_init\(\) — Initialize a condition variable” on page 1255](#)
- [“pthread_cond_timedwait\(\), pthread_cond_timedwait64\(\) — Wait on a condition variable” on page 1259](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)

pthread_cond_timedwait(), pthread_cond_timedwait64() – Wait on a condition variable

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

pthread_cond_timedwait:

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_cond_timedwait(pthread_cond_t *cond, pthread_mutex_t *mutex,
                           const struct timespec *abstime);
```

pthread_cond_timedwait64:

```
#define _LARGE_TIME_API
#define _OPEN_THREADS
#include <pthread.h>

int pthread_cond_timedwait64(pthread_cond_t *cond, pthread_mutex_t *mutex,
                              const struct timespec64 *abstime);
```

SUSV3:

pthread_cond_timedwait:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_cond_timedwait(pthread_cond_t * __restrict__ cond,
                           pthread_mutex_t * __restrict__ mutex,
                           const struct timespec * __restrict__ abstime);
```

pthread_cond_timedwait64:

```
#define _LARGE_TIME_API
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_cond_timedwait64(pthread_cond_t * __restrict__ cond,
                              pthread_mutex_t * __restrict__ mutex,
                              const struct timespec64 * __restrict__ abstime);
```

Compile requirement: Use of the pthread_cond_timedwait64 function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

Allows a thread to wait on a condition variable until satisfied or until a specified time occurs. pthread_cond_timedwait() is the same as pthread_cond_wait() except it returns an error if the absolute time, specified by *abstime*, satisfies one of these conditions:

- Passes before *cond* is signaled or broadcasted.
- Has already been passed at the time of the call.

When such timeouts occur, pthread_cond_timedwait() reacquires the mutex, referenced by *mutex* (created by pthread_mutex_init()).

The two elements within the struct *timespec* are defined as follows:

tv_sec

The time to wait for the condition signal. It is expressed in seconds from midnight, January 1, 1970 UTC. The value specified must be greater than or equal to current calendar time expressed in seconds since midnight, January 1, 1970 UTC and less than 2,147,483,648 seconds.

tv_nsec

The time in nanoseconds to be added to tv_sec to determine when to stop waiting. The value specified must be greater than or equal to zero (0) and less than 1,000,000,000 (1,000 million).

The pthread_cond_timedwait64() function behaves exactly like pthread_cond_timedwait() except that pthread_cond_timedwait64() supports time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, pthread_cond_timedwait() returns 0.

If unsuccessful, pthread_cond_timedwait() returns -1 and sets errno to one of the following values:

Error Code

Description

EAGAIN

For a private condition variable, the time specified by *abstime* has passed.

EINVAL

Can be one of the following error conditions:

- The value specified by *cond* is not valid.
- The value specified by *mutex* is not valid.
- The value specified by *abstime* (tv_sec) is not valid.
- The value specified by *abstime* (tv_nsec) is not valid.
- Different mutexes were specified for concurrent operations on the same condition variable.

ETIMEDOUT

For a shared condition variable, the time specified by *abstime* has passed.

Note: In SUSV3, pthread_cond_timedwait() also returns ETIMEDOUT for a private condition variable, when the time specified by *abstime* has passed.

EPERM

The mutex was not owned by the current thread at the time of the call.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_cond_timedwait() returns an error number to indicate the error.

Usage notes

If the condition variable is shared (PTHREAD_PROCESS_SHARED), the mutex must also be shared, with the _OPEN_SYS_MUTEX_EXT feature defined when the mutex was created and initialized.

If the condition variable is private (PTHREAD_PROCESS_PRIVATE), the mutex must also be private.

If the condition variable is shared, all calls to pthread_cond_wait() or pthread_cond_timedwait() for a given condition variable must use the same mutex for the life of the process, or until both the condition variable and mutex are destroyed (using pthread_cond_destroy() and pthread_mutex_destroy()).

Example

CELEBP21

```

/* CELEBP21 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>
#include <time.h>
#include <errno.h>

main() {
    pthread_cond_t cond;
    pthread_mutex_t mutex;
    time_t T;
    struct timespec t;

    if (pthread_mutex_init(&mutex, NULL) != 0) {
        perror("pthread_mutex_init() error");
        exit(1);
    }

    if (pthread_cond_init(&cond, NULL) != 0) {
        perror("pthread_cond_init() error");
        exit(2);
    }

    if (pthread_mutex_lock(&mutex) != 0) {
        perror("pthread_mutex_lock() error");
        exit(3);
    }

    time(&T);
    t.tv_sec = T + 2;
    t.tv_nsec = 0;
    printf("starting timedwait at %s", ctime(&T));
    if (pthread_cond_timedwait(&cond, &mutex, &t) != 0)
        if (errno == EAGAIN)
            puts("wait timed out");
        else {
            perror("pthread_cond_timedwait() error");
            exit(4);
        }

    time(&T);
    printf("timedwait over at %s", ctime(&T));
}

```

Output:

```

starting timedwait at Fri Jun 16 10:44:00 2006
wait timed out
timedwait over at Fri Jun 16 10:44:02 2006

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_broadcast\(\) — Broadcast a condition” on page 1253](#)
- [“pthread_cond_signal\(\) — Signal a condition” on page 1257](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)
- [“pthread_mutex_init\(\) — Initialize a mutex object” on page 1297](#)

pthread_cond_wait() — Wait on a condition variable

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_cond_wait(pthread_cond_t *cond, pthread_mutex_t *mutex);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_cond_wait(pthread_cond_t * __restrict__ cond,
                     pthread_mutex_t * __restrict__ mutex);
```

General description

Blocks on a condition variable. It must be called with *mutex* locked by the calling thread, or undefined behavior will result. A mutex is locked using `pthread_mutex_lock()`.

cond is a condition variable that is shared by threads. To change it, a thread must hold the *mutex* associated with the condition variable. The `pthread_cond_wait()` function releases this *mutex* before suspending the thread and obtains it again before returning.

The `pthread_cond_wait()` function waits until a `pthread_cond_broadcast()` or a `pthread_cond_signal()` is received. For more information on these functions, refer to “[pthread_cond_broadcast\(\) — Broadcast a condition](#)” on page 1253 and to “[pthread_cond_signal\(\) — Signal a condition](#)” on page 1257.

Returned value

If successful, `pthread_cond_wait()` returns 0.

If unsuccessful, `pthread_cond_wait()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

Different mutexes were specified for concurrent operations on the same condition variable.

EPERM

The mutex was not owned by the current thread at the time of the call.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_cond_wait()` returns an error number to indicate the error.

Usage notes

If the condition variable is shared (`PTHREAD_PROCESS_SHARED`), the mutex must also be shared, with the `_OPEN_SYS_MUTEX_EXT` feature defined when the mutex was created and initialized.

If the condition variable is private (`PTHREAD_PROCESS_PRIVATE`), the mutex must also be private.

If the condition variable is shared, all calls to `pthread_cond_wait()` or `pthread_cond_timedwait()` for a given condition variable must use the same mutex for the life of the process, or until both the condition variable and mutex are destroyed (using `pthread_cond_destroy()` and `pthread_mutex_destroy()`).

Example

CELEBP22

```

/* CELEBP22 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>
#include <time.h>
#include <unistd.h>

pthread_cond_t cond;
pthread_mutex_t mutex;

int footprint = 0;

void *thread(void *arg) {
    time_t T;

    if (pthread_mutex_lock(&mutex) != 0) {
        perror("pthread_mutex_lock() error");
        exit(6);
    }
    time(&T);
    printf("starting wait at %s", ctime(&T));
    footprint++;

    if (pthread_cond_wait(&cond, &mutex) != 0) {
        perror("pthread_cond_timedwait() error");
        exit(7);
    }
    time(&T);
    printf("wait over at %s", ctime(&T));
}

main() {
    pthread_t thid;
    time_t T;
    struct timespec t;

    if (pthread_mutex_init(&mutex, NULL) != 0) {
        perror("pthread_mutex_init() error");
        exit(1);
    }

    if (pthread_cond_init(&cond, NULL) != 0) {
        perror("pthread_cond_init() error");
        exit(2);
    }

    if (pthread_create(&thid, NULL, thread, NULL) != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    while (footprint == 0)
        sleep(1);

    puts("IPT is about ready to release the thread");
    sleep(2);

    if (pthread_cond_signal(&cond) != 0) {
        perror("pthread_cond_signal() error");
        exit(4);
    }

    if (pthread_join(thid, NULL) != 0) {
        perror("pthread_join() error");
        exit(5);
    }
}

```

Output:

```
starting wait at Fri Jun 16 10:54:06 2006
IPT is about ready to release the thread
wait over at Fri Jun 16 10:54:09 2006
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_broadcast\(\) — Broadcast a condition” on page 1253](#)
- [“pthread_cond_signal\(\) — Signal a condition” on page 1257](#)
- [“pthread_cond_timedwait\(\), pthread_cond_timedwait64\(\) — Wait on a condition variable” on page 1259](#)

pthread_condattr_destroy() — Destroy condition variable attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_condattr_destroy(pthread_condattr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_condattr_destroy(pthread_condattr_t *attr);
```

General description

Destroys a condition attribute object. Condition-variable attribute objects are similar to mutex attribute objects because you can use them to manage the characteristics of condition variables in your application. They define the set of values to be used for the condition variable during its creation.

pthread_condattr_init() is used to define a condition variable attribute object. pthread_condattr_destroy() is used to remove the definition of the condition variable attribute object. These functions are provided for portability purposes.

You can define a condition variable without using these functions by supplying a NULL parameter during the pthread_cond_init() call. For more details, refer to [“pthread_cond_init\(\) — Initialize a condition variable” on page 1255](#).

Returned value

If successful, pthread_condattr_destroy() returns 0.

If unsuccessful, pthread_condattr_destroy() returns -1 and sets errno to one of the following values:

Error Code**Description**

EINVAL

The value specified by *attr* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_condattr_destroy()` returns an error number to indicate the error.

Example**CELEBP23**

```
/* CELEBP23 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

main() {
    pthread_condattr_t cond;

    if (pthread_condattr_init(&cond) != 0) {
        perror("pthread_condattr_init() error");
        exit(1);
    }

    if (pthread_condattr_destroy(&cond) != 0) {
        perror("pthread_condattr_destroy() error");
        exit(2);
    }
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_condattr_init\(\) — Initialize a condition attribute object” on page 1268](#)
- [“pthread_cond_init\(\) — Initialize a condition variable” on page 1255](#)
- [“pthread_mutex_init\(\) — Initialize a mutex object” on page 1297](#)

pthread_condattr_getkind_np() — Get kind attribute from a condition variable attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_condattr_getkind_np(pthread_condattr_t *attr, int *kind);
```

General description

Gets the attribute *kind* for the condition variable attribute object *attr*. Condition variable attribute objects are similar to mutex attribute objects. You can use them to manage the characteristics of condition variables in your application. They define the set of values for the condition variable during its creation.

The valid values for the attribute *kind* are:

__COND_DEFAULT

No defined attributes.

__COND_NODEBUG

State changes to this condition variable will *not* be reported to the debug interface, even though it is present.

Returned value

If successful, pthread_condattr_getkind_np() returns 0.

If unsuccessful, pthread_condattr_getkind_np() returns -1 and sets errno to one of the following values:

Error Code**Description****EINVAL**

The value specified for *attr* is not valid.

Example**CELEBP24**

```

/* CELEBP24 */
#pragma runopts(TEST(ALL))

#ifdef _OPEN_THREADS
#define _OPEN_THREADS
#define _OPEN_SYS          /* Needed to identify __COND_NODEBUG and
                           __COND_DEFAULT */
#endif

#include <stdio.h>
#include <pthread.h>

pthread_condattr_t attr;

int kind;

main() {
    if (pthread_condattr_init(&attr) == -1) {
        perror("pthread_condattr_init()");
        exit(1);
    }

    if (pthread_condattr_setkind_np(&attr, __COND_NODEBUG) == -1) {
        perror("pthread_condattr_setkind_np()");
        exit(1);
    }

    if (pthread_condattr_getkind_np(&attr, &kind) == -1) {
        exit(1);
    }

    switch(kind) {
        case __COND_DEFAULT:
            printf("\ncondition variable will have no defined attributes");
            break;

        case __COND_NODEBUG:
            printf("\ncondition variable will have nodebug attribute");
            break;

        default:
            printf("\nattribute kind value returned by \
pthread_condattr_getkind_np() unrecognized");
    }

    exit(0);
}

```

Related information

- “pthread.h — Thread interfaces” on page 53
- “pthread_condattr_init() — Initialize a condition attribute object” on page 1268
- “pthread_condattr_setkind_np() — Set kind attribute from a condition variable attribute object” on page 1270

pthread_condattr_getpshared() — Get the process-shared condition variable attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Language Environment Extension Single UNIX Specification, Version 3 | both | z/OS V1R2 |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS_MUTEX_EXT
#include <pthread.h>

int pthread_condattr_getpshared(const pthread_condattr_t *attr,
                               int *pshared);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_condattr_getpshared(const pthread_condattr_t * __restrict_attr,
                               int * __restrict_pshared);
```

General description

Gets the attribute *pshared* for the condition variable attribute object *attr*. By using *attr*, you can determine its process-shared value for a condition variable.

Valid values for the attribute *pshared* are:

Value

Description

PTHREAD_PROCESS_SHARED

Permits a condition variable to be operated upon by any thread that has access to the memory where the condition variable is allocated; even if the condition variable is allocated in memory that is shared by multiple processes.

PTHREAD_PROCESS_PRIVATE

A condition variable can only be operated upon by threads created within the same process as the thread that initialized the condition variable. If threads of differing processes attempt to operate on such a condition variable, only the process to initialize the condition variable will succeed. When a new process is created by the parent process it will receive a different copy of the private condition variable which can only be used to serialize between threads in the child process.

Note: This is the default value of *pshared*

Returned value

If successful, 0 is returned. If unsuccessful, -1 is returned and the errno value is set. The following is the value of errno:

| Value | Description |
|-------|-------------|
|-------|-------------|

EINVAL
The value specified for *attr* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_condattr_getpshared() returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_condattr_setpshared\(\) — Set the process-shared condition variable attribute” on page 1272](#)
- [“pthread_mutexattr_getpshared\(\) — Get the process-shared mutex attribute” on page 1308](#)
- [“pthread_mutexattr_setpshared\(\) — Set the process-shared mutex attribute” on page 1314](#)
- [“pthread_rwlockattr_getpshared\(\) — Get the processed-shared read or write lock attribute” on page 1328](#)
- [“pthread_rwlockattr_setpshared\(\) — Set the process-shared read or write lock attribute” on page 1330](#)

pthread_condattr_init() — Initialize a condition attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_condattr_init(pthread_condattr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_condattr_init(pthread_condattr_t *attr);
```

General description

Establishes the default values for the condition variables that will be created. A condition attribute (*condattr*) object contains various condition variable characteristics. You can set up a template of these characteristics and then create a set of condition variables with similar characteristics.

Condition variable attribute objects are similar to mutex attribute objects. You can use them to manage the characteristics of condition variables in your application. They define the set of values to be used for the condition variable during its creation. For a valid condition variable attribute, refer to "pthread_condattr_setkind_np() -- Set Kind Attribute from a Condition Variable Attribute Object and pthread_condattr_setpshared() --Set the Process-Shared Condition Variable Attribute

pthread_condattr_init() is used to define a condition variable attribute object. pthread_condattr_destroy() is used to remove the definition of the condition variable attribute object. These functions are provided for portability purposes.

You can define a condition variable without using these functions by supplying a NULL parameter during the pthread_cond_init() call. For more details, refer to [“pthread_cond_init\(\) — Initialize a condition variable”](#) on page 1255.

Returned value

If successful, pthread_condattr_init() returns 0.

If unsuccessful, pthread_condattr_init() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|---------------|--|
| ENOMEM | There is not enough memory to initialize the condition variable attributes object. |
|---------------|--|

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_condattr_init() returns an error number to indicate the error.

Example

CELEBP25

```
/* CELEBP25 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

main() {
    pthread_condattr_t cond;

    if (pthread_condattr_init(&cond) != 0) {
        perror("pthread_condattr_init() error");
        exit(1);
    }

    if (pthread_condattr_destroy(&cond) != 0) {
        perror("pthread_condattr_destroy() error");
        exit(2);
    }
}
```

Related information

- [“pthread.h — Thread interfaces”](#) on page 53
- [“pthread_cond_init\(\) — Initialize a condition variable”](#) on page 1255
- [“pthread_condattr_getpshared\(\) — Get the process-shared condition variable attribute”](#) on page 1267
- [“pthread_condattr_setpshared\(\) — Set the process-shared condition variable attribute”](#) on page 1272
- [“pthread_mutex_init\(\) — Initialize a mutex object”](#) on page 1297

pthread_condattr_setclock() – Sets the clock selection condition variable attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1j Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE 600
#include <pthread.h>
int pthread_condattr_setclock(pthread_condattr_t *attr, clockid_t clock_id);
```

General description

The `pthread_condattr_setclock()` function sets the clock attribute in an initialized attributes object referenced by `attr`.

The `clockid_t` attribute is the clock ID of the clock that is used to measure the timeout service of `pthread_cond_timedwait()`. The default value of the clock attribute shall refer to the system clock.

The valid values for the attribute `clockid_t` are:

CLOCK_REALTIME

The system real-time clock

CLOCK_MONOTONIC

The system monotonic clock

Returned value

If successful, `pthread_condattr_setclock()` returns 0.

If unsuccessful, `pthread_condattr_setclock()` returns an error number to indicate the error.

Error Code

Description

EINVAL

The value specified by `clock_id` does not refer to a known clock.

Related information

- [“pthread.h – Thread interfaces” on page 53](#)
- [“pthread_condattr_init\(\) – Initialize a condition attribute object” on page 1268](#)

pthread_condattr_setkind_np() – Set kind attribute from a condition variable attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_condattr_setkind_np(pthread_condattr_t *attr, int kind);
```

General description

Sets the attribute *kind* for the condition variable attribute object *attr*. Condition variable attribute objects are similar to mutex attribute objects. You can use them to manage the characteristics of condition variables in your application. They define the set of values to be used for the condition variable during its creation.

The valid values for the attribute *kind* are:

__COND_DEFAULT

No defined attributes.

__COND_NODEBUG

State changes to this condition variable will *not* be reported to the debug interface, even though it is present.

Returned value

If successful, pthread_condattr_setkind_np() returns 0.

If unsuccessful, pthread_condattr_setkind_np() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

The value specified for *attr* or *kind* is not valid.

Example

CELEBP26

```
/* CELEBP26 */
#pragma runopts(TEST(ALL))

#ifdef _OPEN_THREADS
#define _OPEN_THREADS
#define _OPEN_SYS /* Needed to identify __COND_NODEBUG and
                  __COND_DEFAULT */
#endif

#include <stdio.h>
#include <pthread.h>

pthread_condattr_t attr;

int kind;

main() {
    if (pthread_condattr_init(&attr) == -1) {
        perror("pthread_condattr_init()");
        exit(1);
    }

    if (pthread_condattr_setkind_np(&attr, __COND_NODEBUG) == -1) {
        perror("pthread_condattr_setkind_np()");
        exit(1);
    }

    if (pthread_condattr_getkind_np(&attr, &kind) == -1) {
        exit(1);
    }

    switch(kind) {
```

```
case __COND_DEFAULT:
    printf("\ncondition variable will have no defined attributes");
    break;

case __COND_NODEBUG:
    printf("\ncondition variable will have nodebug attribute");
    break;

default:
    printf("\nattribute kind value returned by \
pthread_condattr_getkind_np() unrecognized");
}

exit(0);
}
```

Related information

- [“pthread.h – Thread interfaces” on page 53](#)
- [“pthread_condattr_init\(\) – Initialize a condition attribute object” on page 1268](#)
- [“pthread_condattr_getkind_np\(\) – Get kind attribute from a condition variable attribute object” on page 1265](#)

pthread_condattr_setpshared() – Set the process-shared condition variable attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Language Environment Extension Single UNIX Specification, Version 3 | both | z/OS V1R2 |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS_MUTEX_EXT
#include <pthread.h>

int pthread_condattr_setpshared(pthread_condattr_t *attr,
                                int pshared);
```

SUSV3:

```
#define _UNIX03_THREADS
#define _OPEN_SYS_MUTEX_EXT
#include <pthread.h>

int pthread_condattr_setpshared(pthread_condattr_t *attr,
                                int pshared);
```

General description

Sets the attribute *pshared* for the condition variable attribute object *attr*.

A condition variable attribute object (*attr*) allows you to manage the characteristics of condition variables in your application by defining a set of values to be used for a condition variable during its creation. By establishing a condition variable attribute object, you can create many condition variables with the same set of characteristics, without needing to define the characteristics for each and every condition variable. By using *attr*, you can define its process-shared value for a condition variable.

Valid values for the attribute *pshared* are:

Value**Description****PTHREAD_PROCESS_SHARED**

Permits a condition variable to be operated upon by any thread that has access to the memory where the condition variable is allocated; even if the condition variable is allocated in memory that is shared by multiple processes.

PTHREAD_PROCESS_PRIVATE

A condition variable can only be operated upon by threads created within the same process as the thread that initialized the condition variable. If threads of differing processes attempt to operate on such a condition variable, only the process to initialize the condition variable will succeed. When a new process is created by the parent process it will receive a different copy of the private condition variable which can only be used to serialize between threads in the child process.

Note: This is the default value of *pshared*.

Returned value

If successful, 0 is returned. If unsuccessful, -1 is returned and the *errno* value is set. The following is the value of *errno*:

Value**Description****EINVAL**

The value specified for *attr* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_condattr_setpshared()` returns an error number to indicate the error.

Usage notes

It is recommended that you define and initialize `pthread_cond_t` objects in the same compile unit. If you pass a `pthread_cond_t` object around to be initialized, make sure the initialization code has been compiled with the same `_OPEN_SYS_MUTEX_EXT` feature setting as the code that defines the object.

The following sequence may cause storage overlay with unpredictable results:

1. Declare or define a `pthread_cond_t` object (in shared storage) without `#define` of the `_OPEN_SYS_MUTEX_EXT` feature. The created `pthread_cond_t` object is standard size (i.e. small) without the `_OPEN_SYS_MUTEX_EXT` feature defined.
2. Pass the `pthread_cond_t` object to another code unit, which was compiled with the `_OPEN_SYS_MUTEX_EXT` feature defined, to be initialized as a shared object. The `pthread_cond_t` initialization generally involves the following steps:
 - a. `pthread_condattr_init()`
 - b. `pthread_condattr_setpshared()`. This step sets the attribute of the `pthread_cond_t` as `PTHREAD_PROCESS_SHARED` and designates the object to be of extended size.
 - c. `pthread_cond_init()`. This step initializes the passed-in (small) `pthread_cond_t` object as if it is an extended object, causing storage overlay.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_condattr_getpshared\(\) — Get the process-shared condition variable attribute” on page 1267](#)
- [“pthread_mutexattr_getpshared\(\) — Get the process-shared mutex attribute” on page 1308](#)
- [“pthread_mutexattr_setpshared\(\) — Set the process-shared mutex attribute” on page 1314](#)
- [“pthread_rwlockattr_getpshared\(\) — Get the processed-shared read or write lock attribute” on page 1328](#)

- [“pthread_rwlockattr_setpshared\(\) — Set the process-shared read or write lock attribute”](#) on page 1330

pthread_create() — Create a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_create(pthread_t *thread, pthread_attr_t *attr,
                  void *(*start_routine) (void *arg), void *arg);
```

SUSV3

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_create(pthread_t * __restrict_thread,
                  const pthread_attr_t *attr,
                  void *(*start_routine) (void *arg),
                  void * __restrict_arg);
```

General description

Creates a new thread within a process, with attributes defined by the thread attribute object, *attr*, that is created by `pthread_attr_init()`.

If *attr* is NULL, the default attributes are used. See [“pthread_attr_init\(\) — Initialize a thread attribute object”](#) on page 1233 for a description of the thread attributes and their defaults. If the attributes specified by *attr* are changed later, the thread's attributes are not affected.

pthread_t is the data type used to uniquely identify a thread. It is returned by `pthread_create()` and used by the application in function calls that require a thread identifier.

The thread is created running *start_routine*, with *arg* as the only argument. If `pthread_create()` completes successfully, *thread* will contain the ID of the created thread. If it fails, no new thread is created, and the contents of the location referenced by *thread* are undefined.

System default for the thread limit in a process is set by MAXTHREADS in the BPXPRMxx parmlib member.

The maximum number of threads is dependent upon the size of the private area below 16M.

`pthread_create()` inspects this address space before creating a new thread. A realistic limit is 200 to 400 threads.

Special behavior for C++: Because C and C++ linkage conventions are incompatible, `pthread_create()` cannot receive a C++ function pointer as the start routine function pointer. If you attempt to pass a C++ function pointer to `pthread_create()`, the compiler will flag it as an error. You can pass a C or C++ function to `pthread_create()` by declaring it as extern "C".

The started thread provides a boundary with respect to the scope of try-throw-catch processing. A throw done in the start routine or a function called by the start routine causes stack unwinding up to and including the start routine (or until caught). The stack unwinding will not go beyond the start routine back into the thread creator. If the exception is not caught, `terminate()` is called.

The exception stack (for try-throw-catch) are thread-based. The throw of a condition, or re-throw of a condition by a thread does not affect exception processing on another thread, unless the condition is not caught.

Returned value

If successful, `pthread_create()` returns 0.

If unsuccessful, `pthread_create()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAGAIN

The system lacks the necessary resources to create another thread.

EINVAL

The value specified by *thread* is null.

ELEMULTITHREADFORK

`pthread_create()` was invoked from a child process created by calling `fork()` from a multi-threaded process. This child process is restricted from becoming multi-threaded.

ENOMEM

There is not enough memory to create the thread.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_create()` returns an error number to indicate the error.

Example

CELEBP27

```
/* CELEBP27 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdlib.h>
#include <stdio.h>
void *thread(void *arg) {
    char *ret;
    printf("thread() entered with argument '%s'\n", arg);
    if ((ret = (char*) malloc(20)) == NULL) {
        perror("malloc() error");
        exit(2);
    }
    strcpy(ret, "This is a test");
    pthread_exit(ret);
}

main() {
    pthread_t thid;
    void *ret;

    if (pthread_create(&thid, NULL, thread, "thread 1") != 0) {
        perror("pthread_create() error");
        exit(1);
    }

    if (pthread_join(thid, &ret) != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    printf("thread exited with '%s'\n", ret);
}
```

Output:

```
thread() entered with argument 'thread 1'
thread exited with 'This is a test'
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_exit\(\) — Exit a thread” on page 1279](#)
- [“pthread_join\(\) — Wait for a thread to end” on page 1287](#)

pthread_detach() — Detach a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_detach(pthread_t *thread);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_detach(pthread_t thread);
```

General description

Allows storage for the thread whose thread ID is in the location *thread* to be reclaimed when that thread ends. This storage is reclaimed on process exit, regardless of whether the thread was detached, and may include storage for *thread*'s return value. If *thread* has not ended, pthread_detach() will not cause it to end.

pthread_t is the data type used to uniquely identify a thread. It is returned by pthread_create() and used by the application in function calls that require a thread identifier.

Returned value

If successful, pthread_detach() returns 0.

If unsuccessful, pthread_detach() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

The value specified by *thread* is not valid.

ESRCH

A value specified by *thread* refers to a thread that is already detached.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_detach() returns an error number to indicate the error.

Example

CELEBP28

```

/* CELEBP28 */
#define _OPEN_SYS
#define _OPEN_THREADS
#include <pthread.h>
#include <stdlib.h>
#include <stdio.h>

void *thread(void *arg) {
    char *ret;
    printf("thread() entered with argument '%s'\n", arg);
    if ((ret = (char*) malloc(20)) == NULL) {
        perror("malloc() error");
        exit(2);
    }
    strcpy(ret, "This is a test");
    pthread_exit(ret);
}

main() {
    pthread_t thid;
    void *ret;

    if (pthread_create(&thid, NULL, thread, "thread 1") != 0) {
        perror("pthread_create() error");
        exit(1);
    }

    if (pthread_join_d4_np(thid, &ret) != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    printf("thread exited with '%s'\n", ret);

    if (pthread_detach(&thid) != 0) {
        perror("pthread_detach() error");
        exit(4);
    }
}

```

Output:

```

thread() entered with argument 'thread 1'
thread exited with 'This is a test'

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_join\(\) — Wait for a thread to end” on page 1287](#)

pthread_equal() — Compare thread IDs

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```

#define _OPEN_THREADS
#include <pthread.h>

```

```
int pthread_equal(pthread_t t1, pthread_t t2);
```

General description

Compares the thread IDs of *t1* and *t2*.

pthread_t is the data type used to uniquely identify a thread. It is returned by `pthread_create()` and used by the application in function calls that require a thread identifier.

Returned value

If *t1* and *t2* are equal, `pthread_equal()` returns a positive value. Otherwise, the value 0 is returned. If *t1* or *t2* are not valid thread IDs, the behavior is undefined.

If unsuccessful, `pthread_equal()` returns -1.

There are no documented `errno` values. Use `perror()` or `strerror()` to determine the cause of the error.

Example

CELEBP29

```
/* CELEBP29 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

pthread_t thid, IPT;

void *thread(void *arg) {
    if (pthread_equal(IPT, thid))
        puts("the thread is the IPT...?");
    else
        puts("the thread is not the IPT");
}

main() {
    IPT = pthread_self();

    if (pthread_create(&thid, NULL, thread, NULL) != 0) {
        perror("pthread_create() error");
        exit(1);
    }

    if (pthread_join(thid, NULL) != 0) {
        perror("pthread_create() error");
        exit(3);
    }
}
```

Output:

```
the thread is not the IPT
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)
- [“pthread_self\(\) — Get the caller” on page 1334](#)

pthread_exit() — Exit a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

void pthread_exit(void *status);
```

General description

Ends the calling thread and makes *status* available to any thread that calls `pthread_join()` with the ending thread's thread ID.

As part of `pthread_exit()` processing, cleanup and destructor routines may be run:

- For details on the cleanup routines, refer to [“pthread_cleanup_pop\(\) — Remove a cleanup handler”](#) on page 1250 and [“pthread_cleanup_push\(\) — Establish a cleanup handler”](#) on page 1251.
- For details on the destructor routine, refer to [“pthread_key_create\(\) — Create thread-specific data key”](#) on page 1290.

Special behavior for C++: Destructors for automatic objects on the stack will be run when a thread is canceled. The stack is unwound and the destructors are run in reverse order.

Returned value

`pthread_exit()` cannot return to its caller.

There are no documented `errno` values. Use `perror()` or `strerror()` to determine the cause of the error.

Example

CELEBP30

```
/* CELEBP30 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdlib.h>
#include <stdio.h>

void *thread(void *arg) {
    char *ret;

    if ((ret = (char*) malloc(20)) == NULL) {
        perror("malloc() error");
        exit(2);
    }
    strcpy(ret, "This is a test");
    pthread_exit(ret);
}

main() {
    pthread_t thid;
    void *ret;

    if (pthread_create(&thid, NULL, thread, NULL) != 0) {
        perror("pthread_create() error");
        exit(1);
    }
}
```

```

    if (pthread_join(thid, &ret) != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    printf("thread exited with '%s'\n", ret);
}

```

Output:

```
thread exited with 'This is a test'
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cleanup_pop\(\) — Remove a cleanup handler” on page 1250](#)
- [“pthread_cleanup_push\(\) — Establish a cleanup handler” on page 1251](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)
- [“pthread_join\(\) — Wait for a thread to end” on page 1287](#)
- [“pthread_key_create\(\) — Create thread-specific data key” on page 1290](#)

pthread_getconcurrency() — Get the level of concurrency

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R7 POSIX(ON) |

Format

```

#define _OPEN_THREADS 2
#include <pthread.h>

int pthread_getconcurrency(void);

```

General description

pthread_getconcurrency() returns the value set by a previous call to pthread_setconcurrency(), or 0 if pthread_setconcurrency() was not previously called.

Returned value

If successful, pthread_getconcurrency() returns the concurrency level set by a previous call to pthread_setconcurrency(); otherwise, 0.

Related information

- "Thread Cancellation" in the *z/OS XL C/C++ Programming Guide*
- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_setconcurrency\(\) — Set the level of concurrency” on page 1336](#)

pthread_getspecific() – Get the thread-specific value for a key

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_getspecific(pthread_key_t key, void **value);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
void *pthread_getspecific(pthread_key_t key);
```

General description

Returns the thread-specific data associated with the specified *key* for the current thread. If no thread-specific data has been set for *key*, the NULL value is returned in *value*.

Many multithreaded applications require storage shared among threads, where each thread has its own unique value. A thread-specific data key is an identifier, created by a thread, for which each thread in the process can set a unique key *value*.

pthread_key_t is a storage area where the system places the key identifier. To create a key, a thread uses *pthread_key_create()*. This returns the key identifier into the storage area of type *pthread_key_t*. At this point, each of the threads in the application has the use of that key, and can set its own unique value by using *pthread_setspecific()*. A thread can get its own unique value using *pthread_getspecific()*.

Returned value

When unsuccessful, *pthread_getspecific()* sets *errno* to one of the following values:

Error Code

Description

EINVAL

The value for *key* is not valid.

Note: In SUSV3, if the key is invalid, *pthread_getspecific()* returns NULL but does not set or return an *errno* value.

Example

CELEBP31

```
/* CELEBP31 */
#ifdef _OPEN_THREADS
#define _OPEN_THREADS
#endif

#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <pthread.h>
```

```

#define threads 3
#define BUFFSZ 48
pthread_key_t key;

void *threadfunc(void *parm)
{
    int status;
    void *value;
    int threadnum;
    int tnum;
    void *getvalue;
    char Buffer[BUFFSZ];

    tnum = parm;
    threadnum = *tnum;

    printf("Thread %d executing\n", threadnum);

    if (!(value = malloc(sizeof(Buffer))))
        printf("Thread %d could not allocate storage, errno = %d\n",
               threadnum, errno);
    status = pthread_setspecific(key, (void *) value);
    if (status < 0) {
        printf("pthread_setspecific failed, thread %d, errno %d",
               threadnum, errno);
        pthread_exit((void *)12);
    }
    printf("Thread %d setspecific value: %d\n", threadnum, value);

    getvalue = 0;
    status = pthread_getspecific(key, &getvalue);
    if (status < 0) {
        printf("pthread_getspecific failed, thread %d, errno %d",
               threadnum, errno);
        pthread_exit((void *)13);
    }

    if (getvalue != value)
    {
        printf("getvalue not valid, getvalue=%d", (int)getvalue);
        pthread_exit((void *)68);
    }

    pthread_exit((void *)0);
}

void destr_fn(void *parm)
{
    printf("Destructor function invoked\n");
    free(parm);
}

main() {
    int getvalue;
    int status;
    int i;
    int threadparm[threads];
    pthread_t threadid[threads];
    int thread_stat[threads];

    if ((status = pthread_key_create(&key, destr_fn)) < 0) {
        printf("pthread_key_create failed, errno=%d", errno);
        exit(1);
    }

    /* create 3 threads, pass each its number */
    for (i=0; i<threads; i++) {
        threadparm[i] = i+1;
        status = pthread_create(&threadid[i],
                               NULL,
                               threadfunc,
                               (void *)&threadparm[i]);

        if (status < 0) {
            printf("pthread_create failed, errno=%d", errno);
            exit(2);
        }
    }

    for (i=0; i<threads; i++) {
        status = pthread_join(threadid[i], (void *)&thread_stat[i]);
    }
}

```

```

    if ( status < 0 ) {
        printf("pthread_join failed, thread %d, errno=%d\n", i+1, errno);
    }

    if (thread_stat[i] != 0) {
        printf("bad thread status, thread %d, status=%d\n", i+1,
              thread_stat[i]);
    }
}

exit(0);
}

```

CELEBP70

```

/* CELEBP70 */
/* Example using SUSv3 pthread_getspecific() interface */

#define _UNIX03_THREADS 1

#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <pthread.h>

#define threads 3
#define BUFSZ 48
pthread_key_t key;

void *threadfunc(void *parm)
{
    int status;
    void *value;
    int threadnum;
    int *tnum;
    void *getvalue;
    char Buffer[BUFSZ];

    tnum = parm;
    threadnum = *tnum;

    printf("Thread %d executing\n", threadnum);

    if (!(value = malloc(sizeof(Buffer))))
        printf("Thread %d could not allocate storage, errno = %d\n",
              threadnum, errno);

    status = pthread_setspecific(key, (void *) value);
    if ( status < 0 ) {
        printf("pthread_setspecific failed, thread %d, errno %d",
              threadnum, errno);
        pthread_exit((void *)12);
    }
    printf("Thread %d setspecific value: %d\n", threadnum, value);

    getvalue = 0;
    getvalue = pthread_getspecific(key);
    if ( getvalue == 0 ) {
        printf("pthread_getspecific failed, thread %d", threadnum);
        printf(" rc= %d, errno %d, ejr %08x\n", (int)getvalue, errno, __errno2());
        pthread_exit((void *)13);
    } else {
        printf("Success!\n");
        printf("Returned value: %d matches set value: %d\n", getvalue, value);
    }

    if (getvalue != value)
    {
        printf("getvalue not valid, getvalue=%d", (int)getvalue);
        pthread_exit((void *)68);
    }

    pthread_exit((void *)0);
}

void destr_fn(void *parm)
{
    printf("Destructor function invoked\n");
    free(parm);
}

```

```
int main(void)
{
    int      status;
    int      i;
    int      threadparm[threads];
    pthread_t threadid[threads];
    int      thread_stat[threads];

    if ((status = pthread_key_create(&key, destr_fn )) < 0) {
        printf("pthread_key_create failed, errno=%d", errno);
        exit(1);
    }

    /* create 3 threads, pass each its number */
    for (i=0; i<threads; i++) {
        threadparm[i] = i+1;
        status = pthread_create( &threadid[i],
                                NULL,
                                threadfunc,
                                (void *)&threadparm[i]);

        if ( status < 0) {
            printf("pthread_create failed, errno=%d", errno);
            exit(2);
        }
    }

    for ( i=0; i<threads; i++) {
        status = pthread_join( threadid[i], (void *)&thread_stat[i]);
        if ( status < 0) {
            printf("pthread_join failed, thread %d, errno=%d\n", i+1, errno);
        }

        if (thread_stat[i] != 0) {
            printf("bad thread status, thread %d, status=%d\n", i+1,
                  thread_stat[i]);
        }
    }

    exit(0);
}
```

Related information

- [“pthread.h – Thread interfaces” on page 53](#)
- [“pthread_getspecific_d8_np\(\) – Get the thread-specific value for a key” on page 1284](#)
- [“pthread_key_create\(\) – Create thread-specific data key” on page 1290](#)
- [“pthread_setspecific\(\) – Set the thread-specific value for a key” on page 1342](#)

pthread_getspecific_d8_np() – Get the thread-specific value for a key

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| POSIX.4a, draft 8 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

void *pthread_getspecific_d8_np(pthread_key_t key);
```

General description

Returns the thread-specific data associated with the specified *key* for the current thread. If no thread-specific data has been set for *key*, the NULL value is returned.

Many multithreaded applications require storage shared among threads, where each thread has its own unique value. A thread-specific data key is an identifier, created by a thread, for which each thread in the process can set a unique key *value*.

pthread_key_t is a storage area where the system places the key identifier. To create a key, a thread uses `pthread_key_create()`. This returns the key identifier into the storage area of type *pthread_key_t*. At this point, each of the threads in the application has the use of that key, and can set its own unique value by using `pthread_setspecific()`. A thread can get its own unique value using `pthread_getspecific_d8_np()` or `pthread_getspecific()`.

The only difference between `pthread_getspecific_d8_np()` and `pthread_getspecific()` is the syntax of the function.

Returned value

When successful, `pthread_getspecific_d8_np()` returns the thread-specific data value associated with *key*.

When unsuccessful, `pthread_getspecific_d8_np()` returns NULL and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value for *key* is not valid.

Example

```
#ifndef _OPEN_THREADS
#define _OPEN_THREADS
#endif

#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <pthread.h>

#define threads 3
#define BUFFSZ 48
pthread_key_t key;

void *threadfunc(void *);
void destr_fn(void *);

main() {
    int status;
    int i;
    int threadparm[threads];
    pthread_t threadid[threads];
    int thread_stat[threads];

    if ((status = pthread_key_create(&key, destr_fn)) < 0) {
        printf("pthread_key_create failed, errno=%d", errno);
        exit(1);
    }

    /* create 3 threads, pass each its number */
    for (i=0; i<threads; i++) {
        threadparm[i] = i+1;
        status = pthread_create(&threadid[i],
                                NULL,
                                threadfunc,
                                (void *)&threadparm[i]);
        if (status < 0) {
            printf("pthread_create failed, errno=%d", errno);
            exit(2);
        }
    }
}
```

```

    }
}

for ( i=0; i<threads; i++) {
    status = pthread_join( threadid[i], (void *)&thread_stat[i]);
    if ( status < 0) {
        printf("pthread_join failed, thread %d, errno=%d\n", i+1, errno);
    }

    if (thread_stat[i] != 0) {
        printf("bad thread status, thread %d, status=%d\n", i+1,
            thread_stat[i]);
    }
}

exit(0);
}

void *threadfunc(void *parm) {
    int      status;
    int      *void;
    int      threadnum;
    int      *tnum;
    void      *getvalue;
    char      Buffer[BUFSZ];

    tnum = parm;
    threadnum = *tnum;

    printf("Thread %d executing\n", threadnum);

    if (!(value = malloc(sizeof(Buffer))))
        printf("Thread %d could not allocate storage, errno = %d\n",
            threadnum, errno);

    status = pthread_setspecific(key, (void *) value);
    if ( status < 0) {
        printf("pthread_setspecific failed, thread %d, errno %d",
            threadnum, errno);
        pthread_exit((void *)12);
    }
    printf("Thread %d setspecific value: %d\n", threadnum, value);

    getvalue = pthread_getspecific_d8_np(key);
    if ( getvalue == NULL) {
        printf("pthread_getspecific_d8_np failed, thread %d, errno %d",
            threadnum, errno);
        pthread_exit((void *)13);
    }

    pthread_exit((void *)0);
}

void destr_fn(void *parm)
{
    printf("Destructor function invoked\n");
    free(parm)
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_key_create\(\) — Create thread-specific data key” on page 1290](#)
- [“pthread_getspecific\(\) — Get the thread-specific value for a key” on page 1281](#)
- [“pthread_setspecific\(\) — Set the thread-specific value for a key” on page 1342](#)

pthread_join() – Wait for a thread to end

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_join(pthread_t thread, void **status);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_join(pthread_t thread, void **status);
```

General description

Allows the calling thread to wait for the ending of the target *thread*.

pthread_t is the data type used to uniquely identify a thread. It is returned by `pthread_create()` and used by the application in function calls that require a thread identifier.

status contains a pointer to the *status* argument passed by the ending thread as part of `pthread_exit()`. If the ending thread terminated with a return, *status* contains a pointer to the return value. If the thread was canceled, *status* can be set to -1.

Returned value

If successful, `pthread_join()` returns 0.

If unsuccessful, `pthread_join()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EDEADLK

A deadlock has been detected. This can occur if the target is directly or indirectly joined to the current thread.

EINVAL

The value specified by *thread* is not valid.

ESRCH

The value specified by *thread* does not refer to an undetached thread.

Notes:

1. When `pthread_join()` returns successfully, the target thread has been detached.
2. Multiple threads cannot use `pthread_join()` to wait for the same target thread to end. If a thread issues `pthread_join()` for a target thread after another thread has successfully issued `pthread_join()` for the same target thread, the second `pthread_join()` will be unsuccessful.
3. If the thread calling `pthread_join()` is canceled, the target thread is not detached.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_join()` returns an error number to indicate the error.

Example

CELEBP32

```
/* CELEBP32 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdlib.h>
#include <stdio.h>

void *thread(void *arg) {
    char *ret;
    printf("thread() entered with argument '%s'\n", arg);
    if ((ret = (char*) malloc(20)) == NULL) {
        perror("malloc() error");
        exit(2);
    }
    strcpy(ret, "This is a test");
    pthread_exit(ret);
}

main() {
    pthread_t thid;
    void *ret;

    if (pthread_create(&thid, NULL, thread, "thread 1") != 0) {
        perror("pthread_create() error");
        exit(1);
    }

    if (pthread_join(thid, &ret) != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    printf("thread exited with '%s'\n", ret);
}
```

Output:

```
thread() entered with argument 'thread 1'
thread exited with 'This is a test'
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)
- [“pthread_detach\(\) — Detach a thread” on page 1276](#)

pthread_join_d4_np() — Wait for a thread to end

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_SYS
#define _OPEN_SYS
#include <pthread.h>

int pthread_join_d4_np(pthread_t thread, void **status);
```

General description

Allows the calling thread to wait for the ending of the target *thread*.

pthread_t is the data type used to uniquely identify a thread. It is returned by `pthread_create()` and used by the application in function calls that require a thread identifier.

status contains a pointer to the *status* argument passed by the ending thread as part of `pthread_exit()`. If the ending thread ended by a return, *status* contains a pointer to the return value. If the thread was canceled, *status* can be set to -1.

Returned value

If successful, `pthread_join_d4_np()` returns 0.

If unsuccessful, `pthread_join_d4_np()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EDEADLK

A deadlock has been detected. This can occur if the target is directly or indirectly joined to the current thread.

EINVAL

The value specified by *thread* is not valid.

ESRCH

The value specified by *thread* does not refer to an undetached thread.

Notes:

1. When `pthread_join_d4_np()` returns successfully, the target thread has not been detached.
2. Multiple threads can use `pthread_join_d4_np()` to wait for the same target thread to end.

Example

CELEBP33

```
/* CELEBP33 */
#define _OPEN_SYS
#define _OPEN_THREADS
#include <pthread.h>
#include <stdlib.h>
#include <stdio.h>

void *thread(void *arg) {
    char *ret;
    printf("thread() entered with argument '%s'\n", arg);
    if ((ret = (char*) malloc(20)) == NULL) {
        perror("malloc() error");
        exit(2);
    }
    strcpy(ret, "This is a test");
    pthread_exit(ret);
}

main() {
    pthread_t thid;
    void *ret;

    if (pthread_create(&thid, NULL, thread, "thread 1") != 0) {
        perror("pthread_create() error");
        exit(1);
    }

    if (pthread_join_d4_np(thid, &ret) != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    printf("thread exited with '%s'\n", ret);
}
```

```
    if (pthread_detach(&thid) != 0) {  
        perror("pthread_detach() error");  
        exit(4);  
    }  
}
```

Output:

```
thread() entered with argument 'thread 1'  
thread exited with 'This is a test'
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)
- [“pthread_detach\(\) — Detach a thread” on page 1276](#)

pthread_key_create() — Create thread-specific data key

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS  
#include <pthread.h>  
  
int pthread_key_create(pthread_key_t *key, void (*destructor)(void *));
```

SUSV3:

```
#define _UNIX03_THREADS  
#include <pthread.h>  
  
int pthread_key_create(pthread_key_t *key, void (*destructor)(void *));
```

General description

Creates a key identifier, associated with *key*, and returns the key identifier into the storage area of type *pthread_key_t*. At this point, each of the threads in the application has the use of that key, and can set its own unique value by use of *pthread_setspecific()*. A thread can get its own unique value using *pthread_getspecific()*.

The *destructor* routine may be called when the thread ends. It is called when a non-NULL value has been set for the key for this thread, using *pthread_setspecific()*, and the thread:

- Calls *pthread_exit()*
- Does a return from the start routine
- Is canceled because of a *pthread_cancel()* request.

When called, the destructor routine is passed the value bound to the key by the use of *pthread_setspecific()*.

Special behavior for C++: Because C and C++ linkage conventions are incompatible, *pthread_key_create()* cannot receive a C++ function pointer as the start routine function pointer. If you

attempt to pass a C++ function pointer to `pthread_key_create()`, the compiler will flag it as an error. You can pass a C or C++ function to `pthread_key_create()` by declaring it as extern "C".

Returned value

If successful, `pthread_key_create()` returns 0 and stores the newly created key identifier in *key*.

If unsuccessful, `pthread_key_create()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAGAIN

There were not enough system resources to create another thread-specific data key, or the limit is exceeded for the total number of keys per process.

ENOMEM

There is not enough memory to create *key*.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_key_create()` returns an error number to indicate the error.

Example

CELEBP34

```
/* CELEBP34 */
#ifndef _OPEN_THREADS
#define _OPEN_THREADS
#endif

#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <pthread.h>

#define threads 3
#define BUFFSZ 48
pthread_key_t key;

void *threadfunc(void *parm)
{
    int status;
    void *value;
    int threadnum;
    int tnum;
    void *getvalue;
    char Buffer[BUFFSZ];

    tnum = parm;
    threadnum = *tnum;

    printf("Thread %d executing\n", threadnum);

    if (!(value = malloc(sizeof(Buffer))))
        printf("Thread %d could not allocate storage, errno = %d\n",
               threadnum, errno);
    status = pthread_setspecific(key, (void *) value);
    if (status < 0) {
        printf("pthread_setspecific failed, thread %d, errno %d",
               threadnum, errno);
        pthread_exit((void *)12);
    }
    printf("Thread %d setspecific value: %d\n", threadnum, value);

    getvalue = 0;
    status = pthread_getspecific(key, &getvalue);
    if (status < 0) {
        printf("pthread_getspecific failed, thread %d, errno %d",
               threadnum, errno);
        pthread_exit((void *)13);
    }

    if (getvalue != value) {
        printf("getvalue not valid, getvalue=%d", (int)getvalue);
    }
}
```

```
pthread_exit((void *)68);
}

pthread_exit((void *)0);
}

void destr_fn(void *parm)
{
    printf("Destructor function invoked\n");
    free(parm);
}

main() {
    int      getvalue;
    int      status;
    int      i;
    int      threadparm[threads];
    pthread_t threadid[threads];
    int      thread_stat[threads];

    if ((status = pthread_key_create(&key, destr_fn )) < 0) {
        printf("pthread_key_create failed, errno=%d", errno);
        exit(1);
    }

    /* create 3 threads, pass each its number */
    for (i=0; i<threads; i++) {
        threadparm[i] = i+1;
        status = pthread_create( &threadid[i],
                                NULL,
                                threadfunc,
                                (void *)&threadparm[i]);

        if ( status < 0) {
            printf("pthread_create failed, errno=%d", errno);
            exit(2);
        }
    }

    for ( i=0; i<threads; i++) {
        status = pthread_join( threadid[i], (void *)&thread_stat[i]);
        if ( status < 0) {
            printf("pthread_join failed, thread %d, errno=%d\n", i+1, errno);
        }

        if (thread_stat[i] != 0) {
            printf("bad thread status, thread %d, status=%d\n", i+1,
                    thread_stat[i]);
        }
    }

    exit(0);
}
```

Related information

- [“pthread.h – Thread interfaces” on page 53](#)
- [“pthread_getspecific\(\) – Get the thread-specific value for a key” on page 1281](#)
- [“pthread_getspecific_d8_np\(\) – Get the thread-specific value for a key” on page 1284](#)
- [“pthread_setspecific\(\) – Set the thread-specific value for a key” on page 1342](#)

pthread_key_delete() – Delete thread-specific data key

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, version 3 | both | z/OS V1R7 POSIX(ON) |

Format

```
#define _OPEN_THREADS 2
#include <pthread.h>

int pthread_key_delete(pthread_key_t key);
```

General description

`pthread_key_delete()` deletes thread-specific data keys created with `pthread_key_create()`. The thread-specific data values associated with *key* do not need to be NULL when the *key* is deleted. The application is responsible for freeing any storage or cleaning up data structures referring to thread-specific data associated with the deleted *key* in any thread. After *key* has been deleted, passing it to any function taking a thread-specific data key results in undefined behavior.

`pthread_key_delete()` can be called from destructor functions. Calling `pthread_key_delete()` will not cause any destructor functions to be invoked. Any destructor function associated with *key* when it was created will not be called on thread exit after *key* has been deleted.

Returned value

If successful, `pthread_key_delete()` returns 0. Upon failure, `pthread_key_delete()` returns an error number to indicate the error:

Error Code

Description

EINVAL

The key value is invalid.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_getspecific\(\) — Get the thread-specific value for a key” on page 1281](#)
- [“pthread_getspecific_d8_np\(\) — Get the thread-specific value for a key” on page 1284](#)
- [“pthread_key_create\(\) — Create thread-specific data key” on page 1290](#)
- [“pthread_setspecific\(\) — Set the thread-specific value for a key” on page 1342](#)
- [“unsetenv\(\) — Delete an environment variable” on page 1949](#)

pthread_kill() — Send a signal to a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>
#include <signal.h>

int pthread_kill(pthread_t thread, int sig);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <signal.h>

int pthread_kill(pthread_t thread, int sig);
```

General description

Directs a signal *sig* to the thread *thread*. The value of *sig* must be either 0 or one of the symbols defined in `signal.h`. (See [Table 57 on page 1606](#) for a list of signals.) If *sig* is 0, `pthread_kill()` performs error checking but does not send a signal.

pthread_t is the data type used to uniquely identify a thread. It is returned by `pthread_create()` and used by the application in function calls that require a thread identifier.

Special behavior for C++: If a thread is sent a signal using `pthread_kill()` and that thread does not handle the signal, then destructors for local objects may not be executed.

Usage notes

1. The SIGTHSTOP and SIGTHCONT signals can be issued by this function. *pthread_kill()* is the only function that can issue SIGTHSTOP or SIGTHCONT.

Returned value

If successful, `pthread_kill()` returns 0.

If unsuccessful, `pthread_kill()` returns -1 sends no signal, and sets `errno` to one of the following values:

Error Code**Description****EINVAL**

One of the following error conditions exists:

- The thread ID specified by *thread* is not valid.
- The value of *sig* is incorrect or is not the number of a supported signal.

ESRCH

No thread could be found corresponding to that specified by the given thread ID.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_kill()` returns an error number to indicate the error.

Example**CELEBP35**

```
/* CELEBP35 */
#define _OPEN_THREADS

#include <errno.h>
#include <pthread.h>
#include <signal.h>
#include <stdio.h>
#include <unistd.h>

void          *threadfunc(void *parm)
{
    int          threadnum;
    int          *tnum;
    sigset_t      set;

    tnum = parm;
    threadnum = *tnum;

    printf("Thread %d executing\n", threadnum);
```



```

sigemptyset(&set);
if(sigaddset(&set, SIGUSR1) == -1) {
    perror("Sigaddset error");
    pthread_exit((void *)1);
}

if(sigwait(&set) != SIGUSR1) {
    perror("Sigwait error");
    pthread_exit((void *)2);
}

pthread_exit((void *)0);
}

main() {
    int          status;
    int          threadparm = 1;
    pthread_t    threadid;
    int          thread_stat;

    status = pthread_create( &threadid,
                           NULL,
                           threadfunc,
                           (void *)&threadparm);

    if ( status < 0 ) {
        perror("pthread_create failed");
        exit(1);
    }

    sleep(5);

    status = pthread_kill( threadid, SIGUSR1);
    if ( status < 0 )
        perror("pthread_kill failed");

    status = pthread_join( threadid, (void *)&thread_stat);
    if ( status < 0 )
        perror("pthread_join failed");

    exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“signal.h — Exception handling” on page 58](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“killpg\(\) — Send a signal to a process group” on page 933](#)
- [“pthread_self\(\) — Get the caller” on page 1334](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigrelse\(\) — Remove a signal from a thread” on page 1647](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)

pthread_mutex_destroy() – Delete a mutex object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutex_destroy(pthread_mutex_t *mutex);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_mutex_destroy(pthread_mutex_t *mutex);
```

General description

Deletes a mutex object, which identifies a mutex. Mutexes are used to protect shared resources. *mutex* is set to an invalid value, but can be reinitialized using `pthread_mutex_init()`.

Returned value

If successful, `pthread_mutex_destroy()` returns 0.

If unsuccessful, `pthread_mutex_destroy()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBUSY

A request has detected an attempt to destroy the object referenced by *mutex* while it was locked or referenced by another thread (for example, while being used in a `pthread_cond_wait()` or `pthread_cond_timedwait()` function).

EINVAL

The value specified by *mutex* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_mutex_destroy()` returns an error number to indicate the error.

Example

CELEBP36

```
/* CELEBP36 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

main() {
    pthread_mutex_t mutex;

    if (pthread_mutex_init(&mutex, NULL) != 0) {
        perror("pthread_mutex_init() error");
        exit(1);
    }
}
```

```

    if (pthread_mutex_destroy(&mutex) != 0) {
        perror("pthread_mutex_destroy() error");
        exit(2);
    }
}

```

Related information

- “pthread.h — Thread interfaces” on page 53
- “pthread_cond_timedwait(), pthread_cond_timedwait64() — Wait on a condition variable” on page 1259
- “pthread_cond_wait() — Wait on a condition variable” on page 1262
- “pthread_mutex_init() — Initialize a mutex object” on page 1297
- “pthread_mutex_lock() — Wait for a lock on a mutex object” on page 1299
- “pthread_mutex_trylock() — Attempt to lock a mutex object” on page 1301
- “pthread_mutex_unlock() — Unlock a mutex object” on page 1303

pthread_mutex_init() — Initialize a mutex object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```

#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutex_init(pthread_mutex_t *mutex, pthread_mutexattr_t *attr);

```

SUSV3:

```

#define _UNIX03_THREADS
#include <pthread.h>
int pthread_mutex_init(pthread_mutex_t * __restrict__ mutex,
                      const pthread_mutexattr_t * __restrict__ attr);

```

General description

Creates a mutex, referenced by *mutex*, with attributes specified by *attr*. If *attr* is NULL, the default mutex attribute (NONRECURSIVE) is used.

Returned value

If successful, pthread_mutex_init() returns 0, and the state of the mutex becomes initialized and unlocked.

If unsuccessful, pthread_mutex_init() returns -1 and sets errno to one of the following values:

Error Code

Description

EAGAIN

The system lacked the necessary resources (other than memory) to initialize another mutex.

EBUSY

detected an attempt to re-initialize the object referenced by *mutex*, a previously initialized, but not yet destroyed, mutex.

EINVAL

The value specified by *attr* is not valid.

ENOMEM

There is not enough memory to acquire a lock. This errno will only occur in the private path.

EPERM

The caller does not have the privilege to perform the operation.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_mutex_init()` returns an error number to indicate the error.

Usage notes

The `_OPEN_SYS_MUTEX_EXT` feature switch can be optionally included. If the feature is set, then significantly larger `pthread_mutex_t` objects will be defined. The feature is used for the management of mutex and condition variables in shared memory.

If the supplied extended `pthread_mutex_t` object is not in shared memory, `pthread_mutex_init()` will treat the object as a non-shared object, since it is not accessible to any other process.

It is recommended that you define and initialize the `pthread_mutex_t` objects in the same compile unit. If you pass a `pthread_mutex_t` object around to be initialized, make sure the initialization code has been compiled with the same `_OPEN_SYS_MUTEX_EXT` feature setting as the code that defines the object.

The following sequence may cause storage overlay with unpredictable results:

1. Declare or define a `pthread_mutex_t` object (in shared storage) without `#define` of the `_OPEN_SYS_MUTEX_EXT` feature. The created `pthread_mutex_t` object is standard size (i.e. small) without the `_OPEN_SYS_MUTEX_EXT` feature defined.
2. Pass the `pthread_mutex_t` object to another code unit, which was compiled with the `_OPEN_SYS_MUTEX_EXT` feature defined, to be initialized as a shared object. The `pthread_mutex_t` initialization generally involves the following steps:
 - a. `pthread_mutexattr_init()`
 - b. `pthread_mutexattr_setpshared()`. Shared `pthread_mutex_t` objects can be small or of extended size. The presence of the `_OPEN_SYS_MUTEX_EXT` feature declares it to be of extended size.
 - c. `pthread_mutex_init()`. This step initializes the passed-in (small) `pthread_mutex_t` object as if it is an extended object, causing storage overlay.

Example**CELEBP37**

```
/* CELEBP37 */
#ifndef _OPEN_THREADS
#define _OPEN_THREADS
#endif

#include <pthread.h>

main() {
    pthread_mutexattr_t    attr;
    pthread_mutex_t        mut;

    if (pthread_mutexattr_init(&attr) == -1) {
        perror("mutexattr_init error");
        exit(1);
    }

    if (pthread_mutex_init(&mut, &attr) == -1) {
        perror("mutex_init error");
        exit(2);
    }
}
```

```
    exit(0);
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_init\(\) — Initialize a condition variable” on page 1255](#)
- [“pthread_cond_timedwait\(\), pthread_cond_timedwait64\(\) — Wait on a condition variable” on page 1259](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)
- [“pthread_mutexattr_init\(\) — Initialize a mutex attribute object” on page 1311](#)
- [“pthread_mutex_lock\(\) — Wait for a lock on a mutex object” on page 1299](#)
- [“pthread_mutex_trylock\(\) — Attempt to lock a mutex object” on page 1301](#)
- [“pthread_mutex_unlock\(\) — Unlock a mutex object” on page 1303](#)

pthread_mutex_lock() — Wait for a lock on a mutex object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutex_lock(pthread_mutex_t *mutex);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_mutex_lock(pthread_mutex_t *mutex);
```

General description

Locks a mutex object, which identifies a mutex. Mutexes are used to protect shared resources. If the mutex is already locked by another thread, the thread waits for the mutex to become available. The thread that has locked a mutex becomes its current owner and remains the owner until the same thread has unlocked it.

When the mutex has the attribute of recursive, the use of the lock may be different. When this kind of mutex is locked multiple times by the same thread, then a count is incremented and no waiting thread is posted. The owning thread must call `pthread_mutex_unlock()` the same number of times to decrement the count to zero.

The mutex types are described below:

PTHREAD_MUTEX_NORMAL

A normal type mutex does not detect deadlock. That is, a thread attempting to relock this mutex without first unlocking it will deadlock. The mutex is either in a locked or unlocked state for a thread.

PTHREAD_MUTEX_ERRORCHECK

An errorcheck type mutex provides error checking. That is, a thread attempting to relock this mutex without first unlocking it will return with an error. The mutex is either in a locked or unlocked state for a thread. If a thread attempts to relock a mutex that it has already locked, it will return with an error. If a thread attempts to unlock a mutex that is unlocked, it will return with an error.

PTHREAD_MUTEX_RECURSIVE

A recursive type mutex permits a thread to lock many times. That is, a thread attempting to relock this mutex without first unlocking will succeed. This type of mutex must be unlocked the same number of times it is locked before the mutex will be returned to an unlocked state.

PTHREAD_MUTEX_DEFAULT

The default type mutex is mapped to a normal type mutex which does not detect deadlock. That is, a thread attempting to relock this mutex without first unlocking it will deadlock. The mutex is either in a locked or unlocked state for a thread. The normal mutex is the default type mutex.

Returned value

If successful, pthread_mutex_lock() returns 0.

If unsuccessful, pthread_mutex_lock() returns -1 and sets errno to one of the following values:

Error Code**Description****EAGAIN**

The mutex could not be acquired because the maximum number of recursive locks for mutex has been exceeded. This errno will only occur in the shared path.

EDEADLK

The current thread already owns the mutex, and the mutex has a *kind* attribute of `__MUTEX_NONRECURSIVE`.

EINVAL

The value specified by *mutex* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_mutex_lock() returns an error number to indicate the error.

Usage notes

If the `_OPEN_SYS_MUTEX_EXT` feature switch is set, all shared (extended) mutex locks are released when the thread ends, whether normally or abnormally. If the thread ends normally (i.e. pthread_exit() or pthread_cancel()), the first waiter of the mutex lock will be resumed. If the thread ends abnormally, the processes of the mutex waiters for this mutex lock will be terminated.

Example**CELEBP38**

```
/* CELEBP38 */
#ifndef _OPEN_THREADS
#define _OPEN_THREADS
#endif

#include <pthread.h>
#include <stdio.h>

main() {
    pthread_mutex_t mut;

    if (pthread_mutex_init(&mut, NULL) != 0) {
        perror("mutex_lock");
        exit(1);
    }

    if (pthread_mutex_lock(&mut) != 0) {
        perror("mutex_lock");
    }
}
```

```

    exit(2);
}

puts("the mutex has been locked");
exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_init\(\) — Initialize a condition variable” on page 1255](#)
- [“pthread_cond_wait\(\) — Wait on a condition variable” on page 1262](#)
- [“pthread_mutex_destroy\(\) — Delete a mutex object” on page 1296](#)
- [“pthread_mutex_init\(\) — Initialize a mutex object” on page 1297](#)

pthread_mutex_trylock() — Attempt to lock a mutex object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```

#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutex_trylock(pthread_mutex_t *mutex);

```

SUSV3:

```

#define _UNIX03_THREADS
#include <pthread.h>

int pthread_mutex_trylock(pthread_mutex_t *mutex);

```

General description

Locks a mutex object, which identifies a mutex. Mutexes are used to protect shared resources. If `pthread_mutex_trylock()` is locked, it returns immediately.

For recursive mutexes, `pthread_mutex_trylock()` will effectively add to the count of the number of times `pthread_mutex_unlock()` must be called by the thread to release the mutex. (That is, it has the same behavior as a `pthread_mutex_lock()`.)

Returned value

If successful, `pthread_mutex_trylock()` returns 0.

If unsuccessful, `pthread_mutex_trylock()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAGAIN

The mutex could not be acquired because the maximum number of recursive locks for mutex has been exceeded. This `errno` will only occur in the shared path.

EBUSY

mutex could not be acquired because it was already locked.

EINVAL

The value specified by *mutex* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_mutex_trylock()` returns an error number to indicate the error.

Usage notes

1. If the `_OPEN_SYS_MUTEX_EXT` feature switch is set, all shared (extended) mutex locks are released when the thread ends, whether normally or abnormally. If the thread ends normally (i.e. `pthread_exit()` or `pthread_cancel()`), the first waiter of the mutex lock will be resumed. If the thread ends abnormally, the processes of the mutex waiters for this mutex lock will be terminated.

Example**CELEBP40**

```

/* CELEBP40 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>
#include <errno.h>

pthread_mutex_t mutex;

void *thread(void *arg) {
    if (pthread_mutex_trylock(&mutex) != 0)
        if (errno == EBUSY)
            puts("thread was denied access to the mutex");
        else {
            perror("pthread_mutex_trylock() error");
            exit(1);
        }
    else puts("thread was granted the mutex");
}

main() {
    pthread_t thid;

    if (pthread_mutex_init(&mutex, NULL) != 0) {
        perror("pthread_mutex_init() error");
        exit(2);
    }

    if (pthread_create(&thid, NULL, thread, NULL) != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    if (pthread_mutex_trylock(&mutex) != 0)
        if (errno == EBUSY)
            puts("IPT was denied access to the mutex");
        else {
            perror("pthread_mutex_trylock() error");
            exit(4);
        }
    else puts("IPT was granted the mutex");

    if (pthread_join(thid, NULL) != 0) {
        perror("pthread_join() error");
        exit(5);
    }
}

```

Output:

```

IPT was granted the mutex
thread was denied access to the mutex

```


Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_mutex_destroy\(\) — Delete a mutex object” on page 1296](#)
- [“pthread_mutex_init\(\) — Initialize a mutex object” on page 1297](#)

pthread_mutex_unlock() — Unlock a mutex object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutex_unlock(pthread_mutex_t *mutex);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_mutex_unlock(pthread_mutex_t *mutex);
```

General description

Releases a mutex object. If one or more threads are waiting to lock the mutex, pthread_mutex_unlock() causes one of those threads to return from pthread_mutex_lock() with the mutex object acquired. If no threads are waiting for the mutex, the mutex unlocks with no current owner.

When the mutex has the attribute of recursive the use of the lock may be different. When this kind of mutex is locked multiple times by the same thread, then unlock will decrement the count and no waiting thread is posted to continue running with the lock. If the count is decremented to zero, then the mutex is released and if any thread is waiting it is posted.

Returned value

If successful, pthread_mutex_unlock() returns 0.

If unsuccessful, pthread_mutex_unlock() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EINVAL
The value specified by *mutex* is not valid.

EPERM
The current thread does not own the *mutex*.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_mutex_unlock() returns an error number to indicate the error.

Example

CELEBP41

```

/* CELEBP41 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>
#include <errno.h>

pthread_mutex_t mutex;

void *thread(void *arg) {
    if (pthread_mutex_lock(&mutex) != 0) {
        perror("pthread_mutex_lock() error");
        exit(1);
    }

    puts("thread was granted the mutex");

    if (pthread_mutex_unlock(&mutex) != 0) {
        perror("pthread_mutex_unlock() error");
        exit(2);
    }
}

main() {
    pthread_t thid;

    if (pthread_mutex_init(&mutex, NULL) != 0) {
        perror("pthread_mutex_init() error");
        exit(3);
    }

    if (pthread_create(&thid, NULL, thread, NULL) != 0) {
        perror("pthread_create() error");
        exit(4);
    }

    if (pthread_mutex_lock(&mutex) != 0) {
        perror("pthread_mutex_lock() error");
        exit(5);
    }

    puts("IPT was granted the mutex");

    if (pthread_mutex_unlock(&mutex) != 0) {
        perror("pthread_mutex_unlock() error");
        exit(6);
    }

    if (pthread_join(thid, NULL) != 0) {
        perror("pthread_mutex_lock() error");
        exit(7);
    }
}

```

Output:

```

IPT was granted the mutex
thread was granted the mutex

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_mutex_destroy\(\) — Delete a mutex object” on page 1296](#)
- [“pthread_mutex_init\(\) — Initialize a mutex object” on page 1297](#)
- [“pthread_mutex_lock\(\) — Wait for a lock on a mutex object” on page 1299](#)

pthread_mutexattr_destroy() – Destroy a mutex attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_mutexattr_destroy(pthread_mutexattr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_mutexattr_destroy(pthread_mutexattr_t *attr);
```

General description

Destroys an initialized mutex attribute object. With a mutex attribute object, you can manage the characteristics of mutexes in your application. It defines the set of values to be used for the mutex during its creation. By establishing a mutex attribute object, you can create many mutexes with the same set of characteristics, without defining those characteristics for each mutex. `pthread_mutexattr_init()` is used to define a mutex attribute object.

Returned value

If successful, `pthread_mutexattr_destroy()` returns 0.

If unsuccessful, `pthread_mutexattr_destroy()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value specified for *attr* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_mutexattr_destroy()` returns an error number to indicate the error.

Example

CELEBP42

```
/* CELEBP42 */
#define _OPEN_THREADS
#define _OPEN_SYS      /* Needed to identify __MUTEX_RECURSIVE */
#include <pthread.h>
#include <stdio.h>

main() {
    pthread_mutexattr_t attr;
    pthread_mutex_t mutex;

    if (pthread_mutexattr_init(&attr) != 0) {
        perror("pthread_mutex_attr_init() error");
    }
```

```
    exit(1);
}

if (pthread_mutexattr_setkind_np(&attr, __MUTEX_RECURSIVE) != 0) {
    perror("pthread_mutex_attr_setkind_np() error");
    exit(2);
}

if (pthread_mutex_init(&mutex, &attr) != 0) {
    perror("pthread_mutex_init() error");
    exit(3);
}

if (pthread_mutexattr_destroy(&attr) != 0) {
    perror("pthread_mutex_attr_destroy() error");
    exit(4);
}
}
```

Related information

- [“pthread.h – Thread interfaces” on page 53](#)
- [“pthread_cond_init\(\) – Initialize a condition variable” on page 1255](#)
- [“pthread_create\(\) – Create a thread” on page 1274](#)
- [“pthread_mutexattr_init\(\) – Initialize a mutex attribute object” on page 1311](#)

pthread_mutexattr_getkind_np() – Get kind from a mutex attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_mutexattr_getkind_np(pthread_mutexattr_t *attr, int *kind);
```

General description

Gets the attribute *kind* from the mutex attribute object *attr*. With a mutex attribute object, you can manage the characteristics of mutexes in your application. It defines the set of values to be used for the mutex during its creation. By establishing a mutex attribute object, you can create many mutexes with the same set of characteristics without defining those characteristics for each and every mutex.

The values for the attribute *kind* are:

__MUTEX_NONRECURSIVE

A nonrecursive mutex can be locked only once. That is, the mutex is either in a locked or unlocked state for a thread. If a thread attempts to lock a mutex that it has already locked, an error is returned.

_MUTEX_RECURSIVE

A recursive mutex can be locked more than once by the same thread. A count of the number of times the mutex has been locked is maintained. The mutex is unlocked when pthread_mutex_unlock() is performed an equal number of times.

__MUTEX_NONRECURSIVE + __MUTEX_NODEBUG

A nonrecursive mutex can be given an additional attribute, NODEBUG. This indicates that state changes to this mutex will *not* be reported to the debug interface, even if present.

__MUTEX_RECURSIVE + __MUTEX_NODEBUG

A recursive mutex can be given an additional attribute, NODEBUG. This indicates that state changes to this mutex will *not* be reported to the debug interface, even if present.

Returned value

If successful, pthread_mutexattr_getkind_np() returns 0.

If unsuccessful, pthread_mutexattr_getkind_np() returns -1 and sets errno to one of the following values:

Error Code**Description****EINVAL**

The value specified for *attr* is not valid.

Example**CELEBP43**

```

/* CELEBP43 */

#pragma runopts(TEST(ALL))

#ifdef _OPEN_THREADS
#define _OPEN_THREADS
#define _OPEN_SYS      /* Needed to identify __MUTEX_RECURSIVE,
                        __MUTEX_NODEBUG, and __MUTEX_NONRECURSIVE */
#endif

#include <stdio.h>
#include <pthread.h>

pthread_mutexattr_t attr;

int kind;

main() {
    if (pthread_mutexattr_init(&attr) == -1) {
        perror("pthread_mutexattr_init()");
        exit(1);
    }

    if (pthread_mutexattr_setkind_np(&attr, \
        __MUTEX_RECURSIVE + __MUTEX_NODEBUG) == -1 ) {

        perror("pthread_mutexattr_setkind_np()");
        exit(1);
    }

    if (pthread_mutexattr_getkind_np(&attr, &kind) == -1) {
        perror("pthread_mutexattr_getkind_np()");
        exit(1);
    }

    switch(kind) {

        case __MUTEX_NONRECURSIVE:
            printf("\nmutex will be nonrecursive");
            break;

        case __MUTEX_NONRECURSIVE+__MUTEX_NODEBUG:
            printf("\nmutex will be nonrecursive + nodebug");
            break;

        case __MUTEX_RECURSIVE:
            printf("\nmutex will be recursive");
            break;

        case __MUTEX_RECURSIVE+__MUTEX_NODEBUG:
            printf("\nmutex will be recursive + nodebug");
    }
}

```

```
        break;

    default:
        printf("\nattribute kind value returned by \
pthread_mutexattr_getkind_np() unrecognized");
        exit(1);
    }
    exit(0);
}
```

Output:

```
a default mutex will be nonrecursive
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_mutexattr_init\(\) — Initialize a mutex attribute object” on page 1311](#)
- [“pthread_mutexattr_setkind_np\(\) — Set kind for a mutex attribute object” on page 1312](#)

pthread_mutexattr_getpshared() – Get the process-shared mutex attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutexattr_getpshared(const pthread_mutexattr_t *attr, int *pshared);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_mutexattr_getpshared(const pthread_mutexattr_t *__restrict__ attr,
                                int * __restrict__ pshared);
```

General description

The pthread_mutexattr_getpshared() function gets the attribute *pshared* for the mutex attribute object *attr*. By using *attr* with the pthread_mutexattr_getpshared() function you can determine its *process-shared* value for a mutex.

The valid values for the attribute *pshared* are:

PTHREAD_PROCESS_SHARED

Permits a mutex to be operated upon by any thread that has access to the memory where the mutex is allocated, even if the mutex is allocated in memory that is shared by multiple processes.

PTHREAD_PROCESS_PRIVATE

A mutex can only be operated upon by threads created within the same process as the thread that initialized the mutex. When a new process is created by the parent process it will receive a different copy of the private mutex and this new mutex can only be used to serialize between threads in the child process. The default value of the attribute is PTHREAD_PROCESS_PRIVATE.

Returned value

If successful, `pthread_mutexattr_getpshared()` returns 0.

If unsuccessful, `pthread_mutexattr_getpshared()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value specified for *attr* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_mutexattr_getpshared()` returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_mutexattr_setpshared\(\) — Set the process-shared mutex attribute” on page 1314](#)
- [“pthread_rwlockattr_getpshared\(\) — Get the processed-shared read or write lock attribute” on page 1328](#)
- [“pthread_rwlockattr_setpshared\(\) — Set the process-shared read or write lock attribute” on page 1330](#)

pthread_mutexattr_gettype() — Get type of mutex attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutexattr_gettype(const pthread_mutexattr_t *attr, int *type);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_mutexattr_gettype(const pthread_mutexattr_t * __restrict_attr,
                             int * __restrict_type);
```

General description

The `pthread_mutexattr_gettype()` function gets the attribute *type* from the mutex attribute object *attr*.

A mutex attribute object allows you to manage the characteristics of mutexes in your application. It defines the set of values to be used for the mutex during its creation. By establishing a mutex attribute object, you can create many mutexes with the same set of characteristics, without needing to define the characteristics for each and every mutex.

The values for the attribute *type* are:

PTHREAD_MUTEX_NORMAL

A normal type mutex does not detect deadlock. That is, a thread attempting to relock this mutex without first unlocking it will deadlock. The mutex is either in a locked or unlocked state for a thread.

PTHREAD_MUTEX_ERRORCHECK

An errorcheck type mutex provides error checking. That is, a thread attempting to relock this mutex without first unlocking it will return with an error. The mutex is either in a locked or unlocked state for a thread. If a thread attempts to relock a mutex that it has already locked, it will return with an error. If a thread attempts to unlock a mutex that is unlocked, it will return with an error.

PTHREAD_MUTEX_RECURSIVE

A recursive type mutex permits a thread to lock many times. That is, a thread attempting to relock this mutex without first unlocking will succeed. This type of mutex must be unlocked the same number of times it is locked before the mutex will be returned to an unlocked state. If locked, an error is returned.

PTHREAD_MUTEX_DEFAULT

The default type mutex is mapped to a normal type mutex which does not detect deadlock. That is, a thread attempting to relock this mutex without first unlocking it will deadlock. The mutex is either in a locked or unlocked state for a thread. The normal mutex is the default type mutex.

__MUTEX_NONRECURSIVE

A nonrecursive mutex can be locked only once. That is, the mutex is either in a locked or unlocked state for a thread. If a thread attempts to lock a mutex that it has already locked, an error is returned.

__MUTEX_RECURSIVE

A recursive mutex can be locked more than once by the same thread. A count of the number of times the mutex has been locked is maintained. The mutex is unlocked when pthread_mutex_unlock() is performed an equal number of times.

__MUTEX_NONRECURSIVE + __MUTEX_NODEBUG

A nonrecursive mutex can be given an additional attribute, NODEBUG. This indicates that state changes to this mutex will *not* be reported to the debug interface, even if present.

__MUTEX_RECURSIVE + __MUTEX_NODEBUG

A recursive mutex can be given an additional attribute, NODEBUG. This indicates that state changes to this mutex will *not* be reported to the debug interface, even if present.

Returned value

If successful, pthread_mutexattr_gettype() returns 0.

If unsuccessful, pthread_mutexattr_gettype() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

The value specified for *attr* is not valid.

Special behavior for Single UNIX Specification, Version 3:

If unsuccessful, pthread_mutexattr_gettype() returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_mutexattr_settype\(\) — Set type of mutex attribute object” on page 1315](#)

pthread_mutexattr_init() – Initialize a mutex attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_mutexattr_init(pthread_mutexattr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_mutexattr_init(pthread_mutexattr_t *attr);
```

General description

Initializes a mutex attribute object. With a mutex attribute object, you can manage the characteristics of mutexes in your application. It defines the set of values to be used for the mutex during its creation. By establishing a mutex attribute object, you can create many mutexes with the same set of characteristics, without defining those characteristics for each and every mutex.

For a valid mutex attribute, refer to [“pthread_mutexattr_setkind_np\(\) — Set kind for a mutex attribute object” on page 1312](#).

Note: Before freeing up the storage containing the pthread_mutexattr_t object, be sure to destroy it by calling pthread_mutexattr_destroy(). If the pthread_mutexattr_t object is not destroyed before the storage is reused, the results are undefined.

Returned value

If successful, pthread_mutexattr_init() returns 0.

If unsuccessful, pthread_mutexattr_init() returns -1 and sets errno to one of the following values:

Error Code

Description

ENOMEM

There is not enough memory to initialize *attr*.

Special behavior for Single UNIX Specification, Version 3:

If unsuccessful, pthread_mutexattr_init() returns an error number to indicate the error.

Example

CELEBP44

```
/* CELEBP44 */

#define _OPEN_THREADS
#define _OPEN_SYS      /* Needed to identify __MUTEX_RECURSIVE */
#include <pthread.h>
```

```
#include <stdio.h>

main() {
    pthread_mutexattr_t attr;
    pthread_mutex_t mutex;

    if (pthread_mutexattr_init(&attr) != 0) {
        perror("pthread_mutex_attr_init() error");
        exit(1);
    }

    if (pthread_mutexattr_setkind_np(&attr, __MUTEX_RECURSIVE) != 0) {
        perror("pthread_mutex_attr_setkind_np() error");
        exit(2);
    }

    if (pthread_mutex_init(&mutex, &attr) != 0) {
        perror("pthread_mutex_init() error");
        exit(3);
    }

    if (pthread_mutexattr_destroy(&attr) != 0) {
        perror("pthread_mutex_attr_destroy() error");
        exit(4);
    }
}
```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cond_init\(\) — Initialize a condition variable” on page 1255](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)
- [“pthread_mutex_init\(\) — Initialize a mutex object” on page 1297](#)

pthread_mutexattr_setkind_np() — Set kind for a mutex attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#define _OPEN_SYS
#include <pthread.h>

int pthread_mutexattr_setkind_np(pthread_mutexattr_t *attr, int kind);
```

General description

Sets the attribute *kind* for the mutex attribute object *attr*. With a mutex attribute object, you can manage the characteristics of mutexes in your application. It defines the set of values to be used for the mutex during its creation. By establishing a mutex attribute object, you can create many mutexes with the same set of characteristics, without defining those characteristics for each and every mutex.

The valid values for the attribute *kind* are:

__MUTEX_NONRECURSIVE

A nonrecursive mutex can be locked only once. That is, the mutex is either in a locked or unlocked state for a thread. If a thread attempts to lock a mutex that it has already locked, an error is returned.

__MUTEX_RECURSIVE

A recursive mutex can be locked more than once by the same thread. A count of the number of times the mutex has been locked is maintained. The mutex is unlocked when an equal number of `pthread_mutex_unlock()` functions are performed.

__MUTEX_NONRECURSIVE + __MUTEX_NODEBUG

A nonrecursive mutex can be given an additional attribute, `NODEBUG`. This indicates that state changes to this mutex will *not* be reported to the debug interface, even though it is present.

__MUTEX_RECURSIVE + __MUTEX_NODEBUG

A recursive mutex can be given an additional attribute, `NODEBUG`. This indicates that state changes to this mutex will *not* be reported to the debug interface, even though it is present.

Returned value

If successful, `pthread_mutexattr_setkind_np()` returns 0.

If unsuccessful, `pthread_mutexattr_setkind_np()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EINVAL**

The value specified for *attr* or *kind* is not valid.

Example**CELEBP45**

```
/* CELEBP45 */
#pragma runopts(TEST(ALL))

#ifdef _OPEN_THREADS
#define _OPEN_THREADS
#define _OPEN_SYS /* Needed to identify __MUTEX_NODEBUG */
#endif

#include <stdio.h>
#include <pthread.h>

pthread_mutexattr_t attr;

int kind;

main() {
    if (pthread_mutexattr_init(&attr) == -1) {
        perror("pthread_mutexattr_init()");
        exit(1);
    }

    if (pthread_mutexattr_setkind_np(&attr, \
        __MUTEX_RECURSIVE + __MUTEX_NODEBUG) == -1 ) {
        perror("pthread_mutexattr_setkind_np()");
        exit(1);
    }

    if (pthread_mutexattr_getkind_np(&attr, &kind) == -1) {
        perror("pthread_mutexattr_getkind_np()");
        exit(1);
    }

    switch(kind) {
        case __MUTEX_NONRECURSIVE:
            printf("\nmutex will be nonrecursive");
            break;

        case __MUTEX_NONRECURSIVE+__MUTEX_NODEBUG:
            printf("\nmutex will be nonrecursive + nodebug");
            break;

        case __MUTEX_RECURSIVE:
            printf("\nmutex will be recursive");
            break;
    }
}
```

```
        case __MUTEX_RECURSIVE+__MUTEX_NODEBUG:
            printf("\nmutex will be recursive + nodebug");
            break;

        default:
            printf("\nattribute kind value returned by \
pthread_mutexattr_getkind_np() unrecognized");
            exit(1);
    }

    exit(0);
}
```

Related information

- [“pthread.h – Thread interfaces” on page 53](#)
- [“pthread_mutexattr_init\(\) – Initialize a mutex attribute object” on page 1311](#)
- [“pthread_mutexattr_getkind_np\(\) – Get kind from a mutex attribute object” on page 1306](#)

pthread_mutexattr_setpshared() – Set the process-shared mutex attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|-----------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutexattr_setpshared(pthread_mutexattr_t *attr, int pshared);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_mutexattr_setpshared(pthread_mutexattr_t *attr, int pshared);
```

General description

The pthread_mutexattr_setpshared() function sets the attribute *pshared* for the mutex attribute object *attr*.

A mutex attribute object allows you to manage the characteristics of mutexes in your application. It defines the set of values to be used for a mutex during its creation. By establishing a mutex attribute object, you can create many mutexes with the same set of characteristics, without needing to define the characteristics for each and every mutex. By using *attr* with the pthread_mutexattr_setpshared() function you can define its *process-shared* value for a mutex.

The valid values for the attribute *pshared* are:

PTHREAD_PROCESS_SHARED

Permits a mutex to be operated upon by any thread that has access to the memory where the mutex is allocated, even if the mutex is allocated in memory that is shared by multiple processes.

PTHREAD_PROCESS_PRIVATE

A mutex can only be operated upon by threads created within the same process as the thread that initialized the mutex; if threads of differing processes attempt to operate on such a mutex, only the process to initialize the mutex will succeed. When a new process is created by the parent process it will receive a different copy of the private mutex and this new mutex can only be used to serialize between threads in the child process. The default value of the attribute is PTHREAD_PROCESS_PRIVATE

Returned value

If successful, pthread_mutexattr_setpshared() returns 0.

If unsuccessful, pthread_mutexattr_setpshared() returns -1 and sets errno to one of the following values:

Error Code**Description****EINVAL**

The value specified for *attr* or *pshared* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_mutexattr_setpshared() returns an error number to indicate the error.

Related information

- “pthread.h — Thread interfaces” on page 53
- “pthread_mutexattr_getpshared() — Get the process-shared mutex attribute” on page 1308
- “pthread_rwlockattr_getpshared() — Get the processed-shared read or write lock attribute” on page 1328
- “pthread_rwlockattr_setpshared() — Set the process-shared read or write lock attribute” on page 1330

pthread_mutexattr_settype() — Set type of mutex attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|-----------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_mutexattr_settype(pthread_mutexattr_t *attr, int type);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_mutexattr_settype(pthread_mutexattr_t *attr, int type);
```

General description

The pthread_mutexattr_settype() function sets the attribute *type* from the mutex attribute object *attr*.

A mutex attribute object allows you to manage the characteristics of mutexes in your application. It defines the set of values to be used for the mutex during its creation. By establishing a mutex attribute object, you can create many mutexes with the same set of characteristics, without needing to define the characteristics for each and every mutex.

The values for the attribute *type* are:

PTHREAD_MUTEX_NORMAL

A normal type mutex does not detect deadlock. That is, a thread attempting to relock this mutex without first unlocking it will deadlock. The mutex is either in a locked or unlocked state for a thread.

PTHREAD_MUTEX_ERRORCHECK

An errorcheck type mutex provides error checking. That is, a thread attempting to relock this mutex without first unlocking it will return with an error. The mutex is either in a locked or unlocked state for a thread. If a thread attempts to relock a mutex that it has already locked, it will return with an error. If a thread attempts to unlock a mutex that is unlocked, it will return with an error.

PTHREAD_MUTEX_RECURSIVE

A recursive type mutex permits a thread to lock many times. That is, a thread attempting to relock this mutex without first unlocking will succeed. This type of mutex must be unlocked the same number of times it is locked before the mutex will be returned to an unlocked state. If locked, an error is returned.

PTHREAD_MUTEX_DEFAULT

The default type mutex is mapped to a normal type mutex which does not detect deadlock. That is, a thread attempting to relock this mutex without first unlocking it will deadlock. The mutex is either in a locked or unlocked state for a thread. The normal mutex is the default type mutex.

__MUTEX_NONRECURSIVE

A nonrecursive mutex can be locked only once. That is, the mutex is either in a locked or unlocked state for a thread. If a thread attempts to lock a mutex that it has already locked, an error is returned.

__MUTEX_RECURSIVE

A recursive mutex can be locked more than once by the same thread. A count of the number of times the mutex has been locked is maintained. The mutex is unlocked when pthread_mutex_unlock() is performed an equal number of times.

__MUTEX_NONRECURSIVE + __MUTEX_NODEBUG

A nonrecursive mutex can be given an additional attribute, NODEBUG. This indicates that state changes to this mutex will *not* be reported to the debug interface, even if present.

__MUTEX_RECURSIVE + __MUTEX_NODEBUG

A recursive mutex can be given an additional attribute, NODEBUG. This indicates that state changes to this mutex will *not* be reported to the debug interface, even if present.

Returned value

If successful, pthread_mutexattr_settype() returns 0.

If unsuccessful, pthread_mutexattr_settype() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

Either the value type or the value specified for attr is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_mutexattr_settype() returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_mutexattr_gettype\(\) — Get type of mutex attribute object” on page 1309](#)

pthread_once() — Invoke a function once

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>
pthread_once_t once_control = PTHREAD_ONCE_INIT;

int pthread_once(pthread_once_t *once_control, void(*init_routine)());
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
pthread_once_t once_control = PTHREAD_ONCE_INIT;

int pthread_once(pthread_once_t *once_control, void(*init_routine)());
```

General description

Establishes a function that will be executed only once in a given process. You may have each thread call the function, but only the first call causes the function to run. This is true even if called simultaneously by multiple threads. For example, a mutex or a thread-specific data key must be created exactly once. Calling `pthread_once()` prevents the code that creates a mutex or thread-specific data from being called by multiple threads. Without this routine, the execution must be serialized so that only one thread performs the initialization. Other threads that reach the same point in the code are delayed until the first thread is finished.

`pthread_once()` is used in conjunction with a *once control* variable of the type `pthread_once_t`. This variable is a data type that you initialize to the `PTHREAD_ONCE_INIT` constant. It is then passed as a parameter on the `pthread_once()` function call.

init_routine is a normal function. It can be invoked directly outside of `pthread_once()`. In addition, it is the *once_control* variable that determines if the *init_routine* has been invoked. Calling `pthread_once()` with the same routine but with different *once_control* variables, will result in the routine being called twice, once for each *once_control* variable.

Returned value

If successful, `pthread_once()` returns 0.

If unsuccessful, `pthread_once()` returns -1.

There are no documented `errno` values. Use `perror()` or `strerror()` to determine the cause of the error.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_once()` returns an error number to indicate the error.

Example

CELEBP46

```
/* CELEBP46 */
#ifdef _OPEN_THREADS
#define _OPEN_THREADS
```

```

#endif

#include <stdio.h>
#include <errno.h>
#include <pthread.h>

#define threads 3

int          once_counter=0;
pthread_once_t once_control = PTHREAD_ONCE_INIT;

void once_fn(void)
{
    puts("in once_fn");
    once_counter++;
}

void          *threadfunc(void *parm)
{
    int          status;
    int          threadnum;
    int          *tnum;

    tnum = parm;
    threadnum = *tnum;

    printf("Thread %d executing\n", threadnum);

    status = pthread_once(&once_control, once_fn);
    if ( status < 0)
        printf("pthread_once failed, thread %d, errno=%d\n", threadnum,
               errno);

    pthread_exit((void *)0);
}

main() {
    int          status;
    int          i;
    int          threadparm[threads];
    pthread_t     threadid[threads];
    int          thread_stat[threads];

    for (i=0; i<threads; i++) {
        threadparm[i] = i+1;
        status = pthread_create( &threadid[i],
                                NULL,
                                threadfunc,
                                (void *)&threadparm[i]);

        if ( status < 0) {
            printf("pthread_create failed, errno=%d", errno);
            exit(2);
        }
    }

    for ( i=0; i<threads; i++) {
        status = pthread_join( threadid[i], (void *)&thread_stat[i]);
        if ( status < 0)
            printf("pthread_join failed, thread %d, errno=%d\n", i+1, errno);

        if (thread_stat[i] != 0)
            printf("bad thread status, thread %d, status=%d\n", i+1,
                   thread_stat[i]);
    }

    if (once_counter != 1)
        printf("once_fn did not get control once, counter=%d",once_counter);
    exit(0);
}

```

Output:

```

Thread 1 executing
in once_fn
Thread 2 executing
Thread 3 executing

```


Related information

- [“pthread.h — Thread interfaces” on page 53](#)

pthread_rwlock_destroy() — Destroy a read or write lock object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlock_destroy(pthread_rwlock_t *rlock);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_rwlock_destroy(pthread_rwlock_t *rlock);
```

General description

The `pthread_rwlock_destroy()` function deletes a read or write lock object, which is identified by *rlock* and releases any resources used by this read or write lock object. Read/write locks are used to protect shared resources.

Note: *rlock* is set to an invalid value by `pthread_rwlock_destroy()` but can be reinitialized using `pthread_rwlock_init()`.

Returned value

If successful, `pthread_rwlock_destroy()` returns 0.

If unsuccessful, `pthread_rwlock_destroy()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBUSY

An attempt was made to destroy the object referenced by *rlock* while it is locked or referenced as part of a wait on a condition variable.

EINVAL

The value specified by *rlock* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_rwlock_destroy()` returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_init\(\) — Initialize a read or write lock object” on page 1320](#)
- [“pthread_rwlock_rdlock\(\) — Wait for a lock on a read or write lock object” on page 1321](#)

- “pthread_rwlock_tryrdlock() — Attempt to lock a read or write lock object for reading” on page 1322
- “pthread_rwlock_trywrlock() — Attempt to lock a read or write lock object for writing” on page 1323
- “pthread_rwlock_unlock() — Unlock a read or write lock object” on page 1324
- “pthread_rwlock_wrlock() — Wait for a lock on a read or write lock object for writing” on page 1325

pthread_rwlock_init() — Initialize a read or write lock object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlock_init(pthread_rwlock_t *rwlock, pthread_rwlockattr_t *attr);

pthread_rwlock_t rwlock=PTHREAD_RWLOCK_INITIALIZER;
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_rwlock_init(pthread_rwlock_t * __restrict__ rwlock,
                       const pthread_rwlockattr_t * __restrict__ attr);
```

General description

The pthread_rwlock_init() function creates a read or write lock, referenced by *rwlock*, with attributes specified by *attr*. If *attr* is NULL, the default read or write lock attribute (PTHREAD_PROCESS_PRIVATE) is used. Once initialized, the lock can be used any number of times without being reinitialized. Upon successful initialization, the state of the read or write lock becomes initialized and unlocked.

In cases where default read or write lock attributes are appropriate, the macro PTHREAD_RWLOCK_INITIALIZER can be used to initialize read or write locks that are statically allocated. The effect is equivalent to dynamic initialization by a call to pthread_rwlock_init() with parameter *attr* specified as NULL, except that no error checking is done.

Note: Although the SUSv3 standard does not specify a static initializer for read or write locks, the implementation-defined macro PTHREAD_RWLOCK_INITIALIZER_NP may be used for that purpose. It is functionally equivalent in the SUSv3 context to the PTHREAD_RWLOCK_INITIALIZER macro.

Returned value

If successful, pthread_rwlock_init() returns 0, and the state of the read or write lock becomes initialized and unlocked.

If unsuccessful, pthread_rwlock_init() returns -1 and sets errno to one of the following values:

Error Code

Description

EAGAIN

The system lacked necessary resources (other than memory) to initialize another read or write lock.

EINVAL

The value specified by *attr* is not valid.

ENOMEM

There is not enough memory to initialize the read or write lock.

EPERM

The caller does not have the privilege to perform the operation.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_rwlock_init() returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_destroy\(\) — Destroy a read or write lock object” on page 1319](#)
- [“pthread_rwlock_rdlock\(\) — Wait for a lock on a read or write lock object” on page 1321](#)
- [“pthread_rwlock_tryrdlock\(\) — Attempt to lock a read or write lock object for reading” on page 1322](#)
- [“pthread_rwlock_trywrlock\(\) — Attempt to lock a read or write lock object for writing” on page 1323](#)
- [“pthread_rwlock_unlock\(\) — Unlock a read or write lock object” on page 1324](#)
- [“pthread_rwlock_wrlock\(\) — Wait for a lock on a read or write lock object for writing” on page 1325](#)

pthread_rwlock_rdlock() — Wait for a lock on a read or write lock object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlock_rdlock(pthread_rwlock_t *rwlock);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_rwlock_rdlock(pthread_rwlock_t *rwlock);
```

General description

The pthread_rwlock_rdlock() function applies a read lock to the read or write lock referenced by *rwlock*. The calling thread acquires the read lock if a writer does not hold the lock and there are no writers blocked on the lock. In z/OS UNIX, the calling thread does not acquire the lock when a writer does not hold the lock and there are writers waiting for the lock unless the thread already held *rwlock* for read. It will block and wait until there are no writers holding or waiting for the read or write lock. If a writer holds the lock, the calling thread will not acquire the read lock. If the read lock is not acquired, the calling thread blocks (that is, it does not return from the pthread_rwlock_rdlock() call) until it can acquire the lock.

A thread may hold multiple concurrent read locks on *rwlock* (that is successfully call the pthread_rwlock_rdlock() function n times). If so, the thread must perform matching unlocks (that is,

it must call the pthread_rwlock_unlock() function n times). Read/write locks are used to protect shared resources.

Note: If a thread owns locks at the time it is terminated then z/OS UNIX will release those locks.

Returned value

If successful, pthread_rwlock_rdlock() returns 0.

If unsuccessful, pthread_rwlock_rdlock() returns -1 and sets errno to one of the following values:

Error Code Description

EAGAIN

The read lock could not be acquired because the maximum number of read locks for *rwlock* has been exceeded. This errno will only occur in the shared path.

EDEADLK

The current thread already owns the read or write lock for writing.

EINVAL

The value specified by *rwlock* is not valid.

ENOMEM

There is not enough memory to acquire a lock. This errno will only occur in the private path.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_rwlock_rdlock() returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_destroy\(\) — Destroy a read or write lock object” on page 1319](#)
- [“pthread_rwlock_init\(\) — Initialize a read or write lock object” on page 1320](#)

pthread_rwlock_tryrdlock() — Attempt to lock a read or write lock object for reading

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlock_tryrdlock(pthread_rwlock_t *rwlock);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_rwlock_tryrdlock(pthread_rwlock_t *rwlock);
```

General description

The `pthread_rwlock_tryrdlock()` function applies a read lock as in the `pthread_rwlock_rdlock()` function with the exception that the function fails if any thread holds a write lock on *rwlock* or there are writers blocked on *rwlock* unless the thread already held *rwlock* for read. Read/write locks are used to protect shared resources.

If the read or write lock identified by *rwlock* is locked, `pthread_rwlock_tryrdlock()` returns immediately.

When there are only read locks on the read or write lock, `pthread_rwlock_tryrdlock()` will effectively add to the count of the number of times `pthread_rwlock_unlock()` must be called by the thread to release the mutex (that is, it has the same behavior as a `pthread_rwlock_rdlock()` function).

Returned value

If successful, `pthread_rwlock_tryrdlock()` returns 0.

If unsuccessful, `pthread_rwlock_tryrdlock()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAGAIN

The read lock could not be acquired because the maximum number of read locks for *rwlock* has been exceeded. This `errno` will only occur in the shared path.

EBUSY

rwlock could not be acquired because it was already locked.

EINVAL

The value specified by *rwlock* is not valid.

ENOMEM

There is not enough memory to acquire a lock. This `errno` will only occur in the private path.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_rwlock_tryrdlock()` returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_destroy\(\) — Destroy a read or write lock object” on page 1319](#)
- [“pthread_rwlock_init\(\) — Initialize a read or write lock object” on page 1320](#)

pthread_rwlock_trywrlock() — Attempt to lock a read or write lock object for writing

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlock_trywrlock(pthread_rwlock_t *rwlock);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_rwlock_trywrlock(pthread_rwlock_t *rwlock);
```

General description

The pthread_rwlock_trywrlock() function applies a write lock as in the pthread_rwlock_wrlock() function with the exception that the function fails if any thread holds either a read lock or a write lock on *rwlock*. Read/write locks are used to protect shared resources.

If the read or write lock identified by *rwlock* is locked, pthread_rwlock_trywrlock() returns immediately.

Returned value

If successful, pthread_rwlock_trywrlock() returns 0.

If unsuccessful, pthread_rwlock_trywrlock() returns -1 and sets errno to one of the following values:

Error Code
Description

EBUSY
rwlock could not be acquired because it was already locked.

EINVAL
The value specified by *rwlock* is not valid.

ENOMEM
There is not enough memory to acquire a lock. This errno will only occur in the private path.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_rwlock_trywrlock() returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_destroy\(\) — Destroy a read or write lock object” on page 1319](#)
- [“pthread_rwlock_init\(\) — Initialize a read or write lock object” on page 1320](#)

pthread_rwlock_unlock() — Unlock a read or write lock object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlock_unlock(pthread_rwlock_t *rwlock);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
```

```
int pthread_rwlock_unlock(pthread_rwlock_t *rwlock);
```

General description

The `pthread_rwlock_unlock()` function releases a read or write lock object. If one or more threads are waiting to lock the rwlock, `pthread_rwlock_unlock()` causes one or more of these threads to return from the `pthread_rwlock_rdlock()` or the `pthread_rwlock_wrlock()` call with the read or write lock object acquired. If there are multiple threads blocked on *rwlock* for both read locks and write locks, z/OS UNIX will give the read or write lock to the next waiting call whether it is a read or a write request even when there is a writer blocked waiting for the lock. If no threads are waiting for the rwlock, the rwlock unlocks with no current owner.

Returned value

If successful, `pthread_rwlock_unlock()` returns 0.

If unsuccessful, `pthread_rwlock_unlock()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value specified for *rwlock* is not valid.

ENOMEM

There is not enough memory during the unlock process. This `errno` will only occur in the private path.

EPERM

The current thread does not own the read_write lock object.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_rwlock_unlock()` returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_destroy\(\) — Destroy a read or write lock object” on page 1319](#)
- [“pthread_rwlock_init\(\) — Initialize a read or write lock object” on page 1320](#)
- [“pthread_rwlock_rdlock\(\) — Wait for a lock on a read or write lock object” on page 1321](#)
- [“pthread_rwlock_tryrdlock\(\) — Attempt to lock a read or write lock object for reading” on page 1322](#)
- [“pthread_rwlock_trywrlock\(\) — Attempt to lock a read or write lock object for writing” on page 1323](#)
- [“pthread_rwlock_wrlock\(\) — Wait for a lock on a read or write lock object for writing” on page 1325](#)

pthread_rwlock_wrlock() — Wait for a lock on a read or write lock object for writing

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlock_wrlock(pthread_rwlock_t *rwlock);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_rwlock_wrlock(pthread_rwlock_t *rwlock);
```

General description

The `pthread_rwlock_wrlock()` function applies a write lock to the read or write lock referenced by *rwlock*. The calling thread acquires the write lock if no other thread (reader or writer) holds the read or write lock *rwlock*. Otherwise, the thread blocks (that is, does not return from the `pthread_rwlock_wrlock()` call) until it can acquire the lock. In z/OS UNIX the calling thread does not acquire the lock when a writer does not hold the lock and there are writers waiting for the lock. It will block and wait until there are no writers holding or waiting for the read or write lock. If the thread already holds read or write lock for either read or write then a deadlock `errno` will be returned.

Note: If a thread owns locks at the time it is terminated then z/OS UNIX will release those locks.

Returned value

If successful, `pthread_rwlock_wrlock()` returns 0.

If unsuccessful, `pthread_rwlock_wrlock()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EDEADLK

The current thread already owns the read or write lock for writing or reading.

EINVAL

The value specified by *rwlock* is not valid.

ENOMEM

There is not enough memory to acquire a lock. This `errno` will only occur in the private path.

Special behavior for Single UNIX Specification, Version 3:

If unsuccessful, `pthread_rwlock_wrlock()` returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_destroy\(\) — Destroy a read or write lock object” on page 1319](#)
- [“pthread_rwlock_init\(\) — Initialize a read or write lock object” on page 1320](#)

pthread_rwlockattr_destroy() — Destroy a read or write lock attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlockattr_destroy(pthread_rwlockattr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_rwlockattr_destroy(pthread_rwlockattr_t *attr);
```

General description

The `pthread_rwlockattr_destroy()` function destroys an initialized rwlock attribute object.

After a read or write lock attributes object has been used to initialize one or more read or write locks any function affecting the attributes object (including destruction) does not affect any previously initialized read or write locks.

The `pthread_rwlockattr_destroy()` function destroys a read or write lock attributes object. Subsequent use of the object will cause an error until the object is reinitialized by another call to `pthread_rwlockattr_init()`.

Returned value

If successful, `pthread_rwlockattr_destroy()` returns 0.

If unsuccessful, `pthread_rwlockattr_destroy()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value specified for *attr* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_rwlockattr_destroy()` returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlockattr_init\(\) — Initialize a read or write lock attribute object” on page 1329](#)

pthread_rwlockattr_getpshared() – Get the processed-shared read or write lock attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlockattr_getpshared(const pthread_rwlockattr_t *attr, int *pshared);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_rwlockattr_getpshared(const pthread_rwlockattr_t *
    __restrict__ attr,
    int * __restrict__ pshared);
```

General description

The `pthread_rwlockattr_getpshared()` function gets the attribute *pshared* for the read or write lock attribute object *attr*. By using *attr* with the `pthread_rwlockattr_getpshared()` function you can determine its *process-shared* value for a read or write lock.

The valid values for the attribute *pshared* are:

PTHREAD_PROCESS_SHARED

Permits a read or write lock to be operated upon by any thread that has access to the memory where the read or write lock is allocated, even if the read or write lock is allocated in memory that is shared by multiple processes.

PTHREAD_PROCESS_PRIVATE

A read or write lock can only be operated upon by threads created within the same process as the thread that initialized the read or write lock. When a new process is created by the parent process it will receive a different copy of the private read or write lock and this new read or write lock can only be used to serialize between threads in the child process. The default value of the attributed is `PTHREAD_PROCESS_PRIVATE`.

Returned value

If successful, `pthread_rwlockattr_getpshared()` returns 0.

If unsuccessful, `pthread_rwlockattr_getpshared()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value specified for *attr* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_rwlockattr_getpshared()` returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_init\(\) — Initialize a read or write lock object” on page 1320](#)
- [“pthread_rwlockattr_setpshared\(\) — Set the process-shared read or write lock attribute” on page 1330](#)

pthread_rwlockattr_init() — Initialize a read or write lock attribute object

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlockattr_init(pthread_rwlockattr_t *attr);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_rwlockattr_init(pthread_rwlockattr_t *attr);
```

General description

The `pthread_rwlockattr_init()` function initializes a read or write lock attribute object. A read or write lock attribute object allows you to manage the characteristics of read or write locks in your application. It defines the set of values to be used for the read or write lock during its creation. By establishing a read or write lock attribute object, you can create many read or write locks with the same set of characteristics, without needing to define the characteristics for each and every read or write lock.

For a valid read or write lock attribute, refer to [“pthread_rwlockattr_setpshared\(\) — Set the process-shared read or write lock attribute” on page 1330](#).

If `pthread_rwlockattr_init()` is called specifying an already initialized read or write lock attributes object the request is rejected and the current lock attributes object is unchanged.

Returned value

If successful, `pthread_rwlockattr_init()` returns 0.

If unsuccessful, `pthread_rwlockattr_init()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

ENOMEM

There is not enough memory to initialize *attr*.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_rwlockattr_init()` returns an error number to indicate the error.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_rwlock_init\(\) — Initialize a read or write lock object” on page 1320](#)

pthread_rwlockattr_setpshared() — Set the process-shared read or write lock attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------------------|
| z/OS UNIX Single UNIX Specification, Version 3 | both | POSIX(ON) OS/390 V2R7 |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_rwlockattr_setpshared(pthread_rwlockattr_t *attr, int pshared);
```

SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>

int pthread_rwlockattr_setpshared(pthread_rwlockattr_t *attr, int pshared);
```

General description

The `pthread_rwlockattr_setpshared()` function sets the attribute *pshared* for the read or write lock attribute object *attr*.

A read or write lock attribute object allows you to manage the characteristics of read or write locks in your application. It defines the set of values to be used for a read or write lock during its creation. By establishing a read or write lock attribute object, you can create many read or write locks with the same set of characteristics, without needing to define those characteristics for each and every read or write lock. By using *attr* with the `pthread_rwlockattr_setpshared()` function you can define its *process-shared* value for a read or write lock.

The valid values for the attribute *pshared* are:

PTHREAD_PROCESS_SHARED

Permits a read or write lock to be operated upon by any thread that has access to the memory where the read or write lock is allocated, even if the read or write lock is allocated in memory that is shared by multiple processes.

PTHREAD_PROCESS_PRIVATE

A read or write lock can only be operated upon by threads created within the same process as the thread that initialized the read or write lock. When a new process is created by the parent process it will receive a different copy of the private read or write lock and this new read or write lock can only be used to serialize between threads in the child process. The default value of the attributed is `PTHREAD_PROCESS_PRIVATE`.

Returned value

If successful, `pthread_rwlockattr_setpshared()` returns 0.

If unsuccessful, `pthread_rwlockattr_setpshared()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EINVAL

The value specified for *attr* or *pshared* is not valid.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, pthread_rwlockattr_setpshared() returns an error number to indicate the error.

Related information

- “pthread.h — Thread interfaces” on page 53
- “pthread_rwlock_init() — Initialize a read or write lock object” on page 1320
- “pthread_rwlockattr_getpshared() — Get the processed-shared read or write lock attribute” on page 1328

pthread_security_np(), pthread_security_applid_np() — Create or delete thread-level security

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_SYS 1
#include <pthread.h>

int pthread_security_np(int function_code,
                       int identity_type,
                       size_t identity_length,
                       void *identity,
                       char *password,
                       int options);

int pthread_security_applid_np(int function_code,
                              int identity_type,
                              size_t identity_length,
                              void *identity,
                              char *password,
                              int options,
                              const char *applid);
```

General description

pthread_security_np() creates or deletes a thread-level security environment for the calling thread.

The __pthread_security_applid_np() function is equivalent to pthread_security_np() with the added feature that it also allows the application identifier (APPLID) to be supplied that will be passed on to the security product to assist with authentication. This is useful, for example, in situations where a pass ticket is provided and the pass ticket was created with a USERID/APPLID combination. When applid is NULL or a pointer to NULL, no application identifier will be passed on to the security product.

The function supports the following parameters:

Parameter Description

function_code

Specify one of the following:

__CREATE_SECURITY_ENV

Create a thread-level security environment for the calling thread. If a thread-level security environment already exists, it is deleted before a new one is created.

Note: This routine cannot be called from the Initial Processing Thread (IPT) with function code `__CREATE_SECURITY_ENV`.

__DAEMON_SECURITY_ENV

Creates a thread-level security environment for the caller's thread without the need for a password if the caller meets either of the following requirements:

- The caller has READ access to the BPX.DAEMON resource in the FACILITY class and is a superuser.
- The caller has UPDATE access to the BPX.DAEMON resource in the FACILITY class.

If a thread-level security environment already exists, it is deleted before the new environment is created. Using the `__DAEMON_SECURITY_ENV` function code and not specifying a password is similar to using the current BPX.SRV.userid surrogate support. The difference is that the installation does not have to setup individual surrogate profiles for each of the clients that desire a thread level identity in the target server process.

The server will be allowed to create any identity without authentication if it is given permission to the BPX.DAEMON facility class profile.

__DELETE_SECURITY_ENV

Delete the thread-level security environment for the calling thread, if one exists. If the security environment was created using the `__TLS_TASK_ACEE` option, then only the z/OS UNIX security data is deleted (the task-level ACEE is unchanged).

__TLS_TASK_ACEE

Initializes the z/OS UNIX security data for a task that has an existing task-level security environment (task-level ACEE). If the z/OS UNIX security data already exists for the calling task, the existing z/OS UNIX security data is deleted and a new set of z/OS UNIX security data is established.

__TLS_TASK_ACEE_USP

Takes a pre-existing user security packet (USP) from a task-level ACEE and extracts the UID and GID information. This information is then used to build a complete z/OS UNIX security environment for the calling thread. If the calling thread does not have a USP associated with the task-level ACEE, this call is treated as if the `__TLS_TASK_ACEE` function was specified.

identity_type

Specifies the format of the user identity in the argument *identity*. It can have one of the following values:

__USERID_IDENTITY

User identity in the form of a character string (1 to 8 bytes in length).

__CERTIFICATE_IDENTITY

User identity in the form of a `__certificate_t`.

A `__certificate_t` is a structure containing the following elements:

__cert_type

The type of security certificate. Setting value `__CERT_X509`, for example, indicates the certificate is an X.509 security certificate.

__userid

An output field in the `__certificate` structure that will be filled with the user ID associated with the certificate. This output will be up to 8 characters long and NULL-terminated.

__cert_length

The length in bytes of the security certificate.

__cert_ptr

A pointer to the start of the security certificate.

identity_length

Specifies the length of the *identity* parameter. If *identity_type* is `__USERID_IDENTITY`, *identity_length* is the length of the user identity character string. If *identity_type* is `__CERTIFICATE_IDENTITY`, *identity_length* is the length of the `__certificate` structure.

identity

Specifies the user identity according to the *identity_type* parameter.

password

Specifies a user password or PassTicket, or a password phrase. The password must be a NULL terminated string.

options

Specifies options used to tailor the request. *options* must be set to 0.

applid

Specifies the application identifier that will be used for authentication with the security product.

This function is intended to be used by servers which process requests from multiple clients. By creating and building a thread-level security environment for the client, a server can process many client requests without the overhead of issuing *fork/setuid/exec*. See usage notes in `pthread_security_np`, `pthread_security_applid_np` (BPX1TLS, BPX4TLS) — Create or delete thread-level security in z/OS UNIX *System Services Programming: Assembler Callable Services Reference* for additional information.

Returned value

If successful, `pthread_security_np()` returns 0.

If unsuccessful, `pthread_security_np()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCES**

The password or PassTicket, or the password phrase provided is not valid for the passed userid.

EINVAL

A parameter is not valid.

EMVSERR

An MVS environmental error or internal error occurred.

EMVSEXPIRE

The password or PassTicket, or the password phrase provided has expired.

EMVSSAF2ERR

The SAF call to the security product incurred an error.

EMVSSAFEXTRERR

The SAF or RACF RACROUTE EXTRACT service incurred an error. One possible reason is that the user's access was revoked.

ENOSYS

The function is not implemented.

EPERM

One or more of the following conditions were detected:

- The process does not have appropriate privileges to set a thread-level security environment. The caller is not permitted to the BPX.SERVER FACILITY class profile or BPX.SERVER is not defined and the caller is not a superuser.
- No password, PassTicket or password phrase is provided and the BPX.SRV SURROGAT class has not been activated; or no BPX.SRV SURROGAT class profile has been defined for the specified user identity.
- No password, PassTicket or password phrase is provided and the caller is not permitted to the specified user identity's BPX.SRV SURROGAT class profile.

- For function_code __DAEMON_SECURITY_ENV, the caller is not a superuser; or the BPX.DAEMON FACILITY class is defined and the caller is not permitted to the BPX.DAEMON FACILITY class profile.
- A load from an unauthorized (not Program Control protected) library was done in the address space.

ESRCH

The user ID provided as input is not defined to the security product or does not have an OMVS segment defined.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“getlogin\(\) — Get the user login name” on page 732](#)

pthread_self() — Get the caller

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

pthread_t pthread_self(void);
```

General description

Returns the thread ID of the calling thread.

Returned value

There are no documented errno values. Use perror() or strerror() to determine the cause of the error.

Example**CELEBP47**

```
/* CELEBP47 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>

pthread_t thid, IPT;

void *thread(void *arg) {
    if (pthread_equal(IPT, pthread_self()))
        puts("the thread is the IPT...?");
    else
        puts("the thread is not the IPT");

    if (pthread_equal(thid, pthread_self()))
        puts("the thread is the one created by the IPT");
    else
        puts("the thread is not the one created by the IPT...?");
}

main() {
    IPT = pthread_self();
    if (pthread_create(&thid, NULL, thread, NULL) != 0) {
```



```

    perror("pthread_create() error");
    exit(1);
}

if (pthread_join(thid, NULL) != 0) {
    perror("pthread_create() error");
    exit(3);
}
}

```

Output:

```

the thread is not the IPT
the thread is the one created by the IPT

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)
- [“pthread_equal\(\) — Compare thread IDs” on page 1277](#)

pthread_setcancelstate() — Set a thread cancelability state format

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, version 3 | both | z/OS V1R7 POSIX(ON) |

Format

```

#define _OPEN_THREADS 2
#include <pthread.h>

int pthread_setcancelstate(int state, int *oldstate);

```

General description

pthread_setcancelstate() controls whether the thread acts on a cancelation request caused by a call to pthread_cancel(). The old *state* is stored into the location pointed to by *oldstate*. The cancelability states can be:

PTHREAD_CANCEL_ENABLE

The thread can be canceled, but is subject to type. The cancelability types can be found in [“pthread_setcanceltype\(\) — Set a thread cancelability type format” on page 1336](#).

PTHREAD_CANCEL_DISABLE

The thread cannot be canceled.

Returned value

If successful, pthread_setcancelstate() returns 0. Upon failure, returns the following EINVAL error code:

- *state* is an invalid value.

Related information

- "Thread Cancellation" in the [z/OS XL C/C++ Programming Guide](#)
- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cancel\(\) — Cancel a thread” on page 1247](#)

- “[pthread_setcanceltype\(\)](#) — Set a thread cancelability type format” on page 1336
- “[pthread_testcancel\(\)](#) — Establish a cancelation point” on page 1347

pthread_setcanceltype() — Set a thread cancelability type format

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, version 3 | both | z/OS V1R7 POSIX(ON) |

Format

```
#define _OPEN_THREADS 2
#include <pthread.h>

int pthread_setcanceltype(int type, int *oldtype);
```

General description

pthread_setcanceltype() controls when a cancel request is acted on. The old *type* is stored into the location pointed to by *oldtype*. The cancelability types can be:

PTHREAD_CANCEL_ASYNCHRONOUS

The thread can be canceled at any time.

PTHREAD_CANCEL_DEFERRED

The thread can be canceled, but only at cancelation points introduced by invocation of particular functions. For more information, see the [z/OS XL C/C++ Programming Guide](#).

Returned value

If successful, pthread_setcanceltype() returns 0. Upon failure, returns the following EINVAL error code:

- *type* is an invalid value.

Related information

- "Thread Cancellation" in the [z/OS XL C/C++ Programming Guide](#)
- “[pthread.h](#) — Thread interfaces” on page 53
- “[pthread_cancel\(\)](#) — Cancel a thread” on page 1247
- “[pthread_setcancelstate\(\)](#) — Set a thread cancelability state format” on page 1335
- “[pthread_testcancel\(\)](#) — Establish a cancelation point” on page 1347

pthread_setconcurrency() — Set the level of concurrency

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, version 3 | both | z/OS V1R7 POSIX(ON) |

Format

```
#define _OPEN_THREADS 2
#include <pthread.h>

int pthread_setconcurrency(int new_level);
```

General description

pthread_setconcurrency() sets the desired thread concurrency level to *new_level*.

Usage notes

1. z/OS UNIX does not support multiplexing POSIX threads onto TCBs. If successful, pthread_setconcurrency() saves *new_level* for subsequent calls to pthread_getconcurrency() but takes no other action. For related information on the relationship between pthreads and TCBs, see [“pthread_attr_setweight_np\(\) — Set weight of thread attribute object”](#) on page 1246 and [“pthread_attr_setsynctype_np\(\) — Set thread sync type”](#) on page 1245.

Returned value

If successful, pthread_setconcurrency() returns 0. Upon failure, returns one of the following error values:

- EINVAL – The value specified by *new_level* is negative.
- EAGAIN – The value specific by *new_level* would cause a system resource to be exceeded.

Related information

- "Thread Cancellation" in the [z/OS XL C/C++ Programming Guide](#)
- [“pthread.h — Thread interfaces”](#) on page 53
- [“pthread_getconcurrency\(\) — Get the level of concurrency”](#) on page 1280

pthread_setintr() — Set a thread cancelability state

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| POSIX.4a | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_setintr(int state);
```

General description

Controls whether the thread accepts a cancel request that was produced by a call to pthread_cancel(). The cancelability states can be:

PTHREAD_INTR_DISABLE

The thread cannot be canceled.

PTHREAD_INTR_ENABLE

The thread can be canceled, but it is subject to type. The cancelability types can be found in [“pthread_setintrtype\(\) — Set a thread cancelability type”](#) on page 1339.

Usage notes

1. If you are writing to the Single UNIX Specification, Version 3 standard, use pthread_setcancelstate() in place of pthread_setintr().

Returned value

If successful, pthread_setintr() returns the previous state.

If unsuccessful, pthread_setintr() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

state is an invalid value.

Example

CELEBP48

```

/* CELEBP48 */
#define _OPEN_THREADS
#include <stdio.h>
#include <string.h>
#include <pthread.h>
#include <errno.h>
#include <unistd.h>

int thstatus;
char state[60] = "enable/controlled - initial default";

void * thfunc(void *voidptr)
{
    int rc;
    char *parmptr;

    parmptr = voidptr;
    printf("parm = %s.\n", parmptr);

    strcpy(state, "disable/controlled");
    if ( pthread_setintrtype(PTHREAD_INTR_CONTROLLED) == -1 ) {
        printf("set controlled failed. %s\n", strerror(errno));
        thstatus = 103;
        pthread_exit(&thstatus);
    }

    if ( pthread_setintr(PTHREAD_INTR_ENABLE) == -1 ) {
        printf("set enable failed. %s\n", strerror(errno));
        thstatus = 104;
        pthread_exit(&thstatus);
    }

    strcpy(state, "enable/controlled");
    strcat(state, " - pthread_testintr");

    while (1) {
        pthread_testintr();
        sleep(1);
    }

    thstatus = 100;
    pthread_exit(&thstatus);
}

main(int argc, char *argv[]) {
    int rc;
    pthread_attr_t attrarea;
    pthread_t thid;
    char parm[] = "abcdefghijklmnpqrstuvwxy";
    int *statptr;

    if ( pthread_attr_init(&attrarea) == -1 ) {
        printf("pthread_attr_init failed. %s\n", strerror(errno));
        exit(1);
    }

```

```

}

if ( pthread_create(&thid, &attrarea, thfunc, (void *)&parm) == -1) {
    printf("pthread_create failed. %s\n", strerror(errno));
    exit(2);
}

sleep(5);

if ( pthread_cancel(thid) == -1 ) {
    printf("pthread_cancel failed. %s\n", strerror(errno));
    exit(3);
}

if ( pthread_join(thid, (void **)&statptr)== -1 ) {
    printf("pthread_join failed. %s\n", strerror(errno));
    exit(4);
}

if ( statptr == (int *)-1 )
    printf("thread was cancelled. state = %s.\n", state);
else
    printf("thread was not cancelled. thstatus = %d.\n", *statptr);

exit(0);
}

```

Output:

```

parm = abcdefghijklmnopqrstuvwxyz.
thread was canceled. state = enable/controlled - pthread_testintr.

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cancel\(\) — Cancel a thread” on page 1247](#)
- [“pthread_setintrtype\(\) — Set a thread cancelability type” on page 1339](#)
- [“pthread_testintr\(\) — Establish a cancelability point” on page 1348](#)

pthread_setintrtype() — Set a thread cancelability type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| POSIX.4a | both | POSIX(ON) |

Format

```

#define _OPEN_THREADS
#include <pthread.h>

int pthread_setintrtype(int type);

```

General description

Controls when a cancel request is acted on. The cancelability types can be:

PTHREAD_INTR_ASYNCHRONOUS

The thread can be canceled at any time.

PTHREAD_INTR_CONTROLLED

The thread can be canceled, but only at specific points of execution. These are:

- When waiting on a condition variable, which is `pthread_cond_wait()` or `pthread_cond_timedwait()`
- When waiting for the end of another thread, which is `pthread_join()`
- While waiting for an asynchronous signal, which is `sigwait()`
- When setting the calling thread's cancelability state, which is `pthread_setintr()`
- Testing specifically for a cancel request, which is `pthread_testintr()`
- When suspended because of POSIX functions or one of the following C standard functions: `close()`, `fcntl()`, `open()`, `pause()`, `read()`, `tcdrain()`, `tcsetattr()`, `sigsuspend()`, `sigwait()`, `sleep()`, `wait()`, or `write()`

Usage notes

1. If you are writing to the Single UNIX Specification, Version 3 standard, use `pthread_setcanceltype()` in place of `pthread_setintrtype()`.
2. The default cancelability type for newly created threads and the initial thread is `PTHREAD_INTR_CONTROLLED`. If a cancellation request is pending and the cancelability state is set to `PTHREAD_INTR_ASYNCHRONOUS`, the cancellation request is acted upon before control is returned to the invoker.

Returned value

If successful, `pthread_setintrtype()` returns the previous type.

If unsuccessful, `pthread_setintrtype()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

type is an invalid value.

Example

CELEBP50

```
/* CELEBP50 */
#define _OPEN_THREADS
#include <stdio.h>
#include <string.h>
#include <pthread.h>
#include <errno.h>
#include <unistd.h>

int thstatus;
char state[60] = "enable/controlled - initial default";

void * thfunc(void *voidptr)
{
    int rc;
    char *parmptr;

    parmptr = voidptr;
    printf("parm = %s.\n", parmptr);
    if ( pthread_setintrtype(PTHREAD_INTR_CONTROLLED) == -1 ) {
        printf("set controlled failed. %s\n", strerror(errno));
        thstatus = 103;
        pthread_exit(&thstatus);
    }
    strcpy(state, "disable/controlled");

    if ( pthread_setintr(PTHREAD_INTR_ENABLE) == -1 ) {
        printf("set enable failed. %s\n", strerror(errno));
        thstatus = 104;
        pthread_exit(&thstatus);
    }
    strcpy(state, "enable/controlled");
}
```

```

strcat(state, " - pthread_testintr");

while(1) {
    pthread_testintr();
    sleep(1);
}

thstatus = 100;
pthread_exit(&thstatus);
}

main(int argc, char *argv[]) {
    int          rc;
    pthread_attr_t attrarea;
    pthread_t     thid;
    char          parm[] = "abcdefghijklmnopqrstuvwxyz";
    int          *statptr;

    if ( pthread_attr_init(&attrarea) == -1 ) {
        printf("pthread_attr_init failed. %s\n", strerror(errno));
        exit(1);
    }

    if ( pthread_create(&thid, &attrarea, thfunc, (void *)&parm) == -1 ) {
        printf("pthread_create failed. %s\n", strerror(errno));
        exit(2);
    }

    sleep(5);

    if ( pthread_cancel(thid) == -1 ) {
        printf("pthread_cancel failed. %s\n", strerror(errno));
        exit(3);
    }

    if ( pthread_join(thid, (void **)&statptr) == -1 ) {
        printf("pthread_join failed. %s\n", strerror(errno));
        exit(4);
    }

    if ( statptr == (int *)-1 )
        printf("thread was cancelled. state = %s.\n", state);
    else
        printf("thread was not cancelled. thstatus = %d.\n", *statptr);

    exit(0);
}

```

Output:

```

parm = abcdefghijklmnopqrstuvwxyz.
thread was canceled. state = enable/controlled - pthread_testintr.

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cancel\(\) — Cancel a thread” on page 1247](#)
- [“pthread_setintr\(\) — Set a thread cancelability state” on page 1337](#)
- [“pthread_testintr\(\) — Establish a cancelability point” on page 1348](#)

pthread_set_limit_np() — Set task and thread limits

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#define _OPEN_SYS
#include <pthread.h>

int pthread_set_limit_np(int action, int maxthreadtasks, int maxthreads);
```

General description

The `pthread_set_limit_np()` function allows you to control how many tasks and threads can be created for a process. On a single call, you can specify that you want to update either the maximum number of tasks, the maximum number of threads, or both. The maximum number of tasks and threads is dependent upon the size of the private area below 16M. A realistic limit is 200 to 400 tasks and threads.

The *action* can be set to one of the following symbolics, as defined in the `pthread.h` header file:

__STL_MAX_TASKS

Specify this action when only updating the maximum number of tasks.

__STL_MAX_THREADS

Specify this action when only updating the maximum number of threads.

__STL_SET_BOTH

Specify this action when updating both the maximum number of tasks and the maximum number of threads at the same time.

For more information on the allowable values for `maxthreadtasks` and `maxthreads`, see the `BPX1STL` function in [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

Returned value

If successful, `pthread_set_limit_np()` returns 0.

If unsuccessful, `pthread_set_limit_np()` returns -1.

For more information regarding return values and reason codes, see the `BPX1STL` function in [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_attr_setsynctype_np\(\) — Set thread sync type” on page 1245](#)
- [“pthread_attr_setweight_np\(\) — Set weight of thread attribute object” on page 1246](#)

pthread_setspecific() — Set the thread-specific value for a key

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.4a Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_setspecific(pthread_key_t key, void *value);
```


SUSV3:

```
#define _UNIX03_THREADS
#include <pthread.h>
int pthread_setspecific(pthread_key_t key, const void *value);
```

General description

Associates a thread-specific value, *value*, with a key identifier, *key*.

Many multithreaded applications require storage shared among threads but a unique value for each thread. A thread-specific data key is an identifier, created by a thread, for which each thread in the process can set a unique key *value*.

pthread_key_t is a storage area where the system places the key identifier. To create a key, a thread uses `pthread_key_create()`. This returns the key identifier into the storage area of type *pthread_key_t*. At this point, each of the threads in the application has the use of that key, and can set its own unique value by use of `pthread_setspecific()`. A thread can get its own unique value using `pthread_getspecific()`.

Returned value

If successful, `pthread_setspecific()` returns 0.

If unsuccessful, `pthread_setspecific()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EINVAL**

The key identifier *key* is not valid.

ENOMEM

Insufficient memory exists to associate the non-NULL value with the key.

Special behavior for Single UNIX Specification, Version 3: If unsuccessful, `pthread_setspecific()` returns an error number to indicate the error.

Example**CELEBP51**

```
/* CELEBP51 */
#define _OPEN_THREADS

#include <stdio.h>
#include <stdlib.h>
#include <errno.h>
#include <pthread.h>

#define threads 3
#define BUFFSZ 48
pthread_key_t key;

void *threadfunc(void *parm)
{
    int status;
    void *value;
    int threadnum;
    int tnum;
    void *getvalue;
    char Buffer[BUFFSZ];

    tnum = parm;
    threadnum = *tnum;

    printf("Thread %d executing\n", threadnum);

    if (!(value = malloc(sizeof(Buffer))))
        printf("Thread %d could not allocate storage, errno = %d\n",
              threadnum, errno);
    status = pthread_setspecific(key, (void *) value);
```

```

    if ( status < 0 ) {
        printf("pthread_setspecific failed, thread %d, errno %d",
               threadnum, errno);
        pthread_exit((void *)12);
    }
    printf("Thread %d setspecific value: %d\n", threadnum, value);

    getvalue = 0;
    status = pthread_getspecific(key, &getvalue);
    if ( status < 0 ) {
        printf("pthread_getspecific failed, thread %d, errno %d",
               threadnum, errno);
        pthread_exit((void *)13);
    }

    if (getvalue != value) {
        printf("getvalue not valid, getvalue=%d", (int)getvalue);
        pthread_exit((void *)68);
    }

    pthread_exit((void *)0);
}

void destr_fn(void *parm)
{
    printf("Destructor function invoked\n");
    free(parm);
}

main() {
    int         getvalue;
    int         status;
    int         i;
    int         threadparm[threads];
    pthread_t    threadid[threads];
    int         thread_stat[threads];

    if ((status = pthread_key_create(&key, destr_fn )) < 0) {
        printf("pthread_key_create failed, errno=%d", errno);
        exit(1);
    }

    for (i=0; i<threads; i++) {
        threadparm[i] = i+1;
        status = pthread_create( &threadid[i],
                                NULL,
                                threadfunc,
                                (void *)&threadparm[i]);

        if ( status < 0 ) {
            printf("pthread_create failed, errno=%d", errno);
            exit(2);
        }
    }

    for ( i=0; i<threads; i++) {
        status = pthread_join( threadid[i],
                               (void *)&thread_stat[i]);
        if ( status < 0 ) {
            printf("pthread_join failed, thread %d, errno=%d\n", i+1, errno);
        }

        if (thread_stat[i] != 0) {
            printf("bad thread status, thread %d, status=%d\n", i+1,
                  thread_stat[i]);
        }
    }
    exit(0);
}

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_getspecific\(\) — Get the thread-specific value for a key” on page 1281](#)
- [“pthread_getspecific_d8_np\(\) — Get the thread-specific value for a key” on page 1284](#)
- [“pthread_key_create\(\) — Create thread-specific data key” on page 1290](#)

pthread_sigmask() – Examine or change a thread blocked signals format

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, version 3 | both | z/OS V1R7 POSIX(ON) |

Format

```
#define _OPEN_THREADS 2
#include <signal.h>

int pthread_sigmask(int option, const sigset_t *__restrict__ new_set,
                    sigset_t *__restrict__ old_set);
```

General description

pthread_sigmask() examines, changes, or examines and changes the signal mask of the calling thread. If there is only one thread, it does the same for the calling process.

Typically, pthread_sigmask(SIG_BLOCK, ..., ...) is used to block signals during a critical section of code. At the end of the critical section of code, pthread_sigmask(SIG_SETMASK, ..., ...) is used to restore the mask to the previous value returned by pthread_sigmask(SIG_BLOCK, ..., ...).

option indicates the way in which the existing set of blocked signals should be changed. The following are the possible values for *option*, defined in the signal.h header file:

- SIG_BLOCK – Indicates that the set of signals given by *new_set* should be blocked, in addition to the set currently being blocked.
- SIG_UNBLOCK – Indicates that the set of signals given by *new_set* should not be blocked. These signals are removed from the current set of signals being blocked.
- SIG_SETMASK – Indicates that the set of signals given by *new_set* should replace the old set of signals being blocked.

new_set points to a signal set giving the new signals that should be blocked or unblocked (depending on the value of *option*) or it points to the new signal mask if the option was SIG_SETMASK. Signal sets are described in "sigemptyset() – Initialize a Signal Mask to Exclude All Signals" in topic 3.727. If *new_set* is a NULL pointer, the set of blocked signals is not changed. pthread_sigmask() determines the current set and returns this information in **old_set*. If *new_set* is NULL, the value of *option* is not significant. The signal set manipulation functions: sigemptyset(), sigfillset(), sigaddset(), and sigdelset() must be used to establish the new signal set pointed to by *new_set*.

old_set points to a memory location where pthread_sigmask() can store a signal set. If *new_set* is NULL, *old_set* returns the current set of signals being blocked. When *new_set* is not NULL, the set of signals pointed to by *old_set* is the previous set.

If there are any pending unblocked signals, either at the process level or at the current thread's level after pthread_sigmask() has changed the signal mask, then at least one of those signals is delivered to the thread before pthread_sigmask() returns.

The signals SIGKILL, SIGSTOP, or SIGTRACE cannot be blocked. If you attempt to use pthread_sigmask() to block these signals, the attempt is ignored. pthread_sigmask() does not return an error status.

SIGFPE, SIGILL, and SIGSEGV signals that are not artificially generated by kill(), killpg(), raise(), or pthread_kill() (that is, were generated by the system as a result of a hardware or software exception) will not be blocked.

If an artificially raised SIGFPE, SIGILL, or SIGSEGV signal is pending and blocked when an exception causes another SIGFPE, SIGILL, or SIGSEGV signal, both the artificial and exception-caused signals may be delivered to the application.

If pthread_sigmask() fails, the signal mask of the thread is not changed.

Usage Notes

1. The use of the SIGHSTOP and SIGHCONT signal is not supported with this function.

Returned value

If successful, pthread_sigmask() returns 0. Otherwise, pthread_sigmask() returns one of the following error numbers:

EINVAL

option does not have one of the recognized values.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“signal.h — Exception handling” on page 58](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“killpg\(\) — Send a signal to a process group” on page 933](#)
- [“pthread_kill\(\) — Send a signal to a thread” on page 1293](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigismember\(\) — Test if a signal is in a signal mask” on page 1631](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigrelse\(\) — Remove a signal from a thread” on page 1647](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

pthread_tag_np() — Set and query thread tag data

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

int pthread_tag_np(const char *newtag, char *oldtag);
```

General description

The pthread_tag_np() function is used to set and query the contents of the calling thread's tag data.

The parameters supported are:

newtag

Specifies the new tag data to be set for the callers thread. The length of the new tag data must be in the range of 0-65 bytes. If the length is zero (NULL string) the caller's thread tag data will be cleared.

oldtag

Specifies the string where pthread_tag_np() returns the old (current) tag data for the caller's thread. Tag data can be up to 66 bytes (including the trailing NULL).

Returned value

If successful, pthread_tag_np() returns 0.

If unsuccessful, pthread_tag_np() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

One of the following errors was detected:

- All or part of the newtag string is not addressable by the caller.
- All or part of the oldtag string is not addressable by the caller.

EINVAL

The length of the newtag string is not within allowable range (0 to 65 bytes).

EMVSERR

An MVS environmental or internal error has occurred.

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_create\(\) — Create a thread” on page 1274](#)

pthread_testcancel() — Establish a cancelation point

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, version 3 | both | z/OS V1R7 POSIX(ON) |

Format

```
#define _OPEN_THREADS 2
#include <pthread.h>

void pthread_testcancel(void);
```

General description

pthread_testcancel() allows the thread to solicit cancel requests at specific points within the current thread. You must have the cancelability state set to enabled (PTHREAD_CANCEL_ENABLE) for this function to have any effect.

Returned value

pthread_testcancel() returns no values.

Related information

- "Thread Cancellation" in the [z/OS XL C/C++ Programming Guide](#)
- "[pthread.h — Thread interfaces](#)" on page 53
- "[pthread_cancel\(\) — Cancel a thread](#)" on page 1247
- "[pthread_setcancelstate\(\) — Set a thread cancelability state format](#)" on page 1335
- "[pthread_setcanceltype\(\) — Set a thread cancelability type format](#)" on page 1336

pthread_testintr() — Establish a cancelability point

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| POSIX.4a | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

void pthread_testintr(void);
```

General description

Allows the thread to solicit cancel requests at specific points within the current thread. You must have the cancelability state set to enabled (PTHREAD_INTR_ENABLE) for this function to have any effect.

Usage notes

1. If you are writing to the Single UNIX Specification, Version 3 standard, use pthread_testcancel() in place of pthread_testintr().

Returned value

pthread_testintr() returns no values.

There are no documented errno values. Use perror() or strerror() to determine the cause of the error.

Example

CELEBP52

```
/* CELEBP52 */
#define _OPEN_THREADS
#include <stdio.h>
#include <string.h>
#include <pthread.h>
```

```

#include <errno.h>
#include <unistd.h>

int thstatus;
char state[60] = "enable/controlled - initial default";

void * thfunc(void *voidptr)
{
    int rc;
    char *pamptr;

    pamptr = voidptr;
    printf("parm = %s.\n", pamptr);
    if ( pthread_setintrtype(PTHREAD_INTR_CONTROLLED) == -1 ) {
        printf("set controlled failed. %s\n", strerror(errno));
        thstatus = 103;
        pthread_exit(&thstatus);
    }
    strcpy(state, "disable/controlled");

    if ( pthread_setintr(PTHREAD_INTR_ENABLE) == -1 ) {
        printf("set enable failed. %s\n", strerror(errno));
        thstatus = 104;
        pthread_exit(&thstatus);
    }
    strcpy(state, "enable/controlled");

    strcat(state, " - pthread_testintr");

    while(1) {
        pthread_testintr();
        sleep(1);
    }

    thstatus = 100;
    pthread_exit(&thstatus);
}

main(int argc, char *argv[]) {
    int rc;
    pthread_attr_t attrarea;
    pthread_t thid;
    char parm[] = "abcdefghijklmnopqrstuvwxyz";
    int *statptr;

    if ( pthread_attr_init(&attrarea) == -1 ) {
        printf("pthread_attr_init failed. %s\n", strerror(errno));
        exit(1);
    }

    if ( pthread_create(&thid, &attrarea, thfunc, (void *)&parm) == -1 ) {
        printf("pthread_create failed. %s\n", strerror(errno));
        exit(2);
    }

    sleep(5);

    if ( pthread_cancel(thid) == -1 ) {
        printf("pthread_cancel failed. %s\n", strerror(errno));
        exit(3);
    }

    if ( pthread_join(thid, (void **)&statptr) == -1 ) {
        printf("pthread_join failed. %s\n", strerror(errno));
        exit(4);
    }

    if ( statptr == (int *)-1 )
        printf("thread was cancelled. state = %s.\n", state);
    else
        printf("thread was not cancelled. thstatus = %d.\n", *statptr);

    exit(0);
}

```

Output:

```

parm = abcdefghijklmnopqrstuvwxyz.
thread was canceled. state = enable/controlled - pthread_testintr.

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“pthread_cancel\(\) — Cancel a thread” on page 1247](#)
- [“pthread_setintr\(\) — Set a thread cancelability state” on page 1337](#)
- [“pthread_setintrtype\(\) — Set a thread cancelability type” on page 1339](#)

pthread_yield() — Release the processor to other threads

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| POSIX.4a | both | POSIX(ON) |

Format

```
#define _OPEN_THREADS
#include <pthread.h>

void pthread_yield(NULL);
```

General description

The pthread_yield() function allows a thread to give up control of a processor so that another thread can have the opportunity to run.

The parameter to the function must be NULL, because non-NULL values are reserved.

The speed at which the pthread_yield() function releases a processor can be configured by using the _EDC_PTHREAD_YIELD and _EDC_PTHREAD_YIELD_MAX environment variables. The _EDC_PTHREAD_YIELD environment variable is used to configure the pthread_yield() function to release the processor immediately, or to release the processor after a delay. The _EDC_PTHREAD_YIELD_MAX environment variable is used to change the maximum delay to a value less than the default (32 milliseconds).

For more information about the _EDC_PTHREAD_YIELD and _EDC_PTHREAD_YIELD_MAX environment variables, see “Using Environment Variables” in [z/OS XL C/C++ Programming Guide](#).

Returned value

pthread_yield() returns no values.

There are no documented errno values.

Example

CELEBP53

```
/* CELEBP53 */
#define _OPEN_THREADS
#include <pthread.h>
#include <stdio.h>
#include <unistd.h>

void *thread(void *arg) {

    /* A simple loop with only puts() would allow a thread to write several
    lines in a row.
    With pthread_yield(), each thread gives another thread a chance before
    it writes its next line */
```



```

    while (1) {
        puts((char*) arg);
        pthread_yield(NULL);
    }
}

main() {
    pthread_t t1, t2, t3;

    if (pthread_create(&t1, NULL, thread, "thread 1") != 0) {
        perror("pthread_create() error");
        exit(1);
    }

    if (pthread_create(&t2, NULL, thread, "thread 2") != 0) {
        perror("pthread_create() error");
        exit(2);
    }

    if (pthread_create(&t3, NULL, thread, "thread 3") != 0) {
        perror("pthread_create() error");
        exit(3);
    }

    sleep(1);

    exit(0); /* this will tear all threads down */
}

```

Output:

```

thread 1
thread 3
thread 2
thread 1
thread 3
thread 2
thread 1
thread 3
thread 2
thread 1
thread 3

```

Related information

- [“pthread.h — Thread interfaces” on page 53](#)
- [“sched_yield\(\) — Release the processor to other threads” on page 1469](#)

ptsname() — Get name of the subsidiary pseudoterminal device

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#include <stdlib.h>

char *ptsname(int fildes);

```

General description

The ptsname() function returns the name of the subsidiary pseudoterminal device associated with a manager pseudoterminal device. The *fildev* argument is a file descriptor that refers to the manager device. ptsname() returns a pointer to a string containing the path name of the corresponding subsidiary device.

Returned value

If successful, ptsname() returns a pointer to a string which is the name of the pseudoterminal subsidiary device.

If unsuccessful, ptsname() returns a NULL pointer. This could occur if *fildev* is an invalid file descriptor or if the subsidiary device name does not exist in the file system.

No errors are defined.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“grantpt\(\) – Grant access to the subsidiary pseudoterminal device” on page 814](#)
- [“open\(\) – Open a file” on page 1157](#)
- [“ttyname\(\) – Get the name of a terminal” on page 1913](#)
- [“unlockpt\(\) – Unlock a pseudoterminal manager and subsidiary pair” on page 1948](#)

putc(), putchar() – Write a character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

int putc(int c, FILE *stream);
int putchar(int c);
```

General description

Converts *c* to unsigned char and then writes *c* to the output *stream* at the current position. The putchar() function is identical to:

```
putc(c, stdout);
```

These functions are also available as macros in the IBM z/OS C/C++ product. For performance purposes, it is recommended that the macro forms rather than the functional forms be used.

By default, if the stdio.h header file is included, the macro is invoked. Therefore, the stream argument expression should never be an expression with side effects.

The actual function can be accessed using one of the following methods:

- For C only: do *not* include `stdio.h`.
- Specify `#undef`, for example, `#undef putc`.
- Surround the function name by parentheses, for example: `(putc)('a')`.

In a multithread application, in the presence of the feature test macro, `_OPEN_THREADS`, these macros are in an `#undef` status because they are not thread-safe.

`putc()` and `putchar()` are not supported for files opened with `type=record` or `type=blocked`.

`putc()` and `putchar()` have the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

If the application is not multithreaded, then setting the `_ALL_SOURCE_NO_THREADS` feature test macro may improve performance of the application, because it allows use of the inline version of this function.

Returned value

If successful, `putc()` and `putchar()` return the character written.

If unsuccessful, `putc()` and `putchar()` return EOF.

Example

CELEBP54

```
/* CELEBP54

   This example writes the contents of a buffer to a data
   stream.
   The body of the "for" statement is null because the
   example carries out the writing operation in the test
   expression.

*/
#include <stdio.h>
#include <string.h>
#define LENGTH 80

int main(void)
{
    FILE *stream = stdout;
    int i, ch;
    char buffer[LENGTH + 1] = "Hello world\n";

    /* This could be replaced by using the fwrite routine */
    for ( i = 0;
          (i < strlen(buffer)) && ((ch = putc(buffer[i], stream)) != EOF);
          ++i);
}
```

Output:

```
Hello world
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“getc\(\), getchar\(\) — Read a character” on page 689](#)
- [“fputc\(\) — Write a character” on page 606](#)
- [“fwrite\(\) — Write items” on page 678](#)

putenv() – Change or add an environment variable

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

int putenv(char *envvar);
```

General description

Adds a new environment variable or changes the value of an existing one. The argument *envvar* is a pointer to a NULL-terminated character string that should be of the form:

name=value

Where:

1. The first part, *name*, is a character string that represents the name of the environment variable. It is this part of the environment variable that `putenv()` will use when it searches the array of environment variable to determine whether to add or change this environment variable.
2. The second part, `=`, is a separator character (since the equal sign is used as a separator character it cannot appear in the *name*).
3. The third part, *value*, is a NULL-terminated character string that represents the value that the environment variable, *name*, will be set to.

`putenv()` is a simplified form of `setenv()` and is equivalent to

`setenv(name, value, 1)`

Note: Starting with, z/OS V1R2, the storage used to define the environment variable pointed to by *envvar* is added to the array of environment variables. Previously, the system copied the string into system allocated storage. A new environment variable, `_EDC_PUTENV_COPY`, will allow the previous behavior to continue if set to YES. If `_EDC_PUTENV_COPY` is not set or is set to any other value the new behavior will take place.

Special behavior for POSIX C: You can use the external variable `**environ` (defined as `extern char **environ`) to access the array of pointers to environment variables.

Returned value

If successful, `putenv()` returns 0.

If unsuccessful, `putenv()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

ENOMEM

Insufficient memory was available.

Special behavior for z/OS UNIX Services:

EINVAL

The environment variable pointed to by the argument *envvar* does not follow the prescribed format.
The equal sign (=) separating the environment variable name from the value was not found.

Related information

- See the topic about C/370 environmental variables in [z/OS XL C/C++ Programming Guide](#)
- [“stdlib.h — Standard library functions” on page 65](#)
- [“clearenv\(\) — Clear environment variables” on page 283](#)
- [“getenv\(\) — Get value of environment variables” on page 705](#)
- [“__getenv\(\) — Get an environment variable” on page 706](#)
- [“setenv\(\) — Add, delete, and change environment variables” on page 1523](#)

putmsg(), putpmsg() — Send a message on a STREAM

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stropts.h>

int putmsg(int fildes, const struct strbuf *ctlptr,
           const struct strbuf *dataptr, int flags);

int putpmsg(int fildes, const struct strbuf *ctlptr,
            const struct strbuf *dataptr, int band, int flags);
```

General description

The `putmsg()` function creates a message from a process buffer(s) and sends the message to a STREAMS file. The message may contain either a data part, a control part, or both. The data and control parts are distinguished by placement in separate buffers, as described below. The semantics of each part is defined by the STREAMS module that receives the message.

The `putpmsg()` function does the same thing as `putmsg()`, but the process can send messages in different priority bands. Except where noted, all requirements on `putmsg()` also pertain to `putpmsg()`.

The *fildes* argument specifies a file descriptor referencing an open STREAM. The *ctlptr* and *dataptr* arguments each point to a **strbuf** structure.

The *ctlptr* argument points to the structure describing the control part, if any, to be included in the message. The **buf** member in the **strbuf** structure points to the buffer where the control information resides, and the **len** member indicates the number of bytes to be sent. The **maxlen** member is not used by `putmsg()`. In a similar manner, the argument *dataptr* specifies the data, if any, to be included in the message. The *flags* argument indicates what type of message should be sent and is described further below.

To send the data part of a message, *dataptr* must not be a NULL pointer and the **len** member of *dataptr* must be 0 or greater. To send the control part of a message, the corresponding values must be set for *ctlptr*. No data (control) part will be sent if either *dataptr* (*ctlptr*) is a NULL pointer or the **len** member of *dataptr* (*ctlptr*) is set to -1.

For `putmsg()`, if a control part is specified and *flags* is set to `RS_HIPRI`, a high priority message is sent. If no control part is specified, and *flags* is set to `RS_HIPRI`, `putmsg()` fails and sets `errno` to `EINVAL`. If *flags* is set to 0, a normal message (priority band equal to 0) is sent. If a control part and data part are not specified and *flags* is set to 0, no message is sent and 0 is returned.

The `STREAM` head guarantees that the control part of a message generated by `putmsg()` is at least 64 bytes in length.

For `putpmsg()`, the flags are different. The *flags* argument is a bitmask with the following mutually-exclusive flags defined: `MSG_HIPRI` and `MSG_BAND`. If *flags* is set to 0, `putpmsg()` fails and sets `errno` to `EINVAL`. If a control part is specified and *flags* is set to `MSG_HIPRI` and *band* is set to 0, a high-priority message is sent. If *flags* is set to `MSG_HIPRI` and either no control part is specified or *band* is set to a nonzero value, `putpmsg()` fails and sets `errno` to `EINVAL`. If *flags* is set to `MSG_BAND`, then a message is sent in the priority band specified by *band*. If a control part and data part are not specified and *flags* is set to `MSG_BAND`, no message is sent and 0 is returned.

The `putmsg()` function blocks if the `STREAM` write queue is full due to internal flow control conditions, with the following exceptions:

- For high-priority messages, `putmsg()` does not block on this condition and continues processing the message.
- For other messages, `putmsg()` does not block but fails when the write queue is full and `O_NONBLOCK` is set.

The `putmsg()` function also blocks, unless prevented by lack of internal resources, while waiting for the availability of message blocks in the `STREAM`, regardless of priority or whether `O_NONBLOCK` has been specified. No partial message is sent.

The following symbolic constants are defined under `_XOPEN_SOURCE_EXTENDED 1` in `<stropts.h>`.

MSG_ANY

Receive any message.

MSG_BAND

Receive message from specified band.

MSG_HIPRI

Send/Receive high priority message.

MORECTL

More control information is left in message.

MOREDATA

More data is left in message.

Returned value

If successful, `putmsg()` and `putpmsg()` return 0.

If unsuccessful, `putmsg()` and `putpmsg()` return -1 and set `errno` to one of the following values.

Note: z/OS UNIX services do not supply any `STREAMS` devices or pseudodevices. It is impossible for `putmsg()` and `putpmsg()` to send a message on a `STREAM`. It will always return -1 with `errno` set to indicate the failure. See [“open\(\) — Open a file” on page 1157](#)

Error Code**Description****EAGAIN**

A non-priority message was specified, the `O_NONBLOCK` flag is set, and the `STREAM` write queue is full due to internal flow control conditions; or buffers could not be allocated for the message that was to be created.

EBADF

fildev is not a valid file descriptor open for writing.

EINTR

A signal was caught during `putmsg()`.

EINVAL

An undefined value is specified in *flags*, or *flags* is set to `RS_HIPRI` or `MSG_HIPRI` and no control part is supplied, or the STREAM or multiplexer referenced by *fildev* is linked (directly or indirectly) downstream from a multiplexer, or *flags* is set to `MSG_HIPRI` and *band* is nonzero (for `putpmsg()` only).

ENOSR

Buffers could not be allocated for the message that was to be created due to insufficient STREAMS memory resources.

ENOSTR

A STREAM is not associated with *fildev*.

ENXIO

A hang-up condition was generated downstream for the specified STREAM.

EPIPE or EIO

The *fildev* argument refers to a STREAMS-based pipe and the other end of the pipe is closed. A SIGPIPE signal is generated for the calling process.

ERANGE

The size of the data part of the message does not fall within the range specified by the maximum and minimum packet sizes of the topmost STREAM module. This value is also returned if the control part of the message is larger than the maximum configured size of the control part of a message, or if the data part of a message is larger than the maximum configured size of the data part of a message.

In addition, `putmsg()` and `putpmsg()` will fail if the STREAM head had processed an asynchronous error before the call. In this case, the value of `errno` does not reflect the result of `putmsg()` or `putpmsg()` but reflects the prior error.

Related information

- [“stropts.h — Stream interface” on page 67](#)
- [“getmsg\(\), getpmsg\(\) — Receive next message from a STREAMS file” on page 737](#)
- [“poll\(\) — Monitor activity on file descriptors and message queues” on page 1196](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“writev\(\) — Write data on a file or socket from an array” on page 2076](#)

puts() — Write a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

int puts(const char *string);

#define _OPEN_SYS_UNLOCKED_EXT 1
```

```
#include <stdio.h>

int puts_unlocked(const char *string);
```

General description

Writes the string pointed to by *string* to the stream pointed to by `stdout`, and appends the newline character to the output. The terminating NULL character is not written.

If `stdout` points to the text stream, and the output string is longer than the length of the stream's record, the output is *wrapped*. That is, the record is filled with the output characters, the last character of the record is set to a newline character, and the remaining output characters are written to the next record. Such wrapping is repeated until the remaining output characters fit into the record. Please note that the newline character is appended to the last portion of the output string. If the output string is shorter than the record, the remaining characters of the record are filled with blanks—if `stdout` is opened in a text mode—or with NULL characters if the `stdout` is opened in binary mode.

The `puts()` function is not supported for files opened with `type=record` or `type=blocked`.

`puts()` has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`puts_unlocked()` is functionally equivalent to `puts()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `puts()` returns the number of bytes written. However, newline characters used to wrap the data are not counted.

If unsuccessful, `puts()` returns EOF.

If a system write-error occurs, the write stops at the point of failure.

After truncation, `puts()` does not count the truncated characters, but returns the actual number of bytes written.

Example

CELEBP55

```
/* cCELEBP55
   This example writes "Hello World" to stdout.
*/
#include <stdio.h>

int main(void)
{
    if ( puts("Hello World") == EOF )
        printf( "Error in puts\n" );
}
```

Output:

```
Hello World
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)

- “fputs() — Write a string” on page 608
- “gets() — Read a string” on page 770

pututxline(), pututxline64() — Write entry to utmpx database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

pututxline:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <utmpx.h>

struct utmpx *pututxline(const struct utmpx *utmpx);
```

pututxline64:

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _LARGE_TIME_API
#include <utmpx.h>

struct utmpx64 *pututxline64(const struct utmpx64 *utmpx64);
```

General description

The `pututxline()` function writes out the structure into the `utmpx` database, when the calling process has appropriate privileges. The `pututxline()` function uses `getutxid()` to search for a record that satisfies the request. If the `getutxid()` search succeeds, then the entry is replaced. Otherwise, a new entry is made at the end of the database. If the `utmpx` database does not already exist, then `pututxline()` creates the `utmpx` database with file permissions 0644.

If the `ut_type` field in the entry being added is `EMPTY`, it is always placed at the start of the `utmpx` database. For this reason, `pututxline()` must not be used to place `EMPTY` entries in the `utmpx` database.

The `pututxline()` function obtains an exclusive lock in the `utmpx` database on the byte range of the record which is ready to write and releases the lock before returning to its caller. The functions `getutxent()`, `getutxid()`, and `getutxline()` might continue to read and are not affected by `pututxline()`.

Because the `pututxline()` function processes thread-specific data the `pututxline()` function can be used safely from a multithreaded application. If multiple threads in the same process open the database, then each thread opens the database with a different file descriptor. The thread's database file descriptor is closed when the calling thread terminates or the `endutxent()` function is called by the calling thread.

The name of the database file defaults to `/etc/utmpx`. To process a different database file name use the `__utmpxname()` function.

`pututxline()` is not supported when all of the following conditions are true:

- The security environment for the current address space has the trusted attribute.
- Either the effective UID is different than the real UID, or the effective GID is different than the real GID.
- The effective UID is not 0.
- The `utmpx` file is not writable by normal (non-trusted) processes with the current effective UID and GID.

- `pututxline()` is called after `getutxline()`, `getutxid()`, or `getutxent()`, with no intervening calls to `endutxent()` or `__utmpxname()`.

For all entries that match a request, the `ut_type` member indicates the type of the entry. Other members of the entry will contain meaningful data based on the value of the `ut_type` member as follows:

EMPTY

No other members have meaningful data.

BOOT_TIME

`ut_tv` is meaningful.

__RUN_LVL

`ut_tv` and `ut_line` are meaningful

OLD_TIME

`ut_tv` is meaningful.

NEW_TIME

`ut_tv` is meaningful.

USER_PROCESS

`ut_id`, `ut_user` (login name of the user), `ut_line`, `ut_pid`, and `ut_tv` are meaningful.

INIT_PROCESS

`ut_id`, `ut_pid`, and `ut_tv` are meaningful.

LOGIN_PROCESS

`ut_id`, `ut_user` (implementation-specific name of the login process), `ut_pid`, and `ut_tv` are meaningful.

DEAD_PROCESS

`ut_id`, `ut_pid`, and `ut_tv` are meaningful.

The `pututxline64()` function behaves exactly like `pututxline()` except `pututxline64()` uses structure `utmpx64` instead of `struct utmpx` to support time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, `pututxline()` returns a pointer to a `utmpx` structure containing a copy of the entry written to the database.

If unsuccessful, `pututxline()` returns a NULL pointer.

`pututxline()` might fail if the process does not have appropriate privileges.

Related information

- [“utmpx.h — User accounting database” on page 78](#)
- [“endutxent\(\) — Close the utmpx database” on page 425](#)
- [“getutxent\(\), getutxent64\(\) — Read next entry in utmpx database” on page 794](#)
- [“getutxid\(\), getutxid64\(\) — Search by ID utmpx database” on page 795](#)
- [“getutxline\(\), getutxline64\(\) — Search by line utmpx database” on page 797](#)
- [“setutxent\(\) — Reset to start of utmpx database” on page 1588](#)
- [“__utmpxname\(\) — Change the utmpx database name” on page 1957](#)

putw() — Put a machine word on a stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdio.h>

int putw(int w, FILE *stream);
```

General description

The `putw()` function writes the word *w* to the output *stream* (at the position at which the file offset, if defined, is pointing). The size of the word is the size of a type `int`, and varies from machine to machine. The `putw()` function neither assumes nor causes special alignment in the file. The *st_ctime* and *st_mtime* fields of the file will be marked for update between the successful execution of `putw()` and the next successful call to `fflush()` or `fclose()` on the same stream or a call to `exit()` or `abort()`.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use character-based output functions to replace `putw()` for portability.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `putw()` returns 0.

If unsuccessful, `putw()` returns a nonzero value, sets the error indicators for *stream*, and sets `errno` to indicate the error. Refer to [“fread\(\) — Read items” on page 613](#) for `errno` values.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“fwrite\(\) — Write items” on page 678](#)
- [“getw\(\) — Get a machine word from a stream” on page 798](#)

putwc() – Output a wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 Language Environment | both | |

Format

Non-XPG4:

```
#include <stdio.h>
#include <wchar.h>

wint_t putwc(wchar_t wc, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t putwc_unlocked(wchar_t wc, FILE *stream);
```

XPG4:

```
#define _XOPEN_SOURCE
#include <stdio.h>
#include <wchar.h>

wint_t putwc(wint_t wc, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t putwc_unlocked(wchar_t wc, FILE *stream);
```

XPG4 and MSE:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <stdio.h>
#include <wchar.h>

wint_t putwc(wchar_t wc, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t putwc_unlocked(wchar_t wc, FILE *stream);
```

General description

The putwc() function is equivalent to the fputc() function, except that if it is implemented as a macro, it may evaluate stream more than once. Therefore, the argument should never be an expression with side effects. The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you use a non-wide-oriented function with putwc(), undefined results can occur.

putwc() has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

putwc_unlocked() is functionally equivalent to putwc() with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking

thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the wchar header, then the compiler assumes that your program is using the XPG4 variety of the putwc() function, unless you also define the _MSE_PROTOS feature test macro. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

The prototype for the XPG4 variety of the putwc() function is:

```
wint_t putwc(wint_t wc, FILE *stream);
```

The difference between this variety and the MSE variety of the putwc() function is that the first parameter has type wint_t rather than type wchar_t.

Returned value

If successful, putwc() returns the wide character written.

If a write error occurs, the error indicator for the stream is set and WEOF is returned. If an encoding error occurs when converting from a wide character to a multibyte character, the value of the macro EILSEQ is stored in errno and WEOF is returned.

Example

CELEBP56

```
/* CELEBP56 */
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>
#include <errno.h>

int main(void)
{
    FILE    *stream;
    wchar_t *wcs = L"This test string should not cause a WEOF condition";
    int      i;
    int      rc;

    if ((stream = fopen("myfile.dat", "w")) == NULL) {
        printf("Unable to open file\n");
        exit(1);
    }

    for (i=0; wcs[i] != L'\0'; i++) {
        errno = 0;
        if ((rc = putwc(wcs[i], stream)) == WEOF) {
            printf("Unable to putwc() the wide character.\n");
            printf("wcs[%d] = 0x%X\n", i, wcs[i]);
            if (errno == EILSEQ)
                printf("An invalid wide character was encountered.\n");
            exit(1);
        }
    }

    fclose(stream);
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fputwc\(\) — Output a wide-character” on page 609](#)

putwchar() – Output a wide character to standard output

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

Non-XPG4:

```
#include <stdio.h>
#include <wchar.h>

wint_t putwchar(wchar_t wc);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t putwchar_unlocked(wchar_t wc);
```

XPG4:

```
#define _XOPEN_SOURCE
#include <stdio.h>
#include <wchar.h>

wint_t putwchar(wint_t wc);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t putwchar_unlocked(wchar_t wc);
```

XPG4 and MSE:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <stdio.h>
#include <wchar.h>

wint_t putwchar(wchar_t wc);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t putwchar_unlocked(wchar_t wc);
```

General description

The `putwchar()` function is equivalent to: `putwc()(wc stdout)`.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you use a non-wide-oriented function with `putwchar()`, undefined results can occur.

`putwchar()` has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

You may not use `putwc()` or `putwchar()` with files opened as `type=record` or `type=blocked`.

`putwchar_unlocked()` is functionally equivalent to `putwchar()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then the compiler assumes that your program is using the XPG4 variety of the `putwchar()` function, unless you also define the `_MSE_PROTOS` feature test macro. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

The prototype for the XPG4 variety of the `putwchar()` function is:

```
wint_t putwchar(wint_t wc);
```

The difference between this variety and the MSE variety of the `putwchar()` function is that its parameter has type `wint_t` rather than type `wchar_t`.

Returned value

If successful, `putwchar()` returns the wide character written.

If a write error occurs, the error indicator for the stream is set and `WEOF` is returned. If an encoding error occurs when converting from a wide character to a multibyte character, the value of the macro `EILSEQ` is stored in `errno` and `WEOF` is returned.

Example

CELEBP57

```
/* CELEBP57 */
#include <stdio.h>
#include <stdlib.h>
#include <wchar.h>
#include <errno.h>

int main(void)
{
    wchar_t *wcs = L"This test string should not cause a WEOF condition";
    int i;
    int rc;

    for (i=0; wcs[i] != L'\0'; i++) {
        errno = 0;
        if ((rc = putwchar(wcs[i])) == WEOF) {
            printf("Unable to putwchar() the wide character.\n");
            printf("wcs[%d] = 0x%X\n", i, wcs[i]);
            if (errno == EILSEQ)
                printf("An invalid wide character was encountered.\n");
            exit(1);
        }
    }
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fputwc\(\) — Output a wide-character” on page 609](#)

pwrite() — Write data on a file or socket without file pointer change

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R10 |

Format

```
#define _XOPEN_SOURCE 500
#include <unistd.h>

ssize_t pwrite(int fildes, const void *buf, size_t nbyte, off_t offset);
```

General description

The `pwrite()` function performs the same action as `write()`, except that it writes into a given position without changing the file pointer.

The first three arguments to `pwrite()` are the same as `write()` with the addition of a fourth argument *offset* for the desired position inside the file.

Returned value

If successful, `pwrite()` returns the number of bytes actually written to the file associated with *fildes*. This number will never be greater than *nbyte*.

If unsuccessful, `pwrite()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAGAIN

Resources temporarily unavailable. Subsequent requests may complete normally.

EBADF

fildes is not a valid file or socket descriptor.

ECONNRESET

A connection was forcibly closed by a peer.

EDESTADDRREQ

The socket is not connection-oriented and no peer address is set.

EFAULT

Using the *buf* and *nbyte* parameters would result in an attempt to access storage outside the caller's address space.

EFBIG

An attempt was made to write a file that exceeds the system-established maximum file size or the process's file size limit supported by the implementation.

The file is a regular file, *nbyte* is greater than 0 and the starting position is greater than or equal to the offset maximum established in the open file description associated with *fields*.

EINTR

`pwrite()` was interrupted by a signal before it had written any output.

EINVAL

The request is invalid or not supported. The STREAM or multiplexer referenced by *fildes* is linked (directly or indirectly) downstream from a multiplexer.

The *offset* argument is invalid. The value is negative.

EIO

The process is in a background process group and is attempting to write to its controlling terminal, but TOSTOP (defined in the `termios.h` header file) is set, the process is neither ignoring nor blocking SIGTTOU signals, and the process group of the process is orphaned. An I/O error occurred.

EMSGSIZE

The message was too big to be sent as a single datagram.

ENOBUFS

Buffer space is not available to send the message.

ENOSPC

There is no available space left on the output device.

ENOTCONN

The socket is not connected.

ENXIO

A hang-up occurred on the STREAM being written to.

EPIPE

`pwrite()` is trying to write to a pipe that is not open for reading by any other process. This error also generates a SIGPIPE signal. For a connected stream socket the connection to the peer socket has been lost.

ERANGE

The transfer request size was outside the range supported by the STREAMS file associated with *fildev*.

ESPIPE

fildev is associated with a pipe or FIFO.

EWOULDBLOCK

socket is in nonblocking mode and no data buffers are available or the SO_SNDTIMEO timeout value was reached before buffers became available.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“pread\(\) — Read from a file or socket without file pointer change” on page 1213](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

qsort() — Sort array

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

void qsort(void *base, size_t num, size_t width,
           int(*compare)(const void *element1, const void *element2));
```

General description

The `qsort()` function sorts an array of *num* elements, each of *width* bytes in size, where the first element of the array is pointed to by *base*.

The *compare* pointer points to a function, which you supply, that compares two array elements and returns an integer value specifying their relationship. The `qsort()` function calls the comparison function one or more times during the sort, passing pointers to two array elements on each call. The comparison function must compare the elements and return one of the following values:

Value

Meaning

< 0

element1 less than *element2*

0

element1 equal to *element2*

> 0

element1 greater than *element2*

The sorted array elements are stored in increasing order, as returned by the comparison function. You can sort in reverse order by reversing the "greater than" and "less than" logic in the comparison function. If two elements are equal, their order in the sorted array is unspecified. The `qsort()` function overwrites the contents of the array with the sorted elements.

Special behavior for C++: C++ and C linkage conventions are incompatible, and therefore the `qsort()` function cannot receive C++ function pointers. If you attempt to pass a C++ function pointer to the `qsort()` function, the compiler will flag it as an error. To use the C++ `qsort()` function, you must ensure that the comparison function has C linkage, by declaring it as `extern "C"`.

Returned value

The `qsort()` function returns no values.

Example

CELEBQ01

```
/* CELEBQ01

   This example sorts the arguments (argv) in ascending sequence, based on
   the ASCII value of each character and string, and using the comparison
   function compare() supplied in the example.

*/
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

/* Declaration of compare() as a function */
#ifdef __cplusplus
extern "C" int compare(const void *, const void *);
#else
int compare(const void *, const void *); /* macro is automatically */
#endif                               /* defined by the C++/MVS compiler */

int main (int argc, char *argv[ ])
{
    int i;
    argv++;
    argc--;
    qsort((char *)argv, argc, sizeof(char *), compare);
    for (i = 0; i < argc; ++i)
        printf("%s\n", argv[i]);
    return 0;
}

int compare (const void *arg1, const void *arg2)
```

```

{
    /* Compare all of both strings */
    return(strcmp((char **)arg1, *(char **)arg2));
}

```

Output

If the program is passed the arguments:

```
Does, this, really, sort, the, arguments, correctly?
```

then expect the following output.

```

arguments
correctly?
really
sort
the
this
Does

```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“bsearch\(\) — Search arrays” on page 221](#)

quantexpd32(), quantexpd64(), quantexpd128() - Compute the quantum exponent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.11 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <math.h>

int quantexpd32(_Decimal32 x);
int quantexpd64(_Decimal64 x);
int quantexpd128(_Decimal128 x);

int quantexp(_Decimal32 x);    /* C++ only */
int quantexp(_Decimal64 x);    /* C++ only */
int quantexp(_Decimal128 x);   /* C++ only */

```

General description

The `quantexp()` functions compute the quantum exponent of a finite argument.

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) IEEE Decimal Floating-Point for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
3. The "quantum" when referring to a finite decimal floating-point number is defined as the "magnitude of a value of one in the rightmost digit position of the significand". For example, pennies and dollars can be represented respectively as $1 * 10$ with a quantum of -2 and 0, or $1 * 10^{-2}$ and $1 * 10^0$. For more information on the term quantum, see *z/Architecture Principles of Operation*.

Returned value

The quantexp() functions return the quantum exponent of x.
If x is infinite or NaN, they compute INT_MIN and a domain error occurs.

Example

```
/* CELEBQ03
   This example illustrates the quantexpd128() function.
*/
#define __STDC_WANT_DEC_FP__
#include <stdio.h>
#include <math.h>

void main(void)
{
    _Decimal128 x, y;

    x = 4.56DL;
    y = quantexpd128(x);

    printf("quantexpd128( %DDf ) = %DDf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“quantized32\(\), quantized64\(\), quantized128\(\) — Set the exponent of X to the exponent of Y” on page 1370](#)
- [“samequantumd32\(\), samequantumd64\(\), samequantumd128\(\) — Determine if exponents X and Y are the same” on page 1463](#)

quantized32(), quantized64(), quantized128() — Set the exponent of X to the exponent of Y

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 quantized32(_Decimal32 x, _Decimal32 y);
_Decimal64 quantized64(_Decimal64 x, _Decimal64 y);
_Decimal128 quantized128(_Decimal128 x, _Decimal128 y);
```

General description

The quantize functions set the exponent of argument x to the exponent of argument y, while trying to keep the value the same. If the exponent is being increased, the value is correctly rounded according to the current rounding mode. If the result does not have the same value as x, the "inexact" (FP_INEXACT) floating-point exception is raised. If the exponent is being decreased, and the significand of the result has more digits than the type would allow, the result is NaN and the "invalid" (FP_INVALID) floating-point exception is raised.

If one of both operands are NaN, the result is NaN, and the "invalid" floating-point exception may be raised. Otherwise, if only one operand is infinity, the result is NaN, and the "invalid" floating-point exception is raised. If both operands are infinity, the result is DEC_INFINITY, and the sign is the same as x.

The quantize functions do not signal underflow (FP_UNDERFLOW) or overflow (FP_OVERFLOW).

Argument

Description

x

Input value to be converted and perhaps rounded using the exponent of y.

y

Input value whose exponent is used for the output value

Usage notes

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The quantize functions return the number which is equal in value (except for any rounding) and sign to x, and which has been set to be equal to the exponent of y.

Example

```
/* CELEBQ02

   This example illustrates the quantized128() function.
*/

#define __STDC_WANT_DEC_FP__
#include <stdio.h>
#include <math.h>

int main(void)
{
    _Decimal128 price = 64999.99DL;
    _Decimal128 rate  = 0.09875DL;
    _Decimal128 tax    = quantized128(price * rate, 0.01DL);
    _Decimal128 total  = price + tax;

    printf( "price = %22.16DDF\n"
           "  tax = %22.16DDF (price * rate = %-.16DDF)\n"
           "total = %22.16DDF\n"
           , price
           , tax ,           price * rate
           , total
           );

    return 0;
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“samequantumd32\(\), samequantumd64\(\), samequantumd128\(\) — Determine if exponents X and Y are the same” on page 1463](#)
- [“quantexpd32\(\), quantexpd64\(\), quantexpd128\(\) - Compute the quantum exponent” on page 1369](#)

QueryMetrics() – Query WLM system information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/__wlm.h>

int QueryMetrics(struct sysi *sysi_ptr, int *anslen);
```

General description

The QueryMetrics() function provides the ability for an application to query WLM system information.

*sysi_ptr

Points to a buffer that the service is to return the WLM system information. The data returned is in the format of the structure sysi.

*anslen

Points to an integer data field that contains the length of the buffer to return the WLM system information into.

Returned value

If successful, QueryMetrics() returns 0.

If unsuccessful, QueryMetrics() returns -1 and sets errno to one of the following values. If the returned errno and __errno2() indicate the supplied buffer is too small, the *anslen* argument is updated to contain the length required to hold WLM system information.

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM query system information failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class if it is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/__wlm.h – WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) – Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) – Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) – Connect to WLM as a work manager” on page 318](#)

- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“CreateWorkUnit\(\) — Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QuerySchEnv\(\) — Query WLM scheduling environment” on page 1373](#)

QuerySchEnv() — Query WLM scheduling environment

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/__wlm.h>

int QuerySchEnv(struct sethdr *sysi_ptr, int *anslen);
```

General description

The QuerySchEnv() function provides the ability for an application to query WLM scheduling environment.

*sysi_ptr

Points to a buffer that the service is to return the WLM system information. The data returned is in the format of the structure sysi.

*anslen

Points to an integer data field that contains the length of the buffer to return the WLM system information into.

Returned value

If successful, QuerySchEnv() returns 0.

If unsuccessful, QuerySchEnv() returns -1 and sets errno to one of the following values. If the returned errno and __errno2() indicate the supplied buffer is too small, the *anslen* argument is updated to contain the length required to hold WLM system information.

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained an incorrect value.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

The WLM query scheduling environment failed. Use __errno2() to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class if it is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“CheckSchEnv\(\) — Check WLM scheduling environment” on page 273](#)
- [“ConnectServer\(\) — Connect to WLM as a server manager” on page 317](#)
- [“ConnectWorkMgr\(\) — Connect to WLM as a work manager” on page 318](#)
- [“ContinueWorkUnit\(\) — Continue WLM work unit” on page 325](#)
- [“CreateWorkUnit\(\) — Create WLM work unit” on page 345](#)
- [“DeleteWorkUnit\(\) — Delete a WLM work unit” on page 379](#)
- [“DisconnectServer\(\) — Disconnect from WLM server” on page 384](#)
- [“JoinWorkUnit\(\) — Join a WLM work unit” on page 926](#)
- [“LeaveWorkUnit\(\) — Leave a WLM work unit” on page 944](#)
- [“QueryMetrics\(\) — Query WLM system information” on page 1372](#)

QueryWorkUnitClassification() — WLM query enclave classification service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R9 |

Format

```
#include <sys/_wlm.h>

int QueryWorkUnitClassification(wlmetok_t *e_token,
                               struct sysec *sysec_ptr,
                               int *ans_len);
```

General description

Returns the classification attributes of an enclave, using the following parameters:

***e_token**

Points to a work unit enclave token.

***sysec_ptr**

Points to the enclave classification data (mapped by sysec) returned by the QueryWorkUnitClassification function.

***anslen**

The length of the data area provided by the caller to receive the information generated by the service. WLM will update this value with the size of the area needed for the service to work. The minimum area should hold the entire sysec structure through version 3. The existing area will be populated with as much of the information as can be returned.

Returned value

If successful, QueryWorkUnitClassification() returns 0.

If unsuccessful, `QueryWorkUnitClassification()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained a value that is not correct.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

A WLM service failed. Use `__errno2()` to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class, if the BPX.WLMSEVER class is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h – WorkLoad Manager functions” on page 73](#)
- [“ConnectExportImport\(\) – WLM connect for export or import use” on page 316](#)
- [“ExportWorkUnit\(\) – WLM export service” on page 458](#)
- [“ExtractWorkUnit\(\) – Extract enclave service” on page 463](#)
- [“ImportWorkUnit\(\) – WLM import service” on page 838](#)
- [“UnDoExportWorkUnit\(\) – WLM undo export service” on page 1938](#)
- [“UnDoImportWorkUnit\(\) – WLM undo import service” on page 1939](#)
- For more information, see [z/OS MVS Programming: Workload Management Services](#)

raise() – Raise signal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <signal.h>

int raise(int sig);
```

General description

Sends the signal *sig* to the program that issued `raise()`. See [Table 59 on page 1637](#) for the list of signals supported.

You can use `signal()` to specify how a signal will be handled when `raise()` is invoked.

In C++ only, the use of `signal()` and `raise()` with `try()`, `catch()`, or `throw()` is undefined. The use of `signal()` and `raise()` with destructors is also undefined.

Special behavior for POSIX: To obtain access to the special POSIX behavior for `raise()`, the POSIX runtime option must be set ON, and the version of MVS must be 4.3 or higher.

The `raise()` function sends the signal, `sig`, to the process that issued the `raise()`. If the signal is not blocked, it is delivered to the sender before `raise()` returns. See [Table 57 on page 1606](#) in the description of the `sigaction()` function for the list of signals supported.

You can use `signal()` or `sigaction()` to specify how a signal will be handled when `raise()` is invoked.

Special behavior for XPG4.2: To obtain access to the special POSIX behavior for `raise()`, the POSIX runtime option must be set ON, and the version of MVS must be 4.3 or higher.

Several other functions are available to the XPG4.2 application for affecting the behavior of a signal:

- `bsd_signal()`
- `sigignore()`
- `sigset()`

Special behavior for C++: The behavior when mixing signal-handling with C++ exception handling is undefined. Also, the use of signal-handling with constructors and destructors is undefined.

Usage note

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If successful, `raise()` returns 0.

If unsuccessful, `raise()` returns nonzero.

Special behavior for XPG4: The `raise()` function sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of the `sig` argument is an invalid signal number.

Example

CELEBR01

```
/* CELEBR01

This example establishes a signal handler called sig_hand for the
signal SIGUSR1.
The signal handler is called whenever the SIGUSR1 signal is raised and
will ignore the first nine occurrences of the signal.
On the tenth raised signal, it exits the program with an error code of 10.
Note that the signal handler must be reestablished each time it is called.

*/
#include <signal.h>
#include <stdio.h>
#include <stdlib.h>

#ifdef __cplusplus
extern "C" {
#endif
    void sig_hand(int);
#ifdef __cplusplus
}
#endif
int i;

int main(void)
```

```

{
    signal(SIGUSR1, sig_hand); /* set up handler for SIGUSR1 */
    for (i=0; i<10; ++i)
        raise(SIGUSR1);      /* signal SIGUSR1 is raised */
}                             /* sig_hand() is called */

void sig_hand(int dummy)
{
    static int count = 0;      /* initialized only once */

    count++;
    if (count == 10) /* ignore the first 9 occurrences of this signal */
    {
        printf("reached 10th signal\n");
        exit(10);
    }
    else
        signal(SIGUSR1, sig_hand); /* set up the handler again */
}

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“killpg\(\) — Send a signal to a process group” on page 933](#)
- [“pthread_kill\(\) — Send a signal to a thread” on page 1293](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)

rand() — Generate random number

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <stdlib.h>

int rand(void);

```

General description

Generates a pseudo-random integer in the range 0 to RAND_MAX. Use the srand() function before calling rand() to set a seed for the random number generator. If you do not make a call to srand(), the default seed is 1.

Returned value

Returns the calculated value.

Example

CELEBR02

```
/* CELEBR02
   This example prints the first 10 random numbers generated.
*/
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    int x;

    for (x = 1; x <= 10; x++)
        printf("iteration %d, rand=%d\n", x, rand());
}
```

Output

```
iteration 1, rand=16838
iteration 2, rand=5758
iteration 3, rand=10113
iteration 4, rand=17515
iteration 5, rand=31051
iteration 6, rand=5627
iteration 7, rand=23010
iteration 8, rand=7419
iteration 9, rand=16212
iteration 10, rand=4086
```

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“rand_r\(\) – Pseudo-random number generator” on page 1378](#)
- [“srand\(\) – Set seed for rand\(\) function” on page 1703](#)

rand_r() – Pseudo-random number generator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <stdlib.h>

int rand_r(unsigned int *seed);
```

General description

The `rand_r()` function generates a sequence of pseudo-random integers in the range 0 to **RAND_MAX**. (The value of the **RAND_MAX** macro will be at least 32767.)

If `rand_r()` is called with the same initial value for the object pointed to by *seed* and that object is not modified between successive returns and calls to `rand_r()`, the same sequence shall be generated.

Returned value

`rand_r()` returns a pseudo-random integer.

There are no documented errno values.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“rand\(\) — Generate random number” on page 1377](#)
- [“srand\(\) — Set seed for rand\(\) function” on page 1703](#)

random() — A better random-number generator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

long random(void);
```

General description

The `random()` function uses a nonlinear additive feedback random-number generator employing a default state array size of 31 long integers to return successive pseudo-random numbers in the range from 0 to $2^{31}-1$. The period of this random-number generator is approximately $16 \times (2^{31}-1)$. The size of the state array determines the period of the random-number generator. Increasing the state array size increases the period.

With 256 bytes of state information, the period of the random-number generator is greater than 2^{69} .

Like `rand()`, `random()` produces by default a sequence of numbers that can be duplicated by calling `srandom()` with 1 as the seed. The state information for the random functions is maintained on a per-thread basis. For example, calls to `srandom()` in one thread will have no effect on the numbers generated by calls to `random()` in another thread.

Returned value

`random()` returns the generated pseudo-random number.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)

- [“drand48\(\) — Pseudo-random number generator”](#) on page 403
- [“initstate\(\) — Initialize generator for random\(\)”](#) on page 866
- [“setstate\(\) — Change generator for random\(\)”](#) on page 1583
- [“srandom\(\) — Use seed to initialize generator for random\(\)”](#) on page 1704

read() — Read from a file or socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define POSIX_SOURCE
#include <unistd.h>

ssize_t read(int fs, void *buf, size_t N);
```

X/Open

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

ssize_t read(int fs, void *buf, ssize_t N);
```

Berkeley sockets

```
#define _OE_SOCKETS
#include <unistd.h>

ssize_t read(int socket, void *buf, ssize_t N);
```

General description

From the file indicated by the file descriptor *fs*, the `read()` function reads *N* bytes of input into the memory area indicated by *buf*. A successful `read()` updates the access time for the file.

If *fs* refers to a regular file or any other type of file on which the process can seek, `read()` begins reading at the file offset associated with *fs*. If successful, `read()` changes the file offset by the number of bytes read. *N* should not be greater than `INT_MAX` (defined in the `limits.h` header file).

If *fs* refers to a file on which the process cannot seek, `read()` begins reading at the current position. There is no file offset associated with such a file.

If *fs* refers to a socket, `read()` is equivalent to `recv()` with no flags set.

Parameter

Description

fs

The file or socket descriptor.

buf

The pointer to the buffer that receives the data.

N

The length in bytes of the buffer pointed to by the *buf* parameter.

Behavior for sockets: The `read()` call reads data on a socket with descriptor `fs` and stores it in a buffer. The `read()` call applies only to connected sockets. This call returns up to *N* bytes of data. If there are fewer bytes available than requested, the call returns the number currently available. If data is not available for the socket `fs`, and the socket is in blocking mode, the `read()` call blocks the caller until data arrives. If data is not available, and the socket is in nonblocking mode, `read()` returns a -1 and sets the error code to `EWOULDBLOCK`. See “`ioctl()` — Control device” on page 872 or “`fcntl()` — Control open file descriptors” on page 483 for a description of how to set nonblocking mode.

For datagram sockets, this call returns the entire datagram that was sent, provided that the datagram fits into the specified buffer. Excess datagram data is discarded. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been received.

Behavior for streams: A `read()` from a STREAMS file can read data in three different modes: byte-stream mode, message-nondiscard mode, and message-discard mode. The default is byte-stream mode. This can be changed using the `I_SRDOPT` `ioctl()` request, and can be tested with the `I_GRDOPT` `ioctl()`. In byte-stream mode, `read()` retrieves data from the STREAM until as many bytes as were requested are transferred, or until there is no more data to be retrieved. Byte-stream mode ignores message boundaries.

In STREAMS message-nondiscard mode, `read()` retrieves data until as many bytes as were requested are transferred, or until a message boundary is reached. If `read()` does not retrieve all the data in a message, the remaining data is left on the STREAM, and can be retrieved by the next `read()` call. Message-discard mode also retrieves data until as many bytes as were requested are transferred, or a message boundary is reached. However, unread data remaining in a message after the `read()` returns is discarded, and is not available for a subsequent `read()`, `readv()` or `getmsg()` call.

How `read()` handles zero-byte STREAMS messages is determined by the current read mode setting. In byte-stream mode, `read()` accepts data until it has read *N* bytes, or until there is no more data to read, or until a zero-byte message block is encountered. The `read()` function then returns the number of bytes read, and places the zero-byte message back on the STREAM to be retrieved by the next `read()`, `readv()` or `getmsg()`. In message-nondiscard mode or message-discard mode, a zero-byte message returns 0 and the message is removed from the STREAM. When a zero-byte message is read as the first message on a STREAM, the message is removed from the STREAM and 0 is returned, regardless of the read mode.

A `read()` from a STREAMS file returns the data in the message at the front of the STREAM head read queue, regardless of the priority band of the message.

By default, STREAMS are in control-normal mode, in which a `read()` from a STREAMS file can only process messages that contain a data part but do not contain a control part. The `read()` fails if a message containing a control part is encountered at the STREAM head. This default action can be changed by placing the STREAM in either control-data mode or control-discard mode with the `I_SRDOPT` `ioctl()` command. In control-data mode, `read()` converts any control part to data and passes it to the application before passing any data part originally present in the same message. In control-discard mode, `read()` discards message control parts but returns to the process any data part in the message.

In addition, `read()` and `readv()` will fail if the STREAM head had processed an asynchronous error before the call. In this case, the value of `errno` does not reflect the result of `read()` or `readv()` but reflects the prior error. If a hang-up occurs on the STREAM being read, `read()` continues to operate normally until the STREAM head read queue is empty. Thereafter, it returns 0.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the long long data type support enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `read()` returns the number of bytes actually read and placed in *buf*. This number is less than or equal to *N*. It is less than *N* only if:

- `read()` reached the end of the file before reading the requested number of bytes.
- `read()` was interrupted by a signal.
- In POSIX C programs only, the file is a pipe, FIFO special file, or a character special file that has fewer than *N* bytes immediately available for reading.
- If the Physical File System does not support simple reads from directories, `read()` will return 0 if it is used for a directory. Users should use `Opendir()` and `readdir()` instead.

In POSIX C programs only, if `read()` is interrupted by a signal, the effect is one of the following:

- If `read()` has not read any data yet, it returns -1 and sets `errno` to `EINTR`.
- If `read()` has successfully read some data, it returns the number of bytes it read before it was interrupted.

If the starting position for the read operation is at the end of the file or beyond, `read()` returns 0.

In POSIX C programs, if `read()` attempts to read from an empty pipe or a FIFO special file, it has one of the following results:

- If no process has the pipe open for writing, `read()` returns 0 to indicate the end of the file.
- If some process has the pipe open for writing and `O_NONBLOCK` is set to 1, `read()` returns -1 and sets `errno` to `EAGAIN`.
- If some process has the pipe open for writing and `O_NONBLOCK` is set to 0, `read()` blocks (that is, does not return) until some data is written, or the pipe is closed by all other processes that have the pipe open for writing.

With other files that support nonblocking read operations (for example, character special files), a similar principle applies:

- If data is available, `read()` reads the data immediately.
- If no data is available and `O_NONBLOCK` is set to 1, `read()` returns -1 and sets `errno` to `EAGAIN`.
- If no data is available and `O_NONBLOCK` is set to 0, `read()` blocks until some data becomes available.

`read()` causes the signal `SIGTTIN` to be sent when all these conditions exist:

- The process is attempting to read from its controlling terminal.
- The process is running in a background process group.
- The `SIGTTIN` signal is not blocked or ignored.
- The process group of the process is not orphaned.

If `read()` is reading a regular file and encounters a part of the file that has not been written (but before the end of the file), `read()` places 0 bytes into *buf* in place of the unwritten bytes.

If the number of bytes of input that you want to read is 0, `read()` simply returns 0 without attempting any other action.

If the connection is broken on a stream socket, but data is available, then the `read()` function reads the data and gives no error. If the connection is broken on a stream socket, but no data is available, then the `read()` function returns 0 bytes as EOF.

Note: z/OS UNIX services do not supply any STREAMS devices or pseudodevices. It is impossible for `read()` to read any data from a STREAMS-based file indicated by *fs*. It will always return -1 with `errno` set to `EBADF`. `EINVAL` will never be set because there are no multiplexing STREAMS drivers. See [“open\(\) — Open a file” on page 1157](#) for more information.

If unsuccessful, `read()` returns -1 and sets `errno` to one of the following:

Error Code Description

EAGAIN

O_NONBLOCK is set to 1, but data was not available for reading.

EBADF

fs is not a valid file or socket descriptor.

ECONNRESET

A connection was forcibly closed by a peer.

EFAULT

Using the *buf* and *N* parameters would result in an attempt to access memory outside the caller's address space.

EINTR

read() was interrupted by a signal that was caught before any data was available.

EINVAL

N contains a value that is less than 0, or the request is invalid or not supported, or the STREAM or multiplexer referenced by *fs* is linked (directly or indirectly) downstream from a multiplexer.

EIO

The process is in a background process group and is attempting to read from its controlling terminal, and either the process is ignoring or blocking the SIGTTIN signal or the process group of the process is orphaned. For sockets, an I/O error occurred.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOTCONN

A receive was attempted on a connection-oriented socket that is not connected.

EOVERFLOW

The file is a regular file and an attempt was made to read or write at or beyond the offset maximum associated with the file.

ETIMEDOUT

The connection timed out during connection establishment, or due to a transmission timeout on active connection.

EWOULDBLOCK

socket is in nonblocking mode and data is not available to read, or the SO_RCVTIMEO timeout value was reached before data was available.

AT-TLS considerations: If AT-TLS is being used to provide transparent TLS/SSL support for a TCP socket and EWOULDBLOCK is returned on a blocking socket, reissue the select call or receive call to continue. For more information about AT-TLS and determining whether a TCP connection is using AT-TLS, see [Application Transparent Transport Layer Security \(AT-TLS\)](#) in *z/OS Communications Server: IP Programmer's Guide and Reference*.

Example

CELEBR03

```
/* CELEBR03

   This example opens a file and reads input.

*/
#define _POSIX_SOURCE
#include <fcntl.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    int ret, fd;
    char buf[1024];
```

```

system("ls -l / >| ls.output");

if ((fd = open("ls.output", O_RDONLY)) < 0)
    perror("open() error");
else {
    while ((ret = read(fd, buf, sizeof(buf)-1)) > 0) {
        buf[ret] = 0x00;
        printf("block read: \n<%s>\n", buf);
    }
    close(fd);
}

unlink("ls.output");
}

```

Output

```

block read:
<total 0
drwxr-xr-x  3 USER1   SYS1      0 Apr 16 07:59 bin
drwxr-xr-x  2 USER1   SYS1      0 Apr  6 10:20 dev
drwxr-xr-x  4 USER1   SYS1      0 Apr 16 07:59 etc
drwxr-xr-x  2 USER1   SYS1      0 Apr  6 10:15 lib
drwxrwxrwx  2 USER1   SYS1      0 Apr 16 07:55 tmp
drwxr-xr-x  2 USER1   SYS1      0 Apr  6 10:15 u
drwxr-xr-x  6 USER1   SYS1      0 Apr  6 10:15 usr
>

```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“close\(\) — Close a file” on page 293](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fread\(\) — Read items” on page 613](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“lseek\(\) — Change the offset of a file” on page 1023](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“pread\(\) — Read from a file or socket without file pointer change” on page 1213](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

- “writev() — Write data on a file or socket from an array” on page 2076

readdir() — Read an entry from a directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define POSIX_SOURCE
#include <dirent.h>

struct dirent *readdir(DIR *dir);
```

General description

Returns a pointer to a `dirent` structure describing the next directory entry in the directory stream associated with *dir*.

A call to `readdir()` overwrites data produced by a previous call to `readdir()` or `__readdir2()` on the same directory stream. Calls for different directory streams do not overwrite each other's data.

Each call to `readdir()` updates the `st_atime` (access time) field for the directory.

A `dirent` structure contains the character pointer *d_name*, which points to a string that gives the name of a file in the directory. This string ends in a terminating NULL, and has a maximum of NAME_MAX characters.

Save the data from `readdir()`, if required, before calling `closedir()`, because `closedir()` frees the data.

If the contents of a directory have changed since the directory was opened (files added or removed); a call should be made to `rewinddir()` so that subsequent `readdir()` requests can read the new contents.

Special behavior for XPG4: If entries for dot or dot-dot exist, one entry will be returned for dot and one entry will be returned for dot-dot; otherwise they will not be returned.

After a call to `fork()`, either the parent or child (but not both) may continue processing the directory stream using `__readdir2()`, `readdir()`, `rewinddir()`, or `seekdir()`. If both the parent and child processes use these functions, the result is undefined.

Special behavior for XPG4.2: If the entry names a symbolic link, the value of `d_ino` member in *dirent* structure is unspecified.

Returned value

If successful, `readdir()` returns a pointer to a `dirent` structure describing the next directory entry in the directory stream. When `readdir()` reaches the end of the directory stream, it returns a NULL pointer.

If unsuccessful, `readdir()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

EBADF

dir does not yield an open directory stream.

EINVAL

The buffer was too small to contain any directories.

ENOENT

The current position of the directory stream is invalid.

E_OVERFLOW

One of the values in the structure to be returned cannot be represented correctly.

Note: The environment variable `_EDC_SUSV3` can be used to control the behavior of `readdir()` with respect to detecting an `E_OVERFLOW` condition. By default, `readdir()` will not detect that values in the structure returned can be represented correctly. When `_EDC_SUSV3` is set to 1, `readdir()` will check for overflow conditions.

Example**CELEBR04**

```
/* CELEBR04

   This example reads the contents of a root directory.

*/
#define _POSIX_SOURCE
#include <dirent.h>
#include <errno.h>
#include <sys/types.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    DIR *dir;
    struct dirent *entry;

    if ((dir = opendir("/")) == NULL)
        perror("opendir() error");
    else {
        puts("contents of root:");
        while ((entry = readdir(dir)) != NULL)
            printf("  %s\n", entry->d_name);
        closedir(dir);
    }
}
```

Output

```
contents of root:
.
..
bin
dev
etc
lib
tmp
u
usr
```

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“__opendir2\(\) — Open a directory” on page 1170](#)
- [“readdir_r\(\) — Read an entry from a directory” on page 1389](#)
- [“__readdir2\(\), __readdir2_64\(\) — Read directory entry and get file information” on page 1387](#)

- “[rewinddir\(\)](#) — Reposition a directory stream to the beginning” on page 1450
- “[seekdir\(\)](#) — Set position of directory stream” on page 1471
- “[telldir\(\)](#) — Current location of directory stream” on page 1854
- “[fdopendir\(\)](#) — Opens directory associated with file descriptor” on page 502
- “[fdclosedir\(\)](#) — Closes directory associated with file descriptor” on page 494

__readdir2(), __readdir2_64() — Read directory entry and get file information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R6 |

Format

__readdir2:

```
#define _OPEN_SYS_DIR_EXT
#include <dirent.h>

struct dirent *__readdir2(DIR *dir, struct stat *info);
```

__readdir2_64:

```
#define _LARGE_TIME_API
#define _OPEN_SYS_DIR_EXT
#include <dirent.h>

struct dirent *__readdir2_64(DIR *dir, struct stat64 *info);
```

Compile requirement: Use of the `__readdir2_64` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The `__readdir2()` function returns a pointer to a `dirent` structure describing the next directory entry in the directory stream associated with `dir`.

The `__readdir2_64()` function behaves exactly like `__readdir2()` except `__readdir2_64()` uses structure `stat64` instead of `struct stat` to support time beyond 03:14:07 UTC on January 19, 2038.

A `dirent` structure contains the character pointer `d_name`, which points to a string that gives the name of a file in the directory. This string ends in a terminating NULL, and has a maximum of `NAME_MAX` characters.

The `info` argument points to an area of storage that will be filled in with information about the file `d_name`. This information is returned in a `stat` structure defined in the `sys/stat.h` header file. The format of this structure is described in the section about the `lstat()` function. If `info` is NULL, no `stat` information is passed back.

If entries for dot or dot-dot exist, one entry will be returned for dot and one entry will be returned for dot-dot; otherwise they will not be returned.

A call to `__readdir2()` overwrites data produced by a previous call to `__readdir2()` or `readdir()` on the same directory stream. Calls for different directory streams do not overwrite each other's data.

Save the `dirent` data from `__readdir2()`, if required, before calling `closedir()`, because `closedir()` frees the `dirent` data.

The `__readdir2()` function may buffer several directory entries per actual read operation. `__readdir2()` updates the `st_atime` (access time) field of the directory each time the directory is actually read.

After a call to `fork()`, either the parent or child (but not both) may continue processing the directory stream using `__readdir2()`, `readdir()`, `rewinddir()` or `seekdir()`. If both the parent and child processes use these functions, the result is undefined.

If the entry names a symbolic link, the value of `d_ino` member in *dirent* structure is unspecified.

Unpredictable results can occur if `closedir()` is used to close the directory stream before `__readdir2()` is called. If the contents of a directory have changed since the directory was opened (files added or removed), a call should be made to `rewinddir()` so that subsequent `__readdir2()` requests can read the new contents.

The output from this function is similar to a combination of `readdir()` and `lstat()`. In some cases, certain information in the output `stat` structure differs from what `lstat()` would return. Also, the `d_extra` field in *dir* is always NULL for `__readdir2()`.

Returned value

If successful, `__readdir2()` returns a pointer to a *dirent* structure describing the next directory entry in the directory stream. When `__readdir2()` reaches the end of the directory stream, it returns a NULL pointer.

If unsuccessful, `__readdir2()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

EBADF

dir does not yield an open directory stream.

EINVAL

The buffer was too small to contain any directories.

ELOOP

A loop exists in symbolic links. This error occurs if the number of symbolic links in a file name in the directory is greater than `POSIX_SYMLLOOP`.

ENOENT

The current position of the directory stream is invalid.

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“__opendir2\(\) — Open a directory” on page 1170](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“readdir_r\(\) — Read an entry from a directory” on page 1389](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)

readdir_r() — Read an entry from a directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <dirent.h>

int readdir_r(DIR *__restrict__dir, struct dirent *__restrict__entry,
              struct dirent **__restrict__result);
```

General description

The `readdir_r()` function initializes the `dirent` structure referenced by *entry* to represent the directory entry at the current position in the directory stream referred to by *dir*, stores a pointer to this structure at the location referenced by *result*, and positions the directory stream at the next entry.

The storage pointed to by *entry* will be large enough for a `dirent` with an array of `char d_name` member containing at least **NAME_MAX**+1 elements.

On successful return, the pointer returned at **result* will have the same value as the argument *entry*. Upon reaching the end of the directory stream, this pointer will have the value `NULL`.

The `readdir_r()` function will not return directory entries containing empty names. It is unspecified whether entries are returned for dot or dot-dot.

If a file is removed from or added to the directory after the most recent call to `opendir()` or `rewinddir()`, whether a subsequent call to `readdir_r()` returns an entry for that file is unspecified.

The `readdir_r()` function may buffer several directory entries per actual read operation. The `readdir_r()` function marks for update the `st_atime` field of the directory each time the directory is actually read.

Applications wishing to check for error situations should set `errno` to 0 before calling `readdir_r()`. If `errno` is set to non-zero on return, an error occurred.

Returned value

If successful, `readdir_r()` returns 0.

If unsuccessful, `readdir_r()` sets `errno` to one of the following values:

Error Code

Description

EBADF

dir does not refer to an open directory stream.

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)

- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“__opendir2\(\) — Open a directory” on page 1170](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“__readdir2\(\), __readdir2_64\(\) — Read directory entry and get file information” on page 1387](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)

readlink() — Read the value of a symbolic link

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1a XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX1_SOURCE 2
#include <unistd.h>

int readlink(const char *path,
             char *buf, size_t bufsiz);

#define _POSIX_C_SOURCE 200112L
#include <unistd.h>

ssize_t readlink(const char *__restrict__path,
                 char *__restrict__buf, size_t bufsiz);
```

General description

Places the contents of the symbolic link *path* in the buffer *buf*. The size of the buffer is set by *bufsiz*. The result stored in *buf* does not include a terminating NULL character.

If the buffer is too small to contain the value of the symbolic link, that value is truncated to the size of the buffer (*bufsiz*). If the value returned is the size of the buffer, use `lstat()` to determine the actual size of the symbolic link.

Returned value

If successful, when *bufsiz* is greater than 0, `readlink()` returns the number of bytes placed in the buffer. When *bufsiz* is 0 and `readlink()` completes successfully, it returns the number of bytes contained in the symbolic link and the buffer is not changed.

If the returned value is equal to *bufsiz*, you can determine the contents of the symbolic link with either `lstat()` or `readlink()`, with a 0 value for *bufsiz*.

If unsuccessful, `readlink()` returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EACCES
Search permission is denied for a component of the path prefix.

EINVAL

The named file is not a symbolic link.

EIO

An I/O error occurred while reading from the file system.

ELOOP

A loop exists in symbolic links. This error is issued if more than POSIX_SYMLINK_MAX symbolic links are encountered during resolution of the *path* argument.

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters, or some component of *pathname* is longer than **NAME_MAX** characters while **_POSIX_NO_TRUNC** is in effect. For symbolic links, the length of the path name string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using `pathconf()`.

ENOENT

The named file does not exist.

ENOTDIR

A component of the path prefix is not a directory.

Example**CELEBR05**

```
/* CELEBR05 */
#define _POSIX_SOURCE 1
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE

main() {
    char fn[]="readlink.file";
    char sl[]="readlink.symlink";
    char buf[30];
    int fd;

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        close(fd);
        if (symlink(fn, sl) != 0)
            perror("symlink() error");
        else {
            if (readlink(sl, buf, sizeof(buf)) < 0)
                perror("readlink() error");
            else printf("readlink() returned '%s' for '%s'\n", buf, sl);

            unlink(sl);
        }
        unlink(fn);
    }
}
```

Output

```
readlink() returned 'readlink.file' for 'readlink.symlink'
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“lstat\(\), lstat64\(\) — Get status of file or symbolic link” on page 1025](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

readlinkat() — Read value of a symbolic link relative to a directory file descriptor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>           /* Definition of AT_* constants */
#include <unistd.h>

ssize_t readlinkat(int dirfd, const char *pathname, char *buf, size_t bufsz);
```

General description

readlinkat() operates in the same way as readlink() except for the following differences.

- If the *pathname* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *dirfd*, rather than relative to the current working directory of the calling process, as is done by readlink() for a relative *pathname*.
- If *pathname* is relative and *dirfd* is the special value AT_FDCWD, *pathname* is interpreted relative to the current working directory of the calling process.
- If *pathname* is absolute, *dirfd* is ignored.

Returned value

If successful, readlinkat() returns the number of bytes that are placed in *buf*. If the returned value equals *bufsize*, truncation might occur.

If unsuccessful, readlinkat() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

- | | |
|---------------------|--|
| EACCES | Search permission is denied for a component of the path prefix. |
| EBADF | <i>pathname</i> is relative but <i>dirfd</i> is not AT_FDCWD or a valid file descriptor. |
| EINVAL | The named file is not a symbolic link, or there is a problem with the supplied buffer. |
| ELOOP | A loop exists in symbolic links. This error is issued if more than POSIX_SYMLINK_MAX symbolic links are encountered during resolution of <i>pathname</i> . |
| ENAMETOOLONG | <i>pathname</i> is longer than PATH_MAX characters, or some component of <i>pathname</i> is longer than NAME_MAX characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the path name string that is substituted for a symbolic link exceeds PATH_MAX. The PATH_MAX and NAME_MAX values can be determined by using pathconf(). |
| ENOENT | The named file does not exist, or <i>pathname</i> is relative and <i>dirfd</i> refers to a directory that is deleted. |

ENOTDIR

A component of the path prefix is not a directory, or *pathname* is relative and *dirfd* is a file descriptor that refers to a file other than a directory.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“readlink\(\) — Read the value of a symbolic link” on page 1390](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

readv() — Read data on a file or socket and store in a set of buffers

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**X/Open**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/uio.h>

ssize_t readv(int fs, const struct iovec *iov, int iocnt);
```

Berkeley sockets

```
#define _OE_SOCKETS
#include <sys/uio.h>

int readv(int fs, struct iovec *iov, int iocnt);
```

General description

The `readv()` function reads data from a file or a socket with descriptor *fs* and stores it in a set of buffers. The data is scattered into the buffers specified by `iov[0]...iov[iocnt-1]`.

Parameter**Description*****fs***

The file or socket descriptor.

iov

A pointer to an **iovec** structure.

iocnt

The number of buffers pointed to by the *iov* parameter.

The **iovec** structure is defined in **uio.h** and contains the following fields:

Element**Description*****iov_base***

The pointer to the buffer.

iov_len

The length of the buffer.

If the descriptor refers to a socket, then it must be a connected socket.

This call returns a number of bytes of data equal to but not exceeding the sum of all the *iov_len* fields. If less than the number of bytes requested is available, the call returns the number currently available. If data is not available for the socket *fs*, and the socket is in blocking mode, *readv()* call blocks the caller until data arrives. If data is not available and *fs* is in nonblocking mode, *readv()* returns a -1 and sets the error code to EWOULDBLOCK. See [“fcntl\(\) — Control open file descriptors” on page 483](#) or [“ioctl\(\) — Control device” on page 872](#) for a description of how to set nonblocking mode.

For datagram sockets, this call returns the entire datagram that was sent, provided that the datagram fits into the specified buffer. Excess datagram data is discarded. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been received.

For X/Open sockets, if the total number of bytes to read is 0, *readv()* returns 0. If *readv()* is for a file and no data is available, *readv()* returns 0. If a *readv()* is interrupted by a signal before it reads any data, it returns -1 with *errno* set to EINTR. If *readv()* is interrupted by a signal after it has read data, it returns the number of bytes read. If *fs* refers to a socket, *readv()* is the equivalent of *recv()* with no flags set.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, *readv()* returns the number of bytes read into the buffer.

If the connection is broken on a stream socket and data is available, then the *readv()* function reads the data and gives no error. If the connection is broken on a stream socket and no data is available, then the *readv()* function returns 0 bytes as EOF.

If unsuccessful, *readv()* returns -1 and sets *errno* to one of the following values:

Error Code**Description****EAGAIN**

The **O_NONBLOCK** flag is set for the file descriptor and the process would be delayed by the *readv()*.

EBADF

fs is not a valid file or socket descriptor.

ECONNRESET

A connection was forcibly closed by a peer.

EFAULT

Using *iov* and *iovcnt* would result in an attempt to access storage outside the caller's address space.

EINTR

readv() was interrupted by a signal that was caught before any data was available.

EINVAL

iovcnt was not valid, or one of the fields in the *iov* array was not valid.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOTCONN

A receive is attempted on a connection-oriented socket that is not connected.

ETIMEDOUT

The connection timed out during connection establishment, or due to a transmission timeout on active connection.

EWOULDBLOCK

socket is in nonblocking mode and data is not available to read, or the `SO_RCVTIMEO` timeout value was reached before data was available.

AT-TLS considerations: If AT-TLS is being used to provide transparent TLS/SSL support for a TCP socket and `EWOULDBLOCK` is returned on a blocking socket, reissue the `select` call or `receive` call to continue. For more information about AT-TLS and determining whether a TCP connection is using AT-TLS, see [Application Transparent Transport Layer Security \(AT-TLS\)](#) in *z/OS Communications Server: IP Programmer's Guide and Reference*.

Related information

- [“sys/uio.h — Vector I/O operations” on page 73](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“writev\(\) — Write data on a file or socket from an array” on page 2076](#)

realloc() — Change reserved storage block size

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

void *realloc(void *ptr, size_t size);
```

General description

Changes the size of a previously reserved storage block. The *ptr* argument points to the beginning of the block. The *size* argument gives the new size of the block in bytes. The contents of the block are unchanged up to the shorter of the new and old sizes.

If the *ptr* is NULL, `realloc()` reserves a block of storage of *size* bytes. It does not give all bits of each element an initial value of 0.

If *size* is 0 and *ptr* is not NULL, the storage pointed to by *ptr* is freed and NULL is returned.

If you use `realloc()` with a pointer that does not point to a *ptr* created previously by `malloc()`, `calloc()`, or `realloc()`, or if you pass *ptr* to storage already freed, you get undefined behavior—usually an exception.

If you ask for more storage, the contents of the extension are undefined and are not guaranteed to be 0.

The storage to which the returned value points is aligned for storage of any type of object. Under IBM z/OS C only, if 4K alignment is required, the `__4kmalc()` function should be used. (This function is only available to C applications in stand-alone System Programming C (SPC) Facility applications.) The library functions specific to the System Programming C (SPC) environment are described in [z/OS XL C/C++ Programming Guide](#).

To investigate the cause of `realloc()` running out of heap storage, see [z/OS Language Environment Programming Reference](#)

Note: The environment variable `_CEE_REALLOC_CONTROL` controls reallocation that can lead to improved application performance. For more information about the `_CEE_REALLOC_CONTROL` environment variable, see [z/OS XL C/C++ Programming Guide](#).

Special behavior for C++: The C++ keywords `new` and `delete` are not interoperable with `aligned_alloc()`, `calloc()`, `free()`, `malloc()`, `posix_memalign()`, or `realloc()`.

Note: To use the `aligned_alloc()` function, compile the source code with [C11 standard based compilation](#).

Returned value

If successful, `realloc()` returns a pointer to the reallocated storage block. The storage location of the block might be moved. Thus, the returned value is not necessarily the same as the *ptr* argument to `realloc()`.

The returned value is NULL if *size* is 0. If there is not enough storage to expand the block to the given size, the original block is unchanged and a NULL pointer is returned. If `realloc()` returns NULL because there is not enough storage, it will also set `errno` to one of the following values:

Error Code

Description

ENOMEM

Insufficient memory is available

Example

CELEBR06

```
/* CELEBR06

This example allocates storage for the prompted size of array
and then uses &realloc. to reallocate the block to hold the
new size of the array.
The contents of the array are printed after each allocation.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
```

```

{
    long * array;      /* start of the array */
    long * ptr;        /* pointer to array */
    int i;             /* index variable */
    int num1, num2;    /* number of entries of the array */

    void print_array( long *ptr_array, int size);

    printf( "Enter the size of the array\n" );
    scanf( "%i", &num1 );

    /* allocate num1 entries using malloc() */
    if ( (array = (long *)malloc( num1 * sizeof( long ))) != NULL ) {
        for ( ptr = array, i = 0; i < num1 ; ++i ) /* assign values */
            *ptr++ = i;
        print_array( array, num1 );
        printf("\n");
    }
    else { /* malloc error */
        printf( "Out of storage\n" );
        abort();
    }

    /* Change the size of the array ... */
    printf( "Enter the size of the new array\n" );
    scanf( "%i", &num2);

    if ( (array = (long *)realloc( array, num2* sizeof( long ))) != NULL )
    {
        for ( ptr = array + num1, i = num1; i <= num2; ++i )
            *ptr++ = i + 2000; /* assign values to new elements */
        print_array( array, num2 );
    }
    else { /* realloc error */
        printf( "Out of storage\n" );
        abort();
    }
}

void print_array( long * ptr_array, int size )
{
    int i;
    long * index = ptr_array;

    printf("The array of size %d is:\n", size);
    for ( i = 0; i < size; ++i ) /* print the array out */
        printf( " array[ %i ] = %li\n", i, ptr_array[i] );
}

```

Output: If the initial value entered is 2 and the second value entered is 4, then expect the following output:

```

Enter the size of the array
The array of size 2 is:
array[ 0 ] = 0
array[ 1 ] = 1

Enter the size of the new array
The array of size 4 is:
array[ 0 ] = 0
array[ 1 ] = 1
array[ 2 ] = 2002
array[ 3 ] = 2003

```

Related information

- “System Programming C (SPC) Facilities” in [z/OS XL C/C++ Programming Guide](#)
- “spc.h — System library functions and storage allocation” on page 59
- “stdlib.h — Standard library functions” on page 65
- “aligned_alloc() — Allocating aligned memory blocks” on page 157
- “calloc() — Reserve and initialize storage” on page 232
- “free() — Free a block of storage” on page 620

- [“malloc\(\) — Reserve storage block”](#) on page 1035
- [“posix_memalign\(\) — Reserve aligned storage block”](#) on page 1201

realpath() — Resolve path name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

char *realpath(const char *__restrict__file_name, char *__restrict__resolved_name);
```

General description

The realpath() function derives, from the path name pointed to by *file_name*, an absolute path name that names the same file, whose resolution does not involve ":", "..", or symbolic links. The generated path name is stored, up to a maximum of **PATH_MAX** bytes, in the buffer pointed to by *resolved_name*.

Returned value

If successful, realpath() returns a pointer to the resolved name.

If unsuccessful, the contents of the buffer pointed to by *resolved_name* are undefined, realpath() returns a NULL pointer and sets errno to one of the following values:

Error Code

| Description |
|---|
| EACCES Read or search permission was denied for a component of <i>file_name</i> . |
| EINVAL Either the <i>file_name</i> or <i>resolved_name</i> argument is a NULL pointer. |
| EIO An error occurred while reading from the file system. |
| ELOOP Too many symbolic links were encountered in resolving <i>path</i> |
| ENAMETOOLONG Path name is longer than PATH_MAX characters, or some component of path name is longer than NAME_MAX characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the path name string substituted for a symbolic link exceeds PATH_MAX . The PATH_MAX and NAME_MAX values are determined using pathconf(). |
| ENOENT A component of <i>file_name</i> does not name an existing file or <i>file_name</i> points to an empty string. |
| ENOTDIR A component of the path prefix is not a directory. |
| ERANGE File system will return ERANGE if the result to be stored in 'resolved_name' is larger than PATH_MAX . |

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“getcwd\(\) — Get path name of the working directory” on page 697](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)

re_comp() — Compile regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <re_comp.h>

char *re_comp(const char *string);
```

General description

Restriction: This function is not supported in AMODE 64.

The `re_comp()` function converts a regular expression string into an internal form suitable for pattern matching by `re_exec()`.

The parameter *string* is a pointer to a character string defining a source regular expression to be compiled.

If `re_comp()` is called with a NULL argument, the current regular expression remains unchanged.

Strings passed to `re_comp()` must be terminated by a NULL byte, and may include newline characters.

Notes:

1. The `re_comp()` and `re_exec()` functions are supported on the thread-level. They must be issued from the *same* thread to work properly.
2. The `re_comp()` and `re_exec()` functions are provided for historical reasons. These functions were part of the Legacy Feature in Single UNIX Specification, Version 2. They have been withdrawn and are not supported as part of Single UNIX Specification, Version 3. New applications should use the newer functions `fnmatch()`, `glob()`, `regcomp()` and `regexexec()`, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001.
3. The z/OS UNIX implementation of the `re_comp()` function supports only the POSIX locale. Any other locales will yield unpredictable results.

The `re_comp()` function supports simple regular expressions, which are defined below.

Simple regular expressions: A Simple Regular Expression (SRE) specifies a set of character strings. The simplest form of regular expression is a string of characters with no special meaning. A small set of special characters, known as metacharacters, do have special meaning when encountered in patterns.

The following one-character regular expressions (RE) match a single character:

1. An ordinary character *c* (*not* a special character) is a one character regular expression that matches itself.
2. A backslash (\) followed by any special character (that is, |*c* where *c* is any special character) is a one character regular expression that matches the special character itself. The special characters are:

- a. ., *, [, and \ (period, asterisk, left square bracket, and backslash, respectively) which are always special, except when they appear within square brackets ([]).
- b. ^ (caret or circumflex), which is special at the beginning of the entire regular expression, or when it immediately follows the left of a pair of square brackets ([]).
- c. \$ (dollar symbol), which is special at the end of the regular expression.
- d. The character used to bound (delimit) an entire regular expression, which is special for that regular expression.

Note: A backslash (\) followed by an ordinary character is a one character regular expression that matches the ordinary character itself.

- 3. A period (.) is a one-character RE that matches any character, except newline.
- 4. A non-empty string within square brackets (*[string]*) is a one-character RE that matches any one character in that *string*. Thus, *[abc]*, if compared to other strings, would match any which contained a, b, or c.

If the caret symbol (^) is the first character of the string within square brackets (that is, *^[string]*), the one-character RE matches any characters except newline and the remaining characters within the square brackets. Thus, *^[abc]*, if compared to other strings, would *fail* to match any which contains even one a, b, or c.

Ranges may be specified as *c-c*. The hyphen symbol, within square brackets, means "through". It may be used to indicate a range of consecutive ASCII characters. For example, *[0-9]* is equivalent to *[0123456789]*.

The - (hyphen) can be used by itself, but only if it is the first (after an initial ^, if any), or last character in the expression.

The right square bracket (]) can be used as part of the string but only if it is the first character within it (after an initial ^, if any). For example, the expression *[]a-d]* matches either a right square bracket or one of the characters a through d.

The following rules may be used to construct REs from one character REs:

- 1. A one-character RE is a RE that matches whatever the one-character RE matches.
- 2. A one-character RE followed by an asterisk symbol (*) is a RE that matches 0 or more occurrences of the one-character RE. For example, *(a*e)* will match any of the following: e, ae, aaaaae. The longest leftmost match is chosen.
- 3. A one-character RE followed by *\{m\}*, *\{m,\}*, or *\{m,u\}* is a RE that matches a range of occurrences of the one-character RE. Nonnegative integer values enclosed in *\{\}* indicate the number of times to apply the preceding one-character RE. *m* is the minimum number and *u* is the maximum number. *u* must be less than 256. If you specify only *m*, it indicates the exact number of times to apply the regular expression.

\{m,\} is equivalent to *\{m,u\}*. They both match *m* or more occurrences of the expression. The * (asterisk) operation is equivalent to *\{0,\}*.

The maximum number of occurrences is matched.

- 4. REs can be concatenated. The concatenation of REs is a RE that matches the concatenation of the strings matched by each component of the RE.
- 5. A RE enclosed between the character sequences *\(and \)* is a RE that matches whatever the unadorned RE matches. The *\(and \)* sequences are ignored.
- 6. The expression *\n* (where $1 \leq n \leq 9$) matches the same string of characters as was matched by an expression enclosed between *\(and \)* earlier in the same regular expression. The sub-expression it specified is that beginning with the *n*th occurrence of *\(* (counting from the left). For example, in the expression, *\(a\)r\((e)\)1*, the *1* is equivalent to *a*, giving *area*.

An entire RE may be constrained to match only an initial segment or final segment of a line (or both).

- 1. A caret (^) at the beginning of an entire RE constrains that RE to match an initial segment of a line.

2. A dollar symbol (\$) at the end of an entire RE constrains that RE to match a final segment of a line. For example, the construct *^entire RE\$* constrains the entire RE to match the entire line.

Returned value

If the string pointed to by the *string* argument is successfully converted, `re_comp()` returns a NULL pointer. If unsuccessful, `re_comp()` returns a pointer to an error message string (NULL-terminated).

The following `re_comp()` error messages are defined:

```
EDC7008E No previous regular expression
EDC7009E Regular expression too long
EDC7010E \(\) imbalance
EDC7011E \{\} imbalance
EDC7012E [] imbalance
EDC7013E Too many \(\) pairs.
EDC7014E Incorrect range values in \{\}
EDC7015E Back reference number in \digit incorrect
EDC7016E Incorrect endpoint in range expression
```

Note: The error message string is not to be freed by the application. It will be freed when the thread terminates.

Related information

- [“re_comp.h — Regular expression matching functions for re_comp\(\)” on page 56](#)
- [“fnmatch\(\) — Match file name or path name” on page 569](#)
- [“glob\(\) — Generate path names matching a pattern” on page 808](#)
- [“re_exec\(\) — Match regular expression” on page 1412](#)
- [“regcomp\(\) — Compile regular expression” on page 1416](#)
- [“regexec\(\) — Execute compiled regular expression” on page 1421](#)

recv() — Receive data on a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

ssize_t recv(int socket, void *buffer, size_t length, int flags);
```

Berkeley sockets

```
#define _OE_SOCKETS
#include <sys/socket.h>

int recv(int socket, char *buffer, int length, int flags);
```

General description

The `recv()` function receives data on a socket with descriptor *socket* and stores it in a buffer. The `recv()` call applies only to connected sockets.

Parameter

Description

socket

The socket descriptor.

buf

The pointer to the buffer that receives the data.

len

The length in bytes of the buffer pointed to by the *buf* parameter. If the `MSG_CONNTERM` flag is set, the length of the buffer must be zero.

flags

The *flags* parameter is set by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (`|`) must be used to separate them. The `MSG_CONNTERM` flag is mutually exclusive with other flags.

MSG_CONNTERM

Requests that the function completes only when a TCP connection is terminated. It is valid for TCP sockets only. Other normal receive requests are also completed. The application must be able to deal with the fact that a normal receive and this special connection termination receive might be driven in parallel.

MSG_OOB

Reads any out-of-band data on the socket. Out-of-band data is sent when the `MSG_OOB` flag is on for a `send()`, `sendto()`, or `sendmsg()`.

The `fcntl()` command should be used with `F_SETOWN` to specify the recipient, either a pid or a gid, of a SIGURG signal that will be sent when out-of-band data is sent. If no recipient is set, no signal will be sent. For more information, see the `fcntl()` command. The recipient of the data determines whether to receive out-of-band data inline or not inline by the setting of the `SO_OOBINLINE` option of `setsockopt()`. If `SO_OOBINLINE` is set off and the `MSG_OOB` flag is set on, the out-of-band data byte will be read out-of-line. It is invalid for the `MSG_OOB` flag to be set on when `SO_OOBINLINE` is set on. If there is out-of-band data available, and the `MSG_OOB` flag is not set (`SO_OOBINLINE` can be on or off), then the data up to, but not including, the out-of-band data will be read. When the read cursor has reached the out-of-band data byte, then only the out-of-band data will be read on the next read. The `SIOCATMARK` option of `ioctl()` can be used to determine if the read cursor is currently at the out-of-band data byte. For more information, refer to the `setsockopt()` and `ioctl()` commands.

MSG_PEEK

Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation sees the same data.

MSG_WAITALL

Requests that the function block until the full amount of data requested can be returned. The function may return a smaller amount of data if a signal is caught, the connection is terminated, an error is pending, or `SO_RCVTIMEO` is set and the timer is expired for the socket.

This call returns the length of the incoming message or data. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard excess bytes. If data is not available for the socket *socket*, and *socket* is in blocking mode, the `recv()` call blocks the caller until data arrives. If data is not available and *socket* is in nonblocking mode, `recv()` returns a -1 and sets the error code to `EWOULDBLOCK`. See “[fcntl\(\) — Control open file descriptors](#)” on page 483 or “[ioctl\(\) — Control device](#)” on page 872 for a description of how to set nonblocking mode.

For datagram sockets, this call returns the entire datagram that was sent, provided that the datagram fits into the specified buffer. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and application A sends

1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been received.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` feature test macro.

Returned value

If successful, `recv()` returns the length of the message or datagram in bytes. The value 0 indicates the connection is closed.

If unsuccessful, `recv()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EBADF

socket is not a valid socket descriptor.

ECONNRESET

A connection was forcibly closed by a peer.

EFAULT

Using the *buf* and *len* parameters would result in an attempt to access storage outside the caller's address space.

EINTR

The `recv()` call was interrupted by a signal that was caught before any data was available.

EINVAL

The request is invalid or not supported. The `MSG_OOB` flag is set and no out-of-band data is available.

EIO

There has been a network or transport failure.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOTCONN

A receive is attempted on a connection-oriented socket that is not connected.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The specified flags are not supported for this socket type or protocol.

ETIMEDOUT

The connection timed out during connection establishment, or due to a transmission timeout on active connection.

EWOULDBLOCK

socket is in nonblocking mode and data is not available to read, or the `SO_RCVTIMEO` timeout value was reached before data was available.

AT-TLS considerations: If AT-TLS is being used to provide transparent TLS/SSL support for a TCP socket and `EWOULDBLOCK` is returned on a blocking socket, reissue the `select` call or receive call to continue. For more information about AT-TLS and determining whether a TCP connection is using AT-TLS, see [Application Transparent Transport Layer Security \(AT-TLS\)](#) in *z/OS Communications Server: IP Programmer's Guide and Reference*.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)

- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“writev\(\) — Write data on a file or socket from an array” on page 2076](#)

recvfrom() — Receive messages on a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int recvfrom(int socket, void *__restrict__ buffer,
             size_t length, int flags,
             struct sockaddr *__restrict__ address,
             socklen_t *__restrict__ address_length);
```

Berkeley sockets

```
#define _OE_SOCKETS
#include <sys/socket.h>

int recvfrom(int socket, char *buffer,
             int length, int flags,
             struct sockaddr *address,
             int *address_length);
```

General description

The `recvfrom()` function receives data on a socket named by descriptor *socket* and stores it in a buffer. The `recvfrom()` function applies to any datagram socket, whether connected or unconnected.

Parameter Description

socket

The socket descriptor.

buffer

The pointer to the buffer that receives the data.

length

The length in bytes of the buffer pointed to by the *buffer* parameter. If the MSG_CONNTERM flag is set, the length of the buffer must be zero.

flags

A parameter that can be set to 0, MSG_CONNTERM, MSG_PEEK, MSG_OOB, or MSG_WAITALL. The MSG_CONNTERM flag is mutually exclusive with other flags.

MSG_CONNTERM

Requests that the function completes only when a TCP connection is terminated. It is valid for TCP sockets only. Other normal receive requests are also completed. The application must be able to deal with the fact that a normal receive and this special connection termination receive might be driven in parallel.

AT-TLS considerations: If AT-TLS is being used to provide transparent TLS/SSL support for a TCP socket and a receive request with MSG_CONNTERM is outstanding, AT-TLS will immediately honor any TLS/SSL close notify alerts sent by the peer and initiate TLS/SSL session shutdown. For more information about AT-TLS and determining whether a TCP connection is using AT-TLS, see [Application Transparent Transport Layer Security \(AT-TLS\)](#) in *z/OS Communications Server: IP Programmer's Guide and Reference*.

MSG_OOB

Reads any out-of-band data on the socket. Out-of-band data is sent when the MSG_OOB flag is on for a send(), sendto(), or sendmsg().

The fcntl() command should be used with F_SETOWN to specify the recipient, either a pid or a gid, of a SIGURG signal that will be sent when out-of-band data is sent. If no recipient is set, no signal will be sent. For more information, see the fcntl() command. The recipient of the data determines whether to receive out-of-band data inline or not inline by the setting of the SO_OOBINLINE option of setsockopt(). If SO_OOBINLINE is set off and the MSG_OOB flag is set on, the out-of-band data byte will be read out-of-line. It is invalid for the MSG_OOB flag to be set on when SO_OOBINLINE is set on. If there is out-of-band data available, and the MSG_OOB flag is not set (SO_OOBINLINE can be on or off), then the data up to, but not including, the out-of-band data will be read. When the read cursor has reached the out-of-band data byte, then only the out-of-band data will be read on the next read. The SIOCATMARK option of ioctl() can be used to determine if the read cursor is currently at the out-of-band data byte. For more information, refer to the setsockopt() and ioctl() commands.

MSG_PEEK

Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation sees the same data.

MSG_WAITALL

Requests that the function block until the full amount of data requested can be returned. The function may return a smaller amount of data if a signal is caught, the connection is terminated, an error is pending or SO_RCVTIMEO is set and the timer is expired for the socket. For AF_UNIX, the function may also return earlier if out-of-band (OOB) data is inline and there is OOB data to be read. In this case, the data up to the OOB data is returned on the first recvfrom(). The OOB data is returned on the subsequent read request.

address

A pointer to a socket address structure from which data is received. If *address* is nonzero, the source address is returned.

address_length

Must initially point to an integer that contains the size in bytes of the storage pointed to by *address*. On return, that integer contains the size required to represent the address of the connecting socket.

If this value is larger than the size supplied on input, then the information contained in `sockaddr` is truncated to the length supplied on input. If `address` is NULL, `address_length` is ignored.

If `address` is nonzero the source address of the message is filled. `address_length` must first be initialized to the size of the buffer associated with `address` and is then modified on return to indicate the actual size of the address stored there.

If either `address` or `address_length` is a NULL pointer, then `address` and `address_length` are unchanged.

If `address` is nonzero, the source address of the message is filled. `address_length` must first be initialized to the size of the buffer associated with `address`, and is then modified on return to indicate the actual size of the address stored there.

This call returns the length of the incoming message or data. If a datagram packet is too long to fit in the supplied buffer, datagram sockets discard excess bytes. If data is not available for the socket `socket`, and `socket` is in blocking mode, the `recvfrom()` call blocks the caller until data arrives. If data is not available and `socket` is in nonblocking mode, `recvfrom()` returns a -1 and sets the error code to EWOULDBLOCK. See [“fcntl\(\) — Control open file descriptors” on page 483](#) or [“ioctl\(\) — Control device” on page 872](#) for a description of how to set nonblocking mode.

For datagram sockets, this call returns the entire datagram that was sent, provided that the datagram fits into the specified buffer. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been received.

Socket address structure for IPv6: For an AF_INET6 socket, the address is returned in a `sockaddr_in6` address structure. The `sockaddr_in6` structure is defined in the header file **netinet/in.h**.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Note: The `recvfrom()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, `recvfrom()` returns the length of the message or datagram in bytes. The value 0 indicates the connection is closed.

If unsuccessful, `recvfrom()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

`socket` is not a valid socket descriptor.

ECONNRESET

The connection was forcibly closed by a peer.

EFAULT

Using the `buffer` and `length` parameters would result in an attempt to access storage outside the caller's address space.

EINTR

A signal interrupted `recvfrom()` before any data was available.

EINVAL

The request is invalid or not supported. The MSG_OOB flag is set and no out-of-band data is available.

EIO

There has been a network or transport failure.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOTCONN

A receive is attempted on a connection-oriented socket that is not connected.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The specified flags are not supported for this socket type.

ETIMEDOUT

The connection timed out during connection establishment, or due to a transmission timeout on active connection.

EWOULDBLOCK

socket is in nonblocking mode and data is not available to read, or the `SO_RCVTIMEO` timeout value was been reached before data was available.

AT-TLS considerations: If AT-TLS is being used to provide transparent TLS/SSL support for a TCP socket and `EWOULDBLOCK` is returned on a blocking socket, reissue the `select` call or receive call to continue. For more information about AT-TLS and determining whether a TCP connection is using AT-TLS, see [Application Transparent Transport Layer Security \(AT-TLS\)](#) in *z/OS Communications Server: IP Programmer's Guide and Reference*.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“writev\(\) — Write data on a file or socket from an array” on page 2076](#)

recvmsg() — Receive messages on a socket and store in array of message headers

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

ssize_t recvmsg(int socket, struct msghdr *msg, int flags);
```

Berkeley sockets

```
#define _OE_SOCKETS
#include <sys/socket.h>

int recvmsg(int socket, struct msghdr *msg, int flags);
```

General description

The `recvmsg()` function receives messages on a socket with descriptor *socket* and stores them in an array of message headers.

Parameter

Description

socket

The socket descriptor.

msg

An array of message headers into which messages are received.

flags

The *flags* parameter is set by specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (`|`) must be used to separate them. The `MSG_CONNTERM` flag is mutually exclusive with other flags.

MSG_CONNTERM

Requests that the function completes only when a TCP connection is terminated. It is valid for TCP sockets only. Other normal receive requests are also completed. The application must be able to deal with the fact that a normal receive and this special connection termination receive might be driven in parallel.

AT-TLS considerations: If AT-TLS is being used to provide transparent TLS/SSL support for a TCP socket and `EWOULDBLOCK` is returned on a blocking socket, reissue the `select` call or `receive` call to continue. For more information about AT-TLS and determining whether a TCP connection is using AT-TLS, see [Application Transparent Transport Layer Security \(AT-TLS\) in z/OS Communications Server: IP Programmer's Guide and Reference](#).

MSG_OOB

Reads any out-of-band data on the socket. Out-of-band data is sent when the `MSG_OOB` flag is on for a `send()`, `sendto()` or `sendmsg()`.

The `fcntl` command should be used with `F_SETOWN` to specify the recipient, either a pid or a gid, of a `SIGURG` signal that will be sent when out-of-band data is sent. If no recipient is set, no signal will be sent. For more information, see the `fcntl()` command. The recipient of the data determines whether to receive out-of-band data inline or not inline by the setting of the `SO_OOBINLINE` option of `setsockopt()`. If `SO_OOBINLINE` is set off and the `MSG_OOB` flag is set on, the out-of-band data byte will be read out-of-line. It is invalid for the `MSG_OOB` flag to be set on when `SO_OOBINLINE` is set on. If there is out-of-band data available, and the `MSG_OOB` flag is not set (`SO_OOBINLINE` can be on or off), then the data up to, but not including, the out-of-band data will be read. When the read cursor has reached the out-of-band data byte, then only the out-of-band data will be read on the next read, and the output `MSG_OOB msg_flag` in the message header will be set on. The `SIOCATMARK` option of `ioctl()` can be used to determine if the read cursor is currently at the out-of-band data byte. For more information, refer to the `setsockopt()` and `ioctl()` commands.

MSG_PEEK

Peeks at the data present on the socket; the data is returned but not consumed, so that a subsequent receive operation will see the same data.

MSG_WAITALL

Requests that the function block until the full amount of data requested can be returned. The function may return a smaller amount of data if a signal is caught, the connection is terminated, an error is pending or SO_RCVTIMEO is set and the timer is expired for the socket.

A message header is defined by a `msg_hdr` structure. A definition of this structure can be found in the `sys/socket.h` include file and contains the following elements:

Element**Description*****msg_iov***

An array of *iovec* buffers into which the message is placed.

msg_iovlen

The number of elements in the *msg_iov* array. If the MSG_CONNTERM flag is set, the number of elements must be zero.

msg_name

An optional pointer to a buffer where the sender's address is stored.

msg_namelen

The size of the address buffer.

caddr_t msg_accrights

Access rights sent/received (ignored if specified by the user).

int msg_accrightslen

Length of access rights data (ignored if specified by the user).

msg_control

Ancillary data, see below.

msg_controllen

Ancillary data buffer length.

msg_flags

Flags on received message.

Ancillary data consists of a sequence of pairs, each consisting of a `cmsg_hdr` structure followed by a data array. The data array contains the ancillary data message, and the `cmsg_hdr` structure contains descriptive information that allows an application to correctly parse the data.

The `sys/socket.h` header file defines the `cmsg_hdr` structure that includes at least the following members:

Element**Description*****cmsg_len***

Data byte count, including header.

cmsg_level

Originating protocol.

cmsg_type

Protocol-specific type.

The following ancillary data are available at the IPv4 level:

Ancillary data**Description****IP_PKTINFO**

(RAW and UDP) Returns the source IP address for an outgoing packet and the outgoing interface. The data is passed in an `in_pktinfo` structure as defined in `netinet/in.h`.

The following ancillary data are available at the IPv6 level:

Ancillary data Description

IPV6_HOPLIMIT

(RAW, TCP, and UDP) Returns the maximum hop limit for an incoming packet. The data is passed in a structure as defined in `netinet/in.h`.

IPV6_PATHMTU

(RAW and UDP) Returns the path MTU value for the source of a connected socket. The data is passed in a structure as defined in `netinet/in.h`.

IPV6_PKTINFO

(RAW and UDP) Returns the source IP address for an outgoing packet and the outgoing interface. The data is passed in an `in6_pktinfo` structure as defined in `netinet/in.h`.

The following ancillary data are available at the socket level:

Ancillary data Description

SCM_RIGHTS

Returns the data array that contains the access rights to be sent or received. This ancillary data is valid only for the `AF_UNIX` domain. The structure is defined in `sys/socket.h`.

The `sys/socket.h` header file defines the following macros to gain access to the data arrays in the ancillary data associated with a message header:

CMMSG_DATA(*cmsg*)

If the argument is a pointer to a `cmsg_hdr` structure, this macro returns an unsigned character pointer to the data array associated with the `cmsg_hdr` structure.

CMMSG_NXTHDR(*mhdr, cmsg*)

If the first argument is a pointer to a `msg_hdr` structure and the second argument is a pointer to a `cmsg_hdr` structure in the ancillary data, pointed to by the `msg_control` field of that `msg_hdr` structure, this macro returns a pointer to the next `cmsg_hdr` structure, or a NULL pointer if this structure is the last `cmsg_hdr` in the ancillary data.

CMMSG_FIRSTHDR(*mhdr*)

If the argument is a pointer to a `msg_hdr` structure, this macro returns a pointer to the first `cmsg_hdr` structure in the ancillary data associated with this `msg_hdr` structure, or a NULL pointer if there is no ancillary data associated with the `msg_hdr` structure.

The `recvmsg()` function applies to sockets, regardless of whether they are in the connected state.

This call returns the length of the data received. If data is not available for the socket *socket*, and *socket* is in blocking mode, the `recvmsg()` call blocks the caller until data arrives. If data is not available and *socket* is in nonblocking mode, `recvmsg()` returns a -1 and sets the error code to `EWOULDBLOCK`. See [“fcntl\(\) — Control open file descriptors” on page 483](#) or [“ioctl\(\) — Control device” on page 872](#) for a description of how to set nonblocking mode.

For datagram sockets, this call returns the entire datagram that was sent, provided that the datagram fits into the specified buffer. Stream sockets act like streams of information with no boundaries separating data. For example, if applications A and B are connected with a stream socket and application A sends 1000 bytes, each call to this function can return 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been received.

On successful completion, the `msg_flags` member for the message header is the bitwise inclusive-OR of all of the following flags that indicate conditions detected for the received message:

MSG_OOB

Out-of-band data was received.

MSG_TRUNC

Normal data was truncated.

MSG_CTRUNC

Control data was truncated.

Socket address structure for IPv6: For an AF_INET6 socket, the address is returned in a sockaddr_in6 address structure. The sockaddr_in6 structure is defined in the header file `netinet/in.h`.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Note: The `recvmsg()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `recvmsg()` returns the length of the message in bytes. The value 0 indicates the connection is closed.

If unsuccessful, `recvmsg()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

socket is not a valid socket descriptor.

ECONNRESET

The connection was forcibly closed by a peer.

EFAULT

Using *msg* would result in an attempt to access storage outside the caller's address space.

EINTR

The function was interrupted by a signal before any data was available.

EINVAL

The request is invalid or not supported. The sum of the **iov_len** values overflows a **ssize_t**.

EIO

There has been a network or transport failure.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOTCONN

A receive is attempted on a connection-oriented socket that is not connected.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The specified flags are not supported for this socket type.

ETIMEDOUT

The connection timed out during connection establishment, or due to a transmission timeout on active connection.

EWOULDBLOCK

socket is in nonblocking mode and data is not available to read, or the `SO_RCVTIMEO` timeout value was reached before data was available.

AT-TLS considerations: If AT-TLS is being used to provide transparent TLS/SSL support for a TCP socket and `EWOULDBLOCK` is returned on a blocking socket, reissue the select call or receive call to continue. For more information about AT-TLS and determining whether a TCP connection is using AT-TLS, see [Application Transparent Transport Layer Security \(AT-TLS\)](#) in *z/OS Communications Server: IP Programmer's Guide and Reference*.

Related information

- [“sys/socket.h — Sockets definitions”](#) on page 70
- [“connect\(\) — Connect a socket”](#) on page 312
- [“fcntl\(\) — Control open file descriptors”](#) on page 483

- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“writev\(\) — Write data on a file or socket from an array” on page 2076](#)

re_exec() — Match regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <re_comp.h>

int re_exec(const char *string);
```

General description

Restriction: This function is not supported in AMODE 64.

The `re_exec()` function attempts to match the string pointed to by the *string* argument with the last regular expression passed to `re_comp()`.

The parameter *string* is a pointer to a character string to be compared.

Strings passed to `re_exec()` must be terminated by a NULL byte, and may include newline characters.

Notes:

1. The `re_comp()` and `re_exec()` functions are provided for historical reasons. These functions were part of the Legacy Feature in Single UNIX Specification, Version 2. They have been withdrawn and are not supported as part of Single UNIX Specification, Version 3. New applications should use the newer functions `fnmatch()`, `glob()`, `regcomp()` and `regexexec()`, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001.
2. The z/OS UNIX implementation of the `re_exec()` function supports only the POSIX locale. Any other locales will yield unpredictable results.
3. The `re_comp()` and `re_exec()` functions are supported on the thread-level. They must be issued from the *same* thread to work properly.

The `re_exec()` function supports simple regular expressions, which are defined in [“re_comp\(\) — Compile regular expression”](#) on page 1399.

Returned value

If successful, `re_exec()` returns 1 if the input *string* matches the last compiled regular expression.

If unsuccessful, `re_exec()` returns 0 if the input *string* fails to match the last compiled regular expression, and -1 if the compiled regular expression is invalid (indicating an internal error).

Related information

- [“re_comp.h — Regular expression matching functions for re_comp\(\)”](#) on page 56
- [“fnmatch\(\) — Match file name or path name”](#) on page 569
- [“glob\(\) — Generate path names matching a pattern”](#) on page 808
- [“re_comp\(\) — Compile regular expression”](#) on page 1399
- [“regcomp\(\) — Compile regular expression”](#) on page 1416
- [“regex\(\) — Execute compiled regular expression”](#) on page 1421

regcmp() — Compile regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | C only | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <libgen.h>

char *regcmp(const char *pattern[...], (char *)0);
char *regex(const char *cmppat, const char *subject[,subexp,...]);
extern char *__loc1;
```

General description

Restriction: This function is not supported in AMODE 64.

The `regcmp()` function concatenates regular expression (RE) patterns specified by a list of one or more *pattern* arguments. The end of this list must be delimited by a NULL pointer. The `regcmp()` function then converts the concatenated RE pattern into an internal form suitable for use by the pattern matching `regex()` function. If conversion is successful, `regcmp()` returns a pointer to the converted pattern. Otherwise, it returns a NULL pointer. The `regcmp()` function uses `malloc()` to obtain storage for the converted pattern. It is the application's responsibility to free unneeded space so allocated.

The `regex()` function executes a converted pattern *cmppat* against a *subject* string. If *cmppat* matches all or part of the *subject* string, the `regex()` function returns a pointer to the next unmatched character in the *subject* string and sets the external variable `__loc1` to point the first matched character in the *subject* string. If no match is found between *cmppat* and the *subject* string, the `regex()` function returns a NULL pointer.

The `regcmp()` and `regex()` functions are supported in any locale. However, results are unpredictable if they are not run in the same locale.

Following are valid RE symbols and their meaning to the `regcmp()` and `regex()` functions:

Expression Meaning

NUL

Terminate RE pattern and text string

c

Any non-special character, c, is a one-character RE which matches itself.

\s

A backslash (\) followed by a special character, s, is a one-character RE which matches the special character itself.

The following characters are special:

period, ., asterisk, *, plus, +, dollar, \$, left square bracket, [, left brace, {, right brace, }, left parenthesis, (, right parenthesis,), and backslash, \, are always special except when they appear within square brackets ([]).

caret (^) is special at the beginning of an entire RE (which is another name for a pattern).

Note: An non-special character preceded by \ is a one-character RE which matches the non-special character.

yz

Concatenation of REs y and z matches concatenation of strings matched by y and z.

.

The period (.) special character RE matches any single character except the <newline> character.

^

The caret (^) at the beginning of an entire RE is an RE which matches the beginning of a string. Thus, it **anchors** or limits matches by the entire RE to the beginning of strings.

\$

The dollar (\$) at the end of an entire RE is an RE which only the end of a string (delimited by the <NUL> character). Thus, it **anchors** or limits matches by the entire RE to the end of strings.

Note: \n (the C language designation for a <newline> character) must be used in an entire RE to match any embedded or trailing <newline> character in a text string.

(...)

Parentheses are used to delimit a sub-expression which matches whatever the REs comprising the sub-expression would have matched without the delimiting parentheses.

(...)\$n

\$n, where n is a digit between 0 and 9, inclusive, may be used to tag a sub-expression. The tag tells the regex() function to return the substring matched by the sub-expression at address specified by (n+1)th argument after *subject*.

*

A one-character RE or sub-expression followed by an asterisk (*) is a RE that matches zero or more occurrences of the one-character RE or sub-expression. If there is any choice, the longest leftmost string that permits a match is chosen.

+

A one-character RE or sub-expression followed by a plus (+) is a RE that matches one or more occurrences of the one-character RE or sub-expression. Whenever a choice exists, the RE matches as many occurrences as possible.

{m,n}

A one-character RE or sub-expression followed by integer values, m and n, enclosed in braces is a RE which matches repeated occurrences of whatever the preceding one-character RE or sub-expression matched. The value of m, which must be in the range 0 to 255, inclusive, is the minimum number of occurrences required for a match. The value of n which, if specified, must also must be in the range 0 to 255, inclusive, is the maximum. The value of n, if specified, must be greater than or equal to the value m. The following brace expressions are valid:

{m}

Matches exactly m occurrences of the preceding one-character RE or sub-expression.

{m,}

Matches m or more occurrences of the preceding one-character RE or sub-expression. There is no limit on the number of occurrences which will be matched. The plus (+) and asterisk (*) operations are equivalent to {1,} and {0,}, respectively.

{m,n}

Matches between m and n occurrences, inclusive.

Whenever a choice exists, the RE matches as many occurrence as possible.

[...]

A non-empty list of characters enclosed by square brackets is a one-character RE that matches any one character in the list.

[^...]

A non-empty list of characters preceded by a caret (^) enclosed by square brackets is a one-character RE that matches any character except <newline> and the characters in the list. The ^ has special meaning only if it is the first character after the left bracket ([).

[c1-c2]

The hyphen (-) between two characters c1 and c2 within square brackets designates the list of characters whose collating values fall between the collating values of c1 and c2 in the current locale. The collating value of c2 must be greater than or equal to c1. Also, c2 may not be used as the ending point of one range and the starting point of another range. In other words, c1-c2-c3 is invalid.

The - loses special meaning if it occurs first or last in the bracket expression or if it is used for c1 or c2.

The right bracket,], does not terminate a bracket expression when it is the first character within it (after an initial ^, if any). For example, the expression [][0-9] matches a right bracket or a digit in the range 0-9, inclusive.

Notes:

1. Multiple duplication symbols applied to the same RE will be interpreted in the following order of precedence:
 - a. *
 - b. +
 - c. {}
2. RE Order of precedence is as follows, from high to low:
 - a. escaped character \character
 - b. bracket expression [...]
 - c. sub-expression (...)
 - d. duplication * + {}
 - e. concatenation yz
 - f. anchors ^ \$

Note:

The regcmp() and regex() functions are provided for historical reasons. These functions were part of the Legacy Feature in Single UNIX Specification, Version 2. They have been withdrawn and are not supported as part of Single UNIX Specification, Version 3. New applications should use the newer functions fnmatch(), glob(), regcomp() and regexec(), which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001.

If it is necessary to continue using these functions in an application written for Single UNIX Specification, Version 3, define the feature test macro _UNIX03_WITHDRAWN before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If the pattern formed by concatenating the list of *pattern* arguments is successfully converted, regcmp() returns a pointer to the converted pattern. Otherwise, it returns a NULL pointer. If regcmp() is unable to allocate storage for the converted pattern, it sets errno to ENOMEM.

If regex() successfully matches the converted pattern *cmppat* to all or part of the *subject* string, it returns a pointer to the next unmatched character in *subject*. Otherwise, it returns a NULL pointer.

Related information

- [“libgen.h — Pattern matching functions” on page 34](#)
- [“fnmatch\(\) — Match file name or path name” on page 569](#)
- [“glob\(\) — Generate path names matching a pattern” on page 808](#)
- [“re_comp\(\) — Compile regular expression” on page 1399](#)
- [“re_exec\(\) — Match regular expression” on page 1412](#)
- [“regcomp\(\) — Compile regular expression” on page 1416](#)
- [“regexexec\(\) — Execute compiled regular expression” on page 1421](#)

regcomp() — Compile regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 z/OS UNIX | both | |

Format

```
#include <regex.h>

int regcomp(regex_t *_restrict_ preg, const char *_restrict_ pattern, int cflags);
```

General description

Compiles the regular expression specified by *pattern* into an executable string of op-codes.

preg is a pointer to a compiled regular expression.

pattern is a pointer to a character string defining a source regular expression (described below).

cflags is a bit flag defining configurable attributes of compilation process:

- REG_EXTENDED**
Support extended regular expressions.
- REG_ICASE**
Ignore case in match.
- REG_NEWLINE**
Eliminate any special significance to the newline character.

REG_NOSUB

Report only success or fail in `regexexec()`, that is, verify the syntax of a regular expression. If this flag is set, the `regcomp()` function sets `re_nsub` to the number of parenthesized sub-expressions found in *pattern*. Otherwise, a sub-expression results in an error.

The `regcomp()` function uses the definition of characters according to the current `LC_SYNTAX` category. The characters, `[`, `]`, `{`, `}`, `|`, `^`, and `$`, have varying code points in different encoded character sets.

Regular expressions

The functions `regcomp()`, `regerror()`, `regexexec()`, and `regfree()` use regular expressions in a similar way to the UNIX `awk`, `ed`, `grep`, and `egrep` commands.

The simplest form of regular expression is a string of characters with no special meaning. The following characters do have special meaning; they are used to form extended regular expressions:

Symbol**Description**

•

The period symbol matches any one character except the terminal newline character.

[character–character]

The hyphen symbol, within square brackets, means “through”. It fills in the intervening characters according to the current collating sequence. For example, `[a–z]` can be equivalent to `[abc...xyz]` or, with a different collating sequence, it can be equivalent to `[aAbBcC...xXyYzZ]`.

[string]

A string within square brackets specifies any of the characters in *string*. Thus `[abc]`, if compared to other strings, would match any that contained a, b, or c.

No assumptions are made at compile time about the actual characters contained in the range.

{m}{m,}{m,u}

Integer values enclosed in `{}` indicate the number of times to apply the preceding regular expression. *m* is the minimum number, and *u* is the maximum number. *u* must not be greater than `RE_DUP_MAX` (see “[limits.h — Standard values for limits on resources](#)” on page 34).

If you specify only *m*, it indicates the exact number of times to apply the regular expression. `{m,}` is equivalent to `{m,u}`. They both match *m* or more occurrences of the expression.

★

The asterisk symbol indicates 0 or more of any characters. For example, `[a*e]` is equivalent to any of the following: `99ae9`, `aaaaae`, `a999e99`.

\$

The dollar symbol matches the end of the string. (Use `\n` to match a newline character.)

character+

The plus symbol specifies one or more occurrences of a character. Thus, `smith+ern` is equivalent to, for example, `smithhheern`.

[^string]

The caret symbol, when inside square brackets, negates the characters within the square brackets. Thus `[^abc]`, if compared to other strings, would *fail* to match any that contains even one a, b, or c.

(expression)\$n

Stores the value matched by the enclosed regular expression in the $(n+1)^{\text{th}}$ *ret* parameter. Ten enclosed regular expressions are allowed. Assignments are made unconditionally.

(expression)

Groups a sub-expression allowing an operator, such as `*`, `+`, or `[|.]`, to work on the sub-expression enclosed in parentheses. For example, `(a*(cb+)*)$0`.

Note:

- 1. Do *not* use multibyte characters.
- 2. You can use the] (right square bracket) alone within a pair of square brackets, but only if it immediately follows either the opening left square bracket or if it immediately follows [^ . For example: []-] matches the] and – characters.
- 3. All the preceding symbols are *special*. You precede them with \ to use the symbol itself. For example, a\.e is equivalent to a.e.
- 4. You can use the – (hyphen) by itself, but only if it is the first or last character in the expression. For example, the expression [--0] matches either the] or else the characters – through 0. Otherwise, use \-.

Returned value

If successful, regcomp() returns 0.

If unsuccessful, regcomp() returns nonzero, and the content of preg is undefined.

Example

CELEBR07

```
/* CELEBR07
   This example compiles an extended regular expression.
*/
#include <regex.h>
#include <locale.h>
#include <stdio.h>
#include <stdlib.h>

main() {
    regex_t    preg;
    char       *string = "a simple string";
    char       *pattern = ".*(simple).*";
    int        rc;

    if ((rc = regcomp(&preg, pattern, REG_EXTENDED)) != 0) {
        printf("regcomp() failed, returning nonzero (%d)", rc);
        exit(1);
    }
}
```

Related information

- [“regex.h – Regular expression functions” on page 57](#)
- [“regerror\(\) – Return error message” on page 1418](#)
- [“regexexec\(\) – Execute compiled regular expression” on page 1421](#)
- [“regfree\(\) – Free memory for regular expression” on page 1423](#)

regerror() – Return error message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#include <regex.h>

size_t regerror(int errcode, const regex_t *_restrict preg,
                char *_restrict errbuf, size_t errbuf_size);
```

General description

Finds the description for *errcode*. (For a description of regular expressions, see [“Regular expressions”](#) on page 1417.)

Returned value

regerror() returns the integer value that is the size of the buffer needed to hold the generated description string for the error condition corresponding to *errcode*.

regerror() returns the following messages.

errcode

Description String

REG_BADBR

Invalid `\{ \}` range exp

REG_BADPAT

Invalid regular expression

REG_BADRPT

`?*+` not preceded by valid RE

REG_EBOL

`^` anchor and not BOL

REG_EBRACE

`\{ \}` or `{ }` imbalance

REG_EBRACK

`[]` imbalance

REG_ECHAR

Invalid multibyte character

REG_ECOLLATE

Invalid collating element

REG_ECTYPE

Invalid character class

REG_EEOL

`$` anchor and not EOL

REG_EESCAPE

Last character is `\`

REG_EPAREN

`\(\)` or `()` imbalance

REG_ERANGE

Invalid range exp endpoint

REG_ESPACE

Out of memory

REG_ESUBREG

Invalid number in `\digit`

REG_NOMATCH

RE pattern not found

The LC_SYNTAX characters in the messages will be converted to the code points from the current LC_SYNTAX category.

Example

CELEBR08

```
/* CELEBR08

   This example compiles an invalid regular expression, and
   print error message &regerror..

*/
#include <regex.h>
#include <locale.h>
#include <stdio.h>
#include <stdlib.h>

main() {
    regex_t    preg;
    char       *pattern = "a[missing.bracket";
    int        rc;
    char       buffer[100];

    if ((rc = regcomp(&preg, pattern, REG_EXTENDED)) != 0) {
        regerror(rc, &preg, buffer, 100);
        printf("regcomp() failed with '%s'\n", buffer);
        exit(1);
    }
}
```

Related information

- See the topics about internationalization in [z/OS XL C/C++ Programming Guide](#).
- “[regex.h — Regular expression functions](#)” on page 57
- “[regcomp\(\) — Compile regular expression](#)” on page 1416
- “[regexexec\(\) — Execute compiled regular expression](#)” on page 1421
- “[regfree\(\) — Free memory for regular expression](#)” on page 1423

regex() — Execute compiled regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | C only | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <libgen.h>

char *regex(const char *cmppat, const char *subject[,subexp,...]);
extern char *__loc1;
```

General description

Restriction: This function is not supported in AMODE 64.

The regex() function executes a converted pattern *cmppat* produced by the regcomp() function against a *subject* string. If *cmppat* matches all or part of the *subject* string, the regex() function returns a pointer to the next unmatched character in the *subject* string and sets the external variable `__loc1` to point the first

matched character in the *subject* string. If no match is found between *cmppat* and the *subject* string, the `regex()` function returns a NULL pointer.

The `regex()` and `regcomp()` functions are supported in any locale. However, results are unpredictable if they are not run in the same locale.

Refer to [“`regcomp\(\)` — Compile regular expression](#)” on page 1413 for a description of regular expression syntax and semantics supported by the `regex()` and `regcomp()` functions.

Note:

The `regcomp()` and `regex()` functions are provided for historical reasons. These functions were part of the Legacy Feature in Single UNIX Specification, Version 2. They have been withdrawn and are not supported as part of Single UNIX Specification, Version 3. New applications should use the newer functions `fnmatch()`, `glob()`, `regcomp()` and `regexec()`, which provide full internationalized regular expression functionality compatible with IEEE Std 1003.1-2001.

If it is necessary to continue using these functions in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If `regex()` successfully matches the converted pattern *cmppat* to all or part of the *subject* string, it returns a pointer to the next unmatched character in *subject*.

If unsuccessful, `regex()` returns a NULL pointer.

Related information

- [“`libgen.h` — Pattern matching functions](#)” on page 34
- [“`fnmatch\(\)` — Match file name or path name](#)” on page 569
- [“`glob\(\)` — Generate path names matching a pattern](#)” on page 808
- [“`re_comp\(\)` — Compile regular expression](#)” on page 1399
- [“`regcomp\(\)` — Compile regular expression](#)” on page 1416
- [“`re_exec\(\)` — Match regular expression](#)” on page 1412
- [“`regexec\(\)` — Execute compiled regular expression](#)” on page 1421

regexec() — Execute compiled regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```
#include <regex.h>

int regexec(const regex_t *preg, const char *string,
            size_t nmatch, regmatch_t *pmatch, int eflags);
```

XPG4

```
#define _XOPEN_SOURCE
#include <regex.h>
```

```
int regexec(const regex_t *__ preg,
            const char *__ string,
            size_t nmatch, regmatch_t *__ pmatch, int eflags);
```

General description

Compares the NULL-terminated string specified by *string* against the compiled regular expression, *preg*. (For a description of regular expressions, see [“Regular expressions”](#) on page 1417.)

preg is a pointer to a compiled regular expression to compare against STRING.

string is a pointer to a string to be matched.

nmatch is the number of sub-expressions to match.

pmatch is an array of offsets into STRING which matched the corresponding sub-expressions in *preg*.

eflags is a bit flag defining customizable behavior of regexec().

REG_NOTBOL

Indicates that the first character of STRING is not the beginning of the line.

REG_NOTEOL

Indicates that the first character of STRING is not the end of the line.

If *nmatch* parameter is 0 or REG_NOSUB was set on the call to regcomp(), regexec() ignores the *pmatch* argument. Otherwise, the *pmatch* argument points to an array of at least *nmatch* elements. The regexec() function fills in the elements of the array with offsets of the substrings of STRING that correspond to the parenthesized sub-expressions of the original *pmatch* specified to regcomp(). The 0th element of the array corresponds to the entire pattern. If there are more than *nmatch* sub-expressions, only the first *nmatch*-1 are recorded.

When matching a basic or extended regular expression, any given parenthesized sub-expression of *pmatch* might participate in the match of several different substrings of STRING. The following rules determine which substrings are reported in *pmatch*.

1. If a sub-expression participated in a match several times, the offset of the last matching substring is reported in *pmatch*.
2. If a sub-expression did not match in the source STRING, the offset shown in *pmatch* is set to -1.
3. If a sub-expression contains sub-expressions, the data in *pmatch* refers to the last such sub-expression.
4. If a sub-expression matches a zero-length string, the offsets in *pmatch* refer to the byte immediately following the matching string.

If EREG_NOSUB was set when regcomp() was called, the contents of *pmatch* are unspecified.

If REG_NEWLINE was set when regcomp() was called, newline characters are allowed in STRING.

Notes:

1. The string passed to the regexec() function is assumed to be in the initial shift state, unless REG_NOTBOL is specified. If REG_NOTBOL is specified, the shift state used is the shift state after the last call to the regexec() function.
2. The information returned by the regexec() function in the regmatch_t structure has the shift-state at the start and end of the string added. This will assist an application to perform replacements or processing of the partial string. To perform replacements, the application must add the required shift-out and shift-in characters where necessary. No library functions are available to assist the application.
3. If MB_CUR_MAX is specified as 4, but the charmap file does not specify the DBCS characters, and a collating-element (for example, [:a:]) is specified in the pattern, the DBCS characters will not match against the collating-element even if they have an equivalent weight to the collating-element.

Returned value

If a match is found, `regex()` returns 0.

If unsuccessful, `regex()` returns nonzero indicating either no match or an error.

Example

CELEBR09

```
/* CELEBR09

   This example compiles an extended regular expression, and
   match against a string.

   */
#include <regex.h>
#include <locale.h>
#include <stdio.h>
#include <stdlib.h>

main() {
    regex_t    preg;
    char       *string = "a simple string";
    char       *pattern = ".*(simple).*";
    int        rc;
    size_t     nmatch = 2;
    regmatch_t pmatch[2];

    if ((rc = regcomp(&preg, pattern, REG_EXTENDED)) != 0) {
        printf("regcomp() failed, returning nonzero (%d)\n", rc);
        exit(1);
    }

    if ((rc = regexexec(&preg, string, nmatch, pmatch, 0)) != 0) {
        printf("failed to ERE match '%s' with '%s', returning %d.\n",
            string, pattern, rc);
    }

    regfree(&preg);
}
```

Related information

- See the topic about internationalization in [z/OS XL C/C++ Programming Guide](#)
- [“regex.h — Regular expression functions” on page 57](#)
- [“regcomp\(\) — Compile regular expression” on page 1416](#)
- [“regerror\(\) — Return error message” on page 1418](#)
- [“regfree\(\) — Free memory for regular expression” on page 1423](#)

regfree() — Free memory for regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#include <regex.h>

void regfree(regex_t *preg);
```

General description

Frees any memory that was allocated by regcomp() to implement *preg*. The expression defined by *preg* is no longer a compiled regular or extended expression. (For a description of regular expressions, see [“Regular expressions” on page 1417.](#))

Example

CELEBR10

```
/* CELEBR10

   This example compiles an extended regular expression and a
   free regular expression.

*/
#include <regex.h>
#include <locale.h>
#include <stdio.h>
#include <stdlib.h>

main() {
    regex_t    preg;
    char       *pattern = ".*(simple).*";
    int        rc;

    if ((rc = regcomp(&preg, pattern, REG_EXTENDED)) != 0) {
        printf("regcomp() failed, returning nonzero (%d)\n", rc);
        exit(1);
    }

    regfree(&preg);
}
```

Related information

- Chapter s about internationalization in [z/OS XL C/C++ Programming Guide](#)
- [“regex.h – Regular expression functions” on page 57](#)
- [“regcomp\(\) – Compile regular expression” on page 1416](#)
- [“regerror\(\) – Return error message” on page 1418](#)
- [“regexexec\(\) – Execute compiled regular expression” on page 1421](#)

release() – Delete a load module

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | C only | |

Format

```
#include <stdlib.h>

int release(void(*fetch_ptr)());
```

General description

Removes from memory the load modules retrieved by `fetch()` or fetch control blocks created by `fetchep()`. The *fetch_ptr* parameter is obtained from a call to `fetch()` or `fetchep()`. Once released, the `fetch()` and any associated `fetchep()` pointers are no longer valid.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Note: The external entry point name for `release()` is `__rlse()`, *NOT* `__release()`.

All fetched modules and fetch control blocks created by `fetchep()` are released automatically on program termination.

Using `release()` on a module obtained by using `fetch()` will also cause the `release()` of any child fetch control blocks created by `fetchep()` for this module. However, using `release()` on a child fetch control block will have no effect on the parent modules or sibling fetch control blocks obtained by using `fetch()`. Trying to use a fetch control block after it has been released will result in undefined behavior. (A Fetch Control Block (FCB) is an internal executable control block. The fetch pointer points to it.

When non-reentrant modules have been fetched multiple times, you should release them in the reverse order; otherwise, the load modules may not be deleted immediately.

Returned value

If successful, `release()` returns 0.

If unsuccessful, `release()` returns nonzero.

Example

```
/* The following C example uses the fetch() function to load a module, and
   later uses release() to delete the module from memory.
   */
#include <stdlib.h>

void (*fetch_ptr)();

int main(void) {
    fetch_ptr = fetch("sample");
    :
    release(fetch_ptr); /* all modules are released */
}
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“fetch\(\) — Get a load module” on page 516](#)
- [“fetchep\(\) — Share writable static” on page 526](#)

remainder(), remainderf(), remainderl() – Computes the remainder $x \text{ REM } y$

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double remainder(double x, double y);
```

C99

```
#define _ISOC99_SOURCE
#include <math.h>

float remainderf(float x, float y);
long double remainderl(long double x, long double y);
```

C++ TR1 C99

```
#define _TR1_C99
#include <math.h>

float remainder(float x, float y);
long double remainder(long double x, long double y);
```

General description

The remainder() function returns the floating-point remainder when y is nonzero and following the relation

$$r = x - ny$$

The value n is the integral value nearest the exact value x/y and when $|n - x/y| = 1/2$ then the value of n is even.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|------------|-----|------|
| remainder | X | X |
| remainderf | X | X |
| remainderl | X | X |

Restriction: The remainderf() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

If successful, remainder() returns the remainder of the division of x by y as described.

If y is zero, `remainder()` returns `HUGE_VAL` and sets `errno` to `EDOM`.

If $r = 0$, then its sign will be that of x .

Special behavior for IEEE: If successful, `remainder()` returns the remainder of the division of x by y .

If y is zero, `remainder()` returns `NaNQ` and sets `errno` to `EDOM`.

Example

```
/*
 * This program illustrates the use of remainder() function
 */
#define _ISOC99_SOURCE
#include <math.h>
#include <stdio.h>

void main() {
    double number1=3.0, number2=3.5;

    printf("Illustrates the remainder() function");

    #ifdef _BFP
        printf(" (IEEE version)\n\n");
    #else
        printf(" (HFP version)\n\n");
    #endif

    printf("remainder(%.2f,%.2f)=%.2f\n",number1,number2,
           remainder(number1,number2));
    number1=1; number2=2;
    printf("remainder(%.2f,%.2f)=%.2f\n",number1,number2,
           remainder(number1,number2));
    number1=1; number2=0;
    printf("remainder(%.2f,%.2f)=%.2f\n",number1,number2,
           remainder(number1,number2));
}
```

Output

Illustrates the remainder() function (IEEE version)

```
remainder(3.00,3.50)=-0.50
remainder(1.00,2.00)=1.00
remainder(1.00,0.00)=NaNQ(1)
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“abs\(\), absf\(\), absi\(\) — Calculate integer absolute value” on page 105](#)

remainderd32(), remainderd64(), remainderd128() - Computes the remainder $x \text{ REM } y$

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>
```

```

_Decimal32 remainderd32(_Decimal32 x, _Decimal32 y);
_Decimal64 remainderd64(_Decimal64 x, _Decimal64 y);
_Decimal128 remainderd128(_Decimal128 x, _Decimal128 y);

_Decimal32 remainder(_Decimal32 x, _Decimal32 y);      /* C++ only */
_Decimal64 remainder(_Decimal64 x, _Decimal64 y);      /* C++ only */
_Decimal128 remainder(_Decimal128 x, _Decimal128 y);    /* C++ only */

```

General description

The remainder() function returns the decimal floating-point remainder when y is nonzero and following the relation

$$r = x - ny$$

The value n is the integral value nearest the exact value x/y and when

$$|n - x/y| = 1/2$$

then the value of n is even.

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, remainder() returns the remainder of the division of x by y .

If y is zero, remainder() returns NaNQ and sets errno to EDOM.

Example

CELEBR23

```

/* CELEBR23

   This example illustrates the remainderd32() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

void main() {
    _Decimal32 n1=3.0DF, n2=3.5DF;

    printf("Illustrates the remainderd32() function\n");

    printf("remainderd32(%.2Hf,%.2Hf)=%.2Hf\n",n1,n2,remainderd32(n1,n2));
    n1=1.0DF; n2=2.0DF;
    printf("remainderd32(%.2Hf,%.2Hf)=%.2Hf\n",n1,n2,remainderd32(n1,n2));
    n1=1.0DF; n2=0.0DF;
    printf("remainderd32(%.2Hf,%.2Hf)=%.2Hf\n",n1,n2,remainderd32(n1,n2));
}

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)

remove() — Delete file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

int remove(const char *filename);
```

General description

Deletes the file specified by *filename*, unless the file is open. The `remove()` function removes memory files and DASD data sets. (non-DASD data sets, such as tapes, are not supported.) It also removes individual members of PDSs and PDSEs, and even removes memory files that simulate PDSs.

The interpretation of the file name passed to `remove()` depends on whether `POSIX(ON)` is specified. For full details about *filename* considerations, see the topics about opening files in [z/OS XL C/C++ Programming Guide](#).

Memory files must exist and they must be closed. However, if you have z/OS UNIX C application running `POSIX(ON)`, memory files don't need to be closed when removing a memory file. The z/OS UNIX services rules of interoperability apply. See the topics about opening files in [z/OS XL C/C++ Programming Guide](#), for specifying file names for MVS data sets and z/OS UNIX files.

Special behavior for XPG4: If *filename* does not name a directory, `remove(filename)` is equivalent to `unlink(filename)`. If *filename* names a directory, `remove(filename)` is equivalent to `rmdir(filename)`.

Returned value

If successful, `remove()` returns 0.

If unsuccessful, `remove()` returns nonzero to indicate an error.

Example

CELEBR12

```
/* CELEBR12

   When you invoke this example with a file name, the program attempts to
   remove that file.
   It issues a message if an error occurs.

*/
#include <stdio.h>

int main(int argc, char ** argv)
{
    if ( argc != 2 )
        printf( "Usage: %s fn\n", argv[0] );
    else
        if ( remove( argv[1] ) != 0 )
```

```
    printf( "Could not remove file\n" );
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“rename\(\) — Rename file” on page 1434](#)

removexattr(), lremovexattr(), fremovexattr() — Remove an extended attribute

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/xattr.h>

int removexattr(const char *path, const char *name);
int lremovexattr(const char *path, const char *name);
int fremovexattr(int fd, const char *name);
```

General description

Extended attributes are extensions to the normal attributes that are associated with all inodes in the system. They are used as name : value pairs that are associated with files and directories to provide more functions to a file system.

removexattr() removes the extended attribute that is identified by *name* and associated with the given *path* in the file system.

lremovexattr() is identical to removexattr() except that in the case of a symbolic link, the extended attribute is removed from the link itself by lremovexattr(), not the file that it refers to.

fremovexattr() is identical to removexattr() except that the extended attribute is removed from the open file that is referred to by *fd* by fremovexattr() in place of *path*.

Returned value

If successful, 0 is returned.
If unsuccessful, -1 is returned and errno is set to one of the following values:

Error Code
Description

ENAMETOOLONG
pathname is longer than PATH_MAX characters.

ENOATTR
The specified attribute is not set.
Attribute name is NULL or blank.

ENODATA
The specified attribute is not set.

Attribute name is NULL or blank.

ENOTSUP

Extended attributes are not supported by the file system.

Attempting to remove a read-only attribute.

Attempting to remove a general attribute of symbolic link.

ERANGE

Attribute name is longer than 256 characters.

EINVAL

Attempting to remove a general attribute with `fremovexattr()`.

Related information

- [“sys/xattr.h — Extended attributes handling” on page 73](#)
- [“getxattr\(\), lgetxattr\(\), fgetxattr\(\) — Retrieve an extended attribute value” on page 804](#)
- [“listxattr\(\), llistxattr\(\), flistxattr\(\) — List extended attribute names” on page 978](#)
- [“setxattr\(\), lsetxattr\(\), fsetxattr\(\) — Set an extended attribute value” on page 1591](#)

remque() — Remove an element from a double linked list

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <search.h>

void remque(void *element);
```

General description

The `remque()` function removes the element pointed to by *element* from a doubly-linked list. The function operates on pointers to structures which have a pointer to their successor in the list as their first element, and a pointer to their predecessor as the second. The application is free to define the remaining contents of the structure, and manages all storage itself.

Returned value

`remque()` returns no values.

Related information

- [“search.h — Searching tables” on page 58](#)
- [“insque\(\) — Insert an element into a doubly-linked list” on page 871](#)

remquo(), remquof(), remquol() – Computes the remainder.

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R5 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double remquo(double x, double y, int *quo);
float remquof(float x, float y, int *quo);
long double remquol(long double x, long double y, int *quo);
```

C++ TR1 C99

```
#define _TR1_C99
#include <math.h>

float remquo(float x, float y, int *quo);
long double remquo(long double x, long double y, int *quo);
```

General description

The remquo functions compute the same remainder as the remainder functions. In the object pointed to by *quo* they store a value whose sign is the sign of x/y and whose magnitude is congruent modulo 2 to the power n to the magnitude of the integral quotient of x/y , where n is an implementation defined integer greater than or equal to 3.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| remquo | X | X |
| remquof | X | X |
| remquol | X | X |

Restriction: The remquof() function does not support the _FP_MODE_VARIABLE feature test macro.

Returned value

The remquo functions return $x \text{ REM } y$.

Example

```
/*
 * This program illustrates the use of remquol() function
 *
 */
#define _ISOC99_SOURCE
#include <math.h>
#include <stdio.h>

void main() {
```

```

long double number1=3.0L, number2=3.5L;
int quo=0;

printf("Illustrates the remquol() function");

#ifdef _BFP
    printf(" (IEEE version)\n\n");
#else
    printf(" (HFP version)\n\n");
#endif

printf("remquol(%.2Lf,%.2Lf,&quo)=%.2Lf", number1, number2, remquol(number1, number2, &(quo)));
printf("    quo=%i\n", quo);
number1=1.0L; number2=2.0L;
printf("remquol(%.2Lf,%.2Lf,&quo)=%.2Lf", number1, number2, remquol(number1, number2, &(quo)));
printf("    quo=%i\n", quo);
number1=1.0L; number2=0.0L;
printf("remquol(%.2Lf,%.2Lf,&quo)=%.2Lf", number1, number2, remquol(number1, number2, &(quo)));
printf("    quo=%i\n", quo);
}

```

Output

Illustrates the remquol() function (IEEE version)

```

remquol(3.00,3.50,&quo)=-0.50    quo=1
remquol(1.00,2.00,&quo)=1.00    quo=0
remquol(1.00,0.00,&quo)=NaNQ(1) quo=0

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)

__remquod32(), __remquod64(), __remquod128() — Computes the remainder.

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | z/OS V1.11 |

Format

```

#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 __remquod32(_Decimal32 x, _Decimal32 y, int *quo);
_Decimal64 __remquod64(_Decimal64 x, _Decimal64 y, int *quo);
_Decimal128 __remquod128(_Decimal128 x, _Decimal128 y, int *quo);

```

General description

The `__remquo()` functions compute the same remainder as the remainder functions. In the object pointed to by *quo* they store a value whose sign is the sign of *x* or *y* and whose magnitude is congruent modulo 2 to the power *n* to the magnitude of the integral quotient of *x* or *y*, where *n* is an implementation defined integer greater than or equal to 3.

Notes:

1. These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.
2. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

The `__remquo()` functions return $x \text{ REM } y$.

Example

```
/* CELEBR24

   This example illustrates the __remquod64() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>
void main() {
    _Decimal64 x, y, z;
    int n;

    x = 3.0DD;
    y = 3.5DD;
    z = __remquod64(x, y, &n);

    printf("__remquod64( %Df, %Df, %d ) = %Df\n", x, y, n, z);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)

rename() — Rename file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

int rename(const char *oldname, const char *newname);
```

General description

Changes the name of the file, from the name pointed to by *oldname* to the name pointed to by *newname*. The *oldname* pointer must point to the name of an existing file. The *newname* pointer must not specify the name of an existing file. You cannot rename an open file. In case of an error, the name of the file is not changed.

The `rename()` function renames memory files and DASD data sets. (Non-DASD data sets, such as tapes, are not supported.) It also renames individual members of PDSs (and PDSEs); it even renames files that simulate PDSs.

Special behavior for POSIX C: Memory files must be closed unless you are working under z/OS UNIX services.

The interpretation of the file name passed to `rename()` depends on whether the program is running POSIX(ON) or POSIX(OFF).

You cannot rename a z/OS UNIX file to an MVS data set name or rename an MVS data set to a z/OS UNIX file name.

Both *oldname* and *newname* must be of the same type, that is, both directories or both files.

If *newname* already exists, it is removed before *oldname* is renamed to *newname*. Thus, if *newname* specifies the name of an existing directory, it must be an empty directory.

If the *oldname* argument points to a symbolic link, the symbolic link is renamed. If the *newname* argument points to a symbolic link, the link is removed and *oldname* is renamed to *newname*. `rename()` does not affect any file or directory named by the contents of the symbolic link.

For `rename()` to succeed, the process needs write permission on the directory containing *oldname* and the directory containing *newname*. If *oldname* and *newname* are directories, `rename()` also needs write permission on the directories themselves.

If *oldname* and *newname* both refer to the same file, `rename()` returns successfully and performs no other action.

When `rename()` is successful, it updates the change and modification times for the parent directories of *oldname* and *newname*.

Returned value

If successful, `rename()` returns 0.

If unsuccessful, `rename()` returns nonzero and sets `errno` to one of the following values:

Error Code Description

EACCES

An error occurred for one of these reasons:

- The process did not have search permission on some component of the old or new path name.
- The process did not have write permission on the parent directory of the file or directory to be renamed.
- *oldname* or *newname* were directories.
- The process did not have write permission on *oldname* or *newname*.

EBUSY

oldname and *newname* specify directories, but one of them cannot be renamed because it is in use as a root or a mount point.

EINVAL

This error occurs for one of these reasons:

- *oldname* is part of the path name prefix of *newname*.
- *oldname* or *newname* refers to either `.` (dot) or `..` (dot-dot).

EIO

A physical I/O error has occurred.

EISDIR

newname is a directory, but *oldname* is not a directory.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links encountered during resolution of *oldname* or *newname* is greater than `POSIX_SYMLINK_MAX`.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters, or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of

the path name string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using `pathconf()`.

ENOENT

No file or directory named *oldname* was found, or either *oldname* or *newname* was not specified.

ENOSPC

The directory intended to contain *newname* cannot be extended.

ENOTDIR

A component of the path name prefix for *oldname* or *newname* is not a directory, or *oldname* is a directory and *newname* is a file that is not a directory.

ENOTEMPTY

newname specifies a directory, but the directory is not empty.

EPERM or EACCES

The `S_ISVTX` flag is set on the directory containing the file referred to by *oldname* and the caller is not the file owner, nor is the caller the directory owner, nor does the caller have appropriate privileges; or *newname* refers to an existing file, the `S_ISVTX` flag is set on the directory containing this file and the caller is not the file owner, nor is the caller the directory owner, nor does the caller have appropriate privileges.

EROFS

Renaming would require writing on a read-only file system.

EXDEV

oldname and *newname* identify files or directories on different file systems. z/OS UNIX services do not support links between different files systems.

Example

CELEBR13

```
/* CELEBR13

   This example takes two file names as input and uses rename() to change
   the file name from the first name to the second name.

*/
#include <stdio.h>

int main(int argc, char ** argv )
{
    if ( argc != 3 )
        printf( "Usage: %s old_fn new_fn\n", argv[0] );
    else if ( rename( argv[1], argv[2] ) != 0 )
        printf( "Could not rename file\n" );
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“remove\(\) — Delete file” on page 1429](#)

renameat() — Change the name or location of a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>
#include <stdio.h>
int renameat(int olddirfd, const char *oldpath, int newdirfd, const char *newpath);
```

General description

`renameat()` changes the name of the file from the name that is pointed to by *oldpath* to the name that is pointed to by *newpath*.

If *oldpath* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *olddirfd* (rather than relative to the current working directory of the calling process, as is done by `rename()` for a relative path name).

If *oldpath* is relative and *olddirfd* is the special value `AT_FDCWD`, *oldpath* is interpreted relative to the current working directory of the calling process (like `rename()`).

If *oldpath* is absolute, *olddirfd* is ignored.

The interpretation of *newpath* is as for *oldpath*, except that a relative path name is interpreted relative to the directory that is referred to by the file descriptor *newdirfd*.

Returned value

If successful, `renameat()` returns 0.

If unsuccessful, `renameat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

- The process does not have search permission on some component of *oldpath* or *newpath*.
- The process does not have write permission on *oldpath* or *newpath* or on the parent directory of the file or directory to be renamed.

EAGAIN

One of the files or directories is temporarily unavailable.

EBUSY

oldpath and *newpath* specify directories, but one of them cannot be renamed because it is in use as a root or a mount point.

EINVAL

- *oldpath* is part of the path name prefix of *newpath*.
- *oldpath* or *newpath* refers to either `.` (dot) or `..` (dot-dot).

EISDIR

newpath is a directory, but *oldpath* is not a directory.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links that are encountered during the resolution of *newpath* or *oldpath* is greater than `POSIX_SYMLINK_MAX`.

ENAMETOOLONG

The path name is longer than `PATH_MAX` characters, or some component of the path name is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the path name string that is substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined by using `pathconf()`.

ENOENT

No file or directory that is named *oldpath* is found, or either *oldpath* or *newpath* is not specified.

ENOSPC

The directory that is intended to contain *newpath* cannot be extended.

ENOTDIR

A component of the path name prefix for *oldpath* or *newpath* is not a directory, or *oldpath* is a directory and *newpath* is a file but not a directory.

ENOTEMPTY

newpath specifies a directory that is not empty.

EROFS

Renaming requires writing on a read-only file system.

EXDEV

oldpath and *newpath* identify files or directories on different file systems. z/OS UNIX does not support links between different files systems.

EBADF

- *oldpath* is relative but *olddirfd* is not a valid file descriptor.
- *newpath* is relative but *newdirfd* is not a valid file descriptor.

ENOTDIR

- *oldpath* is relative and *olddirfd* is a file descriptor that refers to a file other than a directory.
- *newpath* is relative and *newdirfd* is a file descriptor that refers to a file other than a directory;

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“rename\(\) — Rename file” on page 1434](#)

renameat2() — Change the name or location of a file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <fcntl.h>
#include <stdio.h>

int renameat2(int olddirfd, const char *oldpath, int newdirfd, const char *newpath, unsigned
int flags);
```

General description

renameat2() has an extra *flags* argument comparing to renameat(). A renameat2() call without the *flags* argument is equivalent to renameat().

The *flags* argument is a bit mask that consists of zero or the following flag:

RENAME_NOREPLACE

Do not overwrite *newpath*. Return an error if *newpath* exists.

Returned value

If successful, `renameat2()` returns 0.

If unsuccessful, `renameat2()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

- The process does not have search permission on some component of *oldpath* or *newpath*.
- The process does not have the write permission on *oldpath* or *newpath* or on the parent directory of the file or directory to be renamed.

EAGAIN

One of the files or directories is temporarily unavailable.

EBUSY

oldpath and *newpath* specify directories, but one of them cannot be renamed because it is in use as a root or a mount point.

EINVAL

- *oldpath* is part of the path name prefix of *newpath*.
- *oldpath* or *newpath* refers to either `.` (dot) or `..` (dot-dot).
- An invalid flag was specified in *flags*.

EISDIR

newpath is a directory, but *oldpath* is not a directory.

ELOOP

A loop exists in symbolic links. This error is issued if the number of symbolic links that are encountered during the resolution of *oldpath* or *newpath* is greater than `POSIX_SYMLINK_MAX`.

ENAMETOOLONG

The path name is longer than `PATH_MAX` characters, or some component of the path name is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the path name string that is substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined by using `pathconf()`.

ENOENT

No file or directory that is named *oldpath* is found, or either *oldpath* or *newpath* is not specified.

ENOSPC

The directory that is intended to contain *newpath* cannot be extended.

ENOTDIR

A component of the path name prefix for *oldpath* or *newpath* is not a directory, or *oldpath* is a directory and *newpath* is a file but not a directory.

ENOTEMPTY

newpath specifies a directory that is not empty.

EROFS

Renaming requires writing on a read-only file system.

EXDEV

oldpath and *newpath* identify files or directories on different file systems. z/OS UNIX do not support links between different files systems.

EBADF

- *oldpath* is relative but *olddirfd* is not a valid file descriptor.
- *newpath* is relative but *newdirfd* is not a valid file descriptor.

ENOTDIR

- *oldpath* is relative and *olddirfd* is a file descriptor that refers to a file other than a directory.

- *newpath* is relative and *newdirfd* is a file descriptor that refers to a file other than a directory;

EEXIST

flags contains RENAME_NOREPLACE and *newpath* exists.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“rename\(\) — Rename file” on page 1434](#)

res_init() — Domain name resolver initialization

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int res_init(void);
struct __res_state _res;
```

General description

The `res_init()` function is the Resolver function that initializes the `__res_state` structure for use by other Resolver functions. Initialization normally occurs on the first call to any of the IP address resolution routines commonly called the XL C/C++ Runtime Library Resolver.

The `res_init()` routine does its initialization by passing the `__res_state` structure to the CS for z/OS Resolver. The Resolver reads the "TCPIP.DATA" configuration file and updates the `__res_state` structure. The data in the `__res_state` structure is filled in based on the contents of the "TCPIP.DATA" configuration file and can then be referenced in the `_res` variable. Global configuration and state information that is used by the Resolver routines is kept in the structure `_res`. Most of the values have reasonable defaults and can be left unchanged.

Value

Description

`_res.retrans`

Retransmission time interval is taken from the `ResolverTimeOut` statement found in the "TCPIP.DATA" configuration file.

`_res.retry`

The number of times to retransmit a request. It is taken from the `ResolverUDPRetries` statement found in the "TCPIP.DATA" configuration file.

`_res.options`

Options stored in `_res.options` are defined in `<resolv.h>` and are listed below. Options are stored as a simple bit mask containing the bitwise OR of the options enabled.

Option

Description

RES_INIT

True after the initial name server address and default domain name are initialized, because `res_init()` has been called. This option should only be tested but not set, except by the `res_init()` function.

RES_DEBUG

Print debugging messages.

RES_AAONLY

Accept authoritative answers only. With this option, `res_send()` should continue until it finds an authoritative answer or finds an error. Currently this is not implemented.

RES_USEVC

Use TCP connections for queries instead of UDP datagrams.

RES_STAYOPEN

Used with `RES_USEVC` to keep the TCP connection open between queries. This is useful only in programs that regularly do many queries. UDP should be the normal mode used.

RES_IGNTC

Ignore truncation errors, that is, don't retry with TCP. Currently unused.

RES_RECURSE

Set the recursion-desired bit in queries. This is the default. (`res_send()` does not do iterative queries and expects the name server to handle recursion.)

RES_DEFNAMES

If set, `res_search()` will append the default domain name to single-component names (those that do not contain a dot). This option is enabled by default.

RES_DNSRCH

If this option is set, `res_search()` will search for host names in the current domain and in parent domains. This is used by the standard host lookup routine `gethostbyname()`. This option is enabled by default.

RES_NOALIASES

This option turns off the user level aliasing feature controlled by the "HOSTALIASES" environment variable. Network daemons should set this option.

_res.nscount

The number of name servers specified in the "TCPIP.DATA" configuration file.

_res.*nsaddr_list[0]

The addresses of name servers specified by the `NSINTERADDR` or `NameServer` statements found in the "TCPIP.DATA" configuration file.

_res.dnsrch[0]

The beginning of the list of domains to be searched, as specified in the `SEARCH` statement found in the "TCPIP.DATA" configuration file. The structure will have either a `Default DOMAIN` or `SEARCH`.

_res.defdname[0]

The `Default Domain` name, as specified in the `Domain` or `DomainOrigin` statement found in the "TCPIP.DATA" configuration file. The structure will have either a `Default DOMAIN` or `SEARCH`.

_res.pfcode

Currently this is not implemented.

_res.ndots

The threshold for the number of dots in the domain name, as specified by the `OPTIONS` statement value `ndots:n` found in the "TCPIP.DATA" configuration file. The default is 1.

_res.nsort

The number of elements in `sort_list[]` as listed in the `SORTLIST` statement found in the "TCPIP.DATA" configuration file.

_res.sort_list[0]

The network address and subnet mask in the `SORTLIST` statement found in the "TCPIP.DATA" configuration file.

Returned value

If successful, `res_init()` returns 0.

If unsuccessful, `res_init()` returns -1 and sets `h_errno` to one of the following values:

Error Code

Description

NO_RECOVERY

An error occurred that will continue to fail if tried again. Storage could not be obtained for this thread to contain the `_res` structure.

TRY_AGAIN

An error occurred while initializing the `__res_state` structure name selected, which can be retried.

If successful, `_res` returns the address of `__res_state` structure.

If unsuccessful, `_res` returns NULL and sets `errno` to one of the following values:

Error Code

Description

ENOMEM

The storage needed to define the `_res` structure could not be obtained.

Related information

- For additional information on the TCPIP.DATA configuration, see [z/OS Communications Server: IP Configuration Guide](#).
- [“arpa/nameser.h — Construct and inspect DNS requests” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“resolv.h — IP Address Resolution” on page 57](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“dn_comp\(\) — Resolver domain name compression” on page 398](#)
- [“dn_expand\(\) — Resolver domain name expansion” on page 399](#)
- [“dn_find\(\) — Resolver domain name find” on page 400](#)
- [“dn_skipname\(\) — Resolver domain name skipping ” on page 401](#)
- [“gethostbyname\(\) — Get a host entry by name” on page 720](#)
- [“res_mkquery\(\) — Make resolver query for domain name servers” on page 1442](#)
- [“res_query\(\) — Resolver query for domain name servers” on page 1443](#)
- [“res_querydomain\(\) — Build domain name and resolver query ” on page 1445](#)
- [“res_search\(\) — Resolver query for domain name servers” on page 1446](#)
- [“res_send\(\) — Send resolver query for domain name servers” on page 1447](#)

res_mkquery() — Make resolver query for domain name servers

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
```

```
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int res_mkquery(int op, const char *dname, int class, int type, const u_char *data,
               int datalen, const u_char *newrr_in, u_char *buf, int buflen);
```

General description

This routine is one of several functions used for making, sending and interpreting query and reply messages with Internet domain name servers (DNS).

The `res_mkquery()` function constructs a standard query message and places it in *buf*. It returns the size of the query, or -1 if the query is larger than *buflen*. The query type *op* is usually QUERY, but can be any of the query types defined in `<arpa/nameser.h>`. The domain name for the query given by *dname*. The argument *newrr_in* is currently unused but is intended for making update messages.

Note: The `res_mkquery()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support” on page 2123](#) for details.

Returned value

If successful, `res_mkquery()` returns the size of the query.

If unsuccessful, `res_mkquery()` returns -1. The errors defined in `<arpa/nameser.h>` can be found in the *buf.rcode*, if an answer was supplied in the *buf* buffer.

Related information

- [“arpa/nameser.h — Construct and inspect DNS requests” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“resolv.h — IP Address Resolution” on page 57](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“dn_comp\(\) — Resolver domain name compression” on page 398](#)
- [“dn_expand\(\) — Resolver domain name expansion” on page 399](#)
- [“dn_find\(\) — Resolver domain name find” on page 400](#)
- [“dn_skipname\(\) — Resolver domain name skipping” on page 401](#)
- [“res_init\(\) — Domain name resolver initialization” on page 1440](#)
- [“res_query\(\) — Resolver query for domain name servers” on page 1443](#)
- [“res_querydomain\(\) — Build domain name and resolver query” on page 1445](#)
- [“res_search\(\) — Resolver query for domain name servers” on page 1446](#)
- [“res_send\(\) — Send resolver query for domain name servers” on page 1447](#)

res_query() — Resolver query for domain name servers

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
```

```
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int res_query(const char *dname, int class, int type, u_char *answer, int anslen);
```

General description

This routine is one of several functions used for making, sending and interpreting query and reply messages with Internet domain name servers (DNS).

The `res_query()` function provides an interface to the server query mechanism. It constructs a query, sends it to the local server, awaits a response, and makes preliminary checks on the reply. The query requests information of the specified type and class for the specified fully-qualified domain name *dname*. The reply message is left in the *answer* buffer with length *anslen* supplied by the caller.

Note: The `res_query()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `res_query()` returns the reply message in the *answer* buffer with length *anslen*.

If unsuccessful, `res_query()` returns -1 and sets `herrno` to one of the following values:

Error Code

Description

HOST_NOT_FOUND

The host name provided is not known at any of the domain name servers queried for this request.

NO_DATA

An answer was received but no data was supplied in the *answer* buffer.

NO_RECOVERY

An error occurred that will continue to fail if tried again.

TRY_AGAIN

A error occurred querying the name selected, which can be retried.

Related information

- [“arpa/nameser.h — Construct and inspect DNS requests”](#) on page 16
- [“netinet/in.h — Internet protocol family”](#) on page 50
- [“resolv.h — IP Address Resolution”](#) on page 57
- [“sys/types.h — typedef symbols and structures”](#) on page 71
- [“dn_comp\(\) — Resolver domain name compression”](#) on page 398
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- [“res_init\(\) — Domain name resolver initialization”](#) on page 1440
- [“res_mkquery\(\) — Make resolver query for domain name servers”](#) on page 1442
- [“res_querydomain\(\) — Build domain name and resolver query”](#) on page 1445
- [“res_search\(\) — Resolver query for domain name servers”](#) on page 1446
- [“res_send\(\) — Send resolver query for domain name servers”](#) on page 1447

res_querydomain() – Build domain name and resolver query

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int res_querydomain(const char *name, const char *domain, int class, int type,
                   u_char *answer, int anslen);
```

General description

This routine is one of several functions used for making, sending and interpreting query and reply messages with Internet domain name servers (DNS).

The `res_querydomain()` function builds a fully qualified domain name and returns a `res_query()` to the caller.

Note: The `res_querydomain()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `res_querydomain()` returns a `res_query()` to the caller.

If unsuccessful, `res_querydomain()` returns -1 and sets `herrno` to one of the following values:

Error Code

Description

HOST_NOT_FOUND

The host name provided is not known at any of the domain name servers queried for this request.

NO_DATA

An answer was received but no data was supplied in the *answer* buffer.

NO_RECOVERY

An error occurred that will continue to fail if tried again.

TRY_AGAIN

A error occurred querying the name selected, which can be retried.

Related information

- [“arpa/nameser.h – Construct and inspect DNS requests”](#) on page 16
- [“netinet/in.h – Internet protocol family”](#) on page 50
- [“resolv.h – IP Address Resolution”](#) on page 57
- [“sys/types.h – typedef symbols and structures”](#) on page 71
- [“dn_comp\(\) – Resolver domain name compression”](#) on page 398
- [“dn_expand\(\) – Resolver domain name expansion”](#) on page 399
- [“dn_find\(\) – Resolver domain name find”](#) on page 400

- [“dn_skipname\(\) — Resolver domain name skipping”](#) on page 401
- [“res_init\(\) — Domain name resolver initialization”](#) on page 1440
- [“res_mkquery\(\) — Make resolver query for domain name servers”](#) on page 1442
- [“res_query\(\) — Resolver query for domain name servers”](#) on page 1443
- [“res_search\(\) — Resolver query for domain name servers”](#) on page 1446
- [“res_send\(\) — Send resolver query for domain name servers”](#) on page 1447

res_search() — Resolver query for domain name servers

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int res_search(const char *dname, int class, int type, u_char *answer, int anslen);
```

General description

This routine is one of several functions used for making, sending and interpreting query and reply messages with Internet domain name servers (DNS).

The `res_search()` routine makes a query and awaits a response like `res_query()` but, in addition, it implements the default and search rules controlled by the `RES_DEFNAMES` and `RES_DNSRCH` options. It returns the first successful reply.

Note: The `res_search()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `res_search()` returns the first successful reply.

If unsuccessful, `res_search()` returns -1 and sets `herrno` to one of the following values:

Error Code

Description

HOST_NOT_FOUND

The host name provided is not known at any of the domain name servers queried for this request.

NO_DATA

An answer was received but no data was supplied in the *answer* buffer.

NO_RECOVERY

An error occurred that will continue to fail if tried again.

TRY_AGAIN

A error occurred querying the name selected, which can be retried.

Related information

- [“arpa/nameser.h — Construct and inspect DNS requests” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“resolv.h — IP Address Resolution” on page 57](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“dn_comp\(\) — Resolver domain name compression” on page 398](#)
- [“dn_expand\(\) — Resolver domain name expansion” on page 399](#)
- [“dn_find\(\) — Resolver domain name find” on page 400](#)
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- [“res_init\(\) — Domain name resolver initialization” on page 1440](#)
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- [“res_query\(\) — Resolver query for domain name servers” on page 1443](#)
- [“res_querydomain\(\) — Build domain name and resolver query ” on page 1445](#)
- [“res_send\(\) — Send resolver query for domain name servers” on page 1447](#)

res_send() — Send resolver query for domain name servers

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| BSD 4.3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>

int res_send(const u_char *msg, int msglen, u_char *answer, int anslen);
```

General description

This routine is one of several functions used for sending query and reply messages with Internet domain name servers (DNS).

The `res_send()` routine sends a pre-formatted query and returns an answer. It will call `res_init()` if `RES_INIT` is not set, send the query to the local name server, and handle timeouts and retries. The length of the reply message is returned, or -1 if there were errors.

Note: The `res_send()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, `res_send()` returns the length of the reply message.

If unsuccessful, `res_send()` returns -1. The errors defined in `<arpa/nameser.h>` can be found in the `buf.rcode`, if an answer was supplied in the `answer` buffer.

Related information

- [“arpa/nameser.h — Construct and inspect DNS requests” on page 16](#)
- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“resolv.h — IP Address Resolution” on page 57](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“dn_comp\(\) — Resolver domain name compression” on page 398](#)
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- [“res_query\(\) — Resolver query for domain name servers” on page 1443](#)
- [“res_querydomain\(\) — Build domain name and resolver query ” on page 1445](#)
- [“res_search\(\) — Resolver query for domain name servers” on page 1446](#)

__reset_exception_handler() — Unregister an exception handler routine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <__le_api.h>

int __reset_exception_handler(void);
```

General description

A nonstandard function that unregisters the 'Exception Handler' function, that was previously registered via the `__set_exception_handler()` function, for the current stack frame.

Returned value

If successful, `__reset_exception_handler()` returns 0. Otherwise, -1 is returned and `errno` is set to indicate the error. The following is a possible value for `errno`:

- `EINVAL` — No Exception Handler is registered in the current stack frame.

Related information

- [“__set_exception_handler\(\) — Register an exception handler routine” on page 1528](#)

rewind() – Set file position to beginning of file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

void rewind(FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

void rewind_unlocked(FILE *stream);
```

General description

Repositions the file position indicator of the stream pointed to by *stream*. A call to `rewind()` is the same as the statement below, except that `rewind()` also clears the error indicator for the *stream*.

```
(void) fseek(stream, 0L, SEEK_SET);
```

`rewind_unlocked()` is functionally equivalent to `rewind()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

`rewind()` returns no values.

If an error occurs, `errno` is set. After the error, the file position does not change. The next operation may be either a read or a write operation.

Special behavior for XPG4.2: The `rewind()` function returns -1 and sets `errno` to `ESPIPE` if the underlying file type for the stream is a PIPE or a socket.

Example

CELEBR14

```
/* CELEBR14

   This example first opens a file myfile for input
   and output.
   It writes integers to the file, uses &rewind. to reposition
   the file pointer to the beginning of the file, and then reads
   the data back in.

*/
#include <stdio.h>

int main(void)
{
```

```
FILE *stream;
int data1, data2, data3, data4;
data1 = 1; data2 = -37;

/* Place data in the file */
stream = fopen("myfile.dat", "w+");
fprintf(stream, "%d %d\n", data1, data2);

/* Now read the data file */
rewind(stream);
fscanf(stream, "%d", &data3);
fscanf(stream, "%d", &data4);
printf("The values read back in are: %d and %d\n",
      data3, data4);
}
```

Output

The values read back in are: 1 and -37

Related information

- [“stdio.h – Standard input and output” on page 63](#)
- [“fgetpos\(\) – Get file position” on page 534](#)
- [“fseek\(\) – Change file position” on page 638](#)
- [“fsetpos\(\) – Set file position” on page 647](#)
- [“ftell\(\) – Get current file position” on page 657](#)

rewinddir() – Reposition a directory stream to the beginning

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define POSIX_SOURCE
#include <dirent.h>

void rewinddir(DIR *dir);
```

General description

Repositions an open directory stream to the beginning. *dir* points to a DIR object associated with an open directory.

The next call to readdir() reads the first entry in the directory. If the contents of the directory have changed since the directory was opened, a call to rewinddir() updates the directory stream so that a subsequent readdir() can read the new contents.

Returned value

rewinddir() returns no values.

Example

CELEBR15

```

/* CELEBR15

   This example produces the contents of a directory by opening it,
   rewinding it, and closing it.

   */
#define _POSIX_SOURCE
#include <dirent.h>
#include <errno.h>
#include <sys/types.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    DIR *dir;
    struct dirent *entry;

    if ((dir = opendir("/")) == NULL)
        perror("opendir() error");
    else {
        puts("contents of root:");
        while ((entry = readdir(dir)) != NULL)
            printf("%s ", entry->d_name);
        rewinddir(dir);
        puts("");
        while ((entry = readdir(dir)) != NULL)
            printf("%s ", entry->d_name);
        closedir(dir);
        puts("");
    }
}

```

Output

```

contents of root:
. .. bin dev etc lib tmp u usr
. .. bin dev etc lib tmp u usr

```

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)
- [“fdopendir\(\) — Opens directory associated with file descriptor” on page 502](#)
- [“fdclosedir\(\) — Closes directory associated with file descriptor” on page 494](#)

rexec() — Execute commands one at a time on a remote host

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | POSIX(ON) |

Format

```
#include <rexec.h>

int rexec(char **Host, int Port, char *User, char *Password,
          char *Command, int *ErrFileDescParam)
```

General description

The rexec (remote execution) subroutine allows the calling process to execute commands on a remote host. If the rexec connection succeeds, a socket in the Internet domain of type SOCK_STREAM is returned to the calling process and is given to the remote command as standard input and standard output.

Host contains the name of a remote host that is listed in the /etc/hosts file or /etc/resolv.config file. If the name of the host is not found in either file, the rexec fails.

Port specifies the well-known Defense Advanced Research Projects Agency (DARPA) Internet port to use for the connection. A pointer to the structure that contains the necessary port can be obtained by issuing the following library call: getservbyname("exec","tcp").

User and Password points to a user ID and password valid at the host. Password phrases are not supported.

Command points to the name of the command to be executed at the remote host.

ErrFileDescParam specifies one of the following values:

- Not 0 (zero) = an auxiliary channel to a control process is set up, and a descriptor for it is placed in the ErrFileDescParam parameter. The control process provides diagnostic output from the remote command on this channel and also accepts bytes as signal numbers to be forwarded to the process group of the command. This diagnostic information does not include remote authorization failure, since this connection is set up after authorization has been verified.
- 0 (zero) = the standard error of the remote command is the same as standard output, and no provision is made for sending arbitrary signals to the remote process. In this case, however, it may be possible to send out-of-band data to the remote command.

This function is supported only in a POSIX program.

Note: The rexec() function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If rexec() is successful, the system returns a socket to the remote command.

If rexec() is unsuccessful, the system returns a -1 indicating that the specified host name does not exist.

Related information

- [“rexec.h — rexec\(\) and rexec_af\(\) functions” on page 57](#)
- [“getservbyname\(\) — Get a server entry by name” on page 772](#)
- [“rexec_af\(\) — Execute commands one at a time on a remote host” on page 1452](#)

rexec_af() — Execute commands one at a time on a remote host

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RCF2292 | both | z/OS V1R4 |

Format

```
#define _OPEN_SYS_SOCKET_IPV6
#include <rexec.h>

int rexec_af(char **ahost, unsigned short rport,
             const char *name, const char *pass, const char *cmd,
             int *fd2p, int af);
```

General description

The `rexec_af()` function behaves the same as the `rexec()` function. Instead of creating an `AF_INET` socket, `rexec_af` can also create an `AF_INET6` socket. The *af* argument specifies the address family. It is set to either `AF_INET` or `AF_INET6`.

Note: The `rexec_af()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

When successful, `rexec_af()` returns a socket to the remote command. If unsuccessful, `rexec_af()` returns -1 and may set `errno` to one of the following:

EAFNOSUPPORT

The specified address family is not supported.

Related information

- [“rexec.h — rexec\(\) and rexec_af\(\) functions”](#) on page 57
- [“getservbyname\(\) — Get a server entry by name”](#) on page 772
- [“rexec\(\) — Execute commands one at a time on a remote host”](#) on page 1451

rindex() — Search for character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <strings.h>

char *rindex(const char *string, int c);
```

General description

The `rindex()` function locates the last occurrence of *c* (converted to an unsigned char) in the string pointed to by *string*.

The string argument to the function must contain a NULL character (`\0`) marking the end of the string.

The `rindex()` function is identical to [“strrchr\(\) — Find last occurrence of character in string”](#) on page 1753.

Note: The `rindex()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `strrchr()` function is preferred for portability.

Returned value

If successful, `rintex()` returns a pointer to the first occurrence of `c` (converted to an unsigned character) in the string pointed to by *string*.

If `c` was not found, `rintex()` returns a NULL pointer.

There are no `errno` values defined.

Related information

- [“strings.h — String operations” on page 67](#)
- [“index\(\) — Search for character” on page 839](#)
- [“memchr\(\) — Search buffer” on page 1063](#)
- [“strchr\(\) — Search for character” on page 1720](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) — Search string” on page 1755](#)
- [“strstr\(\) — Locate substring” on page 1756](#)

rint(), rintf(), rintl() — Round to nearest integral value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double rint(double x);
```

C99

```
#define _ISOC99_SOURCE
#include <math.h>

float rintf(float x);
long double rintl(long double x);
```

C++ TR1 C99

```
#define _TR1_C99
#include <math.h>

float rint(float x);
long double rint(long double x);
```

General description

The `rint()` functions return the integral value (represented in a floating-point mode) nearest `x` using the round to nearest mode and may raise the "inexact" floating-point exception if the result differs in value from the argument.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| rint | X | X |
| rintf | X | X |
| rintl | X | X |

Returned value

rint() is always successful in IEEE.

Special behavior for hex: The rint() functions always round toward zero in hexadecimal math.

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“abs\(\), absf\(\), absl\(\) — Calculate integer absolute value”](#) on page 105
- [“isnan\(\) — Test for NaN”](#) on page 916

rintd32(), rintd64(), rintd128() — Round to nearest integral value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 rintd32(_Decimal32 x);
_Decimal64 rintd64(_Decimal64 x);
_Decimal128 rintd128(_Decimal128 x);

_Decimal32 rint(_Decimal32 x);      /* C++ only */
_Decimal64 rint(_Decimal64 x);     /* C++ only */
_Decimal128 rint(_Decimal128 x);   /* C++ only */
```

General description

These functions return the integral value (represented in a decimal floating-point mode) nearest *x* according to the rounding mode and might raise the "inexact" decimal floating-point exception if the result differs in value from the argument.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

These functions are always successful.

Example

```

/* CELEBR21

   This example illustrates the rintd32() function.
*/

#pragma strings(readonly)

#define __STDC_WANT_DEC_FP__
#include <fenv.h>
#include <math.h>
#include <stdio.h>

static void try_rm(int);

/* pass back printable rounding mode */

static
char *rm_str(int rm)
{
    char *s = "undetermined";

    switch (rm)
    {
        case FE_DEC_TONEAREST :
            s = "FE_DEC_TONEAREST" ; break;
        case FE_DEC_TOWARDZERO :
            s = "FE_DEC_TOWARDZERO" ; break;
        case FE_DEC_UPWARD :
            s = "FE_DEC_UPWARD" ; break;
        case FE_DEC_DOWNWARD :
            s = "FE_DEC_DOWNWARD" ; break;
        case FE_DEC_TONEARESTFROMZERO :
            s = "FE_DEC_TONEARESTFROMZERO" ; break;
        case _FE_DEC_TONEARESTTOWARDZERO :
            s = "_FE_DEC_TONEARESTTOWARDZERO" ; break;
        case _FE_DEC_AWAYFROMZERO :
            s = "_FE_DEC_AWAYFROMZERO" ; break;
        case _FE_DEC_PREPAREFORSHORTER :
            s = "_FE_DEC_PREPAREFORSHORTER" ; break;
    }

    return s;
}

/* Try out one passed-in number with rounding mode */

static void try_rm(int rm)
{
    _Decimal32 r32;
    _Decimal32 d32 = 500.99DF;

    (void)fe_dec_setround(rm);

    r32 = rintd32(d32);

    printf("rintd32(%.2HF) = %HG - rounding mode = %s\n",
        d32, r32, rm_str(rm)
    );

    return;
}

int main()
{
    try_rm( FE_DEC_TONEAREST );
    try_rm( FE_DEC_TOWARDZERO );
    try_rm( FE_DEC_UPWARD );
    try_rm( FE_DEC_DOWNWARD );
    try_rm( FE_DEC_TONEARESTFROMZERO );
    try_rm( _FE_DEC_TONEARESTTOWARDZERO );
    try_rm( _FE_DEC_AWAYFROMZERO );
    try_rm( _FE_DEC_PREPAREFORSHORTER );

    return 0;
}

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“isnan\(\) — Test for NaN” on page 916](#)
- [“rint\(\), rintf\(\), rintl\(\) — Round to nearest integral value” on page 1454](#)

rmdir() — Remove a directory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define POSIX_SOURCE
#include <unistd.h>

int rmdir(const char *pathname);
```

General description

Removes a directory, *pathname*, provided that the directory is empty. *pathname* must not end in . (dot) or .. (dot-dot).

If *pathname* refers to a symbolic link, `rmdir()` does not affect any file or directory named by the contents of the symbolic link. `rmdir()` does not remove a directory that still contains files or subdirectories.

Special behavior for XPG4.2: If *pathname* refers to a symbolic link, `rmdir()` fails and sets `errno` to `ENOTDIR`.

If no process currently has the directory open, `rmdir()` deletes the directory itself. The space occupied by the directory is freed for new use. If one or more processes have the directory open when it is removed, the directory itself is not removed until the last process closes the directory. New files cannot be created under a directory after the last link is removed, even if the directory is still open.

`rmdir()` removes the directory even if it is the working directory of a process.

If `rmdir()` is successful, the change and modification times for the parent directory are updated.

Returned value

If successful, `rmdir()` returns 0.

If unsuccessful, `rmdir()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process did not have search permission for some component of *pathname*, or it did not have write permission for the directory containing the directory to be removed.

EBUSY

pathname cannot be removed, because it is currently being used by the system or a process.

EINVAL

The last component of *pathname* contains a . (dot) or a .. (dot-dot).

EIO

A physical I/O error has occurred.

ELOOP

A loop exists in symbolic links. More than POSIX_SYMLINK_MAX (an integer defined in the limits.h header file) symbolic links are detected in the resolution of *pathname*.

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters or some component of *pathname* is longer than **NAME_MAX** characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the path name string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using pathconf().

ENOENT

pathname does not exist, or it is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

ENOTEMPTY

The directory still contains files or subdirectories.

EPERM or EACCES

The S_ISVTX flag is set on the parent directory of the directory to be removed and the caller is not the owner of the directory to be removed, nor is the caller the owner of the parent directory, nor does the caller have the appropriate privileges.

EROFS

The directory to be removed is on a read-only file system.

Example**CELEBR16**

```
/* CELEBR16

   This example removes a directory.

*/
#define _OPEN_SYS
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/stat.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    char new_dir[]="new_dir";
    char new_file[]="new_dir/new_file";
    int fd;

    if (mkdir(new_dir, S_IRWXU|S_IRGRP|S_IXGRP) != 0)
        perror("mkdir() error");
    else if ((fd = creat(new_file, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        close(fd);
        unlink(new_file);
    }

    if (rmdir(new_dir) != 0)
        perror("rmdir() error");
    else
        puts("removed!");
}
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)

- [“unlink\(\) — Remove a directory entry” on page 1945](#)

round(), roundf(), roundl() — Round to the nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double round(double x);
float roundf(float x);
long double roundl(long double x);
```

C++ TR1 C99

```
#define _TR1_C99
#include <math.h>

float round(float x);
long double round(long double x);
```

General description

The `round()` family of functions round x to the nearest integer, in floating-point format and rounding halfway cases away from zero, regardless of the current rounding mode.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|---------------------|-----|------|
| <code>round</code> | X | X |
| <code>roundf</code> | X | X |
| <code>roundl</code> | X | X |

Returned value

The `round()` family of functions returns the rounded integer value.

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceil\(\), ceilf\(\), ceill\(\) — Round up to integral value” on page 249](#)
- [“floor\(\), floorf\(\), floorl\(\) — Round down to integral value” on page 554](#)
- [“llround\(\), llroundf\(\), llroundl\(\) — Round to the nearest integer” on page 981](#)
- [“lrint\(\), lrintf\(\), lrintl\(\) and llrint\(\), llrintf\(\), llrintl\(\) — Round the argument to the nearest integer” on page 1015](#)
- [“lround\(\), lroundf\(\), lroundl\(\) — Round a decimal floating-point number to its nearest integer” on page 1019](#)

- [“nearbyint\(\), nearbyintf\(\), nearbyintl\(\) — Round the argument to the nearest integer” on page 1137](#)
- [“trunc\(\), truncf\(\), trunc\(\) — Truncate an integer value” on page 1899](#)

roundd32(), roundd64(), roundd128() – Round to the nearest integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 roundd32(_Decimal32 x);
_Decimal64 roundd64(_Decimal64 x);
_Decimal128 roundd128(_Decimal128 x);

_Decimal32 round(_Decimal32 x);      /* C++ only */
_Decimal64 round(_Decimal64 x);      /* C++ only */
_Decimal128 round(_Decimal128 x);    /* C++ only */
```

General description

These functions round x to the nearest integer, in decimal floating-point format and rounding halfway cases away from zero, regardless of the current rounding mode.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

These functions return the rounded integer value.

Example

```
/* CELEBR22

   This example illustrates the round64() function.
*/

#pragma strings(readonly)

#define __STDC_WANT_DEC_FP__
#include <fenv.h>
#include <math.h>
#include <stdio.h>

static void try_rm(int, _Decimal64);

/* pass back printable rounding mode */

static
char *rm_str(int rm)
{
    char *s = "undetermined";
```

```

switch (rm)
{
    case FE_DEC_TONEAREST : break;
    case FE_DEC_TONEAREST : s = "FE_DEC_TONEAREST" ; break;
    case FE_DEC_TOWARDZERO : break;
    case FE_DEC_TOWARDZERO : s = "FE_DEC_TOWARDZERO" ; break;
    case FE_DEC_UPWARD : break;
    case FE_DEC_UPWARD : s = "FE_DEC_UPWARD" ; break;
    case FE_DEC_DOWNWARD : break;
    case FE_DEC_DOWNWARD : s = "FE_DEC_DOWNWARD" ; break;
    case FE_DEC_TONEARESTFROMZERO : break;
    case FE_DEC_TONEARESTFROMZERO : s = "FE_DEC_TONEARESTFROMZERO" ; break;
    case FE_DEC_TONEARESTTOWARDZERO : break;
    case FE_DEC_TONEARESTTOWARDZERO : s = "FE_DEC_TONEARESTTOWARDZERO" ; break;
    case FE_DEC_AWAYFROMZERO : break;
    case FE_DEC_AWAYFROMZERO : s = "FE_DEC_AWAYFROMZERO" ; break;
    case FE_DEC_PREPAREFORSHORTER : break;
    case FE_DEC_PREPAREFORSHORTER : s = "FE_DEC_PREPAREFORSHORTER" ; break;
}

return s;
}

/* Try out one passed-in number with rounding mode */
static void try_rm(int rm, _Decimal64 d64)
{
    _Decimal64 r64;

    (void)fe_dec_setround(rm);

    r64 = roundd64(d64);

    printf("roundd64(%.2DF) = %DG - rounding mode = %s\n",
        d64, r64, rm_str(rm)
    );

    return;
}

int main()
{
    try_rm( FE_DEC_TONEAREST, 501.50DD);
    try_rm( FE_DEC_TOWARDZERO, 501.50DD);
    try_rm( FE_DEC_UPWARD, -501.51DD);
    try_rm( FE_DEC_DOWNWARD, -501.49DD);
    try_rm( FE_DEC_TONEARESTFROMZERO, 500.50DD);
    try_rm( FE_DEC_TONEARESTTOWARDZERO, -501.50DD);
    try_rm( FE_DEC_AWAYFROMZERO, 500.49DD);
    try_rm( FE_DEC_PREPAREFORSHORTER, 501.50DD);

    return 0;
}

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“ceild32\(\), ceild64\(\), ceild128\(\) — Round up to integral value” on page 250](#)
- [“floord32\(\), floord64\(\), floord128\(\) — Round down to integral value” on page 555](#)
- [“llroundd32\(\), llroundd64\(\), llroundd128\(\) — Round to the nearest integer” on page 983](#)
- [“lrintd32\(\), lrintd64\(\), lrintd128\(\) and llrintd32\(\), llrintd64\(\), llrintd128\(\) — Round the argument to the nearest integer” on page 1017](#)
- [“lroundd32\(\), lroundd64\(\), lroundd128\(\) — Round a floating-point number to its nearest integer” on page 1020](#)
- [“nearbyintd32\(\), nearbyintd64\(\), nearbyintd128\(\) — Round the argument to the nearest integer” on page 1139](#)
- [“round\(\), roundf\(\), roundl\(\) — Round to the nearest integer” on page 1459](#)
- [“truncd32\(\), truncd64\(\), truncd128\(\) — Truncate an integer value” on page 1900](#)

rpmatch() — Test for a yes or no response match

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <stdlib.h>

int rpmatch(const char *response);
```

External entry point: @@RPMATCH, __rpmatch

General description

Tests whether a string pointed to by *response* matches either the affirmative or the negative response set by LC_MESSAGES category in the current locale.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Returned value

If the string pointed to by *response* matches the affirmative expression in the current locale, rpmatch() returns:

1

If the response string matches the affirmative expression.

0

If the response string matches the negative expression.

-1

If the response string does not match either the affirmative or the negative expression.

Example

CELEBR17

```
/* CELEBR17

   This example asks for a reply, and checks the response.

*/
#include "locale.h"
#include "stdio.h"
#include "stdlib.h"

main() {
    char *response;
    char buffer??(100??);
    int rc;

    printf("Enter reply");
    response = fgets(buffer, 100, stdin);
    rc = rpmatch(response);
    if (rc > 0)
        printf("Response was affirmative\n");
    else if (rc == 0)
        printf("Response was negative\n");
    else
        printf("Response was neither negative or affirmative\n");
}
```


Related information

- “[stdlib.h — Standard library functions](#)” on page 65

samequantumd32(), samequantumd64(), samequantumd128() — Determine if exponents X and Y are the same

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Bool samequantumd32(_Decimal32 x, _Decimal32 y);
_Bool samequantumd64(_Decimal64 x, _Decimal64 y);
_Bool samequantumd128(_Decimal128 x, _Decimal128 y);
```

General description

The samequantum functions determine if the representation exponents of x and y are the same. If both x and y are NaN or infinity, they have the same representation exponents. If exactly one operand is infinity or exactly one operand is NaN, they do not have the same representation exponents. The samequantum functions raise no floating point exceptions.

| Argument | Description |
|----------|--------------------|
| x | First input value |
| y | Second input value |

Note:

- To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
- These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The samequantum functions return true when x and y have the same representation exponents, and false otherwise.

Example

```
/* CELEBS72
   This example illustrates the samequantumd64() function
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
```

```
_Decimal64 a1 = strtod64("1.23" , NULL);
_Decimal64 a2 = strtod64("0.01" , NULL);
_Decimal64 b1 = strtod64("1.234" , NULL);
_Decimal64 b2 = strtod64("0.01" , NULL);
_Decimal64 c1 = strtod64("1.000" , NULL);
_Decimal64 c2 = strtod64("1.00" , NULL);
_Decimal64 d1 = strtod64("0.000" , NULL);
_Decimal64 d2 = strtod64("0.00" , NULL);

printf( "x=%-8.2DF y=%-8.2DF samequantum=%d\n"
        "x=%-8.3DF y=%-8.2DF samequantum=%d\n"
        "x=%-8.3DF y=%-8.2DF samequantum=%d\n"
        "x=%-8.3DF y=%-8.2DF samequantum=%d\n"
        , a1, a2, (int)samequantumd64(a1, a2)
        , b1, b2, (int)samequantumd64(b1, b2)
        , c1, c2, (int)samequantumd64(c1, c2)
        , d1, d2, (int)samequantumd64(d1, d2)
        );

return 0;
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“quantized32\(\), quantized64\(\), quantized128\(\) — Set the exponent of X to the exponent of Y” on page 1370](#)
- [“quantexpd32\(\), quantexpd64\(\), quantexpd128\(\) - Compute the quantum exponent” on page 1369](#)

sbrk() — Change space allocation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 2 | both | |

Format

Non-Single UNIX Specification, Version 2:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

void *sbrk(int incr);
```

Single UNIX Specification, Version 2:

```
#define _XOPEN_SOURCE 500
#include <unistd.h>

void *sbrk(intptr_t incr);
```

General description

Restriction: This function is not supported in AMODE 64.

The sbrk() function is used to change the space allocated for the calling process. The change is made by adding incr bytes to the process's break value and allocating the appropriate amount of space. The amount of allocated space increases when incr is positive and decreases when incr is negative. If incr is zero the current value of the program break is returned by sbrk(). The newly-allocated space is set to

0. However, if the application first decrements and then increments the break value, the contents of the reallocated space are not zeroed.

The storage space from which the `brk()` and `sbrk()` functions allocate storage is separate from the storage space that is used by the other memory allocation functions (`malloc()`, `calloc()`, etc.). Because this storage space must be a contiguous segment of storage, it is allocated from the initial heap segment only and thus is limited to the initial heap size specified for the calling program or the largest contiguous segment of storage available in the initial heap at the time of the first `brk()` or `sbrk()` call. Since this is a separate segment of storage, the `brk()` and `sbrk()` functions can be used by an application that is using the other memory allocation functions. However, it is possible that the user's region may not be large enough to support extensive usage of both types of memory allocation.

Prior usage of the `sbrk()` function has been limited to specialized cases where no other memory allocation function performed the same function. Because the `sbrk()` function may be unable to sufficiently increase the space allocation of the process when the calling application is using other memory functions, the use of other memory allocation functions, such as `mmap()`, is now preferred because it can be used portably with all other memory allocation functions and with any function that uses other allocation functions. Applications that require the use of `brk()` and/or `sbrk()` should refrain from using the other memory allocation functions and should be run with an initial heap size that will satisfy the maximum storage requirements of the program.

The `sbrk()` function is not supported from a multithreaded environment, it will return in error if it is invoked in this environment.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use `malloc()` instead of `brk()` or `sbrk()`.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `sbrk()` returns the previous break value.

If unsuccessful, `sbrk()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

ENOMEM

The requested change would allocate more space than allowed for the calling process.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“brk\(\) — Change space allocation” on page 219](#)

scalb() — Load exponent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <math.h>

double scalb(double x, double n);
```

General description

The scalb() function computes $x \cdot radix^n$.

If *n* is not an integer, it is silently truncated.

Note: This function works in both IEEE Binary Floating-Point and hexadecimal floating-point formats. The *radix* is 16 for hexadecimal floating-point and 2 for IEEE Binary Floating-Point. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

Returned value

If it succeeds, scalb() returns the function of its arguments as described above.

scalb() will fail under the following conditions:

- If the result would underflow, scalb() will return 0 and set errno to ERANGE.
- If the result would overflow, scalb() will return ±HUGE_VAL according to the sign of *x* and set errno to ERANGE.

Special behavior for IEEE: If successful, scalb() returns the value of the *x* parameter times 2 to the power of the *y* parameter.

If the result would overflow, scalb() returns ±HUGE_VAL according to the sign of *x* and sets errno to ERANGE. No other errors can occur.

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“ldexp\(\), ldexpf\(\), ldexpl\(\) — Multiply by a power of two”](#) on page 940

scalbn(), scalbnf(), scalbnl(), scalbln(), scalblnf(), scalblnl() — Load exponent functions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double scalbn(double x, int n);
float scalbnf(float x, int n);
long double scalbnl(long double x, int n);

double scalbln(double x, long int n);
```

```
float scalblnf(float x, long int n);
long double scalblnl(long double x, long int n);
```

C++ TR1 C99

```
#define _TR1_C99
#include <math.h>

float scalbln(float x, long n);
long double scalbln(long double x, long n);
float scalbln(float x, long int n);
long double scalbln(long double x, long int n);
```

General description

The `scalbn()` and `scalbln()` families of functions compute $(x * (\text{FLT_RADIX})^n)$ efficiently, not normally, by computing FLT_RADIX raised to n explicitly.

The radix for z/OS C applications, `FLT_RADIX`, is defined to be 16 under HEX implementation and 2 under IEEE implementation.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|-----------------------|-----|------|
| <code>scalbn</code> | X | X |
| <code>scalbnf</code> | X | X |
| <code>scalbnl</code> | X | X |
| <code>scalbln</code> | X | X |
| <code>scalblnf</code> | X | X |
| <code>scalblnl</code> | X | X |

Restriction: The `scalbnf()` and `scalblnf()` functions do not support the `_FP_MODE_VARIABLE` feature test macro.

Returned value

The `scalbn()` and `scalbln()` families of functions return $(x * (\text{FLT_RADIX})^n)$.

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“exp\(\), expf\(\), expl\(\) — Calculate exponential function” on page 453](#)
- [“expm1\(\), expm1f\(\), expm1l\(\) — Exponential minus one” on page 455](#)
- [“exp2\(\), exp2f\(\), exp2l\(\) — Calculate the base-2 exponential” on page 459](#)
- [“frexp\(\), frexpf\(\), frexpl\(\) — Extract mantissa and exponent of the floating-point value” on page 624](#)
- [“ilogb\(\), ilogbf\(\), ilogbl\(\) — Integer unbiased exponent” on page 834](#)
- [“ldexp\(\), ldexpf\(\), ldexpl\(\) — Multiply by a power of two” on page 940](#)
- [“log\(\), logf\(\), logl\(\) — Calculate natural logarithm” on page 995](#)
- [“logb\(\), logbf\(\), logbl\(\) — Unbiased exponent” on page 996](#)
- [“log1p\(\), log1pf\(\), log1pl\(\) — Natural log of x+1” on page 1002](#)
- [“log10\(\), log10f\(\), log10l\(\) — Calculate base 10 logarithm” on page 1005](#)
- [“log2\(\), log2f\(\), log2l\(\) — Calculate the base-2 logarithm” on page 1007](#)

- “[modf\(\), modff\(\), modfl\(\)](#) — Extract fractional and integral parts of floating-point value” on page 1092

scalbnd32(), scalbnd64(), scalbnd128() and scalblnd32(), scalblnd64(), scalblnd128() — Load exponent functions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 scalbnd32(_Decimal32 x, int n);
_Decimal64 scalbnd64(_Decimal64 x, int n);
_Decimal128 scalbnd128(_Decimal128 x, int n);
_Decimal32 scalbn(_Decimal32 x, int n); /* C++ only */
_Decimal64 scalbn(_Decimal64 x, int n); /* C++ only */
_Decimal128 scalbn(_Decimal128 x, int n); /* C++ only */

_Decimal32 scalblnd32(_Decimal32 x, long int n);
_Decimal64 scalblnd64(_Decimal64 x, long int n);
_Decimal128 scalblnd128(_Decimal128 x, long int n);
_Decimal32 scalbln(_Decimal32 x, long int n); /* C++ only */
_Decimal64 scalbln(_Decimal64 x, long int n); /* C++ only */
_Decimal128 scalbln(_Decimal128 x, long int n); /* C++ only */
```

General description

The scalbn() and scalbln() families of functions compute (x * 10 raised to n) efficiently, not normally, by computing 10 raised to n explicitly.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The scalbn() and scalbln() families of functions return (x * 10 raised to n).

Example

```
/* CELEBS68

   This example illustrates the scalbnd128() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x, y;

    x = 7.2DL;
    y = scalbnd128(x, 6000);
```

```
    printf("scalbnd128(%DDf, 6000) = %DDe\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“expd32\(\), expd64\(\), expd128\(\) — Calculate exponential function ” on page 454](#)
- [“frexpd32\(\), frexpd64\(\), frexpd128\(\) — Extract mantissa and exponent of the decimal floating-point value” on page 625](#)
- [“ilogbd32\(\), ilogbd64\(\), ilogbd128\(\) — Integer unbiased exponent” on page 835](#)
- [“ldexpd32\(\), ldexpd64\(\), ldexpd128\(\) — Multiply by a power of ten” on page 941](#)
- [“logd32\(\), logd64\(\), logd128\(\) — Calculate natural logarithm” on page 999](#)
- [“log10d32\(\), log10d64\(\), log10d128\(\) — Calculate base 10 logarithm” on page 1006](#)
- [“modfd32\(\), modfd64\(\), modfd128\(\) — Extract fractional and integral parts of decimal floating-point value ” on page 1093](#)
- [“scalbn\(\), scalbnf\(\), scalbnl\(\), scalbln\(\), scalblnf\(\), scalblnl\(\) — Load exponent functions” on page 1466](#)

scanf() — Read and format data

The information for this function is included in [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#).

sched_yield() — Release the processor to other threads

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|---------------------|
| Single UNIX Specification, version 3 | both | z/OS V1R7 POSIX(ON) |

Format

```
#define _UNIX03_SOURCE
#include <sched.h>

int sched_yield(void);
```

General description

The `sched_yield()` function allows a thread to give up control of a processor so that another thread can have the opportunity to run. It takes no arguments.

The speed at which the `sched_yield()` function releases a processor can be configured by using the `_EDC_PTHREAD_YIELD` and `_EDC_PTHREAD_YIELD_MAX` environment variables. The `_EDC_PTHREAD_YIELD` environment variable is used to configure the `sched_yield()` function to release the processor immediately, or to release the processor after a delay. The `_EDC_PTHREAD_YIELD_MAX` environment variable is used to change the maximum delay to a value less than the default (32 milliseconds).

For more information about the `_EDC_PTHREAD_YIELD` and `_EDC_PTHREAD_YIELD_MAX` environment variables, see [“Using Environment Variables” in *z/OS XL C/C++ Programming Guide*](#).

Returned value

`sched_yield()` always returns 0.

There are no documented errno values. Use perror() or strerror() to determine the cause of the error.

Related information

- [“sched.h — Manipulate and examine process execution scheduling” on page 57](#)
- [“pthread_yield\(\) — Release the processor to other threads” on page 1350](#)

seed48() — Pseudo-random number initializer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

unsigned short int *seed48(unsigned short int seed16v[3]);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrand48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The lcong48(), seed48(), and srand48() functions are initialization functions, one of which should be invoked before either the drand48(), lrand48() or mrand48() function is called.

The drand48(), lrand48() and mrand48() functions generate a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \qquad n \geq 0$$

The initial values of X, a, and c are:

```
X(0)= 1
a   = 5deece66d (base 16)
c   = b         (base 16)
```

C/370 provides storage to save the most recent 48-bit integer value of the sequence, X(i). This storage is shared by the drand48(), lrand48() and mrand48() functions. The seed48() function is used to reinitialize the most recent 48-bit value in this storage. The seed48() function replaces the low-order (rightmost) 16 bits of this storage with seed16v[0], the middle-order 16 bits with seed16v[1], and the high-order 16 bits with seed16v[2].

The values a and c, may be changed by calling the lcong48() function. The seed48() function restores the initial values of a and c.

Special behavior for z/OS UNIX Services: You can make the seed48() function and other functions in the drand48 family thread-specific by setting the environment variable _RAND48 to the value THREAD before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested, calls to the `drand48()`, `lrand48()` and `rand48()` functions from thread `t` generate a sequence of 48-bit integer values, $X(t,i)$, according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t)) \bmod(2^{**}48) \quad n \geq 0$$

C/370 provides thread-specific storage to save the most recent 48-bit integer value of the sequence, $X(t,i)$. When the `seed48()` function is called from thread `t`, it reinitializes the most recent 48-bit value in this storage. The `seed48()` function replaces the low-order (rightmost) 16 bits of this storage with `seed16v[0]`, the middle-order 16 bits with `seed16v[1]`, and the high-order 16 bits with `seed16v[2]`.

The values of $a(t)$ and $c(t)$ may be changed by calling the `lcong48()` function from thread `t`. When the `seed48()` function is called from this thread, it restores the initial values of $a(t)$ and $c(t)$ for the thread which are:

```
a(t) = 5deece66d (base 16)
c(t) = b         (base 16)
```

Returned value

When `seed48()` is called, it saves the most recent 48-bit integer value in the sequence, $X(i)$, in an array of unsigned short ints provided by C/370 before reinitializing storage for the most recent value in the sequence, $X(i)$. `seed48()` returns a pointer to the array containing the saved value.

Special behavior for z/OS UNIX Services: If thread-specific behavior is requested for the `drand48` family and `seed48()` is called on thread `t`, it saves the most recent 48-bit integer value in the sequence, $X(t,i)$, for the thread in a thread-specific array of unsigned short ints before reinitializing storage for the most recent value in the sequence, $X(t,i)$. `seed48()` returns a pointer to this thread-specific array containing the saved value.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“drand48\(\) – Pseudo-random number generator” on page 403](#)
- [“erand48\(\) – Pseudo-random number generator” on page 430](#)
- [“jrand48\(\) – Pseudo-random number generator” on page 927](#)
- [“lcong48\(\) – Pseudo-random number initializer” on page 939](#)
- [“lrand48\(\) – Pseudo-random number generator” on page 1013](#)
- [“mrand48\(\) – Pseudo-random number generator” on page 1108](#)
- [“nrand48\(\) – Pseudo-random number generator” on page 1153](#)
- [“srand48\(\) – Pseudo-random number initializer” on page 1705](#)

seekdir() – Set position of directory stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <dirent.h>
```

```
void seekdir(DIR *dirp, long int loc);
```

General description

The seekdir() function sets the position of the next readdir() operation on the directory stream specified by dirp to the position specified by loc. The value of loc should have been returned from an earlier call to telldir(). The new position reverts to the one associated with the directory stream when telldir() was performed. If the value of loc was not obtained from an earlier call to telldir() or if a call to rewinddir() occurred between the call to telldir() and the call to seekdir(), the result of subsequent calls to readdir() are unspecified.

Note: If files were added or removed from the directory after telldir() was called and before seekdir() is done, the results are also unspecified.

Returned value

seekdir() returns no values.

If the loc argument is negative, the directory stream is unchanged.

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“telldir\(\) — Current location of directory stream” on page 1854](#)
- [“fdopendir\(\) — Opens directory associated with file descriptor” on page 502](#)
- [“fdclosedir\(\) — Closes directory associated with file descriptor” on page 494](#)

select(), pselect() — Monitor activity on files or sockets and message queues

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _OPEN_MSGQ_EXT
#include <sys/types.h>
#include <sys/time.h>
#include <sys/msg.h>

int select(int nmsgsfds, fd_set *__restrict__ readlist,
```

```
fd_set *__restrict__ writelist, fd_set *__restrict__ exceptlist,
struct timeval *__restrict__ timeout);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <sys/select.h>

int pselect(int nmsgsfds, fd_set *__restrict__ readlist,
            fd_set *__restrict__ writelist, fd_set *__restrict__ exceptlist,
            const struct timespec *__restrict__ timeout,
            const sigset *__restrict__ sigmask);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#define _OPEN_MSGQ_EXT
#include <sys/types.h>
#include <sys/time.h>
#include <sys/msg.h>

int select(int nmsgsfds, fd_set *readlist,
           fd_set *writelist, fd_set *exceptlist,
           struct timeval *timeout);
```

`_OPEN_MSGQ_EXT` must be defined if message queues are to be monitored (X/Open sockets only).

General description

The `pselect()` and `select()` functions monitor activity on a set of sockets and/or a set of message queue identifiers until a timeout occurs, to see if any of the sockets and message queues have read, write, or exception processing conditions pending. This call also works with regular file descriptors, pipes, and terminals.

The `select()` function is equivalent to the `pselect()` function, except as follows:

- For the `select()` function, the timeout period is given in seconds and microseconds in an argument of type struct *timeval*, whereas for the `pselect()` function the timeout period is given in seconds and nanoseconds in an argument of type struct *timespec*.
- The `select()` function has no *sigmask* argument; it will behave as `pselect()` does when *sigmask* is a null pointer.
- Upon successful completion, the `select()` function can modify the object pointed to by the timeout argument.
- The `pselect()` function always behaves as if `_OPEN_MSGQ_EXT` and `_OPEN_SYS_HIGH_DESCRIPTOR` feature test macros are NOT defined.

Parameter

Description

nmsgsfds

The number of message queues and the number of file or socket descriptors to check.

This parameter is divided into two parts. The first half (the high-order 16 bits) gives the number of elements of an array that contains message queue identifiers. This number must not exceed the value 32767.

The second half (the low-order 16 bits) gives the number of bits within a bit set that correspond to the file or socket descriptors to check. This value should equal the greatest descriptor number to check + 1.

If either half of the *nmsgsfds* parameter is equal to a value of 0, the corresponding bit sets or arrays are assumed not to be present.

If `_OPEN_MSGQ_EXT` is not defined, only file or socket descriptors may be monitored. In this case *nmsgsfds* must be less than or equal to `FD_SETSIZE` (defined to be 2048 in `sys/time.h`), and greater than or equal to zero. Also, `FD_SETSIZE` may not be defined by your program.

The bit set used to specify file or socket descriptors is fixed in size with 1 bit for every possible file or socket. Use the *nmsgsfds* parameter to force `pselect()` or `select()` to check only a subset of the allocated bit set.

If your application allocates sockets 3, 4, 5, 6, and 7 and you want to check all of your allocations, the second half of *nmsgsfds* should be set to 8, the highest descriptor you specified + 1. If your application checks sockets 3 and 4, the second half of *nmsgsfds* should be set to 5.

To select on descriptor numbers between 2048 and 65534, either the `_OPEN_MSGQ_EXT` or `_OPEN_SYS_HIGH_DESCRIPTOR` feature test macro must be defined, and a bit set larger than the default size must be used. Note that when you are also selecting on message queues, as is possible when `_OPEN_MSGQ_EXT` is defined, the largest descriptor number is restricted to 2047. To select on descriptor numbers between 65535 and 524287, feature test macro `_OPEN_SYS_HIGH_DESCRIPTOR` must be defined and feature test macro `_OPEN_MSGQ_EXT` must not be defined. In addition, the process' `MAXFILEPROC` limit must be greater than 65536. With this feature, any number of sockets can be selected on (without message queues). `FD_SETSIZE` may also be redefined in this case, though it is recommended that the application explicitly allocate the larger bit set using `malloc()`.

readlist, writelist, exceptlist

Pointers to `fd_set` types, arrays of message queue identifiers, or `sellist` structures to check for reading, writing, and exceptional conditions, respectively. The type of parameter to pass depends on whether you want to monitor file/socket descriptors, message queue identifiers, or both. To monitor file/socket descriptors only, set the high-order halfword of *nmsgsfds* to 0, the low-order halfword to (highest descriptor number + 1), and use `fd_set` pointers. To monitor message queues only, set the low-order halfword of *nmsgsfds* to 0, the high-order halfword to the number of elements in each array you want `select()` to consider, and pass pointers to arrays of message queue identifiers. To monitor both, set *nmsgsfds* as described above, and pass pointers to `sellist` structures.

The `sellist` structure allows you to specify both file/socket descriptors and message queues. Your program must define the `sellist` structure in the following form:

```
struct sellist {
    fd_set fdset;          /* file/socket descriptor bit set */
    int    msgids[max_size]; /* array of message queue identifiers */
};
```

If you use a `sellist` structure, the highest descriptor you can monitor is 2047.

The description of the type *fd_set* is given below. Each integer of the `msgids` array specifies a message queue identifier whose status is to be checked. Elements with a value of -1 are acceptable and will be ignored. The value contained in the first half of *nmsgsfds* determines exactly how many elements of the array are to be checked.

timeout

The pointer to the time to wait for the `pselect()` or `select()` call to complete.

sigmask

The signal mask of the caller by the set of signals pointed to by *sigmask* before examining the descriptors, and will restore the signal mask of the calling thread before returning.

If *timeout* is not a NULL pointer, it specifies a maximum interval to wait for the selection to complete. The maximum timeout value is 31 days. If *timeout* is a NULL pointer, the `pselect()` and `select()` call blocks until a socket or message becomes ready. To poll the sockets and return immediately, *timeout* should be a non-NULL pointer to a zero-valued **timeval** structure or `timespec` structure.

If *sigmask* is not a null pointer, then the `pselect()` function will replace the signal mask of the caller by the set of signals pointed to by *sigmask* before examining the descriptors, and will restore the signal mask of the calling thread before returning.

To allow you to test more than one socket at a time, the sockets to test are placed into a bit set of type *fd_set*. A bit set is a string of bits such that if *x* is an element of the set, the bit representing *x* is set to 1. If *x* is not an element of the set, the bit representing *x* is set to 0. For example, if socket 33 is an element of a bit set, then bit 33 is set to 1. If socket 33 is not an element of a bit set, then bit 33 is set to 0.

Because the bit sets contain a bit for every socket that a process can allocate, the size of the bit sets is constant. If your program needs to allocate a large number of sockets, you may need to increase the size of the bit sets. Increasing the size of the bit sets should be done when you compile the program. To increase the size of the bit sets, define `FD_SETSIZE` before including **sys/time.h**. `FD_SETSIZE` is the largest value of any socket that your program expects to use `pselect()` or `select()` on. It is defined to be 2048 in **sys/time.h**.

Note: `FD_SETSIZE` may only be defined by the application program if the extended version of `select()` is used (by defining `_OPEN_MSGQ_EXT`). Do NOT define `FD_SETSIZE` in your program if a `select` structure will be used.

Note: The z/OS UNIX POSIX.1 implementation allows you to control the maximum number of open descriptors allowed per process. This maximum possible value is 524288. If your application program requires a large number of either socket or file descriptors, you should protect your code from possible runtime errors by:

- Adding a check before your `pselect()`, `select()` or `selectex()` calls to see if the bit set size contained in `nmsgsfds` is larger than `FD_SETSIZE`.
- Dynamically allocate bit strings large enough to hold the largest descriptor value in your application program, rather than rely on the static bit strings created at compile time. When allocating your own bit strings, use `malloc()` to define an area large enough to represent each bit, rounded up to the next 4-byte multiple. For example, if your largest descriptor value is 31, you need 4 bytes; if your largest descriptor is 32, you need 8 bytes.
- If you dynamically allocate your own bit strings, the `FD_ZERO()` macro will *not* work. The application must zero that storage, by using the `memset` function—that is, `memset(ptr,0,mallocsize)`. The other macros can be used with the dynamically allocated bit strings, as long as the descriptor you are manipulating is within the bit string. If the descriptor number is larger than the bit string, unpredictable results can occur.

The application program must make sure that the parameters *readlist*, *writelist*, and *exceptlist* point to bit strings that are as large as the bit string size in parameter `nmsgsfds` z/OS UNIX services will try to access bits 0 through $n - 1$ (where n = the value of the second halfword of `nmsgsfds`), for each of the bit strings. If the bit strings are too short, you will receive unpredictable results when you run your application program.

The following macros are provided to manipulate bit sets.

Macro

Description

FD_ZERO(&fdset)

Sets all bits in the bit set *fdset* to zero. After this operation, the bit set does not contain sockets as elements. This macro should be called to initialize the bit set before calling `FD_SET()` to set a socket as a member.

Note: If you used `malloc()` to dynamically allocate a new area, the `FD_ZERO()` macro can cause unpredictable results and should *not* be used. You should zero the area using the `memset()` function.

FD_SET(sock, &fdset)

Sets the bit for the socket *sock* to a 1, making *sock* a member of the bit set *fdset*.

FD_CLR(sock, &fdset)

Clears the bit for the socket *sock* in bit set *fdset*. This operation sets the appropriate bit to a zero.

FD_ISSET(sock, &fdset)

Returns nonzero if *sock* is a member of the bit set *fdset*. Returns 0 if *sock* is not a member of *fdset*. (This operation returns the bit representing *sock*.)

The following macros are provided to manipulate the `nmsgsfds` parameter and the return value from `pselect()` and `select()`:

Macro

Description

_SET_FDS_MSGS(*nmsgsfds*, *nmsgs*, *nfds*)

Sets the high-order halfword of *nmsgsfds* to *nmsgs*, and sets the low-order halfword of *nmsgsfds* to *nfds*.

_NFDS(*n*)

If the return value *n* from `pselect()` or `select()` is nonnegative, returns the number of descriptors that meet the read, write, and exception criteria. A descriptor may be counted multiple times if it meets more than one given criterion.

_NMSGs(*n*)

If the return value *n* from `pselect()` or `select()` is nonnegative, returns the number of message queues that meet the read, write, and exception criteria. A message queue may be counted multiple times if it meets more than one given criterion.

A socket is ready for reading when incoming data is buffered for it or when a connection request is pending. To test whether any sockets are ready for reading, use either `FD_ZERO()` or `memset()`, if the function was dynamically allocated, to initialize the fdset bit set in *readlist* and invoke `FD_SET()` for each socket to test.

A socket is ready for writing if there is buffer space for outgoing data. A socket is ready for reading if there is data on the socket to be received. For a nonblocking stream socket in the process of connecting the `connect()` will return with a -1. The program needs to check the `errno`. If the `errno` is `EINPROGRESS`, the socket is selected for write when the `connect()` completes. In the situation where the `errno` is not `EINPROGRESS`, the socket will still be selected for write which indicates that there is a pending error on the socket. A call to `write()`, `send()`, or `sendto()` does not block provided that the amount of data is less than the amount of buffer space. If a socket is selected for write, the amount of available buffer space is guaranteed to be at least as large as the size returned from using `SO_SNDBUF` with `getsockopt()`. To test whether any sockets are ready for writing, initialize the fdset bit set in *writelst* with either `FD_ZERO()` or `memset()`, if dynamically allocated, and use `FD_SET()` for each socket to test.

A message queue is ready for reading when any time it has a message on it. It is considered ready for writing when any time it is not full. A message queue is full when it has either reached its number of messages limit or its number of bytes limit. An exception condition exists when a message queue is deleted while a `select()` caller is waiting on the queue.

The programmer can pass `NULL` for any of the *readlist*, *writelst*, and *exceptlist* parameters. However, when they are not `NULL`, they must all point to the same type of structures. For example, suppose the *readlist* points to a *sellist*. If the *writelst* is not `NULL`, it must point to a *sellist* also. Now, let us say the *writelst* is not `NULL`. If the programmer wants to check a set of file descriptors for read status only, the appropriate bits in the bit set in the *sellist* structure pointed to by the *writelst* must be set to 0. If the programmer wants to check a set of message queues for write status only, the appropriate elements in the array in the *sellist* structure pointed to by the *readlist* must be set to -1. Regular files are always ready for reading and writing.

Because the sets of sockets passed to `pselect()` and `select()` are bit sets, the `pselect()` and `select()` call must test each bit in each bit set before polling the socket for its status. The `pselect()` and `select()` call tests only sockets in the range 0 to *n*-1 (where *n* = the value of the second halfword of *nmsgsfds*).

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

The value -1 indicates the error code should be checked for an error. The value zero indicates an expired time limit.

When the return value is greater than 0, then it is similar to *nmsgsfds* in that the high-order 16 bits give the number of message queues, and the low-order 16 bits give the number of descriptors. These values indicate the sum total that meet each of the read, write, and exception criteria. Note that a descriptor or a message queue may be counted multiple times if it meets more than one given criterion. Should the return value for message queues exceed the value 32767, only 32767 will be reported. This is to ensure

that the return value does not appear to be negative. Should the return value for file/socket descriptors be greater than 65535, only 65535 will be reported.

If the return value is greater than 0, the files/sockets that are ready in each bit set are set to 1. Files/ Sockets in each bit set that are not ready are set to zero. Use the macro `FD_ISSET()` with each file/socket to test its status. For those message queues that do not meet the conditions their identifiers in the `msgsid` arrays will be replaced with a value of -1.

Error Code

Description

EBADF

One of the bit sets specified an invalid socket or a message queue identifier is invalid. `FD_ZERO()` was probably not called to clear the bit set before the sockets were set.

EFAULT

One of the parameters contained an invalid address.

EINTR

The `pselect()` or `select()` function was interrupted before any of the selected events occurred and before the timeout interval expired.

EINVAL

One of the fields in the **timeval** structure or **timespec** structure is invalid, or there was an invalid *nmsgsfds* value.

EIO

One of the descriptors in the select mask has become inoperative and it is being repeatedly included in a select even though other operations against this descriptor have been failing with EIO. A socket descriptor, for example, can become inoperative if TCP/IP is shut down. When a descriptor fails a failure from select could not tell you which descriptor had failed so generally select will succeed and these descriptors will be reported to you as being ready for whatever events were specified on the select. Subsequently when the descriptor is used on a receive or other operation you will receive the EIO failure then and can react to the problem with the individual descriptor. In general you would `close()` the descriptor and remove it from the next select mask. If the individual descriptor's failing return code is ignored though and an inoperative descriptor is repeatedly selected on and used, even though each time it is used that call fails with EIO, eventually the select call itself will fail with EIO.

Note: The `pselect()` function can also return `errno`'s set by the `sigprocmask()` function.

Example

In the following example, `select()` is used to poll sockets for reading (socket `sr`), writing (socket `sw`), and exception (socket `se`) conditions, and to check message queue ids `mr`, `mw`, and `me`.

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _OPEN_MSGQ_EXT

#include <sys/types.h>
#include <sys/time.h>
#include <sys/msg.h>

struct sellist {
    fd_set fdset;
    int msgids[2];
};

/*
 * sock_msg_stats(sr, sw, se, mr, mw, me) - Print the status of
 *     sockets sr, sw, and se, and of message queue ids mr, mw,
 *     and me.
 */
int sock_msg_stats(sr, sw, se, mr, mw, me)
int sr, sw, se, mr, mw, me;
{
    struct sellist *reading, *writing, *excepting;
    struct sellist read, write, except;
    struct timeval timeout;
    int rc, max_sock, sock_size, nmsgsfds;
    int msgids[1];          /* we only check 1 message queue */
}
```

select

```
/* What's the maximum socket number? */
max_sock = MAX( sr, sw );
max_sock = MAX( max_sock, se );

/* initialize the static bit sets */
FD_ZERO( &read.fdset );   reading = &read;
FD_ZERO( &write.fdset );  writing = &write;
FD_ZERO( &except.fdset ); excepting = &except;

/* add sr, sw, and se to the appropriate bit set */
FD_SET( sr, &reading->fdset );
FD_SET( sw, &writing->fdset );
FD_SET( se, &excepting->fdset );

/* initialize the message id arrays */
reading->msgids[0] = mr;
writing->msgids[0] = mw;
excepting->msgids[0] = me;

/* set the nmsgsfds parameter */
_SET_FDS_MSGS( nmsgsfds, 1, max_sock+1 );

/* make select poll by sending a 0 timeval */
memset( &timeout, 0, sizeof(timeout) );
/* poll */
rc = select( nmsgsfds, reading, writing, excepting, &timeout);

if ( rc < 0 ) {
    /* an error occurred during the SELECT() */
    perror( "select" );
}
else if ( rc == 0 ) {
    /* no sockets or messages were ready in our little poll */
    printf( "nobody is home.\n" );
}
else {
    if ( _NFDS(rc) > 0 ) {
        /* at least one of the sockets is ready */
        printf("sr is %s\n",
            FD_ISSET(sr,&reading->fdset) ? "READY" : "NOT READY");
        printf("sw is %s\n",
            FD_ISSET(sw,&writing->fdset) ? "READY" : "NOT READY");
        printf("se is %s\n",
            FD_ISSET(se,&excepting->fdset) ? "READY": "NOT READY");
    }
    else {
        if ( _NMSGs(rc) > 0 ) {
            /* at least one message queue is ready */
            printf("mr is %s\n",
                reading->msgids[0] == -1 ? "NOT READY" : "READY");
            printf("mw is %s\n",
                writing->msgids[0] == -1 ? "NOT READY" : "READY");
            printf("me is %s\n",
                excepting->msgids[0] == -1 ? "NOT READY" : "READY");
        }
    }
}
```

CELEBP72

```
/* CELEBP72
```

This example demonstrates the use of pselect()

Expected output:

Parent: Issuing pselect

This is the child

Child: Sending signal to the parent at:

This is the signal handler

Signal received: 14 (14 is SIGALRM)

The pselect call was made at:

The SIGALRM was caught at:

TEST PASSED!

```
*/
#define _POSIX_C_SOURCE 200112L
#include <sys/select.h>
```



```

#include <stdio.h>
#include <fcntl.h>
#include <signal.h>
#include <string.h>
#include <time.h>
#include <unistd.h>

time_t t1,t2;

void incatchr(int signum){
    double diff=0;

    time(&t2);
    printf("\n\nThis is the signal handler\n");
    printf("Signal received: %d (14 is SIGALRM) \n",signum);
    printf("The pselect call was made at: \t%s\n",ctime(&t1));
    printf("The SIGALRM was caught at: \t%s\n",ctime(&t2));
    diff = difftime(t2,t1);
    if(diff < 10) {
        printf("TEST FAILED!\n\n");
    }
    else{
        printf("TEST PASSED!\n\n");
    }
}

int main(void){
    int fd[1], rc, nfd=3, fd1, fd2, fd3;
    pid_t cpid, ppid;
    fd_set fdsread;
    struct sigaction action, info;
    sigset_t pselect_set;
    struct timespec t;
    time_t t3;

    t.tv_sec=10;
    t.tv_nsec=0;

    FD_ZERO(&fdsread);

    action.sa_handler = incatchr;
    action.sa_flags = 0;
    sigaction(SIGALRM,&action,&info);

    sigemptyset(&pselect_set);
    sigaddset(&pselect_set, SIGALRM);

    fd1 = open("./testchd.txt",O_RDWR|O_CREAT);
    fd2 = open("./testchd2.txt",O_RDWR|O_CREAT);
    if((rc=pipe(fd)) != 0){
        printf("Error in pipe\n");
        return(-1);
    }

    FD_SET(fd[0],&fdsread);

    if ((cpid = fork()) < 0){
        printf("Fork error\n");
        return(-1);
    }
    else{
        if (cpid == 0){
            fd3 = open("./testchd.txt",O_RDWR|O_CREAT);
            printf("This is the child\n");
            sleep(2);
            ppid= getppid();
            time(&t3);
            printf("Child: Sending signal to the parent at: ");
            printf("%s",ctime(&t3));
            kill(ppid,SIGALRM);
            sleep(3);
            _exit(0);
        }
        else{
            printf("Parent: Issuing pselect\n\n");
            time(&t1);
            if (pselect(nfd,&fdsread,NULL,NULL,&t,&pselect_set) == -1)
                printf("Error in pselect\n");
        }
        close(fd[0]);
    }
}

```

```
    return 0;
}
```

Related information

- [“sys/msg.h — Message queue structures” on page 69](#)
- [“sys/times.h — Processor times” on page 71](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“msgctl\(\), msgctl64\(\) — Message control operations” on page 1110](#)
- [“msgget\(\) — Get message queue” on page 1112](#)
- [“msgrcv\(\) — Message receive operation” on page 1115](#)
- [“msgsnd\(\) — Message send operations” on page 1119](#)
- [“poll\(\) — Monitor activity on file descriptors and message queues” on page 1196](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)

selectex() — Monitor activity on files or sockets and message queues

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _ALL_SOURCE
#define _OPEN_MSGQ_EXT
#include <sys/types.h>
#include <sys/time.h>
#include <sys/msg.h>

int selectex(int nmsgsfds, fd_set *readlist,
             fd_set *writelist,
             fd_set *exceptlist,
             struct timeval *timeout, int *ecbptr);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#define _ALL_SOURCE
#define _OPEN_MSGQ_EXT
#include <sys/types.h>
#include <sys/time.h>
#include <sys/msg.h>

int selectex(int nmsgsfds, fd_set *readlist,
             fd_set *writelist,
             fd_set *exceptlist,
             struct timeval *timeout, int *ecbptr);
```

_OPEN_MSGQ_EXT must be defined if message queues are to be monitored (X/Open sockets only).

General description

The selectex() function provides an extension to the select() call by allowing you to use an ECB that defines an event not described by readlist, writelist, or exceptlist.

The `selectex()` call monitors activity on a set of files/sockets and message queues until a timeout occurs, or until the ECB is posted, to see if any of the files/sockets and message queues have read, write, or exception processing conditions pending.

When the storage key of the first (or only) ECB matches the caller's PSW key, the kernel performs the wait in the caller's PSW key; otherwise, the kernel performs the wait in the TCB key (TCBPFK). However, if the caller is running in key 0, then the kernel performs the wait in key 0, regardless of the storage key.

See `select()` for more information.

Parameter Description

nmsgsfds

The number of message queues and the number of file or socket descriptors to check. (Refer to `select()` for a full description of this and other parameters below.)

Note: This function is limited to descriptor numbers less than or equal to 65535.

readlist

A pointer to an `fd_set` type, array of message queue identifiers, or *sellist* structure specifying descriptors and message queues to check for reading.

writelist

A pointer to an `fd_set` type, array of message queue identifiers, or *sellist* structure specifying descriptors and message queues to check for writing.

exceptlist

A pointer to an `fd_set` type, array of message queue identifiers, or *sellist* structure specifying descriptors and message queues to be checked for exceptional pending conditions.

timeout

The pointer to the time to wait for the `selectex()` call to complete.

ecbptr

This variable can contain one of the following values:

1. A pointer to a user event control block. To specify this usage of *ecbptr*, the high-order bit must be set to '0' B.
2. A pointer to a list of ECBs. To specify this usage of *ecbptr*, the high-order bit must be set to '1' B.
The list can contain the pointers for up to 1013 ECBs. The high-order bit of the last pointer in the list must be set to '1' B.
3. A NULL pointer. This indicates no ECBs are specified.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

The value -1 indicates the error code should be checked for an error. The value 0 indicates an expired time limit or that the ECB is posted.

When the return value is greater than 0, then it is similar to *nmsgsfds* in that the high-order 16 bits give the number of message queues, and the low-order 16 bits give the number of descriptors. These values indicate the sum total that meet each of the read, write, and exception criteria. Note that a descriptor or a message queue may be counted multiple times if it meets more than one requested criterion. Should the return value for message queues exceed the value 32767, only 32767 will be reported. This is to ensure that the return value does not appear to be negative. Should the return value for file/socket descriptors be greater than 65535, only 65535 will be reported.

If the return value is greater than 0, the files/sockets that are ready in each bit set are set to 1. Files/Sockets in each bit set that are not ready are set to zero. Use the macro `FD_ISSET()` with each socket to test its status. For those message queues that do not meet the conditions their identifiers in the *msgsid* array will be replaced with a value of -1.

Error Code Description

EBADF

One of the descriptor sets specified an incorrect descriptor or a message queue identifier is invalid.

EFAULT

One of the parameters contained an invalid address.

EINTR

`selectex()` was interrupted before any of the selected events occurred and before the timeout interval expired.

EINVAL

One of the fields in the *timeval* structure is incorrect.

EIO

One of the descriptors in the select mask has become inoperative and it is being repeatedly included in a select even though other operations against this descriptor have been failing with EIO. A socket descriptor, for example, can become inoperative if TCP/IP is shut down. A failure from select can not tell you which descriptor has failed so generally select will succeed and these descriptors will be reported to you as being ready for whatever event they were being selected for. Subsequently when the descriptor is used on a receive or other operation you will receive the EIO failure and can react to the problem with the individual descriptor. In general you would close() the descriptor and remove it from the next select mask. If the individual descriptor's failing return code is ignored though and an inoperative descriptor is repeatedly selected on and used, even though each time it is used that call fails with EIO, eventually the select call itself will fail with EIO.

Related information

- [“sys/msg.h — Message queue structures” on page 69](#)
- [“sys/times.h — Processor times” on page 71](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“msgctl\(\), msgctl64\(\) — Message control operations” on page 1110](#)
- [“msgget\(\) — Get message queue” on page 1112](#)
- [“msgrcv\(\) — Message receive operation” on page 1115](#)
- [“msgsnd\(\) — Message send operations” on page 1119](#)
- [“poll\(\) — Monitor activity on file descriptors and message queues” on page 1196](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“send\(\) — Send data on a socket” on page 1493](#)

semctl(), semctl64() — Semaphore control operations

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

semctl:

```
#define _XOPEN_SOURCE
#include <sys/sem.h>

int semctl(int semid, int semnum, int cmd, ...);
```

semctl64:

```
#define _LARGE_TIME_API
#define _XOPEN_SOURCE
#include <sys/sem.h>

int semctl64(int semid, int semnum, int cmd, ...);
```

Compile requirement: Use of the `semctl64()` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The `semctl()` or `semctl64()` function performs control operations in semaphore set *semid* as specified by the argument *cmd*.

Depending on the value of argument *cmd*, argument *semnum* may be ignored or identify one specific semaphore number.

The fourth argument is optional and depends upon the operation requested. If required, it is of type *union semun*, which the application program must explicitly declare:

```
union semun {
    int          val;
    struct semid_ds *buf;
    unsigned short *array;
} arg;
```

Each semaphore in the semaphore set is represented by the following anonymous data structure:

| | | |
|--------------------|---------|---|
| unsigned short int | semval | Semaphore value |
| pid_t | sempid | Process ID of last operation |
| unsigned sort int | semcnt | Number of processes waiting for semval to become greater than current value |
| unsigned short int | semzcnt | Number of processes waiting for semval to become zero |

When `semctl()` or `semctl64()` is used to identify one specific semaphore number for commands `GETVAL`, `SETVAL`, `GETPID`, `GETNCNT`, and `GETZCNT`, then references are made to this anonymous data structure for the semaphore *semnum*.

The following semaphore control operations as specified by argument *cmd* may be specified. The level of permission required for each operation is shown with each command. These symbolic constants are defined by the `<sys/sem.h>` header:

GETVAL

Returns the value of `semval`, if the current process has read permission.

SETVAL

Sets the value of `semval` to `arg.val`, where `arg` is the value of the fourth argument to `semctl()` or `semctl64()`. When this command is successfully executed, the `semadj` value corresponding to the specified semaphore in all processes is cleared. This command requires alter permission. For an `__IPC_BINSEM` semaphore set the only values that may be set are zero and one.

GETPID

Returns the most recent process to update the semaphore (*sempid*), if the current process has read permission.

GETNCNT

Returns the number of threads waiting on the semaphore to become greater than the current value, if the current process has read permission.

GETZCNT

Returns the number of threads waiting on the semaphore to become zero, if the current process has read permission. For an `__IPC_BINSEM` semaphore set this operation will always return a zero; threads are not allowed to wait for the semaphore to become zero in this type of semaphore set.

GETALL

Stores *semvals* for each semaphore in the semaphore set and place into the array pointed to by *arg.array*, where *arg.* is the fourth argument to `semctl()` or `semctl64()`. `GETALL` requires read permission. It is the caller's responsibility to ensure that the storage allocated is large enough to hold the number of semaphore elements. The number of semaphore values stored is *sem_nsems*, which may be obtained using the **IPC_STAT** command.

SETALL

Sets *semval* values for each semaphore in the semaphore set according to the array pointed to by *arg.array*, where *arg* is the fourth argument to `semctl()` or `semctl64()`. `SETALL` requires alter permission. Each *semval* value must be zero or positive. When this command is successfully executed, the *semadj* values corresponding to each specified semaphore in all processes are cleared. It is the caller's responsibility to ensure that the storage allocated is large enough to hold the number of semaphore elements. The number of semaphore values set is *sem_nsems*, which may be obtained using the **IPC_STAT** command. If `__IPC_BINSEM` was specified on the `semget`, this option should not be used while there is the possibility of other threads performing semaphore operations on this semaphore, as there may be no serialization while updating the semaphore values; therefore a `SETALL` will not be allowed after a `semop` has been done to the `__IPC_BINSEM` semaphore set. Also, for the `__IPC_BINSEM` semaphore set, the only values that may be set are zero and one.

IPC_STAT

This command obtains status information for the semaphore identifier specified by *semid*. This requires read permission. This information is stored in the address specified by the fourth argument defined by data structure *semid_ds* or *semid_ds64*.

IPC_SET

Set the value of the *sem_perm.uid*, *sem_perm.gid*, and *sem_perm.mode* in *semid_ds* or *semid_ds64* data structure for the semaphore identifier specified by *semid*. These values are set to the values found in *semid_ds* or *semid_ds64* structure pointed to by the fourth argument.

Any value for *sem_perm.uid* and *semperm.gid* may be set.

Only mode bits defined under `semget()` function argument *semflg* may be set in *sem_perm.mode*.

This command can only be executed by a process that has an effective user ID equal to either that of a process with appropriate privileges or to the value of *sem_perm.cuid* or *sem_perm.uid* in the *semid_ds* or *semid_ds64* structure associated with *semid*.

IPC_RMID

Remove the semaphore identifier specified by argument *semid* from the system and free the storage for the set of semaphores in the *semid_ds* or *semid_ds64* structure.

This command can only be executed by a process that has an effective user ID equal to either that of a process with appropriate privileges or to the value of *sem_perm.cuid* or *sem_perm.uid* in the *semid_ds* or *semid_ds64* structure associated with *semid*. For an `__IPC_BINSEM` semaphore set, it is recommended that all use of `semop` should be completed before removing the semaphore ID.

The `semctl64()` function behaves exactly like `semctl()` except `semctl64()` uses union `semun64` instead of union `semun` if required to support time beyond 03:14:07 UTC on January 19, 2038. `semun64` needs application program's explicit declaration:

```
union semun64 {
    int val;
    struct semid_ds64 *buf;
    unsigned short *array;
} arg;
```

Union `semun64` uses struct `semid_ds64` pointer as its second member instead of struct `semid_ds` pointer.

Returned value

If successful, the value returned by `semctl()` or `semctl64()` depends on the value of the argument *cmd* as follows:

GETVAL

value of `semval` is returned

GETPID

value of `sempid` is returned

GETNCNT

value of `semncnt` is returned

GETZCNT

value of `semzcnt` is returned

All others

value of zero is returned

If unsuccessful, `semctl()` or `semctl64()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Operation permission (read or write) is denied to the calling process.

EINVAL

The value of argument *semid* is not a valid semaphore identifier, or the value of *semnum* is less than zero or greater than or equal to the number of semaphores in the set, or the argument *cmd* is not a valid command, or the bits specified for `sem_perm.mode` are undefined. Note that the valid range of *semnum* is 0 to (number of semaphores in the set minus 1).

EPERM

The argument *cmd* has a value of **IPC_RMID** or **IPC_SET** and the effective user ID of the caller is not that of a process with appropriate privileges and is not the value of `sem_perm.cuid` or `sem_perm.uid` in the `semid_ds` or `semid_ds64` data structure associated with *semid*.

ERANGE

The argument *cmd* has a value of **SETVAL** or **SETALL** and the `semval` value to be set exceeds the system limit as defined in `<sys/sem.h>`.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“sys/sem.h — Semaphore facility” on page 70](#)
- [“semget\(\) — Get a set of semaphores” on page 1486](#)
- [“semop\(\) — Semaphore operations” on page 1488](#)

semget() — Get a set of semaphores

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <sys/sem.h>

int semget(key_t key, int nsems, int semflg);
```

General description

The `semget()` function returns the semaphore identifier associated with *key*.

A semaphore identifier is created with a `semid_ds` data structure, see `<sys/sem.h>`, associated with *nsems* semaphores when any of the following is true:

- Argument *key* has a value of **IPC_PRIVATE**
- Argument *key* is not associated with a semaphore ID and (`semflg & IPC_CREAT`) is non zero.

Valid values for the field *semflg* include any combination of the following defined in `<sys/ipc.h>` and `<sys/modes.h>`:

IPC_CREAT

Creates a semaphore if the *key* specified does not already have an associated ID. **IPC_CREATE** is ignored when **IPC_PRIVATE** is specified.

IPC_EXCL

Causes the `semget()` function to fail if the *key* specified has an associated ID. **IPC_EXCL** is ignored when **IPC_CREAT** is not specified or **IPC_PRIVATE** is specified.

__IPC_BINSEM

Binary semaphore - semaphore must behave in a binary manner: number of semaphore operations must be 1 and the `semop` must be 1 with a `semval` of 0 or the `semop` must be -1 with a `semval` of 0 or 1. `SEM_UNDO` is now allowed on a `semop()` with this option. The use of this flag will cause improved performance if the PLO instruction is available on the hardware.

See [z/OS XL C/C++ Programming Guide](#) for further information on semaphore performance.

__IPC_SHORTHOLD

This flag states that it is known that the application will only hold the resource being serialized for extremely short time intervals. When this flag is combined with the `__IPC_BINSEM` flag, the default first-in-first-out (FIFO) ordering of semaphore obtain requesters will be bypassed, to allow short duration requesters to successfully obtain the semaphore (and hopefully release it) within the interval it normally takes to dispatch the next pending waiter for that semaphore.

S_IRUSR

Permits read access when the effective user ID of the caller matches either `sem_perm.cuid` or `sem_perm.uid`.

S_IWUSR

Permits write access when the effective user ID of the caller matches either `sem_perm.cuid` or `sem_perm.uid`.

S_IRGRP

Permits read access when the effective group ID of the caller matches either `sem_perm.cgid` or `sem_perm.gid`.

S_IWGRP

Permits write access when the effective group ID of the caller matches either `sem_perm.cgid` or `sem_perm.gid`.

S_IROTH

Permits others read access

S_IWOTH

Permits others write access

When a semaphore set associated with argument *key* already exists, setting **IPC_EXCL** and **IPC_CREAT** in argument *semflg* will force `semget()` to fail.

When a `semid_ds` data structure is created the following anonymous data structure is created for each semaphore in the set:

| | | |
|--------------------|----------------------|--|
| unsigned short int | <code>semval</code> | Semaphore value |
| pid_t | <code>sempid</code> | Process ID of last operation |
| unsigned sort int | <code>semcnt</code> | Number of processes waiting for <code>semval</code> to become greater than current value |
| unsigned short int | <code>semzcnt</code> | Number of processes waiting for <code>semval</code> to become zero |

The following fields are initialized when a `semid_ds` data structure is created:

- The fields `sem_perm.cuid` and `sem_perm.uid` are set equal to the effective user ID of the calling process.
- The fields `sem_perm.cgid` and `sem_perm.gid` are set equal to effective group ID of the calling process.
- The low-order 9 bits of `sem_perm.mode` are set to the value in the low-order 9 bits of *semflg*.
- The field `sem_nsems` is set to the value of *nsems*.
- The field `sem_otime` is set to 0.
- The field `sem_ctime` is set to the current time.
- The anonymous data structure containing `semval` for each semaphore is not initialized. `semctl()` commands **SETVAL** and **SETALL** should be used to initialize each semaphore's `semval` value.

Usage notes

1. Semaphores created with `__IPC_BINSEM` will show this bit and may show the `IPC_PLOINUSE` bit in the `S_MODE` byte returned with *w_getipc*.

Returned value

If successful, `semget()` returns a nonnegative semaphore identifier.

If unsuccessful, `semget()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCES**

A semaphore identifier exists for the argument *key*, but access permission as specified by the low-order 9 bits of *semflg* could not be granted.

EEXIST

A semaphore identifier exists for the argument *key* and both **IPC_CREAT** and **IPC_EXCL** are specified in *semflg*.

EINVAL

The value of *nsems* is either less than zero or greater than the system limit. A semaphore identifier associated with *key* does not exist and the *nsems* is zero. A semaphore identifier associated with *key* already exists and the *nsems* value specified on `semget()` when the semaphore identifier was created is less than the *nsems* value on the current `semget()`. The *semflg* argument specified flags not currently supported.

ENOENT

A semaphore identifier does not exist for the argument *key* and **IPC_CREAT** is not specified.

ENOSPC

A system limit of number of semaphore identifiers has been reached.

When *semflg* equals 0, the following applies:

- If a semaphore identifier has already been created with *key* earlier, and the calling process of this `semget()` has read and/or write permissions to it, then `semget()` returns the associated semaphore identifier.
- If a semaphore identifier has already been created with *key* earlier, and the calling process of this `semget()` does not have read and/or write permissions to it, then `semget()` returns -1 and sets `errno` to `EACCES`.
- If a semaphore identifier has not been created with *key* earlier, then `semget()` returns -1 and sets `errno` to `ENOENT`.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“sys/sem.h — Semaphore facility” on page 70](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“ftok\(\) — Generate an interprocess communication \(IPC\) key” on page 662](#)
- [“semctl\(\), semctl64\(\) — Semaphore control operations” on page 1482](#)
- [“semop\(\) — Semaphore operations” on page 1488](#)

semop() — Semaphore operations

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <sys/sem.h>

int semop(int semid, struct sembuf *sops, size_t nsops);
```

General description

The `semop()` function performs semaphore operations atomically on a set of semaphores associated with argument *semid*. The argument *sops* is a pointer to an array of `sembuf` data structures. The argument *nsops* is the number of `sembuf` structures in the array.

The structure `sembuf` is defined as follows:

```
short  sem_num  Semaphore number in the range 0 to (nsems - 1)
short  sem_op   Semaphore operation
short  sem_flg  Operation flags
```

Each semaphore in the semaphore set, identified by `sem_num`, is represented by the following anonymous data structure. This data structure for all semaphores is updated atomically when `semop()` returns successfully:

```
unsigned short int    semval    Semaphore value
pid_t                sempid    Process ID of last operation
unsigned short int    semcnt    Number of processes waiting for semval to become
                                greater than current value
unsigned short int    semzcnt    Number of processes waiting for semval to become zero
```

Each semaphore operation specified by `sem_op` is performed on the corresponding semaphore specified by `semid` and `sem_num`.

The variable `sem_op` specifies one of three semaphore operations:

1. If `sem_op` is a negative integer and the calling process has alter permission, one of the following will occur:
 - If `semval`, see `<sys/sem.h>`, is greater than or equal to the absolute value of `sem_op`, the absolute value of `sem_op` is subtracted from `semval`.
 - If `semval` is less than the absolute value of `sem_op` and `(sem_flg & IPC_NOWAIT)` is nonzero, `semop()` will return immediately.
 - If `semval` is less than the absolute value of `sem_op` and `(sem_flg & IPC_NOWAIT)` is zero, `semop()` will increment the `semcnt` associated with the specified semaphore and suspend execution of the calling process until one of the following conditions occurs:
 - The value of `semval` becomes greater than or equal to the absolute value of `sem_op`. When this occurs, the value of `semcnt` associated with the specified semaphore is decremented, the absolute value of `sem_op` is subtracted from `semval`.
 - The `semid` for which the calling process is awaiting action is removed from the system. When this occurs, `errno` is set equal to `EIDRM` and `-1` is returned.
 - The calling process receives a signal that is to be caught. When this occurs, the value of `semcnt` associated with the specified semaphore is decremented, and the calling process resumes execution in the manner prescribed in `sigaction()`.
2. If `sem_op` is a positive integer and the calling process has alter permission, the value of `sem_op` is added to `semval`.
3. If `sem_op` is zero and the calling process has read permission, one of the following will occur:
 - If `semval` is zero, `semop()` will return immediately.
 - If `semval` is nonzero and `(sem_flg & IPC_NOWAIT)` is nonzero, `semop()` will return immediately.
 - If `semval` is nonzero and `(sem_flg & IPC_NOWAIT)` is 0, `semop()` will increment the `semzcnt` associated with the specified semaphore and suspend execution of the calling thread until one of the following occurs:
 - The value of `semval` becomes 0, at which time the value of `semzcnt` associated with the specified semaphore is decremented.
 - The `semid` for which the calling process is awaiting action is removed from the system. When this occurs, `errno` is set equal to `EIDRM` and `-1` is returned.
 - The calling process receives a signal that is to be caught. When this occurs, the value of `semzcnt` associated with the specified semaphore is decremented, and the calling process resumes execution in the manner prescribed in `sigaction()`.

- Upon successful completion, the value of `sempid` for each semaphore specified in the array pointed to by `sops` is set equal to the process ID of the calling process.

`sem_flg` contains the **IPC_NOWAIT** and **SEM_UNDO** flags described as follows:

IPC_NOWAIT

Will cause `semop()` to return `EAGAIN` rather than place the thread into wait state.

SEM_UNDO

Will result in `semadj` adjustment values being maintained for each semaphore on a per process basis. If `sem_op` value is not equal to zero and **SEM_UNDO** is specified, then `sem_op` value is subtracted from the current process's `semadj` value for that semaphore. When the current process is terminated, see `exit()`, the `semadj` value(s) will be added to the `semval` for each semaphore. The `semctl()` command **SETALL** may be used to clear all `semadj` values in all processes. If `__IPC_BINSEM` was specified on `semget` for this semaphore, the `SEM_UNDO` flag will cause an error to be returned.

A semaphore set created with the `__IPC_BINSEM` flag must behave in the following manner: number of semaphore operations must be 1 and the `semop` must be +1 with a `semval` of 0 or the `semop` must be -1 with a `semval` of 0 or 1. `SEM_UNDO` is not allowed on a `semop()` with this option. The use of this flag will cause improved performance if the PLO instruction is available on the hardware.

Returned value

If successful, `semop()` returns 0. Also the `semid` parameter value for each semaphore that is operated upon is set to the process ID of the calling process.

If unsuccessful, `semop()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

E2BIG

The value `nsops` is greater than the system limit.

EACCES

Operation permission is denied to the calling process. Read access is required when `sem_op` is zero. Write access is required when `sem_op` is not zero.

EAGAIN

The operation would result in suspension of the calling process but **IPC_NOWAIT** in `sem_flg` was specified.

EFBIG

`sem_num` is less than zero or greater or equal to the number of semaphores in the set specified on in `semget()` argument `nsems`.

EIDRM

`semid` was removed from the system while the invoker was waiting.

EINTR

`semop()` was interrupted by a signal.

EINVAL

The value of argument `semid` is not a valid semaphore identifier. For an `__IPC_BINSEM` semaphore set, the `sem_op` is other than +1 for a `sem_val` of 0 or -1 for a `sem_val` of 0 or 1. Also, for an `__IPC_BINSEM` semaphore set, the number of semaphore operations is greater than one.

ENOSPC

The limit on the number of individual processes requesting a **SEM_UNDO** would be exceeded.

ERANGE

An operation would cause `semval` or `semadj` to overflow the system limit as defined in `<sys/sem.h>`.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“sys/sem.h — Semaphore facility” on page 70](#)

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“exec functions” on page 442](#)
- [“exit\(\) — End program” on page 449](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“semctl\(\), semctl64\(\) — Semaphore control operations” on page 1482](#)
- [“semget\(\) — Get a set of semaphores” on page 1486](#)
- [“__semop_timed\(\) — Semaphore operations with timeout” on page 1491](#)

__semop_timed() — Semaphore operations with timeout

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R10 |

Format

```
#define _OPEN_SYS_TIMED_EXT 1
#include <time.h>
#include <sys/sem.h>

int __semop_timed(int semid, struct sembuf *sops, size_t nsops,
                  struct timespec *set)
```

General description

Performs semaphore operations atomically on a set of semaphores associated with argument *semid*. The argument *sops* is a pointer to an array of *sembuf* data structures. The argument *nsops* is the number of *sembuf* structures in the array. The argument *set* the structure *timespec* with the timeout values.

The structure *sembuf* is defined as follows:

```
short sem_num  Semaphore number in the range 0 to (nsems - 1)
short sem_op   Semaphore operation
short sem_flg  Operation flags
```

Each semaphore in the semaphore set, identified by *sem_num*, is represented by the following anonymous data structure. This data structure for all semaphores is updated automatically when *semop()* returns successfully:

| | | |
|--------------------|----------------|--|
| unsigned short int | <i>semval</i> | Semaphore value |
| pid_t | <i>sempid</i> | Process ID of last operation |
| unsigned sort int | <i>semcnt</i> | Number of processes waiting for <i>semval</i> to become greater than current value |
| unsigned short int | <i>semzcnt</i> | Number of processes waiting for <i>semval</i> to become zero |

Each semaphore operation specified by *sem_op* is performed on the corresponding semaphore specified by *semid* and *sem_num*.

The variable *sem_op* specifies one of three semaphore operations:

1. If `sem_op` is a negative integer and the calling process has alter permission, one of the following will occur:
 - If `semval`, see `<sys/sem.h>`, is greater than or equal to the absolute value of `sem_op`, the absolute value of `sem_op` is subtracted from `semval`.
 - If `semval` is less than the absolute value of `sem_op` and `(sem_flg & IPC_NOWAIT)` is nonzero, `semop()` will return immediately.
 - If `semval` is less than the absolute value of `sem_op` and `(sem_flg & IPC_NOWAIT)` is zero, `semop()` will increment the `semncnt` associated with the specified semaphore and suspend execution of the calling process until one of the following conditions occurs:
 - The value of `semval` becomes greater than or equal to the absolute value of `sem_op`. When this occurs, the value of `semncnt` associated with the specified semaphore is decremented, the absolute value of `sem_op` is subtracted from `semval`.
 - The `semid` for which the calling process is awaiting action is removed from the system. When this occurs, `errno` is set equal to `EIDRM` and `-1` is returned.
 - The calling process receives a signal that is to be caught. When this occurs, the value of `semncnt` associated with the specified semaphore is decremented, and the calling process resumes execution in the manner prescribed in `sigaction()`.
2. If `sem_op` is a positive integer and the calling process has alter permission, the value of `sem_op` is added to `semval`.
3. If `sem_op` is zero and the calling process has read permission, one of the following will occur:
 - If `semval` is zero, `semop()` will return immediately.
 - If `semval` is nonzero and `(sem_flg & IPC_NOWAIT)` is nonzero, `semop()` will return immediately.
 - If `semval` is nonzero and `(sem_flg & IPC_NOWAIT)` is 0, `semop()` will increment the `semzcnt` associated with the specified semaphore and suspend execution of the calling thread until one of the following occurs:
 - The value of `semval` becomes 0, at which time the value of `semzcnt` associated with the specified semaphore is decremented.
 - The `semid` for which the calling process is awaiting action is removed from the system. When this occurs, `errno` is set equal to `EIDRM` and `-1` is returned.
 - The calling process receives a signal that is to be caught. When this occurs, the value of `semzcnt` associated with the specified semaphore is decremented, and the calling process resumes execution in the manner prescribed in `sigaction()`.
 - Upon successful completion, the value of `sempid` for each semaphore specified in the array pointed to by `sops` is set equal to the process ID of the calling process.

The variable, `set`, gives the timeout specification.

- If the `__semop_timed()` function finds that none of the semaphores specified by `semid` are received, it waits for the time interval specified in the **timespec** structure referenced by `set`. If the **timespec** structure pointed to by `set` is zero-valued and if none of the semaphores specified by `semid` are received, then `__semop_timed()` returns immediately with `EAGAIN`. A **timespec** with the `tv_sec` field set with `INT_MAX`, as defined in `<limits.h>`, will cause the `__semop_timed()` service to wait until a semaphore is received. If `set` is the `NULL` pointer, it will be treated the same as when **timespec** structure was supplied with the `tv_sec` field set with `INT_MAX`.

Returned value

If successful, `__semop_timed()` returns 0. Also the `semid` parameter value for each semaphore that is operated upon is set to the process ID of the calling process.

If unsuccessful, `__semop_timed()` returns `-1` and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

E2BIG

The value *nsops* is greater than the system limit.

EACCES

Operation permission is denied to the calling process. Read access is required when *sem_op* is zero. Write access is required when *sem_op* is not zero.

EAGAIN

The operation would result in suspension of the calling process but **IPC_NOWAIT** in *sem_flg* was specified. This would result if the timeout specified expires before a semop is posted.

EFBIG

sem_num is less than zero or greater or equal to the number of semaphores in the set specified on in *semget()* argument *nsems*.

EIDRM

semid was removed from the system while the invoker was waiting.

EINTR

__semop_timed() was interrupted by a signal.

EINVAL

The value of argument *semid* is not a valid semaphore identifier.

ENOSPC

The limit on the number of individual processes requesting a **SEM_UNDO** would be exceeded.

ERANGE

An operation would cause *semval* or *semadj* to overflow the system limit as defined in `<sys/sem.h>`.

Related information

- [“sys/sem.h – Semaphore facility” on page 70](#)
- [“time.h – Time and date” on page 75](#)
- [“semop\(\) – Semaphore operations” on page 1488](#)

send() – Send data on a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**X/Open:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

ssize_t send(int socket, const void *buffer, size_t length, int flags);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/socket.h>

int send(int socket, char *buffer, int length, int flags);
```

General description

The `send()` function sends data on the socket with descriptor *socket*. The `send()` call applies to all connected sockets.

Parameter Description

socket

The socket descriptor.

msg

The pointer to the buffer containing the message to transmit.

length

The length of the message pointed to by the *msg* parameter.

flags

The *flags* parameter is set by If more than one flag is specified, the logical OR operator (`|`) must be used to separate them.

MSG_OOB

Sends out-of-band data on sockets that support this notion. Only `SOCK_STREAM` sockets support out-of-band data. The out-of-band data is a single byte.

Before out-of-band data can be sent between two programs, there must be some coordination of effort. If the data is intended to not be read inline, the recipient of the out-of-band data must specify the recipient of the `SIGURG` signal that is generated when the out-of-band data is sent. If no recipient is set, no signal is sent. The recipient is set up by using `F_SETOWN` operand of the `fcntl` command, specifying either a pid or gid. For more information on this operand, refer to the `fcntl` command.

The recipient of the data determines whether to receive out-of-band data inline or not inline by the setting of the `SO_OOBINLINE` option of `setsockopt()`. For more information on receiving out-of-band data, refer to the `setsockopt()`, `recv()`, `recvfrom()` and `recvmsg()` commands.

MSG_DONTRROUTE

The `SO_DONTRROUTE` option is turned on for the duration of the operation. This is usually used only by diagnostic or routing programs.

If there is not enough available buffer space to hold the socket data to be transmitted, and the socket is in blocking mode, `send()` blocks the caller until additional buffer space becomes available. If the socket is in nonblocking mode, `send()` returns -1 and sets the error code to `EWOULDBLOCK`. See [“fcntl\(\) — Control open file descriptors” on page 483](#) or [“ioctl\(\) — Control device” on page 872](#) for a description of how to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, provided that the datagram fits into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been sent.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, `send()` returns 0 or greater indicating the number of bytes sent. However, this does not assure that data delivery was complete. A connection can be dropped by a peer socket and a `SIGPIPE` signal generated at a later time if data delivery is not complete.

If unsuccessful, `send()` returns -1 indicating locally detected errors and sets `errno` to one of the following values. No indication of failure to deliver is implicit in a `send()` routine.

Error Code Description

EBADF

socket is not a valid socket descriptor.

ECONNRESET

A connection was forcibly closed by a peer.

EDESTADDRREQ

The socket is not connection-oriented and no peer address is set.

EFAULT

Using the *msg* and *length* parameters would result in an attempt to access storage outside the caller's address space.

EINTR

A signal interrupted `send()` before any data was transmitted.

EIO

There has been a network or transport failure.

EMSGSIZE

The message was too big to be sent as a single datagram.

ENOBUFS

Buffer space is not available to send the message.

ENOTCONN

The socket is not connected.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The *socket* argument is associated with a socket that does not support one or more of the values set in *flags*.

EPIPE

For a connected stream socket the connection to the peer socket has been lost. A SIGPIPE signal is sent to the calling process.

EWOULDBLOCK

socket is in nonblocking mode and no data buffers are available or the SO_SNDTIMEO timeout value was reached before buffers became available.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)

- “[socket\(\)](#) — Create a socket” on page 1677
- “[write\(\)](#) — Write data on a file or socket” on page 2070
- “[writev\(\)](#) — Write data on a file or socket from an array” on page 2076

send_file() — Send file data over a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCKET_EXT2
#include <sys/socket.h>

int send_file(int *socket_ptr, struct sf_parms *sf_struct, int options);
```

General description

The `send_file()` function sends data from the file associated with the open file handle over the connection associated with the socket.

The function takes the following arguments:

socket_ptr

A pointer to a socket file descriptor.

sf_struct

A pointer to a structure that contains variables needed by `sendfile` - header information, file information, trailer information and results of operation. See below for details.

options

Specifies one of the following options:

SF_CLOSE

Close the connection after the data has been successfully sent or queued for transmission.

SF_REUSE

Prepare the socket for reuse after the data has been successfully sent or queued for transmission and the existing connection closed.

0

Do not close the socket (use zero for no options).

Send_File Structure - sf_parms

Argument `sf_struct` points to a struct `sf_parms` that contains the file descriptor, a header data buffer, and a trailer data buffer.

The struct `sf_parms` is defined in `<sys/sockets.h>` and contains the following elements:

header_data

Pointer to a buffer that contains header data which is to be sent before the file data. It may be a NULL pointer if `header_length` is zero.

header_length

Specifies the number of bytes in the `header_data`. It must be set to zero to indicate that header data is not to be sent.

file_descriptor

File descriptor for a file that has been opened for read. This is the descriptor for the file that contains the data to be transmitted.

file_size

The size, in bytes, of the file associated with *file_descriptor*. This field is filled in by the system.

file_offset

Specifies the byte offset into the file from which to start sending data.

file_bytes

Specifies the number of bytes from the file to be transmitted. Setting *file_bytes* to -1 will transmit the entire file from the *offset*. In this case the system will replace the -1 with (actual file size - *file_offset*). Setting *file_bytes* to 0 will result in no file data being transmitted and *file_descriptor* is ignored. If *file_descriptor* is not a regular file it may be necessary to supply a specific value for *file_bytes* unless a normal End Of File (EOF) indication is expected from *file_descriptor* during this operation or you simply want the operation to run forever transferring bytes as they arrive.

trailer_data

Pointer to a buffer that contains trailer data which is to be sent after the file data.

trailer_length

Specifies the number of bytes in the *trailer_data*.

bytes_sent

Number of bytes that were sent in this call to `send_file()`. If it takes multiple calls to `send_file()` to send all the data (due to signal-handling) then this field contains the value for the last call to `send_file()`, it is not a running total. This field is set by the system.

The `send_file()` function attempts to write *header_length* bytes from the buffer pointed to by *header_data*, followed by *file_bytes* from the file associated with *file_descriptor*, followed by *trailer_length* bytes from the buffer pointed to by *trailer_data*, over the connection associated with the socket pointed to by *socket_ptr*.

As data is sent, the system will update elements in *sf_struct* so that if the `send_file()` function is interrupted by a signal, the application simply needs to reissue `send_file()`.

If the application sets *file_offset* > the actual file size, or *file_bytes* > (the actual file size - *file_offset*), the return value will be -1 and `errno` set to *EINVAL*.

If `O_NONBLOCK` is set on the socket file descriptor, the function may return -1 with `errno` set to *EWOULDBLOCK* or *EAGAIN*, or it may complete before all the data is sent. If `O_NONBLOCK` is not set, `send_file()` blocks until the requested data can be sent.

`SF_CLOSE` and `SF_REUSE` will only be effective after all the data has been sent successfully.

If *options* = `SF_REUSE`, and socket reuse is not supported, the system will close the socket and set the socket pointed to by *socket_ptr* to -1. See “Application usage” on page 1497 for details.

Application usage

The function `send_file()` is designed to work with `accept_and_recv()` to provide an efficient file transfer capability for a connection oriented server with short connection times and high connection rates.

On the first call to `accept_and_recv()`, it is recommended that the application set the socket pointed to by *accept_socket* to -1. This will cause the system to assign the accepting socket. On the call to `send_file()`, if the application requests socket reuse (*options* = `SF_REUSE`) and the system does not support it, the system will close the socket pointed to by *socket_ptr* and will set the socket pointed to by *socket_ptr* to -1. The application then passes this value onto the next call to `accept_and_recv()` (by setting *accept_socket* = **socket_ptr*).

To take full advantage of the performance improvements offered by the `accept_and_recv()` and `send_file()` functions, a process/thread model different from the one where a parent accepts in a loop and spins off child process threads is needed. The parent/process thread is eliminated. Multiple worker processes/threads are created, and each worker process/thread then executes the `accept_and_recv()`.

and `send_file()` functions in a loop. The performance benefits of `accept_and_recv()` and `send_file()` include fewer buffer copies, recycled sockets, and optimal scheduling.

Note: The function `send_file()` can be useful by itself for long living socket connections. It does not have to be paired with `accept_and_recv()`. To leave the socket open after `send_file()`, specify a 0 for the *options* parameter.

Returned value

If successful, `send_file()` returns 0.

`send_file()` returns 1 if the request was interrupted by a signal, or because a nonblocking descriptor would have blocked, while sending data. Since the *sf_parms* structure is updated by the system to account for the data that has been sent you can continue the operation from where it was interrupted by recalling `send_file()` without changing the *sf_parms* structure.

If unsuccessful, `send_file()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The calling process does not have the appropriate privileges.

EAGAIN

`socket_ptr` is in nonblocking mode and no data buffers are available or the `SO_SNDTIMEO` timeout value was reached before buffers became available.

EBADF

One of the following occurred:

1. *socket_ptr* is not a valid descriptor or was not open for writing.
2. *file_descriptor* is not a valid descriptor or was not open for reading.

ECONNABORTED

A connection has been aborted.

ECONNRESET

A connection has been forcibly closed by a peer.

EFAULT

The data buffer pointed to by *socket_ptr*, *file_size*, *header_data*, or *trailer_data* was not valid.

EINTR

`send_file()` was interrupted by a signal that was caught before any data was sent.

EINVAL

The value specified by *options* is not valid.

EIO

An I/O error occurred.

EMSGSIZE

The message is too large to be sent all at once, as the socket requires.

ENETDOWN

The local interface to reach the destination is unknown.

ENETUNREACH

No route to the destination is present.

ENOBUFS

No buffer space is available.

ENOMEM

There was insufficient memory available to complete the operation.

ENOSR

There were insufficient STREAMS resources available for the operation to complete.

ENOSYS

This function is not supported in the current environment.

ENOTCONN

The socket is not connected.

ENOTSOCK

The file descriptor pointed to by the *socket_ptr* argument does not refer to a socket.

EPIPE

The socket is shutdown for writing, or the socket is in connection mode and is no longer connected.

EWOULDBLOCK

socket_ptr is in nonblocking mode and no data buffers are available or the SO_SNDTIMEO timeout value was reached before buffers became available.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“accept_and_recv\(\) — Accept connection and receive first message” on page 111](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“socket\(\) — Create a socket” on page 1677](#)

sendmsg() — Send messages on a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**X/Open:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

ssize_t sendmsg(int socket, struct msghdr *msg, int flags);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/socket.h>

int sendmsg(int socket, struct msghdr *msg, int flags);
```

General description

The `sendmsg()` function sends messages on a socket with a socket descriptor passed in an array of message headers.

Parameter**Description****socket**

The socket descriptor.

msg

An array of message headers from which messages are sent.

flags

Specifying one or more of the following flags. If more than one flag is specified, the logical OR operator (|) must be used to separate them.

MSG_OOB

Sends out-of-band data on the socket. Only SOCK_STREAM sockets support out-of-band data. The out-of-band data is a single byte.

Before out-of-band data can be sent between two programs, there must be some coordination of effort. If the data is intended to not be read inline, the recipient of the out-of-band data must specify the recipient of the SIGURG signal that is generated when the out-of-band data is sent. If no recipient is set, no signal is sent. The recipient is set by setting the *action* parameter of the fcntl() function to F_SETOWN and specifying either a PID or GID. For more information on setting a recipient for out-of-band data, see [“fcntl\(\) — Control open file descriptors” on page 483](#).

The recipient of the data determines whether to receive out-of-band data inline or not inline by the setting of the SO_OOBINLINE socket option using the setsockopt() function. For more information on receiving out-of-band data, see [“setsockopt\(\) — Set options associated with a socket” on page 1573](#), [“recv\(\) — Receive data on a socket” on page 1401](#), [“recvfrom\(\) — Receive messages on a socket” on page 1404](#), and [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#).

MSG_DONTROUTE

The SO_DONTROUTE socket option is turned on for the duration of the operation. This flag is typically used by diagnostic or routing programs.

A message header is defined by the msghdr structure, which can be found in the sys/socket.h header file and contains the following elements:

Element**Description****msg_iov**

An array of *iovec* buffers containing the message.

msg_iovlen

The number of elements in the *msg_iov* array.

msg_name

An optional pointer to the buffer containing the recipient's address.

msg_namelen

The size of the address buffer.

caddr_t msg_accrightrights

Access rights sent or received (ignored if specified by the user). This field is ignored by z/OS UNIX services.

int msg_accrightrightslen

Length of access rights data (ignored if specified by the user). This field is ignored by z/OS UNIX services.

msg_control

Ancillary data.

msg_controllen

Ancillary data buffer length.

msg_flags

Flags on received message.

Ancillary data consists of a sequence of pairs, each consisting of a cmsghdr structure followed by a data array. The data array contains the ancillary data message and the cmsghdr structure contains descriptive information that allows an application to correctly parse the data.

The sys/socket.h header file defines the cmsghdr structure that includes at least the following elements:

| Element | Description |
|---------|-------------|
|---------|-------------|

cmsg_len

| |
|------------------------------------|
| Data byte count, including header. |
|------------------------------------|

cmsg_level

| |
|-----------------------|
| Originating protocol. |
|-----------------------|

cmsg_type

| |
|-------------------------|
| Protocol-specific type. |
|-------------------------|

The following ancillary data are available at the IPv4 level:

| Ancillary data | Description |
|----------------|-------------|
|----------------|-------------|

IP_PKTINFO

| |
|---|
| (RAW and UDP) Specifies the interface packets are sent over and the IP address used as the packet source IP. The data is passed in an <code>in_pktinfo</code> structure as defined in <code>netinet/in.h</code> . |
|---|

The following ancillary data are available at the IPv6 level:

| Ancillary data | Description |
|----------------|-------------|
|----------------|-------------|

IPV6_HOPLIMIT

| |
|---|
| (RAW, TCP, and UDP) Specifies the maximum hop limit for an outgoing packet. The data is passed in a structure as defined in <code>netinet/in.h</code> . |
|---|

IPV6_PATHMTU

| |
|---|
| (RAW and UDP) Specifies the path MTU value for the destination of a connected socket. The data is passed in a structure as defined in <code>netinet/in.h</code> . |
|---|

IPV6_PKTINFO

| |
|--|
| (RAW and UDP) Specifies the interface packets are sent over and the IP address used as the packet source IP. The data is passed in an <code>in6_pktinfo</code> structure as defined in <code>netinet/in.h</code> . |
|--|

The following ancillary data are available at the socket level:

| Ancillary data | Description |
|----------------|-------------|
|----------------|-------------|

SCM_RIGHTS

| |
|---|
| Specifies the data array that contains the access rights to be sent or received. This ancillary data is valid only for the <code>AF_UNIX</code> domain. The data is passed in a structure as defined in <code>sys/socket.h</code> . |
|---|

The `sys/socket.h` header file defines the following macros to gain access to the data arrays in the ancillary data associated with a message header:

CMMSG_DATA(*cmsg*)

If the argument is a pointer to a `cmsg_hdr` structure, this macro returns an unsigned character pointer to the data array associated with the `cmsg_hdr` structure.

CMMSG_NXTHDR(*mhdr, cmsg*)

If the first argument is a pointer to a `msg_hdr` structure and the second argument is a pointer to a `cmsg_hdr` structure in the ancillary data (pointed to by the `msg_control` field of that `msg_hdr` structure), this macro returns a pointer to the next `cmsg_hdr` structure or a NULL pointer if this structure is the last `cmsg_hdr` structure in the ancillary data.

CMMSG_FIRSTHDR(*mhdr*)

If the argument is a pointer to a `msg_hdr` structure, this macro returns a pointer to the first `cmsg_hdr` structure in the ancillary data associated with this `msg_hdr` structure, or a NULL pointer if there is no ancillary data associated with the `msg_hdr` structure.

The `sendmsg()` call applies to sockets regardless of whether they are in the connected state.

This call returns the length of the data sent. If there is not enough available buffer space to hold the socket data to be transmitted, and the socket is in blocking mode, `sendmsg()` blocks the caller until additional buffer space becomes available. If the socket is in nonblocking mode, `sendmsg()` returns -1 and

sets the error code to EWOULDBLOCK. See [“fcntl\(\) — Control open file descriptors”](#) on page 483 or [“ioctl\(\) — Control device”](#) on page 872 for a description of how to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, provided that the datagram fits into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been sent.

Socket address structure for IPv6: For an AF_INET6 socket, if msg_name is specified then the address should be in a sockaddr_in6 address structure. The sockaddr_in6 structure is defined in the header file netinet/in.h.

Special behavior for C++: To use this function with C++, you must use the _XOPEN_SOURCE_EXTENDED 1 feature test macro.

Note: The sendmsg() function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, sendmsg() returns the length of the message in bytes.

A value of 0 or greater indicates the number of bytes sent, however, this does not assure that data delivery was complete. A connection can be dropped by a peer socket and a SIGPIPE signal generated at a later time if data delivery is not complete.

If unsuccessful, sendmsg() returns -1 and sets errno to one of the following values:

Error Code Description

EADDRNOTAVAIL

The *ip6_addr* is not available for use on the *ip6_ifindex* interface.

EAFNOSUPPORT

The address family is not supported (it is not AF_UNIX, AF_INET, or AF_INET6).

EBADF

socket is not a valid socket descriptor.

ECONNREFUSED

The attempt to connect was rejected.

ECONNRESET

A connection was forcibly closed by a peer.

EFAULT

Using *msg* would result in an attempt to access storage outside the caller's address space.

EHOSTUNREACH

No route to the destination exists over the interface specified by *ifi6_index*.

EINTR

A signal interrupted sendmsg() before any data was transmitted.

EINVAL

msg_namelen is not the size of a valid address for the specified address family.

EIO

There has been a network or transport failure.

EMSGSIZE

The message was too big to be sent as a single datagram. The default is *large-envelope-size*. (Envelopes are used to hold datagrams and fragments during TCP/IP processing. Large envelopes hold UDP datagrams greater than 2KB while they are processed for output, and when they are waiting for an application program to receive them on input.)

ENETDOWN

The interface specified by *ip6_ifindex* is not enabled for IPv6 use.

ENOBUFS

Buffer space is not available to send the message.

ENOTCONN

The socket is not connected.

ENOTSOCK

The descriptor is for a file, not for a socket.

ENXIO

The interface specified by *ip6_ifindex* does not exist.

EOPNOTSUPP

The *socket* argument is associated with a socket that does not support one or more of the values set in *flags*.

EPIPE

For a connected stream socket the connection to the peer socket has been lost. A SIGPIPE signal is sent to the calling process.

EWouldBlock

socket is in nonblocking mode and no data buffers are available or the SO_SNDTIMEO timeout value was reached before buffers became available.

The following are for AF_UNIX only:

Error Code**Description****EACCES**

Search permission is denied for a component of the path prefix, or write access to the named socket is denied.

EIO

An I/O error occurred while reading from or writing to the file system.

ELOOP

Too many symbolic links were encountered in translating the pathname in the socket address.

ENAMETOOLONG

A component of a pathname exceeded **NAME_MAX** characters, or an entire pathname exceeded **PATH_MAX** characters.

ENOENT

A component of the pathname does not name an existing file or the pathname is an empty string.

ENOTDIR

A component of the path prefix of the pathname in the socket address is not a directory.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)

- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“writev\(\) — Write data on a file or socket from an array” on page 2076](#)

sendto() — Send data on a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

ssize_t sendto(int socket, const void *buffer, size_t length, int flags,
               const struct sockaddr *address, size_t address_len);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/socket.h>

int sendto(int socket, char *buffer, int length, int flags,
           struct sockaddr *address, int address_len);
```

General description

The `sendto()` function sends data on the socket with descriptor *socket*. The `sendto()` call applies to either connected or unconnected sockets.

Parameter

Description

socket

The socket descriptor.

buffer

The pointer to the buffer containing the message to transmit.

length

The length of the message in the buffer pointed to by the *msg* parameter.

flags

Setting these flags is not supported in the AF_UNIX domain. The following flags are available:

MSG_OOB

Sends out-of-band data on the socket. Only SOCK_STREAM sockets support out-of-band data. The out-of-band data is a single byte.

Before out-of-band data can be sent between two programs, there must be some coordination of effort. If the data is intended to not be read inline, the recipient of the out-of-band data must

specify the recipient of the SIGURG signal that is generated when the out-of-band data is sent. If no recipient is set, no signal is sent. The recipient is set up by using `F_SETOWN` operand of the `fcntl()` command, specifying either a pid or gid. For more information on this operand, refer to the `fcntl()` command.

The recipient of the data determines whether to receive out-of-band data inline or not inline by the setting of the `SO_OOBINLINE` option of `setsockopt()`. For more information on receiving out-of-band data, refer to the `setsockopt()`, `recv()`, `recvfrom()` and `recvmsg()` commands.

MSG_DONTROUTE

The `SO_DONTROUTE` option is turned on for the duration of the operation. This is usually used only by diagnostic or routing programs.

address

The address of the target.

addr_len

The size of the address pointed to by *address*.

If there is not enough available buffer space to hold the socket data to be transmitted, and the socket is in blocking mode, `sendto()` blocks the caller until additional buffer space becomes available. If the socket is in nonblocking mode, `sendto()` returns -1 and sets the error code to `EWOULDBLOCK`. See [“fcntl\(\) — Control open file descriptors” on page 483](#) or [“ioctl\(\) — Control device” on page 872](#) for a description of how to set nonblocking mode.

For datagram sockets, this call sends the entire datagram, provided that the datagram fits into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, applications using stream sockets should place this call in a loop, calling this function until all data has been sent.

Socket address structure for IPv6: The `sockaddr_in6` structure is added to the **netinit/in.h** header. It is used to pass IPv6 specific addresses between applications and the system.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Note: The `sendto()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, `sendto()` returns the number of characters sent.

A value of 0 or greater indicates the number of bytes sent, however, this does not assure that data delivery was complete. A connection can be dropped by a peer socket and a SIGPIPE signal generated at a later time if data delivery is not complete.

No indication of failure to deliver is implied in the return value of this call when used with datagram sockets.

If unsuccessful, `sendto()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EAFNOSUPPORT

The address family is not supported (it is not `AF_UNIX` or `AF_INET`).

EBADF

socket is not a valid socket descriptor.

ECONNREFUSED

The attempt to connect was rejected.

ECONNRESET

A connection was forcibly closed by a peer.

EFAULT

Using the *msg* and *length* parameters would result in an attempt to access storage outside the caller's address space.

EINTR

A signal interrupted `sendto()` before any data was transmitted.

EINVAL

addr_len is not the size of a valid address for the specified address family.

EIO

There has been a network or transport failure.

EMSGSIZE

The message was too big to be sent as a single datagram. The default is *large-envelope-size*. (Envelopes are used to hold datagrams and fragments during TCP/IP processing. Large envelopes hold UDP datagrams greater than 2KB while they are processed for output, and when they are waiting for an application program to receive them on input.)

ENOBUFS

Buffer space is not available to send the message.

ENOTCONN

The socket is not connected.

ENOTSOCK

The descriptor is for a file, not for a socket.

EOPNOTSUPP

The *socket* argument is associated with a socket that does not support one or more of the values set in *flags*.

EPIPE

For a connected stream socket the connection to the peer socket has been lost. A SIGPIPE signal is sent to the calling process.

EPROTOTYPE

The protocol is the wrong type for this socket. A SIGPIPE signal is sent to the calling process.

EWouldBlock

socket is in nonblocking mode and no data buffers are available or the SO_SNDTIMEO timeout value was reached before buffers became available.

The following are for AF_UNIX only:

Error Code**Description****EACCES**

Search permission is denied for a component of the path prefix, or write access to the named socket is denied.

EIO

An I/O error occurred while reading from or writing to the file system.

ELOOP

Too many symbolic links were encountered in translating the path name in the socket address.

ENAMETOOLONG

A component of a path name exceeded **NAME_MAX** characters, or an entire path name exceeded **PATH_MAX** characters.

ENOENT

A component of the path name does not name an existing file or the path name is an empty string.

ENOTDIR

A component of the path prefix of the path name in the socket address is not a directory.

Related information

- “[sys/socket.h — Sockets definitions](#)” on page 70
- “[read\(\) — Read from a file or socket](#)” on page 1380
- “[readv\(\) — Read data on a file or socket and store in a set of buffers](#)” on page 1393
- “[recv\(\) — Receive data on a socket](#)” on page 1401
- “[recvfrom\(\) — Receive messages on a socket](#)” on page 1404
- “[recvmsg\(\) — Receive messages on a socket and store in array of message headers](#)” on page 1407
- “[select\(\), pselect\(\) — Monitor activity on files or sockets and message queues](#)” on page 1472
- “[send\(\) — Send data on a socket](#)” on page 1493
- “[sendmsg\(\) — Send messages on a socket](#)” on page 1499
- “[socket\(\) — Create a socket](#)” on page 1677
- “[write\(\) — Write data on a file or socket](#)” on page 2070
- “[writev\(\) — Write data on a file or socket from an array](#)” on page 2076

__server_classify() — Set classify area field

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/server.h>

int __server_classify(server_classify_t handle,
                     server_classify_field_t field,
                     const char *value);
```

General description

The `__server_classify()` function sets fields in a classify data area. The 'classify data area' is created and initialized by invoking the `__server_classify_create()` function. This 'classify data area' is subsequently used with the `__server_pwu()` function to interface with WorkLoad Manager (WLM).

The *handle* argument is a 'classify data area' created on a previous invocation of the `__server_classify_create()` function.

The *field* argument must be one of the following values:

_SERVER_CLASSIFY_ACCTINFO

Set the accounting information. When specified, value contains a NULL-terminated character string of up to 143 characters containing the account information for the work unit to be created.

_SERVER_CLASSIFY_COLLECTION

Set the customer defined name for a group of associated packages. When specified, value contains a NULL-terminated character string of up to 18 characters containing the collection name associated with the work unit to be created.

_SERVER_CLASSIFY_CONNECTION

Set the name associated with the environment creating the work unit. When specified, value contains a NULL-terminated character string of up to 8 characters containing the connection name associated with the environment creating the work unit.

_SERVER_CLASSIFY_CONNTKN

Set the connection token that was returned on a call to `__ConnectWorkMgr()` or `__ConnectServerMgr()`. When specified, value contains a integer value representing the connection token returned on a call to `__ConnectWorkMgr()` or `__ConnectServerMgr()`.

_SERVER_CLASSIFY_CORRELATION

Set the name associated with the user/program creating the work unit. When specified, value contains a NULL-terminated character string of up to 12 characters that contains the name associated with the user/program creating the work unit.

_SERVER_CLASSIFY_LUNAME

Set the local LU name associated with the requester. When specified, value contains a NULL-terminated character string of up to 8 characters containing the local LU name associated with the requester.

_SERVER_CLASSIFY_NETID

Set the network ID associated with the requester. When specified, value contains a NULL-terminated character string of up to 8 characters containing the network ID associated with the requester.

_SERVER_CLASSIFY_PACKAGE

Set the package name for a set of associated SQL statements. When specified, value contains a NULL-terminated character string of up to 8 characters containing the package name associated with the work unit to be created.

_SERVER_CLASSIFY_PERFORM

Set the performance group number (PGN) associated with the work unit. When specified, value contains a NULL-terminated character string of up to 8 characters containing the PGN associated with the work unit to be created.

_SERVER_CLASSIFY_PLAN

Set the access plan name for a set of associated SQL statements. When specified, value contains a NULL-terminated character string of up to 8 characters containing the access plan name associated with the work unit to be created.

_SERVER_CLASSIFY_PRCNAME

Set the DB2® stored SQL procedure name associated with the work unit. When specified, value contains a NULL-terminated character string of up to 18 characters containing the DB2 stored SQL procedure name associated with the work unit to be created.

_SERVER_CLASSIFY_PRIORITY

Set the priority associated with the work unit to be created. When specified, value contains a integer value representing the priority of the work unit to be created.

_SERVER_CLASSIFY_RPTCLSNM@

Set the pointer to an 8 character buffer to receive the output report class name for the work unit to be created. When specified, value contains the pointer to an 8 character buffer to receive the output report class name for the work unit to be created.

_SERVER_CLASSIFY_SCHEDENV

Set the scheduling environment information. When specified, value contains a NULL-terminated character string of up to 16 characters containing the scheduling environment name associated with the work unit.

_SERVER_CLASSIFY_SERVCLS@

Set the pointer to an integer field to receive the output service class for the work unit to be created. When specified, value contains the pointer to a integer field to receive the output service class for the work unit to be created.

_SERVER_CLASSIFY_SERVCLSNM@

Set the pointer to an 8 character buffer to receive the output service class name for the work unit to be created. When specified, value contains the pointer to an 8 character buffer to receive the output service class name for the work unit to be created.

_SERVER_CLASSIFY_SOURCELU

Set the source LU name associated with the requester. When specified, value contains a NULL-terminated character string of up to 17 characters containing the source LU name associated with the requester.

_SERVER_CLASSIFY_SUBCOLN

Set the subsystem collection name. When specified, the value contains a NULL-terminated character string of up to 8 characters, containing the subsystem collection name associated with the work unit.

_SERVER_CLASSIFY_SUBSYSTEM_PARM

Set the transaction subsystem parameter. When specified, *value* contains a NULL-terminated character string of up to 255 characters containing the subsystem parameter being used for the __server_pwu() call.

_SERVER_CLASSIFY_TRANSACTION_CLASS

Set the transaction class. When specified, *value* contains a NULL-terminated character string of up to 8 characters containing the name of the transaction class for the __server_pwu() call.

_SERVER_CLASSIFY_TRANSACTION_NAME

Set the transaction name. When specified, *value* contains a NULL-terminated character string of up to 8 characters containing the name of the transaction for the __server_pwu() call.

_SERVER_CLASSIFY_USERID

Set the user ID. When specified, *value* contains a NULL-terminated character string of up to 8 characters containing the name of the user for the __server_pwu() call.

The *value* argument is the value that the specified 'classify data area' field is to be set to. (For valid values, refer to [z/OS MVS Programming: Workload Management Services](#).)

The classify area is specific to the calling thread. The __server_classify() function call must be done on the same thread of execution as the __server_classify_create(). Use of the classify area by another thread can lead to unpredictable results.

Returned value

If successful, __server_classify() returns 0.

If unsuccessful, __server_classify() returns -1 and sets errno to one of the following values:

Error Code**Description****E2BIG**

The character string specified for a classify field is too large.

EINVAL

The classify field symbolic is not valid.

Related information

- [“sys/server.h — WorkLoad Manager services” on page 70](#)
- [“__server_classify_create\(\) — Create a classify area” on page 1510](#)
- [“__server_classify_destroy\(\) — Delete a classify area” on page 1510](#)
- [“__server_classify_reset\(\) — Reset a classify area to an initial state” on page 1511](#)
- [“__server_init\(\) — Initialize server” on page 1512](#)
- [“__server_pwu\(\) — Process server work unit” on page 1514](#)

__server_classify_create() – Create a classify area

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/server.h>

server_classify_t __server_classify_create(void);
```

General description

The `__server_classify_create()` function creates a classify data area to be used on a subsequent `__server_pwu()` or `CreateWorkUnit()` call. The resulting classify data area can be filled in by calls to the `__server_classify()` function. The information in the classify area is used to establish the Transaction class, Transaction Name, user ID, and subsystem parameters for the `__server_pwu()` call or to establish the classification rules for the `CreateWorkUnit()` call.

The resulting classify area is specific to the calling thread. Use of the classify area by another thread can lead to unpredictable results.

Returned value

If successful, `__server_classify_create()` returns a *classify_t* which is a handle to the classify area.

If unsuccessful, `__server_classify_create()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

ENOMEM

Not enough storage is available.

Related information

The classify data area created by this function can be used without serialization only by the creating thread. In addition, storage for this structure is automatically freed at thread termination.

- [“sys/server.h – WorkLoad Manager services” on page 70](#)
- [“__server_classify\(\) – Set classify area field” on page 1507](#)
- [“__server_classify_destroy\(\) – Delete a classify area” on page 1510](#)
- [“__server_classify_reset\(\) – Reset a classify area to an initial state” on page 1511](#)
- [“__server_init\(\) – Initialize server” on page 1512](#)
- [“__server_pwu\(\) – Process server work unit” on page 1514](#)

__server_classify_destroy() – Delete a classify area

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/server.h>

void __server_classify_destroy(server_classify_t area);
```

General description

The `__server_classify_destroy()` function deletes a classify data area previously created by a `__server_classify()` call. The *area* parameter specifies the classify area to be deleted. Storage for the classify area is freed. This function must be executed by the same thread that created the classify area.

Returned value

`__server_classify_destroy()` returns no values.

Related information

- [“sys/server.h — WorkLoad Manager services” on page 70](#)
- [“__server_classify\(\) — Set classify area field” on page 1507](#)
- [“__server_classify_create\(\) — Create a classify area” on page 1510](#)
- [“__server_classify_reset\(\) — Reset a classify area to an initial state” on page 1511](#)
- [“__server_init\(\) — Initialize server” on page 1512](#)
- [“__server_pwu\(\) — Process server work unit” on page 1514](#)

[__server_classify_reset\(\) — Reset a classify area to an initial state](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/server.h>

void __server_classify_reset(server_classify_t area);
```

General description

The `__server_classify_reset()` function resets a classify data area to its initial state. This is equivalent to destroying the classify area and creating another, and is intended to be a higher performance path for applications which must repeatedly change parameters in a classify area. The *area* parameter specifies the handle of the classify area to be reset, and was previously obtained by a `__server_classify()` call. This function must be executed by the same thread that created the classify area.

Returned value

`__server_classify_reset()` returns no values.

Related information

- [“sys/server.h — WorkLoad Manager services” on page 70](#)
- [“__server_classify\(\) — Set classify area field” on page 1507](#)

- “[__server_classify_create\(\)](#) — Create a classify area” on page 1510
- “[__server_classify_destroy\(\)](#) — Delete a classify area” on page 1510
- “[__server_init\(\)](#) — Initialize server” on page 1512
- “[__server_pwu\(\)](#) — Process server work unit” on page 1514

__server_init() — Initialize server

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/server.h>

int __server_init(int *managertype, const char *subsysname,
                  const char *applen, int paralleu);
```

General description

The `__server_init()` function provides the ability for a server address space to connect to WorkLoad Manager (WLM) for the purpose of queueing and servicing work requests.

The parameters supported are:

***managertype**

Points to one or more of the following values that indicate the type of WLM manager the caller is requesting to become. The following are the supported values:

SRV_WORKMGR

Indicates that WLM work management services be made available to the calling address space. This value can be combined with the `SRV_QUEUEMGR` and `SRV_SERVERMGR` values.

SRV_QUEUEMGR

Indicates that WLM queue management services be made available to the calling address space. This value can be combined with the `SRV_WORKMGR` and `SRV_SERVERMGR` values.

SRV_SERVERMGR

Indicates that WLM server management services be made available to the calling address space. This value can be combined with the `SRV_WORKMGR` and `SRV_QUEUEMGR` values.

SRV_SERVERMGRDYNAMIC

Indicates that the WLM work management is to track the number of threads this address space will need. It prepares the address space to support the `__service_thread_query()` function. For `SRV_SERVERMGRDYNAMIC` the *paralleu* parameter has the same effect as it does for `SRV_SERVERMGR`, in that, it indicates the maximum number of parallel work units that the server can create. The server would initially create some number of threads less than this maximum. The dynamic capability then allows the server to tap into WLM to tell the server when to increase or decrease the number of threads in the address space.

***subsysname**

Points to a NULL-terminated character string containing the generic subsystem type (CICS, IMS, WEB, etc.). When `SRV_WORKMGR` is specified for the *managertype* parameter this is the primary category under which WLM classification rules are grouped. The character string can be up to 4 bytes in length.

***subsysname**

Points to a NULL-terminated character string containing the subsystem name used for classifying work requests when SRV_WORKMGR is specified for the *managertype* parameter. When SRV_SERVERMGR is specified for the *managertype* parameter the subsystem name should match the subsystem name specified on the corresponding call to `__server_init()` for a work manager (SRV_WORKMGR *managertype*). The character string can be up to 8 bytes in length. When SRV_QUEUEMGR is specified for the *managertype* parameter the combination of the *subsysname* and *subsysname* parameter values must be unique to a single MVS system.

***applenv**

Points to a NULL-terminated character string that contains the name of the application environment under which work requests are served. The character string can be up to 32 bytes in length. This parameter is only valid when SRV_SERVERMGR is specified for the *managertype* parameter. It should be NULL for all other *managertype* values.

paralleleu

Specifies the maximum number of tasks within the address space which will be created to process concurrent work requests. This parameter is valid when both or either SRV_SERVERMGR and SRV_SERVERMGRDYNAMIC are specified for the *managertype* parameter. It is ignored for all other *managertype* values.

A successful call to `__server_init()` results in the calling address space being connected to WLM for the WLM management services requested. Additionally, for a successful server manager WLM connection call (SRV_SERVERMGR *managertype*), the calling process is made a child of, and is placed in the session and process group of the corresponding work manager. The corresponding work manager is the process that called `server_init()` for the *managertype* combination SRV_WORKMGR+SRV_QUEUEMGR with the same *subsysname* and *subsysname* values specified as the server manager process. This parent/child relationship allows the server manager and the work manager to use signals to communicate with each other.

Returned value

If successful, `__server_init()` returns 0.

If unsuccessful, `__server_init()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EINVAL**

The *managertype* parameter contains a value that is not correct.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

A WLM service failed. Use `__errno2()` to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class, if the BPX.WLMSEVER is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/server.h — WorkLoad Manager services” on page 70](#)
- [“__server_classify\(\) — Set classify area field” on page 1507](#)
- [“__server_classify_create\(\) — Create a classify area” on page 1510](#)
- [“__server_classify_destroy\(\) — Delete a classify area” on page 1510](#)
- [“__server_classify_reset\(\) — Reset a classify area to an initial state” on page 1511](#)
- [“__server_pwu\(\) — Process server work unit” on page 1514](#)

__server_pwu() – Process server work unit

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/server.h>

int __server_pwu(int fcncode, const char *transclass,
                const char *applenv, server_classify_t classify,
                int *appldatalen, void **appldata,
                struct __srv_fd_list **fdlstruc);
```

General description

The `__server_pwu()` function provides a general purpose interface for managing and processing work using WorkLoad Manager (WLM) services. The capabilities this service provides include the ability to put work requests onto the WLM work queues, obtain work from the WLM work queues, transfer work to other WLM work servers, end units of work, delete WLM enclaves and refresh WLM work servers.

The parameters supported are:

fcncode

Contains one or more of the following values that indicate the function that is requested:

SRV_PUT_NEWWRK

Indicates that a new work request be put onto the work queue for an application environment server identified by the *applenv* parameter as part of a newly created WLM enclave. This value cannot be combined with any other *fcncode* value.

SRV_PUT_SUBWRK

Indicates that a new work request be put onto the work queue for an application environment server identified by the *applenv* parameter as part of the WLM enclave associated with the calling thread. This value can be combined with the `SRV_END_WRK` *fcncode* value.

SRV_TRANSFER_WRK

Indicates that the last work request obtained by the calling thread be transferred to the work queue of the target application environment server. As part of the transfer, the calling thread is disassociated from its WLM enclave. This value cannot be combined with any other *fcncode* value.

SRV_GET_WRK

Indicates that a new work request be obtained from the WLM work queue for the calling application environment server. The `SRV_GET_WRK` *fcncode* also results in the calling thread being associated with the WLM enclave of the work request. If the calling thread is already associated with a WLM enclave due to a prior call to `__server_pwu()` for `SRV_GET_WRK`, it is disassociated from the prior WLM enclave, as well as associated with the obtained work request. When the calling thread goes thru task termination or when its process is terminated the work request is ended and the associated WLM enclave is deleted if it is owned by the terminating task or process. The `SRV_GET_WRK` caller owns the enclave, if the work was queued using the `SRV_PUT_NEWWRK` or `SRV_TRANSFER_WRK` functions. If the caller is a thread created using `pthread_create` (*pthread*), the thread task owns the enclave. If the caller is not a *pthread*, the process owns the enclave. This value can be combined with the `SRV_END_WRK` and `SRV_DEL_ENC` *fcncode* values.

SRV_REFRESH_WRK

Indicates that the servers associated with the application environments managed by the calling work and queue manager are to be refreshed. This will cause all servers to complete existing work

requests and then terminate. New servers will then be started to process new work. This value cannot be combined with any other *fcncode* value.

SRV_END_WRK

Indicates that the calling thread is to be disassociated from its WLM enclave. This value can be combined with the SRV_DEL_ENC, SRV_PUT_SUBWRK and SRV_GET_WRK *fcncode* values.

SRV_DEL_ENC

Indicates that the WLM enclave associated with the calling thread is to be deleted. This value can be combined with the SRV_GET_WRK and SRV_END_WRK *fcncode* values.

SRV_DISCONNECT

Indicates that the calling server's connection to WLM is to be severed. Once a server is disconnected from WLM, it can no longer use this service to process more requests for the application environment it had been connected to (using a call to the `server_init()` function). If a SRV_DISCONNECT is performed by a work and queue manager, all related server managers implicitly lose their connection to WLM. This also results in the related server managers losing their ability to process more requests using this service.

SRV_DISCONNECT_COND

Indicates that the calling server's connection to WLM is to be severed only if the caller has no more WLM enclaves that it is still managing. A work and queue manager is still managing an enclave if it has yet to be serviced by a server manager. Once a server is disconnected from WLM, it can no longer use this service to process more requests for the application environment it had been connected to (using a call to the `server_init()` function). If a SRV_DISCONNECT_COND is performed by a work and queue manager, all related server managers implicitly lose their connection to WLM. This also results in the related server managers losing their ability to process more requests using this service.

***transclass**

Points to a NULL-terminated character string that represents the name of the transaction class to be associated with the work request. This parameter is only valid when the SRV_PUT_NEWWRK *fcncode* parameter value is specified. It should be NULL for the other *fcncode* parameter values. The character string can be up to 8 bytes in length.

***applenv**

Points to a NULL-terminated character string that contains the name of the application environment under which work requests are served. This parameter is valid for the set of SRV_PUT *fcncode* values, the SRV_TRANSFER_WRK *fcncode* value and the SRV_REFRESH_WRK *fcncode* value. It should be NULL for the other *fcncode* parameter values. The character string can be up to 32 bytes in length.

***classify**

Points to a character string that contains the classification information for the work request macro.

***apldatalen**

When one of the SRV_PUT or SRV_TRANSFER *fcncode* parameter values is specified this is a supplied parameter that points to an integer containing the length of the application data specified by the ****apldata** parameter. When the SRV_GET_WRK *fcncode* value is specified, this is an output parameter where the `__server_pwu()` function is to return the length of the application data associated with the obtained work request. **apldatalen* is only valid when one of the SRV_PUT, SRV_GET_WRK or SRV_TRANSFER *fcncode* parameter values is specified, it is ignored otherwise. The maximum length supported for the application data is 10 megabytes.

****apldata**

When one of the SRV_PUT or SRV_TRANSFER *fcncode* parameter values is specified this is a supplied parameter that points to the application data string. This application data allows the caller to uniquely identify the specific work the caller is requesting. When the SRV_GET_WRK *fcncode* value is specified, this is an output parameter where the `__server_pwu()` function is to return a pointer to the application data associated with the obtained work request. The returned data area will be an identical copy of the data area that was supplied on the corresponding `__server_pwu()` call to put the work request on a WLM work queue. ****apldata** is only valid when one of the SRV_PUT, SRV_GET_WRK or SRV_TRANSER *fcncode* parameter values is specified, it is ignored otherwise.

****fdlstruc**

When one of the SRV_PUT or SRV_TRANSFER *fcncode* parameter values is specified the ****fdlstruc** parameter is an input parameter that contains a pointer to a __srv_fd_list structure. The __srv_fd_list structure contains the following members:

| | | |
|-----|-------------|---------------------------|
| int | fdcount | count of file descriptors |
| int | flags | flag SRV_FDCLOSE |
| int | fd(SRV_FDS) | file descriptor list |

The supplied __srv_fd_list structure contains the count of file descriptors to be propagated, followed by the list of file descriptors that are to be propagated to the process that calls server_pwu() to obtain the work request created by the call to this service. If the SRV_FDCLOSE flag is turned on in the flags field of the __srv_fd_list structure, all file descriptors in the list are closed in the calling process. If a NULL pointer is specified, no file descriptors are propagated. When the ****fdlstruc** parameter is used to propagate file descriptors, the caller must ensure that all of the file descriptors in the list are valid open file descriptors in the caller's process, and are not being closed during the processing of this service. If this is not the case, then this function cannot guarantee the proper propagation of the specified file descriptors. When the SRV_GET_WRK *fcncode* parameter value is specified the ****fdlstruc** parameter is an output parameter where the __server_pwu() function returns a pointer to the __srv_fd_list structure associated with the obtained work request. The returned __srv_fd_list structure will contain the count of file descriptors in the returned structure, followed by the list of remapped file descriptor values in the calling process of the file descriptors that were supplied in the __srv_fd_list structure on the corresponding __server_pwu() call to put the work request on a WLM work queue. The flags field in the returned __srv_fd_list structure will be NULL. The ****fdlstruc** parameter is only valid when one of the SRV_PUT, SRV_TRANSFER or SRV_GET_WRK *fcncode* parameter values are specified. It is ignored otherwise. The maximum number of file descriptors supported in the file descriptor list structure is 64.

A successful call to __server_pwu() for the SRV_PUT_NEWWRK *fcncode* not only creates a work request that is placed onto a WLM work queue, but it also creates a new WLM enclave for that work to run in when the work request is obtained. By comparison, the SRV_PUT_SUBWRK and SRV_TRANSFER_WRK *fcncode*s, queue work requests that are part of the existing WLM enclave of the calling thread.

A successful call to __server_pwu() for the SRV_GET_WRK *fcncode* not only results in the caller obtaining a work request from a WLM work queue associated with the caller's application environment, but also results in the calling thread being associated with the WLM enclave associated with the obtained work request.

Usage of the server_pwu function requires the calling address space to have successfully issued a call to the __server_init() function.

For the SRV_PUT_NEWWRK function to run successfully, the caller must have successfully issued a call to the __server_init() service for one of the following *managertype* parameter combinations:

- SRV_WORKMGR + SRV_QUEUEMGR
- SRV_WORKMGR + SRV_QUEUEMGR + SRV_SERVERMGR

For the SRV_PUT_SUBWRK and SRV_TRANSFER_WRK functions to run successfully, the caller must have successfully issued a call to the __server_init() service for one of the following *managertype* parameter combinations:

- SRV_WORKMGR + SRV_QUEUEMGR SRV_SERVERMGR
- SRV_SERVERMGR

For the SRV_GET_WRK, SRV_END_WRK and SRV_DEL_ENC functions to run successfully, the caller must have successfully issued a call to the __server_init() service for one of the following *managertype* parameter combinations:

- SRV_WORKMGR + SRV_QUEUEMGR SRV_SERVERMGR
- SRV_SERVERMGR

For the SRV_REFRESH_WRK function to run successfully, the caller must have successfully issued a call to the __server_init() service for any of the following *managertype* parameter combinations:

- SRV_WORK_MGR + SRV_QUEUE_MGR
- SRV_WORK_MGR + SRV_QUEUE_MGR + SRV_SERVER_MGR

Returned value

If successful, __server_pwu() returns 0.

If unsuccessful, __server_pwu() returns -1 and sets errno to one of the following values:

Error Code

Description

EAGAIN

The requested service could not be performed at the current time. Use __errno2() to obtain the reason code for the failure.

EFAULT

An argument of this service contained an address that was not accessible to the caller.

EINVAL

The *managertype* parameter contains a value that is not correct.

EMVSERR

A MVS environmental or internal error has occurred. Use __errno2() to obtain the exact reason for the failure.

EMVSWLMERROR

A WLM service failed. Use __errno2() to obtain the WLM service reason code for the failure.

Related information

- [“sys/server.h — WorkLoad Manager services” on page 70](#)
- [“__server_classify\(\) — Set classify area field” on page 1507](#)
- [“__server_classify_create\(\) — Create a classify area” on page 1510](#)
- [“__server_classify_destroy\(\) — Delete a classify area” on page 1510](#)
- [“__server_classify_reset\(\) — Reset a classify area to an initial state” on page 1511](#)
- [“__server_init\(\) — Initialize server” on page 1512](#)

__server_threads_query() — Query the number of threads

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R10 |

Format

```
#include <sys/server.h>

int __server_threads_query(int *threads);
```

General description

Provides information about the number of threads a server should be using for this server environment. After a successful query, *threads* will contain the number of threads that the WorkLoad Manager (WLM) recommends for this address space.

Usage notes

This service is a privileged service that requires the caller to be authorized in one of the following ways:

- Have read access to the BPX.WLMSEVER FACILTY class profile
- Have a UID=0 when the BPX.WLMSEVER FACILTY class profile is not defined

Returned value

If successful, __server_threads_query() returns 0.

If unsuccessful, __server_threads_query() returns -1 and sets errno to one of the following values:

Error Code
Description

EINTR
The wait was interrupted by an unblocked, caught signal. No further waiting will occur for this call. __server_threads_query() can be reissued to begin waiting again.

EPERM
The caller is not permitted to perform the specified operation.

Related information

- [“sys/server.h — WorkLoad Manager services” on page 70](#)

setbuf() — Control buffering

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

void setbuf(FILE *__restrict__stream, char *__restrict__buffer);
```

General description

Controls buffering for the specified *stream*. The *stream* pointer must refer to an open file, and setbuf() must be the first operation on the stream.

If the *buffer* argument is NULL, the *stream* is unbuffered. If not, the buffering mode will be full buffer and the *buffer* must point to a character array of length at least BUFSIZ, which is the buffer size defined in the `stdio.h` header file. I/O functions use the *buffer*, which you specify here, for input/output buffering instead of the default system-allocated buffer for the given *stream*. If the buffer does not meet the requirements of the IBM z/OS C/C++ product, the buffer is not used.

The setvbuf() function is more flexible than setbuf(), because you can specify the type of buffering and size of buffer.

Note: If you use `setvbuf()` or `setbuf()` to define your own buffer for a stream, you must ensure that the buffer is available the whole time that the stream associated with the buffer is in use.

For example, if the buffer is an automatic array (block scope) and is associated with the stream `s`, leaving the block causes the storage to be deallocated. I/O operations of stream `s` are prevented from using deallocated storage. Any operation on `s` would fail because the operation would attempt to access the nonexistent storage.

To ensure that the buffer is available throughout the life of a program, make the buffer a variable allocated at file scope. This can be achieved by using an identifier of type *array* declared at file scope, or by allocating storage (with `malloc()` or `calloc()`) and assigning the storage address to a pointer declared at file scope.

VSAM file types do not support unbuffered I/O, causing requests for unbuffered I/O to fail.

Returned value

`setbuf()` returns no values.

For details about `errno` values, and about buffers you may have set, see discussions about buffering in *z/OS XL C/C++ Programming Guide*.

Example

CELEBS01

```
/* CELEBS01

This example opens the file myfile.dat for writing.
It then calls the &setbuf. function to establish a buffer of
length BUFSIZ.
When string is written to the stream, the buffer buf is used
and contains the string before it is flushed to the file.

*/
#include <stdio.h>

int main(void)
{
    char buf[BUFSIZ];
    char string[] = "hello world";
    FILE *stream;

    stream = fopen("myfile.dat", "wb,recfm=f");

    setbuf(stream,buf);          /* set up buffer */

    fwrite(string, sizeof(string), 1, stream);

    printf("%s\n",buf);          /* string is found in buf now */

    fclose(stream);              /* buffer is flushed out to myfile.dat */
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fclose\(\) — Close file” on page 482](#)
- [“fflush\(\) — Write buffer to file” on page 530](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“setvbuf\(\) — Control buffering” on page 1589](#)

setcontext() — Restore user context

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ucontext.h>

int setcontext(const ucontext_t *ucp);
```

General description

The `setcontext()` function restores the user context pointed to by `ucp`. A successful call to `setcontext()` does not return; program execution resumes at the point specified by the `ucp` argument passed to `setcontext()`. The `ucp` argument should be created either by a prior call to `getcontext()`, or by being passed as an argument to a signal handler. If the `ucp` argument was created with `getcontext()`, program execution continues as if the corresponding call of `getcontext()` had just returned. If the `ucp` argument was modified with `makecontext()`, program execution continues with the function passed to `makecontext()`. When that function returns, the process continues as if after a call to `setcontext()` with the context pointed to by the `uc_link` member of the `ucontext_t` structure if it is not equal to 0. If the `uc_link` member of the `ucontext_t` structure pointed to by the `ucp` argument is equal to 0, then this context is the main context, and the process will exit when this context returns. The effects of passing a `ucp` argument obtained from any other source are undefined.

`setcontext()` is similar in some respects to `siglongjmp()` (and `longjmp()` and `_longjmp()`). The `getcontext()`–`setcontext()` pair, the `sigsetjmp()`–`siglongjmp()` pair, the `setjmp()`–`longjmp()` pair, and the `_setjmp()`–`_longjmp()` pair cannot be intermixed. A context saved by `getcontext()` should be restored only by `setcontext()`.

Notes:

1. Some compatibility exists with `siglongjmp()`, so it is possible to use `siglongjmp()` from a signal handler to restore a context created with `getcontext()`, but it is not recommended.
2. If the `ucontext` that is input to `setcontext()` has not been modified by `makecontext()`, you must ensure that the function that calls `getcontext()` does not return before you call the corresponding `setcontext()` function. Calling `setcontext()` after the function calling `getcontext()` returns causes unpredictable program behavior.
3. If `setcontext()` is used to jump back into an XPLINK routine, any `alloca()` requests issued by the XPLINK routine after the earlier `getcontext()` was called and before `setcontext()` is called are backed out. All storage obtained by these `alloca()` requests is freed before the XPLINK routine is resumed.
4. If `setcontext()` is used to jump back into a non-XPLINK routine, `alloca()` requests made after `getcontext()` and before `setcontext()` are not backed out.
5. If `ucp` is pointing to a user context of a different execution stack from the current, the user context should be either a freshly modified one (by `makecontext()`) or the most recently saved one (by `getcontext()` or `swapcontext()`) when running on its stack.
6. If `ucp` is pointing to a user context of a different execution stack from the current, the current stack is never collapsed and any resource associated with it is never freed after `setcontext()` being called.

This function is supported only in a POSIX program.

The **<ucontext.h>** header file defines the **ucontext_t** type as a structure that includes the following members:

| | | |
|------------|-------------|--|
| mcontext_t | uc_mcontext | A machine-specific representation of the saved context. |
| ucontext_t | *uc_link | Pointer to the context that will be resumed when this context returns. |
| sigset_t | uc_sigmask | The set of signals that are blocked when this context is active. |
| stack_t | uc_stack | The stack used by this context. |

Special behavior for C++: If `getcontext()` and `setcontext()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. The use of `getcontext()` and `setcontext()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Do not issue `getcontext()` in a C++ constructor or destructor, since the saved context would not be usable in a subsequent `setcontext()` or `swapcontext()` after the constructor or destructor returns.

Special behavior for XPLINK-compiled C/C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **jmp_buf**, **sigjmp_buf** or **ucontext_t** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **jmp_buf**, **sigjmp_buf** or **ucontext_t** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **jmp_buf**, **sigjmp_buf** or **ucontext_t** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from a XPLINK routine. If `__XPLINK__` is not defined, the Language Environment V2R10 and later headers define a shorter **jmp_buf**, **sigjmp_buf** or **ucontext_t** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If a XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **jmp_buf**, **sigjmp_buf** or **ucontext_t** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

If successful, `setcontext()` does not return.

If unsuccessful, `setcontext()` returns -1.

There are no `errno` values defined.

Example

This example saves the context in `main` with the `getcontext()` statement. It then returns to that statement from the function `func` using the `setcontext()` statement. Since `getcontext()` always returns 0 if successful, the program uses the variable `x` to determine if `getcontext()` returns as a result of `setcontext()` or not.

```
/* This example shows the usage of getcontext() and setcontext(). */

#define _XOPEN_SOURCE_EXTENDED 1
#include <stdio.h>
#include <ucontext.h>

void func(void);

int x = 0;
ucontext_t context, *cp = &context;

int main(void) {
    getcontext(cp);
    if (!x) {
        printf("getcontext has been called\n");
        func();
    }
}
```

```

    }
    else {
        printf("setcontext has been called\n");
    }
}

void func(void) {
    x++;
    setcontext(cp);
}

```

Output

```

getcontext has been called
setcontext has been called

```

Related information

- [“ucontext.h — Context related functions” on page 76](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“makecontext\(\) — Modify user context” on page 1032](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

setegid() — Set the effective group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1a Single UNIX Specification, Version 3 | both | |

Format

```

#define _POSIX1_SOURCE 2
#include <unistd.h>

int setegid(gid_t gid);

```

General description

Sets the effective group ID (GID) of a process to *gid*, if *gid* is equal to the real GID or the saved set GID of the calling process, or if the process has appropriate privileges. The real GID, the saved set GID, and any supplementary GIDs are not changed.

Returned value

If successful, setegid() returns 0.

If unsuccessful, setegid() returns -1 and sets errno to one of the following values:

Error Code Description

EINVAL

The value specified for *gid* is incorrect and is not supported by the implementation.

EPERM

The process does not have appropriate privileges, and *gid* does not match the real GID or the saved set GID.

Example

CELEBS02

```
/* CELEBS02

   This example changes your effective GID.

*/
#define _POSIX1_SOURCE 2
#include <unistd.h>
#include <stdio.h>

main() {
    printf("your effective group id is %d\n", (int) getegid());
    if (setegid(500) != 0)
        perror("setegid() error");
    else
        printf("your effective group id was changed to %d\n",
              (int) getegid());
}
```

Output

```
your effective group id is 512
your effective group id was changed to 500
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“getegid\(\) — Get the effective group ID” on page 703](#)
- [“getgid\(\) — Get the real group ID” on page 709](#)
- [“setgid\(\) — Set the group ID” on page 1532](#)

setenv() — Add, delete, and change environment variables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1a Single UNIX Specification, Version 3 Language Environment | both | |

Format

POSIX - C only:

```
#define _POSIX1_SOURCE 2
#include <env.h>
```

```
int setenv(const char *var_name, const char *new_value, int change_flag)
```

Single UNIX Specification, Version 3:

```
#define _UNIX03_SOURCE
#include <stdlib.h>

int setenv(const char *var_name, const char *new_value, int change_flag)
```

Non-POSIX:

```
#include <stdlib.h>

int setenv(const char *var_name, const char *new_value, int change_flag)
```

General description

Adds, changes, and deletes environment variables.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

var_name is a pointer to a character string that contains the name of the environment variable to be added, changed, or deleted. If `setenv()` is called with *var_name* containing an equal sign ('='), `setenv()` will fail, and `errno` will be set to indicate that an invalid argument was passed to the function.

new_value is a pointer to a character string that contains the value of the environment variable named in *var_name*. If *new_value* is a NULL pointer, it indicates that all occurrences of the environment variable named in *var_name* be deleted.

change_flag is a flag that can take any integer value:

Nonzero

Change the existing entry. If *var_name* has already been defined and exists in the environment variable table, its value *will* be updated with *new_value*. If *var_name* was previously undefined, it will be appended to the table.

0

Do not change the existing entry.

If *var_name* has already been defined and exists in the environment variable table, its value will *not* be updated with *new_value*. However, if *var_name* was previously undefined, it will be appended to the table.

Notes:

1. The value of the *change_flag* is irrelevant if *new_value*=NULL.
2. You should not define environment variables that begin with '_BPXK_' since they might conflict with variable names defined by z/OS UNIX services. `setenv()` uses the BPX1ENV callable service to pass environment variables that begin with '_BPXK_' to the kernel.

Also, do not use '_EDC_' and '_CEE_'. They are used by the runtime library and the Language Environment.

Environment variables set with the `setenv()` function will only exist for the life of the program, and are not saved before program termination. Other ways to set environment variables are found in “Using Environment Variables” in [z/OS XL C/C++ Programming Guide](#).

Special behavior for POSIX C: Under POSIX, `setenv()` is available if one of the following is true:

- Code is [ISO C/C++ compliant](#), uses `#include <env.h>`, and has the POSIX feature tests turned on.
- Code is compiled with [long external names](#) and prelinked with the OMVS option.

Returned value

If successful, `setenv()` returns 0.

If unsuccessful, `setenv()` returns -1 and sets `errno` to indicate the type of failure that occurred.

Error Code

Description

EINVAL

The `name` argument is a null pointer, points to an empty string, or points to a string containing an '=' character.

Note: Starting with z/OS V1.9, environment variable `_EDC_SUSV3` can be used to control the behavior of `setenv()` with respect to setting `EINVAL` when `var_name` is a null pointer, points to an empty string or points to a string containing an '=' character. By default, `setenv()` will not set `EINVAL` for these conditions. When `_EDC_SUSV3` is set to 1, `setenv()` will set `errno` to `EINVAL` if one of these conditions is true.

ENOMEM

Insufficient memory was available to add a variable or its value to the environment.

Example

CELEBS03

```
/* CELEBS03

This example (program 1) sets the environment variable
_EDC_ANSI_OPEN_DEFAULT.
A child program (program 2) is then initiated via a system
call.
The example illustrates that environment variables are
propagated forward to a child program, but not backward to
the parent.

*/
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    char *x;

    /* set environment variable _EDC_ANSI_OPEN_DEFAULT to "Y" */
    setenv("_EDC_ANSI_OPEN_DEFAULT", "Y", 1);

    /* set x to the current value of the _EDC_ANSI_OPEN_DEFAULT */
    x = getenv("_EDC_ANSI_OPEN_DEFAULT");

    printf("program1 _EDC_ANSI_OPEN_DEFAULT = %s\n",
        (x != NULL) ? x : "undefined");

    /* call the child program */
    system("program2");

    /* set x to the current value of the _EDC_ANSI_OPEN_DEFAULT */
    x = getenv("_EDC_ANSI_OPEN_DEFAULT");

    printf("program1 _EDC_ANSI_OPEN_DEFAULT = %s\n",
        (x != NULL) ? x : "undefined");
}
```

CELEBS04

```
/* CELEBS04

Program 2:
A child program of CELEBS03, which is initiated via a system call.

*/
#include <stdio.h>
#include <stdlib.h>
```

```
int main(void)
{
    char *x;

    /* set x to the current value of the _EDC_ANSI_OPEN_DEFAULT*/
    x = getenv("_EDC_ANSI_OPEN_DEFAULT");

    printf("program2 _EDC_ANSI_OPEN_DEFAULT = %s\n",
        (x != NULL) ? x : "undefined");

    /* clear the Environment Variables Table */
    setenv("_EDC_ANSI_OPEN_DEFAULT", NULL, 1);

    /* set x to the current value of the _EDC_ANSI_OPEN_DEFAULT*/
    x = getenv("_EDC_ANSI_OPEN_DEFAULT");

    printf("program2 _EDC_ANSI_OPEN_DEFAULT = %s\n",
        (x != NULL) ? x : "undefined");
}
```

Output

```
program1 _EDC_ANSI_OPEN_DEFAULT = Y
program2 _EDC_ANSI_OPEN_DEFAULT = Y
program2 _EDC_ANSI_OPEN_DEFAULT = undefined
program1 _EDC_ANSI_OPEN_DEFAULT = Y
```

Related information

- See the topic about using environment variables in [z/OS XL C/C++ Programming Guide](#).
- [“stdlib.h — Standard library functions” on page 65](#)
- [“clearenv\(\) — Clear environment variables” on page 283](#)
- [“getenv\(\) — Get value of environment variables” on page 705](#)
- [“__getenv\(\) — Get an environment variable” on page 706](#)
- [“putenv\(\) — Change or add an environment variable” on page 1354](#)
- [“system\(\) — Execute a command” on page 1800](#)

seteuid() — Set the effective user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1a Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX1_SOURCE 2
#include <unistd.h>

int seteuid(uid_t uid);
```

General description

Sets the effective user ID (UID) to *uid* if *uid* is equal to the real UID or the saved set user ID of the calling process, or if the process has appropriate privileges. The real UID and the saved set UID are not changed.

The seteuid() function is not supported from an address space running multiple processes, since it would cause all processes in the address space to have their security environment changed unexpectedly.

seteuid() can be used by daemon processes to change the identity of a process in order for the process to be used to run work on behalf of a user. In z/OS UNIX, changing the identity of a process is done by changing the real and effective UIDs and the auxiliary groups. In order to change the identity of the process on MVS completely, it is necessary to also change the MVS security environment. The identity change will only occur if the EUID value is specified, changing just the real UID will have no effect on the MVS environment.

The seteuid() function invokes MVS SAF services to change the MVS identity of the address space. The MVS identity that is used is determined as follows:

- If an MVS user ID is already known by the kernel from a previous call to a kernel function (for example, getpwnam()) and the UID for this user ID matches the UID specified on the seteuid() call, then this user ID is used.
- For nonzero target UIDs, if there is no saved user ID or the UID for the saved user ID does not match the UID requested on the seteuid() call, the seteuid() function queries the security database (for example, using getpwnam) to retrieve a user ID. The retrieved user ID is then used.
- If the target UID=0 and a user ID is not known, the seteuid() function always sets the MVS user ID to BPXROOT or the value specified on the SUPERUSER parm in sysparms. BPXROOT is set up during system initialization as a superuser with a UID=0. The BPXROOT user ID is not defined to the BPX.DAEMON FACILITY class profile. This special processing is necessary to prevent a superuser from gaining daemon authority.
- A nondaemon superuser that attempts to set a user ID to a daemon superuser UID fails with an EPERM.

When the MVS identity is changed, the auxiliary list of groups is also set to the list of groups for the new user ID.

If the seteuid() function is issued from multiple tasks within one address space, use synchronization to ensure that the seteuid() functions are not performed concurrently. The execution of seteuid() function concurrently within one address space can yield unpredictable results.

Returned value

If successful, seteuid() returns 0.

If unsuccessful, seteuid() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

The value specified for *uid* is incorrect and is not supported by the implementation.

EPERM

The process does not have appropriate privileges, and *uid* does not match the real UID or the saved set UID.

Example

CELEBS05

```
/* CELEBS05
   This example changes the effective UID.
*/
#define _POSIX1_SOURCE 2
#include <unistd.h>
#include <stdio.h>

main() {
    printf("your effective user id is %d\n", (int) geteuid());
    if (seteuid(25) != 0)
        perror("seteuid() error");
    else
        printf("your effective user id was changed to %d\n",
```

__set_exception_handler

```
(int) geteuid());  
}
```

Output

```
your effective user id is 0  
your effective user id was changed to 25
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“geteuid\(\) — Get the effective user ID” on page 708](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)
- [“setreuid\(\) — Set real and effective user IDs” on page 1566](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)

__set_exception_handler() — Register an exception handler routine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| | both | |

Format

```
#include <__le_api.h>  
  
int __set_exception_handler( void(*exception_handler) (struct __cib *, void *),  
                           void * user_data);
```

General description

Restriction: This function is only valid for AMODE 64.

A nonstandard function that registers an 'Exception Handler' function for the current stack frame. Exception Handlers are used to process 'exceptions' at the thread level (unlike signal catchers which process signals at the process level).

Parameter

Description

exception_handle

Address of a function descriptor that is associated with an 'Exception Handler' function.

user_data

A user definable token that will be passed to the 'Exception Handler' function.

Exception Handlers are invoked for the following conditions:

| Table 52. Invoked Exception Handlers | | | |
|--------------------------------------|---------------|----------------|------------------|
| Exception | Feedback Code | Message Number | Resulting Signal |
| Operation | CEE341 | CEE3201S | SIGILL |
| Privileged-operation | CEE342 | CEE3202S | SIGILL |
| Execute | CEE343 | CEE3203S | SIGILL |
| Protection | CEE344 | CEE3204S | SIGSEGV |

Table 52. Invoked Exception Handlers (continued)

| Exception | Feedback Code | Message Number | Resulting Signal |
|--|---------------|----------------|------------------|
| Addressing | CEE345 | CEE3205S | SIGSEGV |
| Specification | CEE346 | CEE3206S | SIGILL |
| Data | CEE347 | CEE3207S | SIGFPE |
| Fixed-point overflow Note: Not processed in a C/C++ application. | CEE348 | CEE3208S | SIGFPE |
| Fixed-point divide by zero | CEE349 | CEE3209S | SIGFPE |
| Decimal overflow exception | CEE34A | CEE3210S | SIGFPE |
| Decimal divide by zero | CEE34B | CEE3211S | SIGFPE |
| Exponent overflow | CEE34C | CEE3212S | SIGFPE |
| Exponent underflow Note: Not processed in a C/C++ application. | CEE34D | CEE3213S | SIGFPE |
| Significance Note: Not processed in a C/C++ application. | CEE34E | CEE3214S | SIGFPE |
| Floating-point divide by zero | CEE34F | CEE3215S | SIGFPE |
| IEEE Binary Floating-Point inexact (truncated) | CEE34G | CEE3216S | SIGFPE |
| IEEE Binary Floating-Point inexact (incremented) | CEE34H | CEE3217S | SIGFPE |
| IEEE Binary Floating-Point exponent underflow | CEE34I | CEE3218S | SIGFPE |
| IEEE Binary Floating-Point exponent underflow inexact (truncated) | CEE34J | CEE3219S | SIGFPE |
| IEEE Binary Floating-Point exponent underflow inexact (incremented) | CEE34K | CEE3220S | SIGFPE |
| IEEE Binary Floating-Point exponent overflow | CEE34L | CEE3221S | SIGFPE |
| IEEE Binary Floating-Point exponent overflow inexact (truncated) | CEE34M | CEE3222S | SIGFPE |
| IEEE Binary Floating-Point exponent overflow inexact (incremented) | CEE34N | CEE3223S | SIGFPE |
| IEEE Binary Floating-Point divide by zero | CEE34O | CEE3224S | SIGFPE |
| IEEE Binary Floating-Point invalid operation | CEE34P | CEE3225S | SIGFPE |
| Compare and Trap Data Exception | CEE352 | CEE3234S | SIGFPE |

| Table 52. Invoked Exception Handlers (continued) | | | |
|--|---------------|----------------|------------------|
| Exception | Feedback Code | Message Number | Resulting Signal |
| Vector-processing exception of IEEE invalid operation | CEE354 | CEE3236S | SIGFPE |
| Vector-processing exception of IEEE division-by-zero | CEE355 | CEE3237S | SIGFPE |
| Vector-processing exception of IEEE exponent-overflow | CEE356 | CEE3238S | SIGFPE |
| Vector-processing exception of IEEE exponent-underflow | CEE357 | CEE3239S | SIGFPE |
| Vector-processing exception of IEEE inexact | CEE358 | CEE3240S | SIGFPE |
| Retryable abend | CEE35I | CEE3250C | SIGABND |

When one of the exceptions listed above occurs, on a specific thread with a registered Exception Handler, Language Environment will invoke the handler function with the following syntax:

```
void exception_handler(struct __cib * cib, void * user_data);
```

Parameter Description

cib

Address of the Language Environment Condition Information Block (CIB).

user_data

A user definable token that was specified when the Exception Handler was registered.

An Exception Handler function should never return to Language Environment. It should terminate the thread with `pthread_exit()`, terminate the process with `exit()`, or resume execution at a predefined point with `setjmp()` and `longjmp()`. If the Exception Handler returns to Language Environment, the thread will be abnormally terminated.

- In a Posix environment only the thread is abnormally terminated, and the thread exit status is set to -1. Equivalent to:

```
pthread_exit( (void *) -1);
```

- In a non-Posix environment the entire Language Environment (process as well as thread) is abnormally terminated. Equivalent to:

```
exit(-1);
```

Returned value

If successful, `__set_exception_handler()` returns 0. Otherwise, -1 is returned and `errno` is set to indicate the error. The following is a possible value for `errno`:

- `EINVAL` — The Exception Handler is invalid.

Application usage

1. Multiple Exception Handlers may not be registered for a single stack frame. Only the last one registered is honored.
2. Exception Handlers may be nested, but they must be on different stack frames.

3. Once an Exception Handler is registered, it remains active across calls to nested functions, and will be automatically unregistered once the flow returns from the stack frame in which the call to `__set_exception_handler()` was invoked.
4. If an Exception Handler is registered, it remains active across subsequence function calls (nested function calls), unless one of the nested functions registers another exception handler. In which case the first exception handler is suspended.
5. Exception Handlers are automatically unregistered when a `longjmp()` returns to a stack frame earlier on the stack than the frame on which the Exception Handler was registered. All Exception Handlers that are associated with stack frames that are traversed as a result of a `longjmp()` are automatically unregistered.
6. When an Exception Handler is given control, it is disabled. Any other Exception Handler (that may have been previously registered) is not set active. In other words, when the Exception Handler is given control there is no Exception Handler active. It is suspended.
 - Any exception that occurs while the Exception Handler is executing, will be processed in the same way that Language Environment processes exceptions when no Exception Handlers are present.
 - If the Exception Handler needs to be able to handle exceptions that occur during the execution of the Exception Handler, the handler must invoke `__set_exception_handler()` to register another (or re-register the same) Exception Handler.
7. One and only one, Exception Handler will be invoked for a condition (the Handler that is active for the stack frame on which the condition (or exception) occurred).
8. If an Exception Handler exists and the condition is one of those listed above, all of the standard Language Environment condition processing is bypassed (including, when `POSIX(ON)`, the mapping of the exception into a signal). Instead, the one active Exception Handler is given control, and it has one opportunity to 'handle' the exception. If it does not handle the exception then abnormal termination will occur.
9. Functions used to affect the processing of signals, have no impact on the processing of Exception Handlers. That is, blocking or ignoring `SIGABND`, `SIGFPE`, `SIGILL`, or `SIGSEGV` will not prevent Exception Handlers from getting control.
10. In order for Exception Handlers to work, the Language Environment 'TRAP' runtime option must be set on (i.e., `TRAP(ON)` or `TRAP(ON, NOSPIE)`).

Related information

- [“exit\(\) — End program” on page 449](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“pthread_exit\(\) — Exit a thread” on page 1279](#)
- [“__reset_exception_handler\(\) — Unregister an exception handler routine” on page 1448](#)
- [“setjmp\(\) — Preserve stack environment” on page 1542](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)

setgid() – Set the group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX1_SOURCE 2
#include <unistd.h>

int setgid(gid_t gid);
```

General description

Sets one or more of the group IDs (GIDs) for the current process to *gid*.

If *gid* is the same as the process's real GID or the saved set-group-ID, setgid() always succeeds and sets the effective GID to *gid*.

If *gid* is not the same as the process's real GID, setgid() succeeds only if the process has appropriate privileges. If the process has such privileges, setgid() sets the real GID, the effective GID, and saved set GID to *gid*.

setgid() does not change any supplementary GIDs of the calling process.

Returned value

If successful, setgid() returns 0.

If unsuccessful, setgid() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

The value of *gid* is incorrect.

EPERM

The process does not have appropriate privileges to set the GID.

Example

CELEBS06

```
/* CELEBS06

   This example sets your GID.

*/
#define _POSIX_SOURCE 1
#include <unistd.h>
#include <stdio.h>

main() {
    printf("your group id is %d\n", (int) getgid());
    if (setgid(500) != 0)
        perror("setgid() error");
    else
        printf("your group id was changed to %d\n",
```

```

        (int) getgid());
    }

```

Output

```

your group id is 512
your group id was changed to 500

```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“getegid\(\) — Get the effective group ID” on page 703](#)
- [“getgid\(\) — Get the real group ID” on page 709](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)

setgrent() — Reset group database to first entry

The information for this function is included in [“endgrent\(\) — Group database entry functions” on page 419](#).

setgroups() — Set the supplementary group ID list for the process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#define _OPEN_SYS
#include <sys/types.h>
#include <grp.h>

int setgroups(const int size, const gid_t list[]);

```

General description

setgroups() sets the supplementary group IDs for the process to the list provided in the *list* array. The argument *size* gives the number of `gid_t` elements in *list* array. The maximum number of supplementary groups for a strictly conforming program is **NGROUPS_MAX**, as defined in `<limits.h>` Or, refer to `sysconf()` (see [“sysconf\(\) — Determine system configuration options” on page 1794](#)) for information on dynamically determining the number of supplementary groups allowed.

The caller of this function must be a superuser.

Returned value

If successful, setgroups() returns 0.

If unsuccessful, setgroups() returns -1 and sets `errno` to one of the following values:

Error Code

Description

EFAULT

The *list* and *size* specify an array that is partially or completely outside of addressable storage for the process.

EINVAL

The *size* parameter is greater than the maximum allowed.

EMVSERR

An MVS environmental or internal error occurred.

EMVSSAF2ERR

The Security Authorization Facility (SAF) had an error.

EPERM

The caller is not authorized, only authorized users are allowed to alter the supplementary group IDs list.

Related information

- [“grp.h — Access group databases” on page 27](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“getgroups\(\) — Get a list of supplementary group IDs” on page 715](#)
- [“initgroups\(\) — Initialize the supplementary group ID list for the process” on page 865](#)

sethostent() — Open the host information data set

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**X/Open:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

void sethostent(int stayopen);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

void sethostent(int stayopen);
```

General description

The `sethostent()` function opens and rewinds the local host tables. If the *stayopen* flag is nonzero, the local host tables remain open after each call.

You can use the `X_SITE` environment variable to specify different local host tables and override those supplied by the z/OS global resolver during initialization.

Note: For more information on these local host tables or the environment variables, see [z/OS Communications Server: IP Configuration Guide](#).

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

`sethostent()` returns no values.

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endhostent\(\) — Close the host information data set” on page 420](#)
- [“endnetent\(\) — Close network information data sets” on page 421](#)
- [“gethostbyaddr\(\) — Get a host entry by address” on page 718](#)
- [“gethostbyname\(\) — Get a host entry by name” on page 720](#)
- [“gethostent\(\) — Get the next host entry” on page 722](#)

sethostname() — Set the name of the host processor

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

Berkeley sockets:

```
#define _XPLATFORM_SOURCE
#include <unistd.h>

int sethostname(const char *name, size_t len);
```

General description

`sethostname()` sets the host name to the value that is given in the character array *name*. The *len* argument specifies the number of bytes in *name*. The *name* argument does not require a NULL terminator. `sethostname()` is supported for callers in an IBM z/OS Container Platform environment only.

Parameter

Description

name

The character array that contains the host name to be set.

len

The length of the host name.

Returned value

If successful, `sethostname()` returns 0.

If unsuccessful, `sethostname()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

ENOTSUP

`sethostname()` is not supported from a process in the default UTS namespace.

EINVAL

name is not valid. *len* is less than or equal to zero or larger than the maximum allowed size, or no associated UTS namespace is found.

EACCES

Permission denied. For callers not in an IBM z/OS Container Platform environment, the caller is not running as a superuser (UID=0) and does not have access to the BPX.SUPERUSER FACILITY resource or the caller is not APF authorized. For callers in an IBM z/OS Container Platform environment, the caller does not have access to the CONTAINER UNIXPRIV resource or the environment is not program-controlled.

EAGAIN

The resource is temporarily unavailable or the caller is not authorized to access the TCP/IP stack.

EMVSERR

An MVS environmental or internal error occurs. Contact IBM support.

Usage notes

1. The caller of `sethostname()` must be in an IBM z/OS Container Platform environment and satisfy either one of the following requirements:
 - Runs as a superuser (UID=0).
 - Has access to the BPX.SUPERUSER FACILITY resource.
 - Has access to the SAF resource CONTAINERS in the UNIXPRIV class and is in a program-controlled environment.
2. The values for the host name must conform to the following rules:
 - Maximum of 63 characters.
 - Must contain one or more tokens that are separated by a period ('.').
 - Each token must be at least one character and fewer than 64 characters.
 - Each token must start with a letter or number.
 - The remaining characters in each token must be a letter, number, hyphen ('-') or underscore ('_').

setibmopt() – Set IBM TCP/IP image

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>

int setibmopt(int cmd, struct ibm_tcpimage *bfrp);
```

General description

The `setibmopt()` function call is used to set TCP/IP options. Currently, the only supported command is `IBMTCP_IMAGE` which allows the `setibmopt()` to choose the active TCP/IP image stack the application will connect to.

To reset `ibm_tcpimage` to nothing chosen, set the *name* to all blanks.

The chosen transport is inherited over `fork()` and preserved over `exec()`. If this is not desired, the child process should call `setibmopt()` with a blank name to reset the TCP/IP image for the child.

Parameter Description

cmd

The value in *cmd* must be set to the command to be performed. Currently, only IBMTCP_IMAGE is supported and must be paired with the *bfrp* parameter as described.

bfrp

The pointer to a `ibm_tcpimage` structure.

To set the TCP/IP image for a socket, the application should set values in the `ibm_tcpimage` structure as follows:

Element Description

status

0 means is not known and need not be checked. Currently, this is the only value with meaning.

version

0 means the version is to be set on return if known.

name

The name must be left justified, uppercase, padded with blanks, and be the name of an active TCP stack.

Returned value

If successful, `setibmopt()` returns 0.

If unsuccessful, `setibmopt()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EFAULT

Using the *bfrp* supplied would result in access of a storage location that is inaccessible.

EIBMBADTCPNAME

A name of a PFS was specified that either is not configured or is not a Sockets PFS.

EOPNOTSUPP

The *cmd* is a function that is not supported.

ENXIO

The name that was specified did not match an AF_INET socket stack, but Common Inet is not configured on this system. Because this system does not have multiple AF_INET socket transports configured, there is already a natural affinity to one single stack, and this failure may not be a problem for the application.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“__iptcpn\(\) — Retrieve the resolver supplied jobname or user ID” on page 894](#)

setibmssockopt() — Set IBM specific options associated with a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCKET_EXT
#include <sys/socket.h>

int setibmssocket(int s, int level, int optname, char *optval, size_t optlen);
```

General description

These options are only valid on IBM systems and can be specified to allow improved processing of requests on sockets.

Parameter Description

s

The socket descriptor.

level

The level for which the option is set.

optname

The name of a specified socket option. The socket option currently available is:

- SO_EioIfNewTP

optval

The pointer to option data.

optlen

The length of the option data.

Usage notes

The SO_EioIfNewTP option allows a socket application that has bound INADDRANY to be notified if a new common inet transport provider was activated after the socket was created. In order to activate this option, the option data should have a value of 1. To deactivate this option, supply a value of 0 for the option data. This option can be useful to a server that is listening - waiting for requests to come in from a number of sources. When a new transport provider is activated while this option is in effect, the application program will receive an EIO on the next accept, select or read request. Once this happens, the application should close the current socket and create a new one - thus enabling the socket to communicate with the new transport provider.

Returned value

If successful, setibmssocket() returns 0.

If unsuccessful, setibmssocket() returns -1 and sets errno to one of the following values:

Error Code Description

EBADF

The s parameter is not a valid socket descriptor.

EFAULT

Using *optval* and *optlen* parameters would result in an attempt to access storage outside the caller's address space.

ENOPROTOPT

The *optname* parameter is unrecognized. The *level* parameter is not SOL_SOCKET. The domain of the socket descriptor is not AF_INET. The socket descriptor is not a datagram type socket.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

- “fcntl() — Control open file descriptors” on page 483
- “getibmssockopt() — Get IBM specific options associated with a socket” on page 726
- “getsockopt() — Get the options associated with a socket” on page 778
- “ibmsflush() — Flush the application-side datagram queue” on page 824
- “setsockopt() — Set options associated with a socket” on page 1573

setipv4sourcefilter() — Set source filter

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3678 | both | z/OS V1.9 |

Format

```
#define _OPEN_SYS_SOCK_EXT3
#include <netinet/in.h>

int setipv4sourcefilter(int s, struct in_addr interface, struct in_addr group,
                      uint32_t fmode, uint32_t numsrc, struct in_addr *slist);
```

General description

This function allows applications to set and replace the current multicast filtering state for a tuple consisting of socket, interface, and multicast group values.

A multicast filter is described by a filter mode, which is MCAST_INCLUDE or MCAST_EXCLUDE, and a list of source addresses which are filtered.

This function is IPv4-specific, must be used only on AF_INET sockets with an open socket of type SOCK_DGRAM or SOCK_RAW.

If the function is unable to obtain the required storage, control will not return to the caller. Instead the application will terminate due to an out of memory condition (if the reserve stack is available and the caller is not XPLINK), or it will terminate with an abend indicating that storage could not be obtained.

Argument

Description

s

Identifies the socket.

interface

Holds the local IP address of the interface.

group

Holds the IP multicast address of the group.

fmode

Identifies the filter mode. The value of this field must be either MCAST_INCLUDE or MCAST_EXCLUDE, which are likewise defined in <netinet/in.h>.

numsrc

Holds the number of source addresses in the slist array.

slist

Points to an array of IP addresses of sources to include or exclude depending on the filter mode.

Returned value

If successful, the function returns 0. Otherwise, it returns -1 and sets errno to one of the following values.

errno

Description

EADDRNOTAVAIL

The specified interface address is incorrect for this host, or the specified interface address is not multicast capable.

EBADF

s is not a valid socket descriptor.

EINVAL

Interface or group is not a valid IPv4 address, or the socket s has already requested multicast setsockopt options.

ENOBUFS

The number of the source addresses exceeds the allowed limit.

EPROTOTYPE

The socket s is not of type SOCK_DGRAM or SOCK_RAW.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“getipv4sourcefilter\(\) — Get source filter” on page 729](#)

setitimer() — Set value of an interval timer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/time.h>

int setitimer(int which, struct itimerval *value, struct itimerval *ovalue);
```

General description

setitimer() sets the value of an interval timer. An interval timer is a timer which sends a signal after each repetition (interval) of time.

The *which* argument indicates what kind of time is being controlled. Values for *which* are:

ITIMER_REAL

This timer is marking real (clock) time. A SIGALRM signal is generated after each interval of time.

Note: alarm() also sets the real interval timer.

ITIMER_VIRTUAL

This timer is marking process virtual time. Process virtual time is the amount of time spent while executing in the process, and can be thought of as a CPU timer. A SIGVTALRM signal is generated after each interval of time.

ITIMER_PROF

This timer is marking process virtual time plus time spent while the system is running on behalf of the process. A SIGPROF signal is generated after each interval of time.

Note: In a multithreaded environment, each of the above timers is specific to a thread of execution for both the generation of the time interval and the measurement of time. For example, an `ITIMER_VIRTUAL` timer will mark execution time for just the thread, not the entire process.

The *value* argument points to an `itimerval` structure containing the timer value to be set. The structure contains:

it_interval

timer interval

When `it_interval` is nonzero, it is used as the value which `it_value` is initialized to after each timer expiration. If `it_interval` is zero, the timer is disabled **after the next expiration**, subject to the value in `it_value`.

it_value

current timer value to be set

When `it_value` is nonzero, it is used as the initial value to establish the timer with, that is, the time to the next timer expiration. If `it_value` is zero, the timer is **immediately** disabled.

The *ovalue* argument points to an `itimerval` structure in which the current value of the timer is returned. If *ovalue* is a NULL pointer, the current timer value is not returned. The structure contains:

it_interval

current timer interval

it_value

current timer value

For both `itimerval` structures, each of the fields (`it_interval` and `it_value`) is a `timeval` structure, and contains:

tv_sec

seconds since January 1, 1970 Coordinated Universal Time (UTC)

tv_usec

microseconds

Returned value

If successful, `setitimer()` returns 0, and if *ovalue* was non-NULL, *ovalue* points to the `itimerval` structure containing the old timer values.

If unsuccessful, `setitimer()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

which is not a valid timer type, or the *value* argument has an incorrect (noncanonical) form. The `tv_seconds` field must be a nonnegative integer, and the `tv_usec` field must be a nonnegative integer in the range of 0-1,000,000.

Usage of the `ITIMER_PROF` timer generates a `SIGPROF` signal which may interrupt an in-progress function. Thus, programs using this timer may need to be able to restart an interrupted function.

Related information

- [“sys/time.h — Time types” on page 71](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“getitimer\(\) — Get value of an interval timer” on page 730](#)
- [“gettimeofday\(\), gettimeofday64\(\) — Get date and time” on page 790](#)
- [“sleep\(\) — Suspend execution of a thread” on page 1668](#)
- [“ualarm\(\) — Set the interval timer” on page 1921](#)

- “usleep() — Suspend execution for an interval” on page 1951

setjmp() — Preserve stack environment

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <setjmp.h>

int setjmp(jmp_buf env);
```

General description

Saves a stack environment that can subsequently be restored by `longjmp()`. The `setjmp()` and `longjmp()` functions provide a way to perform a nonlocal goto. They are often used in signal handlers.

A call to `setjmp()` causes it to save the current stack environment in *env*. A subsequent call to `longjmp()` restores the saved environment and returns control to a point corresponding to the `setjmp()` call. The values of all variables, except register variables and nonvolatile automatic variables, accessible to the function receiving control, contain the values they had when `longjmp()` was called. The values of register variables are unpredictable. Nonvolatile *auto* variables that are changed between calls to `setjmp()` and `longjmp()` are also unpredictable.

An invocation of `setjmp()` must appear in one of the following contexts only:

- The entire controlling expression of a selection or iteration statement.
- One operand of a relational or equality operator with the other operand an integral constant expression, with the resulting expression being the entire controlling expression of a selection or iteration statement.
- The operand of a unary “!” operator with the resulting expression being the entire controlling expression of a selection or iteration.
- The entire expression of an expression statement (possibly cast to void).

Note: Ensure that the function that calls `setjmp()` does not return before you call the corresponding `longjmp()` function. Calling `longjmp()` after the function calling `setjmp()` returns causes unpredictable program behavior.

Special behavior for POSIX C: To save and restore a stack environment that includes a signal mask, use `sigsetjmp()` and `siglongjmp()`, instead of `setjmp()`.

The `sigsetjmp()`—`siglongjmp()` pair, the `setjmp()`—`longjmp()` pair, the `_setjmp()`—`_longjmp()` pair, and the `getcontext()`—`setcontext()` pair *cannot* be intermixed. A stack environment saved by `setjmp()` can only be restored by `longjmp()`.

Special behavior for C++: If `setjmp()` and `longjmp()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. The use of `setjmp()` and `longjmp()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Special behavior for XPG4.2: In a program that was compiled with the feature test macro `_XOPEN_SOURCE_EXTENDED` defined, another pair of functions, `_setjmp()`—`_longjmp()`, are available. On this implementation, these calls are functionally identical to `setjmp()`—`longjmp()`. Therefore it is possible, but not recommended, to intermix the `setjmp()`—`longjmp()` pair with the `_setjmp()`—`_longjmp()` pair.

Special behavior for XPLINK-compiled C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Language Environment V2R10 and later headers define a shorter **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

`setjmp()` returns 0 after saving the stack environment.

If `setjmp()` returns as a result of a `longjmp()` call, it returns the *value* argument of `longjmp()`, or the value 1 if the *value* argument of `longjmp()` is equal to 0.

Example

This example stores the stack environment at the statement:

```
if(setjmp(mark) != 0) ...
```

When the system first performs the `if` statement, it saves the environment in *mark* and sets the condition to FALSE because `setjmp()` returns 0 when it saves the environment. The program prints the message: `setjmp has been called`.

The subsequent call to function *p* tests for a local error condition, which can cause it to perform the `longjmp()` function. Then control returns to the original `setjmp()` function using the environment saved in *mark*. This time the condition is TRUE because -1 is the returned value from the `longjmp()` function. The program then performs the statements in the block and prints: `longjmp has been called`. Finally, the program calls the `recover` function and exits.

```
/* This example shows the effect of having set the stack environment. */
#include <stdio.h>
#include <setjmp.h>

jmp_buf mark;

void p(void);
void recover(void);

int main(void)
{
    if (setjmp(mark) != 0) {
        printf("longjmp has been called\n");
        recover();
        exit(1);
    }
    printf("setjmp has been called\n");
    :
    p();
}
```

```

:
}

void p(void)
{
    int error = 0;
:
    error = 9;
:
    if (error != 0)
        longjmp(mark, -1);
:
}

void recover(void)
{
:
:
}

```

Related information

- [“setjmp.h — Manipulate program state” on page 58](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“_setjmp\(\) — Set jump point for a nonlocal goto” on page 1544](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

_setjmp() — Set jump point for a nonlocal goto

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _XOPEN_SOURCE_EXTENDED 1
#include <setjmp.h>

int _setjmp(jmp_buf env);

```

General description

The `_setjmp()` function saves a stack environment that can subsequently be restored by `_longjmp()`. The `_setjmp()` and `_longjmp()` functions provide a way to perform a nonlocal goto. They are often used in signal handlers.

A call to `_setjmp()` causes it to save the current stack environment in *env*. A subsequent call to `_longjmp()` restores the saved environment and returns control to a point corresponding to the `_setjmp()` call. The values of all variables, except register variables, and except nonvolatile automatic variables, accessible to the function receiving control contain the values they had when `_longjmp()` was called. The values of register variables are unpredictable. Nonvolatile *auto* variables that are changed between calls to `_setjmp()` and `_longjmp()` are also unpredictable.

An invocation of `_setjmp()` must appear in one of the following contexts only:

1. The entire controlling expression of a selection or iteration statement.
2. One operand of a relational or equality operator with the other operand an integral constant expression, with the resulting expression being the entire controlling expression of a selection or iteration statement.
3. The operand of a unary "!" operator with the resulting expression being the entire controlling expression of a selection or iteration.
4. The entire expression of an expression statement (possibly cast to void).

The X/Open standard states that `_setjmp()` and `_longjmp()` are functionally identical to `longjmp()` and `setjmp()`, respectively, with the addition restriction that `_setjmp()` and `_longjmp()` do not manipulate the signal mask. However, on this implementation `longjmp()` and `setjmp()` do not manipulate the signal mask. So on this implementation `_setjmp()` and `_longjmp()` are literally identical to `longjmp()` and `setjmp()`, respectively.

To save and restore a stack environment, including the current signal mask, use `sigsetjmp()` and `siglongjmp()` instead of `_setjmp()` and `_longjmp()`, or `setjmp()` and `longjmp()`.

The `_setjmp()`—`_longjmp()` pair, the `setjmp()`—`longjmp()` pair, the `sigsetjmp()`—`siglongjmp()` pair, and the `getcontext()`—`setcontext()` pair cannot be intermixed. A stack environment saved by `_setjmp()` can be restored only by `_longjmp()`.

Notes:

1. However, on this implementation, since the `_setjmp()`—`_longjmp()` pair are functionally identical to the `setjmp()`—`longjmp()` pair it is possible to intermix them, but it is not recommended.
2. Ensure that the function that calls `_setjmp()` does not return before you call the corresponding `_longjmp()` function. Calling `_longjmp()` after the function calling `_setjmp()` returns causes unpredictable program behavior.

Special behavior for C++: If `_setjmp()` and `_longjmp()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. The use of `_setjmp()` and `_longjmp()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Special behavior for XPLINK-compiled C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Language Environment V2R10 and later headers define a shorter **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

`_setjmp()` returns 0 after saving the stack environment.

If `_setjmp()` returns as a result of a `_longjmp()` call, it returns the *value* argument of `_longjmp()`, or 1 if the *value* argument of `_longjmp()` was 0.

Related information

- [“setjmp.h — Manipulate program state” on page 58](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“setjmp\(\) — Preserve stack environment” on page 1542](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

setkey() — Set encoding key

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

void setkey(const char *key);
```

General description

The `setkey()` function transforms the *key* argument array into data encryption keys which are used by the `encrypt()` function to encode blocks of data.

The *key* argument of `setkey()` is an array of length 64 bytes containing only the bytes with numerical value of 0 and 1. If this 64 byte array is divided into groups of 8, the low-order byte of each group is ignored. The `setkey()` function transforms the remaining 56 bytes, each with values 0 or 1, into 16 48-bit keys according to the Data Encryption Standard (DES) key algorithm.

Special behavior for z/OS UNIX Services: When `setkey()` is called from a thread, the array of 16 bit-bit keys produced by `setkey()` is unique to the thread. Thus, for each thread from which the `encrypt()` function is called by a threaded application, the `setkey()` function must first be called from each thread.

Returned value

`setkey()` returns no values.

Special behavior for z/OS UNIX Services: The `setkey()` function will set `errno` to one of the following values:

Error Code

Description

EINVAL

64 byte input array contains bytes with values other than 0x00 or 0x01.

ENOMEM

Unable to allocate storage for DES keys on thread from which setkey() invoked.

Note: Because setkey() returns no values, applications wishing to check for errors should set errno to 0, call setkey(), then test errno and, if it is nonzero, assume an error has occurred.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“__cnvblk\(\) — Convert block” on page 299](#)
- [“crypt\(\) — String encoding function” on page 347](#)
- [“encrypt\(\) — Encoding function” on page 418](#)

setlocale() — Set locale

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 SAA Language Environment z/OS UNIX C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <locale.h>

char *setlocale(int category, const char *locale);
```

General description

Sets, changes, or queries *locale* categories or groups of categories. It does this action according to the values of the *locale* and *category* arguments.

A *locale* is the complete definition of the part of a user's program that depends on language and cultural conventions. You can accept the default value of *locale*, or you can set it to one of the supplied locales listed in the appendix , “Supplied Locales”, in *z/OS XL C/C++ Programming Guide*. Some examples of the supplied locales are: “C”, “POSIX”, “SAA”, “S370”, “Fr_BE.IBM-1047”, “En_GB.IBM-285”, “En_US.IBM-1047”, “Fr_BE.IBM-1148@euro”, and “Fr_BE.IBM-1148”.

Note that non-POSIX programs may exploit the POSIX style of locale support. This use of environment variables also applies to non-POSIX programs that use POSIX locale support.

Effect of setlocale() on Language Environment: The current locale set with the setlocale() function affects only some C library functions. (See [Table 53 on page 1548](#)). It does not affect the CEE locale set and query functions available under Language Environment and described in the [z/OS Language Environment Programming Reference](#).

The category argument

The *category* argument may be set to one of these values:

Table 53. Values for Category Arguments of *setlocale()*

| Category | Purpose |
|-------------|--|
| LC_ALL | Specifies all categories that are associated with the program's locale. |
| LC_COLLATE | <p>Defines the collation sequence, that is, the relative order of collation elements (characters and multicharacter collation elements) in the program's locale. The collation sequence definition is used by regular expression, pattern matching, and sorting functions.</p> <p>These string functions are affected by the defined collation sequence: <code>strcoll()</code>, <code>strxfrm()</code>, <code>wscoll()</code>, and <code>wcsxfrm()</code>.</p> <p>LC_CTYPE, LC_COLLATE, and LC_SYNTAX should refer to the same locale. Changing just one of them may invalidate another.</p> |
| LC_CTYPE | <p>Defines character classification and case conversion for characters in the program's locale. Affects the behavior of character-handling functions that are defined in the <code>ctype.h</code> header file: <code>csid()</code>, <code>isalnum()</code>, <code>isalpha()</code>, <code>isblank()</code>, <code>iswblank()</code>, <code>iscntrl()</code>, <code>isdigit()</code>, <code>isgraph()</code>, <code>islower()</code>, <code>isprint()</code>, <code>ispunct()</code>, <code>isspace()</code>, <code>isupper()</code>, <code>iswalnum()</code>, <code>iswalpha()</code>, <code>iswcntrl()</code>, <code>iswctype()</code>, <code>iswdigit()</code>, <code>iswgraph()</code>, <code>iswlower()</code>, <code>iswprint()</code>, <code>iswpunct()</code>, <code>iswspace()</code>, <code>iswupper()</code>, <code>iswxdigit()</code>, <code>isxdigit()</code>, <code>tolower()</code>, <code>toupper()</code>, <code>towlower()</code>, <code>towupper()</code>, <code>wcsid()</code>, and <code>wctype()</code>.</p> <p>Affects behavior of the <code>printf()</code> and <code>scanf()</code> families of functions: <code>fprintf()</code>, <code>printf()</code>, <code>sprintf()</code>, <code>fscanf()</code>, <code>scanf()</code>, and <code>sscanf()</code>.</p> <p>Affects the behavior of wide-character input/output functions: <code>fgetwc()</code>, <code>fgetws()</code>, <code>getwc()</code>, <code>getwchar()</code>, <code>fputwc()</code>, <code>fputws()</code>, <code>putwc()</code>, <code>putwchar()</code>, and <code>ungetwc()</code>.</p> <p>Affects the behavior of multibyte and wide-character functions: <code>mblen()</code>, <code>mbtowc()</code>, <code>mbstowcs()</code>, <code>wctomb()</code>, <code>wcstombs()</code>, <code>mbrlen()</code>, <code>mbrtowc()</code>, <code>mbsrtowcs()</code>, <code>wcrtomb()</code>, <code>wcsrtombs()</code>, <code>wcswidth()</code>, <code>wcwidth()</code>, <code>wcstod()</code>, <code>wcstol()</code>, and <code>wcstoul()</code>.</p> <p>LC_CTYPE, LC_COLLATE, and LC_SYNTAX should refer to the same locale. Changing just one of them may invalidate another.</p> |
| LC_MESSAGES | <p>Under IBM z/OS C/C++ support, it affects the messages that are returned by the <code>nl_langinfo()</code> function and it also affects <code>rpmatch()</code>.</p> <p>The LC_MESSAGES <i>category</i> will <i>not</i> affect the messages for the following functions: <code>perror()</code>, <code>strerror()</code>, and <code>regerror()</code>.</p> <p>In the locale of a C program running with POSIX(ON), it defines affirmative and negative response patterns.</p> |
| LC_MONETARY | <p>Affects monetary information that is returned by <code>localeconv()</code> and the <code>strfmon()</code> function. It defines the rules and symbols that are used to format monetary numeric information in the program's locale. The formatting rules and symbols are strings. <code>localeconv()</code> returns pointers to these strings with names found in the <code>locale.h</code> header file.</p> |

Table 53. Values for Category Arguments of `setlocale()` (continued)

| Category | Purpose |
|------------|---|
| LC_NUMERIC | <p>Affects the decimal-point character for the formatted input/output and string conversion functions, and the nonmonetary formatting information returned by the <code>localeconv()</code> function, specifically:</p> <ul style="list-style-type: none"> • The <code>printf()</code> family of functions • The <code>scanf()</code> family of functions • <code>strtod()</code> • <code>atof()</code> <p>The formatting rules and symbols are strings. <code>localeconv()</code> returns pointers to the strings with names found in the <code>locale.h</code> header file.</p> |
| LC_TIME | <p>Defines time and date format information in the program's locale that is used by the <code>strftime()</code>, <code>strptime()</code>, and <code>wcsftime()</code> functions.</p> |
| LC_SYNTAX | <p>Affects the behavior of functions that use encoded values to format characters:</p> <ul style="list-style-type: none"> • <code>printf()</code> family of functions • <code>scanf()</code> family of functions • <code>regcomp()</code> • <code>strfmon()</code> <p>LC_SYNTAX also affects values that may be retrieved by using the <code>getsyntax()</code> function.</p> <p>LC_CTYPE, LC_COLLATE, and LC_SYNTAX should refer to the same locale. Changing just one of them may invalidate another.</p> |
| LC_TOD | <p>Affects the behavior of the functions that are related to time zone and Daylight Saving Time information in the program's locale, when time zone and Daylight Saving Time information is not defined by the TZ environment variable. This information is used by <code>ctime()</code>, <code>localtime()</code>, <code>mktime()</code>, and <code>strftime()</code>.</p> |

For a POSIX program, the functions `ctime()`, `localtime()`, `mktime()`, `setlocale()`, and `strftime()` call the `tzset()` function to override LC_TOD category information when TZ is defined and valid.

The locale argument

Identifies the locale. For a list of locales provided by IBM, see the topic about supplied locales in [z/OS XL C/C++ Programming Guide](#).

If the value of an environment variable is used, it must be a valid locale name. If so, `setlocale()` sets the specified category to the named locale, and returns a string giving the name of the locale. Otherwise, `setlocale()` does not change the program's locale and returns a NULL pointer. Valid *category* names include names of locales that are provided by IBM. Also, names of locales, which are created by using the z/OS XL C/C++ locale definition mechanism, are valid.

The null-string ("") locale value: If "" is specified, the locale-related environment variables are checked. If the locale name is not defined by the environment variables, the default is "S370" when running POSIX(OFF) and "C" when running POSIX(ON).

For both C and C++ languages, and whether you are using POSIX or not, if a program by using POSIX-style locale support specifies "" for the value of *locale*, then `setlocale()` interrogates locale-related environment variables in the program's environment to find a locale name or names to use. The locale name is chosen according to the first of the following conditions that applies:

1. If the environment variable LC_ALL is defined and is not NULL, the value of LC_ALL is used. That value is applied to all categories.
2. If individual environmental variables are defined, then their values are used for the categories.
3. If the environment variable LANG is defined and is not NULL, the value of LANG is used.
4. If no non-NULL environment variable is present to supply a value, "C" is used.

If a program by using POSIX-style locale support specifies LC_ALL for the value of *category* and "" for the value of *locale*, setlocale() searches environment variables in the way that is described to obtain a locale name for each category. If all the locale names obtained identify valid locales, setlocale() sets each category to the appropriate locale and returns a string naming the locale that is associated with each category. Otherwise, setlocale() does not change the program's locale and returns a NULL pointer.

Default locale: The relationship between the POSIX C and SAA C locales is as follows.

Using C or C++ languages with the runtime option POSIX(OFF):

1. The SAA C locale definition is the default. "C", "SAA", and "S370" are synonyms for the SAA C locale definition, which is prebuilt into the library.

The source file EDC\$SAAC LOCALE is provided for reference, but cannot be used to alter the definition of this prebuilt locale.

2. Issuing setlocale(*category*, "") has the following effect:

- Locale-related environment variables are checked to find the name of locales to use to set the *category* specified. Querying the locale with setlocale(*category*, NULL) returns the name of the locales that are specified by the appropriate environment variables.
 - If no non-NULL environment variable is present, it is the equivalent of having issued setlocale(*category*, "S370"). That is, the locale that is chosen is the SAA C locale definition, and querying the locale with setlocale(*category*, NULL), returns "S370" as the locale name.
3. If no setlocale() function is issued or setlocale(LC_ALL, "C") is used, then the locale that is chosen is the prebuilt SAA C locale, and querying the locale with setlocale(*category*, NULL), returns "C" as the locale name.
 4. For setlocale(LC_ALL, "SAA"), the locale that is chosen is the prebuilt SAA C locale, and querying the locale with setlocale(*category*, NULL), returns "SAA" as the locale name.
 5. For setlocale(LC_ALL, "S370"), the locale that is chosen is the prebuilt SAA C locale, and querying the locale with setlocale(*category*, NULL), returns "S370" as the locale name.
 6. For setlocale(LC_ALL, "POSIX"), the locale that is chosen is the prebuilt POSIX C locale, and querying the locale with setlocale(*category*, NULL), returns "POSIX" as the locale name.

Using z/OS XL C with the runtime option POSIX(ON):

1. The POSIX C locale definition is the default. "C" and "POSIX" are synonyms for the POSIX C locale definition, which is prebuilt into the library.

The source file EDC\$POSX LOCALE is provided for reference, but cannot be used to alter the definition of this prebuilt locale.

2. Issuing setlocale(*category*, "") has the following effect:

- Locale-related environment variables are checked to find the name of locales that can set the *category* specified. Querying the locale with setlocale(*category*, NULL) returns the name of the locale that is specified by the appropriate environment variables.
 - If no non-NULL environment variable is present, the result is equivalent to having issued setlocale(*category*, "C"). That is, the locale that is chosen is the POSIX C locale definition, and querying the locale with setlocale(*category*, NULL), returns "C" as the locale name.
3. If no setlocale() function is issued or if setlocale(LC_ALL, "C") is used, the locale that is chosen is the prebuilt POSIX C locale. Querying the locale with setlocale(*category*, NULL) returns "C" as the locale name.

4. For `setlocale(LC_ALL, "POSIX")` the locale chosen is the prebuilt POSIX C locale. Querying the locale with `setlocale(category, NULL)` returns "POSIX" as the locale name.
5. For `setlocale(LC_ALL, "SAA")` the locale chosen is the prebuilt SAA C locale. Querying the locale with `setlocale(category, NULL)` returns "SAA" as the locale name.
6. For `setlocale(LC_ALL, "S370")` the locale chosen is the prebuilt SAA C locale. Querying the locale with `setlocale(category, NULL)` returns "S370" as the locale name.

The `setlocale()` function supports locales that are built by using the `localedef` utility, as well as locales built by using the assembly language source and produced by the `EDCLOC` macro. Find more information about old format locales in "Internationalization: Locales and Character Sets", in [z/OS XL C/C++ Programming Guide](#).

Special behavior for z/OS UNIX Services

The `LOCPATH` environment variable specifies a colon-separated list of z/OS UNIX directories. If `LOCPATH` is defined, `setlocale()` searches z/OS UNIX directories in the order that is specified by `LOCPATH` for locale object files it requires. Locale object files in the HFS are produced by the `localedef` utility running under z/OS UNIX. If `LOCPATH` is not defined and `setlocale()` is called by a POSIX program, `setlocale()` looks in the default locale directory, `/usr/lib/nls/locale`, for locale object files it requires. If `setlocale()` does not find a locale object that it requires, it converts the locale name to a PDS member name and searches locale PDS load libraries that are associated with the program calling `setlocale()`.

Locale names may be file names, relative path names, or absolute path names. `LOCPATH` is used if file name rather than path name is specified. Also, `//` preceding a file name tells `setlocale()` to skip HFS search and to convert the name to a load module name of the form `EDC$xxxx`, and to search MVS load libraries for a member to load with this name. Also, `//` preceding a file name tells `setlocale()` to skip the search to convert the name to a load module PDS name. XPLINK locale object PDS names begin with `EDC`. Non-XPLINK locale object load module names begin with `CEH`. See [z/OS XL C/C++ Programming Guide](#), section titled *Locale Naming Conventions* for further information regarding locale object names.

All locales that are supplied by IBM come in two versions: non-XPLINK and XPLINK. The HFS-resident XPLINK locale objects are distinguished from their non-XPLINK versions by a ".xplink" suffix on the HFS path name. PDS-resident XPLINK locale objects are distinguished from their non-XPLINK versions by a "CEH" prefix. The non-XPLINK PDS-resident locale objects have a prefix of "EDC".

It is the convention to specify locales by using the locale descriptive names. The runtime loads the non-XPLINK or XPLINK locale as appropriate.

It is also possible to specify a locale's relative or full path name on the `setlocale` call. However, the runtime does nothing to ensure that the locale is the appropriate version. `Setlocale` uses the locale object exactly as specified whether it is a relative or fully qualified path name. For example, `setlocale()` will fail if it is given an XPLINK locale full path name but the application is a non-XPLINK application. Similarly, `setlocale()` will fail if it is given a non-XPLINK locale full path name but the application is an XPLINK application. These problems are avoided if the locale names are the descriptive locale names.

Invocation sequence for `setlocale()`

In all three variations of the `setlocale()` function call, a pointer to a string that represents the locale value is returned. Also, in all variations, if the value for either *category* or *locale* is invalid, `setlocale()` returns a NULL pointer and the operating environment is not changed.

Each variation causes a different function to be performed:

1. `setlocale(category, locale);`

When an explicit locale is named, the *category* named in the call is set according to the named locale.

2. `setlocale(category, "");`

When the locale argument of the `setlocale()` function is given as a NULL string (""), the `setlocale()` function sets the locale environment according to the environment variables. If these are not set, the

default locale "S370" is used. This locale may be customized when the z/OS XL C/C++ product is installed.

The environment variables are not currently supported under all z/OS XL C/C++ environments. The preceding processing allows the `setlocale()` function to use the environment variables if they are available, and to use the "S370" locale otherwise.

3. `setlocale(category, (char *) 0);`

When a NULL pointer is given as a locale, a pointer to a string that represents the current locale for the specified *category* is returned. The string has the property that if it were specified as the locale of a subsequent `setlocale()` call of the same *category*, the current locale would be restored. For example, the following sequence is effectively a no-op:

```
setlocale(category, setlocale(category, (char *) 0));
```

When called with a NULL string (for example `setlocale(LC_ALL, "")`), `setlocale()` determines the locale to be set, by using the environment variables, and checking them in this order:

- 1. LC_ALL. If set, it specifies the name for all categories; it can override the values in the other environmental variables.
- 2. LC_COLLATE, LC_CTYPE, LC_MESSAGES, LC_MONETARY, LC_NUMERIC, LC_TIME, LC_SYNTAX, and LC_TOD. If set, these variables specify the locale name for the given *category*.
- 3. LANG.

The `setlocale()` function uses the `getenv()` function to retrieve the environment variables if the system supports the `getenv()` function. Under CICS it is not supported.

Querying the locale

When *locale* is set to a NULL pointer, `setlocale()` returns a string indicating the program's locale without changing it. This provides a means to query the program's current locale. To query the locale, give a NULL pointer as the second parameter. For example, to query all the categories of your locale, use a statement like the following:

```
char *string = setlocale(LC_ALL, NULL);
```

Returned value

If successful, `setlocale()` returns a pointer to the string associated with the specified *category* for the new *locale*. The string can be used on a subsequent call to restore that part of the program's locale.

Note: Because the string that a successful call to `setlocale()` points to may be overwritten by subsequent calls to the `setlocale()` function, you should copy the string if you plan to use it later.

If unsuccessful, `setlocale()` returns a NULL pointer and the program's locale is not changed.

If successful, `setlocale()` returns a string whose contents depend on the values of the *category* and *locale* arguments as shown in the following table.

| Table 54. Return String as Determined by Category and Locale Values | | |
|---|---------------------|--|
| Category Value | Locale Value | Return String |
| Specific category | NULL pointer | current-locale-name for category |
| | new-locale-name | new-locale-name for category |
| | "" (Null string) | If the environmental variables are set, new-locale-name: environment-variable-value or C. If the environmental variables are not set, and if non-POSIX Program, then S370 or SAA. |

Table 54. Return String as Determined by Category and Locale Values (continued)

| Category Value | Locale Value | Return String |
|----------------|---------------------|--|
| LC_ALL | NULL pointer | One of these: <ul style="list-style-type: none"> • locale-name • locale-name-list: locale-name1, locale-name2, ..., if different names for one or more categories. |
| | new-locale-name | new-locale-name (same for all categories) |
| | "" (Null string) | One of these: <ul style="list-style-type: none"> • new-locale-name: environment-variable-value or C • locale-name-list: environment-variable-value-list if different names for one or more categories. <p>If environmental variables are not set, and if non-POSIX program, then S370 (same for all categories).</p> |

If the string returned contains a locale name list, the names have the following order:

1. LC_COLLATE locale-name
2. LC_CTYPE locale-name
3. LC_MONETARY locale-name
4. LC_NUMERIC locale-name
5. LC_TIME locale-name
6. LC_TOD locale-name
7. LC_MESSAGES locale-name
8. LC_SYNTAX locale-name

If unsuccessful, `setlocale()` returns a NULL pointer and does not change the program's locale. Failure can result if:

- An incorrect *category* value is used.
- An incorrect *locale* value is used.
- The value of the environment variable used by `setlocale()` when the value of *locale* is "" is an undefined or incorrect locale name.

Note: If `setlocale()` is called and an application has called `pthread_create()` to create another thread, setting or changing the locale with `setlocale()` returns a NULL pointer and does not change the current locale.

Example

CELEBS07

```
/* CELEBS07

   This example sets the locale of the program to be
   Fr_FR.IBM-1047 and prints the string that is associated with
   the locale.

   */
#include <stdio.h>
#include <locale.h>

char *string;
```

setlocale

```
int main(void)
{
    string = setlocale(LC_ALL, "Fr_FR.IBM-1047");
    if (string != NULL)
        printf(" %s \n",string);
}
```

CELEBS08

```
/* CELEBS08

This example uses &setenv. to set the value of the
environment variable LC_TIME to FRAN, calls &setloc. to set
all categories to default values, uses &setloc. to query all
categories, and uses &printf. to print results.

*/
#include <stdio.h>
#include <stdlib.h>
#include <env.h>
#include <locale.h>

int main(void)
{
    char *string;
    setenv("LC_TIME", "FRAN", 1);
    setlocale(LC_ALL, "");
    string = setlocale(LC_ALL, NULL);
    printf("string = %s \n", string);
}
```

Output

If the example is run with POSIX(OFF), the result of printf() is:

```
string = "S370,S370,S370,S370,FRAN,S370,S370,S370"
```

If the example is run with POSIX(ON), the result of printf() is:

```
string = "C,C,C,C,FRAN,C,C,C"
```

Example

The following example shows euro currency support:

```
/* EUROSAMP
This example sets the locale of the program to be
Fr_BE.IBM-1148 and Fr_BE.IBM-1148@euro and prints
the string associated with each locale.
*/
#include <stdio.h>
#include <locale.h>

int main(void)
{
    char *string;

    string = setlocale(LC_ALL,"Fr_BE.IBM-1148");
    if (string != NULL)
        printf("String = %s \n",string);

    string = setlocale(LC_ALL,"Fr_BE.IBM-1148@euro");
    if (string != NULL)
        printf("String = %s \n",string);
}
```

Output

```
String = Fr_BE.IBM-1148
String = Fr_BE.IBM-1148@euro
```

Related information

- [“localdef.h — Data structures for locale objects” on page 36](#)
- [“locale.h — Locale settings” on page 36](#)
- [“getenv\(\) — Get value of environment variables” on page 705](#)
- [“localeconv\(\) — Query numeric conventions” on page 988](#)
- [“nl_langinfo\(\) — Retrieve locale information” on page 1152](#)

setlogmask() — Set the mask for the control log

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <syslog.h>

int setlogmask(int maskpri);
```

General description

The `setlogmask()` function sets the log priority mask for the current process to *maskpri* and returns the previous mask. If the *maskpri* argument is 0 (zero), the current log mask is not modified. Calls by the current process to the `syslog()` function with a priority not set in *maskpri* are rejected. The mask for an individual priority *pri* is calculated by the macro `LOG_MASK(pri)`; The mask for all priorities up to and including *toppri* is given by the macro `LOG_UPTO(toppri)`. The default log mask allows all priorities to be logged.

Returned value

If successful, `setlogmask()` returns the value of the previous mask setting.

No errors are defined.

Related information

- [“syslog.h — System error logging” on page 67](#)
- [“closelog\(\) — Close the control log” on page 297](#)
- [“openlog\(\) — Open the system control log” on page 1172](#)
- [“syslog\(\) — Send a message to the control log” on page 1798](#)

setnetent() — Open the network information data set

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

void setnetent(int stayopen);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

void setnetent(int stayopen);
```

General description

The `setnetent()` function opens and rewinds the `tcpip.HOSTS.ADDRINFO` data set, which contains information about known networks. If the `stayopen` flag is nonzero, the `tcpip.HOSTS.ADDRINFO` remains open after each call to `setnetent()`.

You can use the **X_ADDR** environment variable to specify a data set other than `tcpip.HOSTS.ADDRINFO`.

Note: For more information on these data sets and environment variables, `tcpip.HOSTS.ADDRINFO`, see *z/OS Communications Server: IP Configuration Guide*.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

`setnetent()` returns no values.

Related information

- [“netdb.h — Network database operations” on page 45](#)
- [“endhostent\(\) — Close the host information data set” on page 420](#)
- [“endnetent\(\) — Close network information data sets” on page 421](#)
- [“getnetbyaddr\(\) — Get a network entry by address” on page 741](#)
- [“getnetbyname\(\) — Get a network entry by name” on page 743](#)
- [“getnetent\(\) — Get the next network entry” on page 744](#)

set_new_handler() – Register a function for new_handler()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ISO/ANSI C++ | C++ only | |

Format

```
#include <new>

new_handler set_new_handler(new_handler ph) throw();
```

General description

The `set_new_handler()` function is part of the z/OS XL C++ error handling mechanism. If you have registered a new-handler function with `set_new_handler()`, that new-handler function will be called by the new operator if it is unable to allocate storage. If you have not registered a new-handler function, the default behavior is for the new operator to return NULL.

The argument supplied to `set_new_handler()` is of type `new_handler` as defined in the header `<new>` (that is, a pointer to a function with a void return type and no arguments).

For C++ applications that are compiled NOXPLINK, the variable containing the address of the new handler function is statically bound with the executable. This means that each executable has its own new handler function which is shared only by the other functions that are linked as part of that executable. This is true even if multiple threads are using that same executable. This means that you cannot issue a `set_new_handler()` from within a non-XPLINK DLL if the new handler function is to be invoked outside of that DLL.

For C++ applications that are compiled XPLINK, the new handler function is truly global, so the DLL restriction is lifted. In a multithreaded environment consisting of XPLINK executables, the new handler function created by a call to `set_new_handler()` still applies to all threads in the (POSIX) process.

The required behavior of a new handler is to perform one of the following operations:

- Make more storage available for allocation and then return.
- Call either `abort()` or `exit(int)`.
- Throw an object of type `bad_alloc`.

Returned value

Returns a value of type `new_handler`. The function pointed to is the function that was previously called by the `set_new_handler()` function, or NULL if a new handler function was not established.

Refer to [z/OS XL C/C++ Language Reference](#) for more information about z/OS XL C++ error handling, including the new operator and the `set_new_handler()` functions.

Related information

- [“new — Storage allocation and free” on page 88](#)

setns() – Allow for a thread to join a descendant namespace

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | C++ only | |

Format

```
#define _XPLATFORM_SOURCE
#include <sched.h>

int setns(int fd, int nstype);
```

General description

setns() moves the current process to an existing mount, network, IPC, or UTS namespace or specify the existing namespace to which subsequent children belong.

When fd refers to a PID file directory, one or more flags must be specified.

When fd refers to a /proc/[pid]/ns link, only a single flag matching the namespace type that is referred to by the file descriptor or a 0 flag might be specified.

The following nstypes are supported by the setns service:

| Table 55. Supported constants for the nstypes argument | |
|--|---|
| nstypes | Description |
| CLONE_NEWIPC | Reassociate the process into the IPC namespace that is associated with the input file descriptor. If specified, fd must refer to either an IPC link in the /proc/[pid]/ns directory or a PID file descriptor. |
| CLONE_NEWNS | Reassociate the process into the mount namespace that is associated with the input file descriptor. If specified, fd must refer to either a mount link in the /proc/[pid]/ns directory or a PID file descriptor. |
| CLONE_NEWPID | Reassociate the process into the IPC namespace that is associated with the input file descriptor. If specified, fd must refer to either a PID link in the /proc/[pid]/ns directory or a PID file descriptor. |

Table 55. Supported constants for the *nstypes* argument (continued)

| nstypes | Description |
|----------------|---|
| CLONE_NEWUTS | <p>Reassociate the process into the UTS namespace that is associated with the input file descriptor.</p> <p>If specified, <i>fd</i> must refer to either a UTS link in the <code>/proc/[pid]/ns</code> directory or a PID file descriptor.</p> <p>Restriction:</p> <p>The CLONE_NEWUTS flag cannot be specified in a multiprocess address space. This results in an <code>errno EINVAL</code>.</p> |

Returned value

If successful, `setns()` returns 0.

If unsuccessful, `setns()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

The input parameter *fd* is invalid.

EINVAL

An invalid bit was specified in *nstype*. `setns()` supports the following *nstype*: `CLONE_NEWNS`, `CLONE_NEWPID`, `CLONE_NEWIPC`, `CLONE_NEWNET`, and `CLONE_NEWUTS`. Any other type results in the operation failing with an `EINVAL` error.

ENOMEM

The process requires more space than is available.

EPERM

The calling process does not have the required privileges for this operation.

ESRCH

The calling process does not have appropriate privileges.

Related information

- [“sched.h — Manipulate and examine process execution scheduling” on page 57](#)
- [“clone\(\) — Create a child process” on page 289](#)
- [“unshare\(\) — Isolate a process from one or more of its namespaces” on page 1949](#)

setpeer() — Preset the socket peer address

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------------|-----------------|---------------------|
| z/OS UNIX | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>
```

```
int setpeer(int socket, struct sockaddr *address, int length, char *name);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/socket.h>

int setpeer(int socket, struct sockaddr *address, int length, char *name);
```

General description

The `setpeer()` function presets the peer address associated with a socket.

Note: Neither `AF_INET`, `AF_UNIX`, nor `AF_INET6` support this function.

Parameter Description

socket

The socket descriptor.

address

The address of the socket peer.

length

The length of the socket address.

name

The name of a field indicating the conditions of the peer request.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

`setpeer()` always returns -1.

Error Code Description

EINVAL

The request is invalid or not supported.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

setpgid() — Set process group ID for job control

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>
```

```
int setpgid(pid_t pid, pid_t pgid);
```

General description

Sets the process group ID (PGID) of a process within the session of the calling process, so you can reassign a process to a different process group, or start a new process group with the specified process as its group leader.

`pid_t pid` is the process ID (PID) of the process whose PGID you want to change. This must either be the caller of `setpgid()` or one of its children, and it must be in the caller's session. It cannot be the PID of a session leader. If `pid` is zero, the system uses the PID of the process calling `setpgid()`.

`pid_t pgid` is the new PGID you want to assign to the process identified by `pid`. If `pgid` indicates an existing process group, it must be in the caller's session. If `pgid` is zero, the system uses the PID of the process indicated by `pid` as the ID for the new process group. The new group is created in the caller's session.

Returned value

If successful, `setpgid()` returns 0.

If unsuccessful, `setpgid()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The value of `pid` matches the PID of a child of the calling process, but the child has successfully run one of the EXEC functions.

EINVAL

`pgid` is less than zero or has some other unsupported value.

EPERM

The caller cannot change the PGID of the specified process. Some possible reasons are:

- The specified process is a session leader.
- `pid` matches the PID of a child of the calling process, but the child is not in the same session as the caller.
- `pgid` does not match the PID of the process specified by `pid`, and it does not match the PGID of any other process in the caller's session.

ESRCH

`pid` does not match the PID of the calling process or any of its children.

Example

CELEBS09

```
/* CELEBS09

   This example sets the PGID.

*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <sys/types.h>
#include <stdio.h>

main() {
    pid_t pid;
    int p1[2], p2[2];
    char c='?';

    if (pipe(p1) != 0)
        perror("pipe() #1 error");
    else if (pipe(p2) != 0)
```

```
    perror("pipe() #2 error");
else
    if ((pid = fork()) == 0) {
        printf("child's process group id is %d\n", (int) getpgrp());
        write(p2[1], &c, 1);
        puts("child is waiting for parent to complete task");
        read(p1[0], &c, 1);
        printf("child's process group id is now %d\n", (int) getpgrp());
        exit(0);
    }
    else {
        printf("parent's process group id is %d\n", (int) getpgrp());
        read(p2[0], &c, 1);
        printf("parent is performing setpgid() on pid %d\n", (int) pid);
        if (setpgid(pid, 0) != 0)
            perror("setpgid() error");
        write(p1[1], &c, 1);
        printf("parent's process group id is now %d\n", (int) getpgrp());
        sleep(5);
    }
}
```

Output

```
parent's process group id is 5767174
child's process group id is 5767174
parent is performing setpgid() on pid 131084
parent's process group id is now 5767174
child is waiting for parent to complete task
child's process group id is now 131084
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“getpgrp\(\) — Get the process group ID” on page 752](#)
- [“setpgrp\(\) — Set process group ID” on page 1562](#)
- [“setsid\(\) — Create session, set process group ID” on page 1571](#)
- [“tcsetpgrp\(\) — Set the foreground process group ID” on page 1847](#)

setpgrp() — Set process group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

pid_t setpgrp(void);
```

General description

If the calling process is not already a session leader, setpgrp() sets the process group ID of the calling process to the process ID of the calling process. If a new process group is created, it is created within the session of the calling process.

Returned value

If successful, `setpgrp()` returns the new process group ID.

If unsuccessful, `setpgrp()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EPERM

The calling process is a session leader.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“getpgrp\(\) — Get the process group ID” on page 752](#)
- [“setpgid\(\) — Set process group ID for job control” on page 1560](#)
- [“setsid\(\) — Create session, set process group ID” on page 1571](#)
- [“tcsetpgrp\(\) — Set the foreground process group ID” on page 1847](#)

setpriority() — Set process scheduling priority

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/resource.h>

int setpriority(int which, id_t who, int priority);
```

General description

`setpriority()` sets the scheduling priority of a process, process group or user.

Processes are specified by the values of the *which* and *who* arguments. The *which* argument may be any one of the following set of symbols defined in the `sys/resource.h` include file:

PRIO_PROCESS

indicates that the *who* argument is to be interpreted as a process ID

PRIO_PGRP

indicates that the *who* argument is to be interpreted as a process group ID

PRIO_USER

indicates that the *who* argument is to be interpreted as a user ID

The *who* argument specifies the ID (process, process group, or user). A 0 (zero) value for the *who* argument specifies the current process, process group or user ID.

The *priority* argument specifies the scheduling priority. It is specified as a signed integer in the range, -20 to 19. Negative priorities cause more favorable scheduling. The default priority is 0. If the value specified to `setrlimit()` is less than the system's lowest supported priority value, the system's lowest supported value is used; if it is greater than the system's highest supported value, the system's highest

supported value is used. The setting of a process's scheduling priority value has the equivalent effect on a process's nice value, since they both represent the process's relative CPU priority. For example, setting one's scheduling priority value to its maximum value (19) has the equivalent effect of increasing one's nice value to its maximum value ((2*NZERO)-1), and will be reflected on the nice(), getpriority() and setpriority() functions.

If more than one process is specified, setpriority() sets the priorities of all of the specified processes to the specified value.

Only a process with appropriate privilege can lower its priority.

Returned value

If successful, setpriority() returns 0.

If unsuccessful, setpriority() returns -1 and sets errno to one of the following values:

Error Code
Description

EACCES
The priority is being changed to a lower value and the current process does not have the appropriate privilege.

EINVAL
The symbol specified in the *which* argument was not recognized, or the value of the *who* argument is not a valid process ID, process group ID or user ID.

ENOSYS
The system does not support this function.

EPERM
A process was located, but neither the real nor effective user ID of the executing process match the effective user ID of the process whose priority is to be changed.

ESRCH
No process could be located using the *which* and *who* argument values specified.

Related information

- [“sys/resource.h — XSI resource operations” on page 70](#)
- [“getpriority\(\) — Get process scheduling priority” on page 756](#)
- [“nice\(\) — Change priority of a process” on page 1150](#)

setprotoent() — Open the protocol information data set

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

void setprotoent(int stayopen);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

void setprotoent(int stayopen);
```

General description

The `setprotoent()` function opens and rewinds the */etc/protocol* or the *tcpip.ETC.PROTO* data set. If the *stayopen* flag is nonzero, the */etc/protocol* or the *tcpip.ETC.PROTO* data set remains open after each call.

Special behavior for C++

To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

`setprotoent()` returns no values.

Related information

- “[netdb.h — Network database operations](#)” on page 45
- “[endprotoent\(\) — Work with a protocol entry](#)” on page 422
- “[getprotobyname\(\) — Get a protocol entry by name](#)” on page 757
- “[getprotobynumber\(\) — Get a protocol entry by number](#)” on page 759
- “[getprotoent\(\) — Get the next protocol entry](#)” on page 760

setpwent() — Reset user database search

The information for this function is included in “[endpwent\(\) — User database functions](#)” on page 423.

setregid() — Set real and effective group IDs

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int setregid(gid_t rgid, gid_t egid);
```

General description

The `setregid()` function sets the real and/or effective GIDs for the calling process to the values specified by the input real and effective GID values. If a specified value is equal to -1, the corresponding real or effective GID of the calling process is left unchanged.

A process with appropriate privileges can set the real and effective GID to any valid GID value. An unprivileged process can only set the effective GID if the EGID argument is equal to either the real,

effective, or saved GID of the process. An unprivileged process can only set the real GID if the RGID argument is equal to either the real, effective, or saved GID of the process.

If the `setregid()` function is issued from multiple tasks within one address space, use synchronization to ensure that the `setregid()` functions are not performed concurrently. The execution of `setregid()` function concurrently within one address space can yield unpredictable results.

The `setregid()` function does not change any supplementary GIDs of the calling process.

Returned value

If successful, `setregid()` returns 0.

If unsuccessful, neither of the group IDs will be changed, `setregid()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EINVAL
The value of the *rgid* or *egid* argument is invalid or out-of-range.

EMVSSAF2ERR
The SAF call IRRSSU00 incurred an error.

EPERM
The processes does not have appropriate privileges and a change other than changing the real group ID to the saved set-group-ID, or changing the effective group ID to the real group ID or the saved group ID, was requested.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)
- [“setreuid\(\) — Set real and effective user IDs” on page 1566](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)

setreuid() — Set real and effective user IDs

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int setreuid(uid_t ruid, uid_t euid);
```

General description

The `setreuid()` function sets the real and/or effective UIDs for the calling process to the values specified by the input real and effective UID values. If a specified value is equal to -1, the corresponding real or effective UID of the calling process is left unchanged.

A process with appropriate privileges can set the real and effective UID to any valid UID value. An unprivileged process can only set the effective UID if the EUID argument is equal to either the real, effective, or saved UID of the process. An unprivileged process can only set the real UID if the RUID argument is equal to either the real, effective, or saved UID of the process.

The `setreuid()` function is not supported from an address space running multiple processes, since it would cause all processes in the address space to have their security environment changed unexpectedly.

`setreuid()` can be used by daemon processes to change the identity of a process in order for the process to be used to run work on behalf of a user. In z/OS UNIX, changing the identity of a process is done by changing the real and effective UIDs and the auxiliary groups. In order to change the identity of the process on MVS completely, it is necessary to also change the MVS security environment. The identity change will only occur if the EUID value is specified, changing just the real UID will have no effect on the MVS environment.

The `setreuid()` function invokes MVS SAF services to change the MVS identity of the address space. The MVS identity that is used is determined as follows:

- If an MVS user ID is already known by the kernel from a previous call to a kernel function (for example, `getpwnam()`) and the UID for this user ID matches the UID specified on the `setreuid()` call, then this user ID is used.
- For nonzero target UIDs, if there is no saved user ID or the UID for the saved user ID does not match the UID requested on the `setreuid()` call, the `setreuid()` function queries the security database (for example, using `getpwnam()`) to retrieve a user ID. The retrieved user ID is then used.
- If the target UID=0 and a user ID is not known, the `setreuid()` function always sets the MVS user ID to BPXROOT or the value specified on the SUPERUSER parm in sysparms. BPXROOT is set up during system initialization as a superuser with a UID=0. The BPXROOT user ID is not defined to the BPX.DAEMON FACILITY class profile. This special processing is necessary to prevent a superuser from gaining daemon authority.
- A nondaemon superuser that attempts to set a user ID to a daemon superuser UID fails with an EPERM.

When the MVS identity is changed, the auxiliary list of groups is also set to the list of groups for the new user ID.

If the `setreuid()` function is issued from multiple tasks within one address space, use synchronization to ensure that the `setreuid()` functions are not performed concurrently. The execution of `setreuid()` function concurrently within one address space can yield unpredictable results.

Returned value

If successful, `setreuid()` returns 0.

If unsuccessful, neither of the group IDs will be changed, `setreuid()` returns -1, and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of the *rgid* or *egid* argument is invalid or out-of-range.

EMVSSAF2ERR

The SAF call IRRSSU00 incurred an error.

EPERM

The processes does not have appropriate privileges and a change other than changing the real group ID to the saved set-group-ID, or changing the effective group ID to the real group ID or the saved group ID, was requested.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

- [“exec functions” on page 442](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)
- [“seteuid\(\) — Set the effective user ID” on page 1526](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)

setrlimit() — Control maximum resource consumption

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/resource.h>

int setrlimit(int resource, const struct rlimit *rlp);
```

General description

The `setrlimit()` function sets resource limits for the calling process. A resource limit is a pair of values; one specifying the current (soft) limit, the other a maximum (hard) limit.

The soft limit may be modified to any value that is less than or equal to the hard limit. For certain *resource* values, (RLIMIT_CPU, RLIMIT_NOFILE, RLIMIT_AS), the soft limit cannot be set lower than the existing usage.

The hard limit may be lowered to any value that is greater than or equal to the soft limit. The hard limit can be raised only by a process which has superuser authority. Both the soft limit and hard limit can be changed by a single call to `setrlimit()`.

The value `RLIM_INFINITY` defined in `<sys/resource.h>`, is considered to be larger than any other limit value. If a call to `getrlimit()` returns `RLIM_INFINITY` for a resource, it means the implementation does not enforce limits on that resource. Specifying `RLIM_INFINITY` as any resource limit values on a successful call to `setrlimit()` inhibits enforcement of that resource limit.

The *resource* argument specifies which resource to set the hard and/or soft limits for, and may be one of the following values:

RLIMIT_CORE

The maximum size of a dump of memory (in bytes) allowed for the process. A value of 0 (zero) prevents file creation. Dump file creation will stop at this limit.

RLIMIT_CPU

The maximum amount of CPU time (in seconds) allowed for the process. If the limit is exceeded, a SIGXCPU signal is sent to the process and the process is granted a small CPU time extension to allow for signal generation and delivery. If the extension is used up, the process is terminated with a SIGKILL signal. An attempt to set the CPU limit lower than that already used will result in an EINVAL errno.

RLIMIT_DATA

The maximum size of the break value for the process, in bytes. In this implementation, this resource always has a hard and soft limit value of `RLIM_INFINITY`. A call to `setrlimit()` to set this resource to any value other than `RLIM_INFINITY` will fail with an errno of EINVAL.

RLIMIT_FSIZE

The maximum file size (in bytes) allowed for the process. A value of 0 (zero) prevents file creation. If the size is exceeded, a SIGXFSZ signal is sent to the process. If the process is blocking, catching, or ignoring SIGXFSZ, continued attempts to increase the size of a file beyond the limit will fail with an errno of EFBIG.

RLIMIT_MEMLIMIT

The maximum amount of usable storage above the 2 gigabyte bar (in 1 megabyte segments) that can be allocated. Any attempt to extend the usable amount of virtual storage above the 2 gigabyte bar fails.

RLIMIT_NOFILE

The maximum number of open file descriptors allowed for the process. This number is one greater than the maximum value that may be assigned to a newly created descriptor. (That is, it is one-based.) Any function that attempts to create a new file descriptor beyond the limit will fail with an EMFILE errno. An attempt to set the open file descriptors limit lower than that already used will result in an EINVAL errno.

Restrictions: This value may not exceed 524288.

RLIMIT_STACK

The maximum size of the stack for a process, in bytes. Note that in z/OS UNIX services, the stack is a per-thread resource. In this implementation, this resource always has a hard and soft limit value of RLIM_INFINITY. A call to setrlimit() to set this resource to any value other than RLIM_INFINITY will fail with an errno of EINVAL.

RLIMIT_AS

The maximum address space size for the process, in bytes. If the limit is exceeded, malloc() and mmap() functions will fail with an errno of ENOMEM. Also, automatic stack growth will fail.

The *rlp* argument points to a `rlimit` structure. This structure contains the following members:

rlim_cur

The current (soft) limit

rlim_max

The maximum (hard) limit

Refer to the `<sys/resource.h>` header for more detail.

The resource limit values are propagated across exec and fork.

Special behavior for z/OS UNIX Services: An exception exists for exec processing in conjunction with daemon support. If a daemon process invokes exec and it had previously invoked setuid() before exec, the RLIMIT_CPU, RLIMIT_AS, RLIMIT_CORE, RLIMIT_FSIZE, and RLIMIT_NOFILE limit values are set based on the limit values specified in the kernel parmlib member BPXPRMxx.

For processes which are not the only process within an address space, the RLIMIT_CPU and RLIMIT_AS limits are shared with all the processes within the address space. For RLIMIT_CPU, when the soft limit is exceeded, action will be taken on the first process within the address space. If the action is termination, all processes within the address space will be terminated.

In addition to the RLIMIT_CORE limit values, the dump file defaults are set by SYSMDUMP defaults. Refer to *z/OS MVS Initialization and Tuning Reference* for more information on setting up SYSMDUMP defaults using the IEADMRO0 parmlib member.

Dumps of memory are taken in 4160 byte increments. Therefore, RLIMIT_CORE values affect the size of memory dumps in 4160 byte increments. For example, if the RLIMIT_CORE soft limit value is 4000, the dump will contain no data. If the RLIMIT_CORE soft limit value is 8000, the maximum size of a memory dump is 4160 bytes.

When setting RLIMIT_NOFILE, the hard limit cannot exceed the system defined limit of 524288.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this

function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `setrlimit()` returns 0.

If unsuccessful, `setrlimit()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

An invalid *resource* was specified, or the soft limit to set exceeds the hard limit to set, the soft limit to set is below the current usage, or the resource does not allow any value other than `RLIM_INFINITY`.

EPERM

The limit specified to `setrlimit()` would have raised the maximum limit value, and the calling process does not have appropriate privileges.

Related information

- [“stropts.h — Stream interface” on page 67](#)
- [“sys/resource.h — XSI resource operations” on page 70](#)
- [“brk\(\) — Change space allocation” on page 219](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getdtablesize\(\) — Get the file descriptor table size” on page 703](#)
- [“getrlimit\(\) — Get current or maximum resource consumption” on page 767](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“sigaltstack\(\) — Set or get signal alternate stack context” on page 1622](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)
- [“ulimit\(\) — Get or set process file size limits” on page 1924](#)

setservernt() — Open the network services information data set

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <netdb.h>

void setservernt(int stayopen);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <netdb.h>

void setservent(int stayopen);
```

General description

The `setservent()` function opens and rewinds the `/etc/services` or the `tcip.ETC.SERVICES` data set. For more information on `/etc/services` or the `tcip.ETC.SERVICES` data set, see [z/OS Communications Server: IP Configuration Guide](#). If the `stayopen` flag is nonzero, the `tcip.ETC.SERVICES` data set remains open after each call.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

`setservent()` returns no values.

Related information

- “[netdb.h — Network database operations](#)” on page 45
- “[endservent\(\) — Close network services information data sets](#)” on page 424
- “[getservbyname\(\) — Get a server entry by name](#)” on page 772
- “[getservent\(\) — Get the next service entry](#)” on page 774

setsid() — Create session, set process group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

pid_t setsid(void);
```

General description

Creates a new session with the calling process as its session leader. The caller becomes the process group leader of a new process group. The calling process must not be a process group leader already. The caller does not have a controlling terminal.

The process group ID (PGID) of the new process group is equal to the process ID (PID) of the caller. The caller starts as the only process in the new process group and in the new session.

Returned value

If successful, setsid() returns the value of the caller's new PGID.

If unsuccessful, setsid() returns -1 and sets errno to one of the following values:

Error Code

Description

EPERM

One of the following error conditions exists:

- The caller is already a process group leader.
- The caller's PID matches the PGID of some other process.

Example

CELEBS10

```
/* CELEBS10

   This example creates a new session.

*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <sys/types.h>
#include <stdio.h>

main() {
    pid_t pid;
    int p[2];
    char c='?';

    if (pipe(p) != 0)
        perror("pipe() error");
    else
        if ((pid = fork()) == 0) {
            printf("child's process group id is %d\n", (int) getpgrp());
            write(p[1], &c, 1);
            setsid();
            printf("child's process group id is now %d\n", (int) getpgrp());
            exit(0);
        }
        else {
            printf("parent's process group id is %d\n", (int) getpgrp());
            read(p[0], &c, 1);
            sleep(5);
        }
}
```

Output

```
child's process group id is 262152
child's process group id is now 262150
parent's process group id is 262152
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“getpid\(\) — Get the process ID” on page 754](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“setpgid\(\) — Set process group ID for job control” on page 1560](#)

- “sigaction() — Examine or change a signal action” on page 1605

setsockopt() — Set options associated with a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int setsockopt(int socket, int level, int option_name,
               const void *option_value, socklen_t option_length);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/types.h>
#include <sys/socket.h>

int setsockopt(int socket, int level, int option_name,
               char *option_value, int *option_length);
```

IPv6: To include support for IPv6 socket options, add the following code:

```
#define _OPEN_SYS_SOCK_IPV6 1
#include <netinet/in.h>
```

ip_mreq structure: To include the ip_mreq structure in your program, add the following code:

```
#define _XOPEN_SOURCE 500
#include <netinet/in.h>
```

or

```
#define _OPEN_SYS_SOCK_EXT3
#include <netinet/in.h>
```

group_req structure: To include the group_req structure in your program, add the following code:

```
#define _OPEN_SYS_SOCK_EXT3
#include <netinet/in.h>
```

group_source_req structure: To include the group_source_req structure in your program, add the following code:

```
#define _OPEN_SYS_SOCK_EXT3
#include <netinet/in.h>
```

ipv6_mreq structure: To include the ipv6_mreq structure in your program, add the following code:

```
#define _OPEN_SYS_SOCK_IPV6
#include <netinet/in.h>
```

icmp6_filter structure: To include the `icmp6_filter` structure in your program, add the following code:

```
#define _OPEN_SYS_SOCKET_IPV6
#include <netinet/icmp6.h>
```

General description

The `setsockopt()` function sets options associated with a socket. Options can exist at multiple protocol levels.

Parameter

Description

socket

The socket descriptor.

level

The level for which the option is being set.

option_name

The name of a specified socket option.

option_value

The pointer to option data.

option_length

The length of the option data.

When manipulating socket options, you must specify the level at which the option resides and the name of the option. To manipulate options at the socket level, the *level* parameter must be set to `SOL_SOCKET` as defined in `sys/socket.h`. To manipulate options at the IPv4 or IPv6 level, the *level* parameter must be set to `IPPROTO_IP` as defined in `sys/socket.h` or `IPPROTO_IPV6` as defined in `netinet/in.h`. To manipulate options at any other level, such as the TCP level, supply the appropriate protocol number for the protocol controlling the option. The `getprotobyname()` call can be used to return the protocol number for a named protocol.

The *option_value* and *option_length* parameters are used to pass data used by the particular set command. The *option_value* parameter points to a buffer containing the data needed by the set command. The *option_value* parameter is optional and can be set to the NULL pointer, if data is not needed by the command. The *option_length* parameter must be set to the size of the data pointed to by *option_value*.

All of the socket-level options except `SO_LINGER`, `SO_RCVTIMEO` and `SO_SNDTIMEO`, expect *option_value* to point to an integer and *option_length* to be set to the size of an integer. When the integer is nonzero, the option is enabled. When it is zero, the option is disabled. The `SO_LINGER` option expects *option_value* to point to a **linger** structure, as defined in `sys/socket.h`. This structure is defined in the following example:

```
struct linger
{
    int    l_onoff;           /* option on/off */
    int    l_linger;         /* linger time */
};
```

The *l_onoff* field is set to 0 if the `SO_LINGER` option is begin disabled. A nonzero value enables the option. The *l_linger* field specifies the amount of time to linger on close. The units of *l_linger* are seconds.

The following options are recognized at the IPv4 level:

Option

Description

IP_ADD_MEMBERSHIP

(RAW and UDP) This option is used to join a multicast group on a specific interface (an interface has to be specified with this option). Only applications that want to receive multicast datagrams need to join multicast groups. Applications that only transmit will not need to do so.

The multicast IP address and the interface IP address will be passed in the following structure available in `netinet/in.h`:

```
struct ip_mreq
{
    struct in_addr imr_multiaddr; /* IP multicast addr of group */
    struct in_addr imr_interface; /* local IP addr of interface */
};
```

If `INADDR_ANY` is specified on the interface address of the `mreq` structure passed a default interface will be chosen as follows:

- If the group address specified in the `mreq` structure was specified on a `GATEWAY` statement use that interface.
- If 224.0.0.0 was specified on `GATEWAY` statement use that interface.
- If `DEFAULTNET` was specified and is multicast capable use that interface.

IP_ADD_SOURCE_MEMBERSHIP

(RAW and UDP) This option is used to join a source-specific multicast group specified by the `ip_mreq_source` structure. The `ip_mreq_source` structure is defined in `netinet/in.h`.

IP_BLOCK_SOURCE

(RAW and UDP) This option is used to block from a given source to a given multicast group (for example, if the user "mutes" that source). The source multicast group is specified by the `ip_mreq_source` structure which is defined in `netinet/in.h`.

IP_DROP_MEMBERSHIP

(RAW and UDP) This option is used to leave a multicast group.

The multicast IP address and the interface IP address will be passed in the following structure available in `netinet/in.h`:

```
struct ip_mreq
{
    struct in_addr imr_multiaddr; /* IP multicast addr of group */
    struct in_addr imr_interface; /* local IP addr of interface */
};
```

If `INADDR_ANY` is specified on the interface address of the `mreq` structure passed the system will drop the first group that matches the group (class D) address without regard to the interface.

IP_DROP_SOURCE_MEMBERSHIP

(RAW and UDP) This option is used to leave a source-specific multicast group specified by the `ip_mreq_source` structure. The `ip_mreq_source` structure is defined in `netinet/in.h`.

IP_MULTICAST_IF

(RAW and UDP) Sets the interface for sending outbound multicast datagrams from this socket application. Multicast datagrams will be transmitted only on one interface at a time. An IP address is passed in an `in_addr` structure.

If `INADDR_ANY` is specified for the interface address passed a default interface will be chosen as follows:

- If 224.0.0.0 was specified on the `GATEWAY` statement use that interface.
- If `DEFAULTNET` was specified and is multicast capable use that interface.

IP_MULTICAST_LOOP

(RAW and UDP) Enables or disables loopback of outgoing multicast datagrams. Default is enable. When it is enabled, multicast applications that have joined the outgoing multicast group can receive a copy of the multicast datagrams destined for that address/port pair. The loopback indicator is passed as an `u_char`. The value 0 is specified to disable loopback. The value 1 is specified to enable loopback.

IP_MULTICAST_TTL

(RAW and UDP) Sets the IP time-to-live of outgoing multicast datagrams. Default value is 1 (that is, multicast only to the local subnet). The TTL value is passed as an `u_char`.

IP_RECVPKINFO

(RAW and UDP) Enables or disables returning the destination IP address of an incoming packet and the interface over which the packet was received as IP_PKTINFO ancillary data on recvmsg() function calls. The option value is specified as an int. A nonzero value enables the option; 0 disables the option.

This option is protected by the _OPEN_SYS SOCK_EXT4 feature test macro.

IP_UNBLOCK_SOURCE

(RAW and UDP) This option is used to undo the operation performed with the IP_BLOCK_SOURCE option (for example, if the user "mutes" that source). The source group is specified by the ip_mreq_source structure, which is defined in netinet/in.h.

IP_TTL

(TCP and UDP) This option is used to set the time-to-live field in the IP header for the SOCK_STREAM(TCP) and SOCK_DGRAM (UDP) sockets. This socket option allows the application to limit the lifetime of the packet in the network and prevent it from circulating indefinitely. This option is an IPv4-only socket option. Valid values are in the range 1–255. If not specified, the value is obtained from the TCP/IP stack and set via the IPCONFIG TTL configuration statement.

Note: IP_TTL can be used only when _XPLATFORM_SOURCE is defined.

MCAST_BLOCK_SOURCE

(RAW and UDP) This option is used to block data from a given source to a given group (for example, if the user "mutes" that source). The source is specified by the group_source_req structure, which is defined in netinet/in.h.

MCAST_JOIN_GROUP

(RAW and UDP) This option is used to join an any-source group. The group is specified by the group_req structure. The group_req structure is defined in netinet/in.h.

MCAST_JOIN_SOURCE_GROUP

(RAW and UDP) This option is used to join a source-specific group. The source is specified by the group_source_req structure which is defined in netinet/in.h.

MCAST_LEAVE_GROUP

(RAW and UDP) This option is used to leave an any-source group. The group is specified by the group_req structure. The group_req structure is defined in netinet/in.h.

MCAST_LEAVE_SOURCE_GROUP

(RAW and UDP) This option is used to leave a source-specific group. The source is specified by the group_source_req structure which is defined in netinet/in.h.

MCAST_UNBLOCK_SOURCE

(RAW and UDP) This option is used to undo the operation performed with the MCAST_BLOCK_SOURCE option (e.g., if the user then "unmutes" the source). The source is specified by the group_source_req structure which is defined in netinet/in.h.

The following options are recognized at IPv6 level:

Option**Description****IPv6_ADDR_PREFERENCES**

(TCP and UDP) Used to set the source address selection preference flags for a given socket. The socket option value (optval) is a 32-bit unsigned integer argument. The argument consists of a number of flags where each flag indicates a source address selection preference. These flags indicate the application's preferences for a source address, but will be ignored by the TCP stack if an IP address with the preferred address attributes is not available. For example, a preference flag of IPV6_PREFER_SRC_TMP tells the stack that the application would prefer to use a temporary IPv6 source address rather than a public source address. You can combine multiple flags with logical OR to express multiple preferences as long as the flags are not contradictory. The constants for the flag bit values are defined in netinet/in.h.

IPv6_CHECKSUM

(RAW) For a RAW (non-ICMPv6) socket, this option instructs the kernel to compute and store a checksum for output and verifies the received checksum on input. This prevents applications from

having to perform source address selection on the packets sent. This option specifies an integer value into the user data where the checksum is located. This option can be disabled by specifying an option value of -1.

IPV6_DONTFRAG

(RAW and UDP) This option turns off the automatic inserting of a fragment header in the packet for UDP and raw sockets.

IPV6_DSTOPTS

(RAW and UDP) The application can remove any sticky destination options header by calling `setsockopt()` for this option with a zero option length.

IPV6_HOPOPTS

(RAW and UDP) The application can remove any sticky hop-by-hop options header by calling `setsockopt()` for this option with a zero option length.

IPV6_JOIN_GROUP

(RAW and UDP) Controls the receipt of multicast packets by joining the multicast group specified by the `ipv6_mreq` structure that is passed. The `ipv6_mreq` structure is defined in `netinet/in.h`.

IPV6_LEAVE_GROUP

(RAW and UDP) Controls the receipt of multicast packets by leaving the multicast group specified by the `ipv6_mreq` structure that is passed. The `ipv6_mreq` structure is defined in `netinet/in.h`.

IPV6_MULTICAST_HOPS

(RAW and UDP) Sets the hop limit for outgoing multicast packets. The hop limit value is passed as an `int`.

IPV6_MULTICAST_IF

(RAW and UDP) Sets the interface for outgoing multicast packets. An interface index is used to specify the interface. It is passed as an `u_int`.

IPV6_MULTICAST_LOOP

(RAW and UDP) If a multicast datagram is sent to a group to which the sending host itself belongs (on the outgoing interface), a copy of the datagram is looped back by the IP layer for local delivery if this option is set to one. If this option is set to zero, a copy is not looped back. Other option values return an `errno` of `EINVAL`. The default is one (loopback). The option value is passed as an `int`.

IPV6_NEXTHOP

(RAW and UDP) Specifies the next hop for the datagram as a socket address structure.

IPV6_RECVDSTOPTS

(RAW and UDP) To receive destination options header this option must be enabled.

IPV6_RECVHOPLIMIT

(RAW, TCP, and UDP) When this option is enabled, the received hop limit from an incoming packet will be returned as `IPV6_HOPLIMIT` ancillary data on `recvmsg()` function calls. The option value is specified as an `int`. A nonzero value enables the option, zero disables the option.

IPV6_RECVHOPOPTS

(RAW and UDP) To receive a hop-by-hop options header this option must be enabled.

IPV6_RECVPATHMTU

(RAW and UDP) Enables the receipt of `IPV6_PATHMTU` ancillary data on `recvmsg()` function calls.

IPV6_RECVPKTINFO

(RAW and UDP) Enables or disables returning the destination IP address of an incoming packet and the interface over which the packet was received as `IPV6_PKTINFO` ancillary data on `recvmsg()` function calls. The option value is specified as an `int`. A nonzero value enables the option; 0 disables the option.

IPV6_RECVRTHDR

(RAW and UDP) To receive a routing header this option must be enabled.

IPV6_RECVTCLASS

(RAW, TCP, and UDP) To receive the traffic class this option must be enabled.

IPV6_RTHDR

(RAW and UDP) The application can remove any sticky routing header by calling `setsockopt()` for this option with a zero option length.

IPV6_RTHDRDSTOPTS

(RAW and UDP) The application can remove any sticky destination options header by calling `setsockopt()` for this option with a zero option length.

IPV6_TCLASS

(RAW, TCP, and UDP) To specify the traffic class value this option must be enabled.

IPV6_UNICAST_HOPS

(RAW and UDP) Used to control hop limit in outgoing unicast IPv6 packets. The hop limit value is passed as an int.

IPV6_USE_MIN_MTU

(RAW, TCP, and UDP) Indicates whether the IP layer will use the minimum MTU size (1280) for sending packets, bypassing path MTU discovery. The option value is passed as an int. A value of -1 causes the default values for unicast (disabled) and multicast (enabled) destinations to be used. A value of 0 disables this option for unicast and multicast destinations. A value of 1 enables this option for unicast and multicast destinations and the minimum MTU size will be used.

IPV6_V6ONLY

(RAW, TCP, and UDP) Used to determine whether a socket is restricted to IPv6 communications only. The default setting is off. The option value is passed as an int. A non-zero value means the option is enabled (socket can only be used for IPv6 communications). 0 means the option is disabled.

Note: To use these options, you must use the feature test macro `#define _OPEN_SYS_SOCKET_IPV6`.

The following options are recognized at the ICMPv6 level:

Option**Description****ICMP6_FILTER**

(RAW) Used to filter ICMPv6 messages. The option value is passed as an `icmp6_filter` structure. The `icmp6_filter` structure is defined in `netinet/icmp6.h`.

The following options are recognized at the socket level:

Option**Description****SO_BROADCAST**

Toggles the ability to broadcast messages. If enabled, this option allows the application program to send broadcast messages over *socket*, if the interface specified in the destination supports broadcasting of packets. This option has no meaning for stream sockets.

SO_DEBUG

Turns on recording of debugging information. This option enables or disables debugging in the underlying protocol modules. This option takes an int value.

SO_KEEPALIVE

Toggles the TCP keep-alive mechanism for a stream socket. When activated, the keep-alive mechanism periodically sends a packet on an otherwise idle connection. If the remote TCP does not respond to the packet or to retransmissions of the packet, the connection is terminated with the error ETIMEDOUT.

SO_LINGER

Lingers on close if data is present. When this option is enabled and there is unsent data present when `close()` is called, the calling application program is blocked during the `close()` call, until the data is transmitted or the connection has timed out. If this option is disabled, the TCP/IP address space waits to try to send the data. Although the data transfer is usually successful, it cannot be guaranteed, because the TCP/IP address space waits only a finite amount of time trying to send the data. The `close()` call returns without blocking the caller. This option has meaning only for stream sockets.

SO_OOBINLINE

Toggles the reception of out-of-band data. When this option is enabled, it causes out-of-band data to be placed in the normal data input queue as it is received, making it available to `recv()`, `recvfrom()`, and `recvmsg()` without having to specify the `MSG_OOB` flag in those calls. When this option is disabled, it causes out-of-band data to be placed in the priority data input queue as it is received, making it available to `recv()`, `recvfrom()`, and `recvmsg()` only by specifying the `MSG_OOB` flag in those calls. This option has meaning only for stream sockets.

_SO_PROPAGATEUSERID

Toggles propagating a user ID (UID) over an `AF_UNIX` stream socket. When enabled, user (UID) information is extracted from the system when the `connect()` function is invoked. Then, when the `accept()` function is invoked, the acceptor assumes the identity of the connector until the accepted socket is closed.

SO_RCVBUF

Sets receive buffer size. This option takes an `int` value. The value cannot be set after the socket is connected.

SO_RCVTIMEO

Sets the timeout specifying the maximum amount of time an input function waits until it completes.

It accepts a *timeval* structure with the number of seconds and microseconds specifying the limit on how long to wait for an input operation to complete. The *timeval* structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds can be a value in the range from 0 to 2,678,400 (equal to 31 days), and the microseconds can be a value in the range from 0 to 1,000,000 (equal to 1 second). While the *timeval* structure can be specified using microsecond granularity, the internal TCP/IP timers used to implement this function have a granularity of approximately 100 milliseconds.

If a receive operation has blocked for this much time without receiving additional data, it returns with a partial count or `errno` set to `EWOULDBLOCK` if no data is received. The default for this option is zero, which indicates that a receive operation does not time out.

SO_REUSEADDR

Toggles local address reuse. When enabled, this option allows local addresses that are already in use to be bound. This alters the normal algorithm used in the `bind()` call.

The system checks at connect time to ensure that the local address and port do not have the same foreign address and port. The error `EADDRINUSE` is returned if the association already exists.

After the `SO_REUSEADDR` option is active, the following situation is supported:

A server can `bind()` the same port multiple times as long as every invocation uses a different local IP address and the wildcard address `INADDR_ANY` is used only one time per port.

SO_SNDBUF

Sets send buffer size. This option takes an `int` value. The value cannot be set after the socket is connected.

SO_SNDTIMEO

Sets the timeout value specifying the amount of time that an output function blocks due to flow control preventing data from being sent.

It accepts a *timeval* structure with the number of seconds and microseconds specifying the limit on how long to wait for an input operation to complete. The *timeval* structure contains the number of seconds and microseconds specified as fullword binary numbers. The seconds can be a value in the range from 0 to 2,678,400 (equal to 31 days), and the microseconds can be a value in the range from 0 to 1,000,000 (equal to 1 second). While the *timeval* structure can be specified using microsecond granularity, the internal TCP/IP timers used to implement this function have a granularity of approximately 100 milliseconds.

If a send operation has blocked for this time, it returns with a partial count or with `errno` set to `EWouldBlock` if no data is sent. The default for this option is zero, which indicates that a send operation does not time out.

SO_SECINFO

Toggles receiving security information. When enabled on an `AF_UNIX` UDP socket, the `recvmsg()` function will return security information about the sender of each datagram as ancillary data. This information contains the sender's user ID, UID, GID, and job name and it is mapped by the `secsinfo` structure in `sys/socket.h`.

Note: To use these options, you must use the Feature Test Macro `#define _OPEN_SYS_SOCKET_IPV6`.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, `setsockopt()` returns 0.

If unsuccessful, `setsockopt()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EADDRNOTAVAIL**

The `ip6_addr` is not available for use on the `ip6_ifindex` interface or the tuple consisting of socket, interface, and multicast group values does not exist..

EBADF

The *socket* parameter is not a valid socket descriptor.

EDOM

The send or receive timeout values exceed 31 days.

EFAULT

Using *option_value* and *option_length* parameters would result in an attempt to access storage outside the caller's address space.

EHOSTUNREACH

No route to the destination exists over the interface that is specified by `ip6_ifindex`.

EINVAL

The specified option is invalid at the specified socket level or the socket has been shut down.

ENETDOWN

The interface that is specified by `ip6_ifindex` is not enabled for IPv6 use.

ENOBUFS

Insufficient system resources are available to complete the call or a maximum of 64 source filters can be specified per multicast group, interface pair.

ENOPROTOPT

The *option_name* parameter is unrecognized, or the *level* parameter is not `SOL_SOCKET`.

ENOSYS

The function is not implemented. You attempted to use a function that is not yet available.

ENOTSOCK

The descriptor is for a file, not for a socket.

ENXIO

The interface that is specified by `ip6_ifindex` does not exist.

Example

The following are examples of the `setsockopt()` call. See [“getsockopt\(\) — Get the options associated with a socket” on page 778](#) for examples of how the `getsockopt()` options set are queried.

```
int rc;
int s;
int option_value;
struct linger l;
int setsockopt(int s, int level, int option_name,
char *option_value,
int option_len);
:
/* I want out of band data in the normal input queue */
option_value = 1;
rc = setsockopt(s, SOL_SOCKET, SO_OOBINLINE,
(char *) &option_value, sizeof(int));
:
/* I want to linger on close */
l.l_onoff = 1;
l.l_linger = 100;
rc = setsockopt(s, SOL_SOCKET, SO_LINGER,
(char *) &l, sizeof(l));
```

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getprotobyname\(\) — Get a protocol entry by name” on page 757](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- For more information about IPv4 socket options, see [z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference](#).
- For more information about IPv6 socket options, see [z/OS Communications Server: IPv6 Network and Appl Design Guide](#).

setsourcefilter() — Set source filter

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| RFC3678 | both | z/OS V1.9 |

Format

```
#define _XOPEN_SYS_SOCK_EXT3
#include <netinet/in.h>

int setsourcefilter(int s, uint32_t interface, struct sockaddr *group,
socklen_t grouplen, uint32_t fmode, uint32_t numsrc,
struct sockaddr_storage *slist);
```

General description

This function allow applications to set and replace the current multicast filtering state for a tuple consisting of socket, interface, and multicast group values.

A multicast filter is described by a filter mode, which is MCAST_INCLUDE or MCAST_EXCLUDE, and a list of source addresses which are filtered.

This function is protocol-independent. It can be on either AF_INET or AF_INET6 sockets of the type SOCK_DGRAM or SOCK_RAW.

If the function is unable to obtain the required storage, control will not return to the caller. Instead the application will terminate due to an out of memory condition (if the reserve stack is available and the caller is not XPLINK), or it will terminate with an abend indicating that storage could not be obtained.

Argument

Description

s

Identifies the socket.

interface

Holds the local the index of the interface.

group

Points to either a sockaddr_in structure for IPv4 or a sockaddr_in6 structure for IPv6 that holds the IP multicast address of the group.

grouplen

Gives the length of the sockaddr_in or sockaddr_in6 structure.

fmode

Identifies the filter mode. The value of this field will be either MCAST_INCLUDE or MCAST_EXCLUDE, which are likewise defined in <netinet/in.h>.

numsrc

Holds the number of source addresses in the slist array.

slist

Points to an array of IP addresses of sources to include or exclude depending on the filter mode.

Returned value

If successful, the function returns 0. Otherwise, it returns -1 and sets errno to one of the following values.

errno

Description

EBADF

s is not a valid socket descriptor.

EAFNOSUPPORT

The address family of the input sockaddr is not AF_INET or AF_INET6.

EPROTOTYPE

The socket s is not of type SOCK_DGRAM or SOCK_RAW.

EINVAL

Interface or group is not a valid address, or the socket s has already requested multicast setsockopt options (refer to z/OS Communications Server: IP Sockets Application Programming Interface Guide and Reference for details.) Or if the group address family is AF_INET and grouplen is not at least size of sockaddr_in or if the group address family is AF_INET6 and grouplen is not at least size of sockaddr_in6 or if grouplen is not at least size of sockaddr_in.

ENOBUFS

The number of the source addresses exceeds the allowed limit.

Related information

- [“netinet/in.h — Internet protocol family” on page 50](#)
- [“getsourcefilter\(\) — Get source filter” on page 785](#)

setstate() — Change generator for random()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

char *setstate(const char *state);
```

General description

The `setstate()` function allows switching between state arrays used by the `random()` function once a state has been initialized. The array defined by the `state` argument is used for further random-number generation by the calling thread until `initstate()` is called or `setstate()` is called again. The `setstate()` function returns a pointer to the previous state array.

After initialization, a state array can be restarted at a different point by calling `setstate()` with the desired state, followed by `srandom()` with the desired seed.

Returned value

If successful, `setstate()` returns a pointer to the previous state array.

If unsuccessful, `setstate()` returns a NULL pointer. The function will fail and write a message to standard error if it detects that the state information has been damaged.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“drand48\(\) — Pseudo-random number generator” on page 403](#)
- [“initstate\(\) — Initialize generator for random\(\)” on page 866](#)
- [“rand\(\) — Generate random number” on page 1377](#)
- [“rand_r\(\) — Pseudo-random number generator” on page 1378](#)
- [“random\(\) — A better random-number generator” on page 1379](#)
- [“srandom\(\) — Use seed to initialize generator for random\(\)” on page 1704](#)

set_terminate() – Register a function for terminate()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ANSI/ISO C++ | C++ only | |

Format

```
#include <exception>

terminate_handler set_terminate(terminate_handler ph) throw();
```

General description

The `set_terminate()` function is part of the z/OS XL C++ error handling mechanism. The argument supplied to `set_terminate()` is of type `terminate_handler` as defined in the header `<exception>` (that is, a pointer to a function with a void return type and no arguments). The function specified will be called by the `terminate()` function.

Note that the function registered for `terminate()` must terminate execution of the program without returning to its caller(). If `set_terminate()` has not yet been called, then `terminate()` calls a system-defined default terminate handler, which calls `abort()`.

In a multithreaded environment, the terminate function created by the issuance of a `set_terminate()` call applies to all threads in the (POSIX) process. If a thread throws an exception which is not caught by that thread of execution, then `terminate()` is called. The default `terminate()` action calls `abort()` which by default cause a SIGABRT signal. If there is no signal handler, then SIGABRT terminates the process. You can override this with a thread-level termination by supplying a function which invokes `pthread_exit()` as a terminate function. This terminates the thread but not the process.

Returned value

`set_terminate()` returns the address of the previous `terminate_handler`.

Refer to [z/OS XL C/C++ Language Reference](#) for more information about z/OS XL C++ exception handling, including the `set_terminate()` function.

Related information

- [“exception – Exception handling”](#) on page 87
- [“terminate\(\) – Terminate after failures in C++ error handling”](#) on page 1856

_SET_THLIIPADDR() – Set the client's IP address

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/__ussos.h>

int _SET_THLIIPADDR(ln, ipaddr);
```

General description

The `_SET_THLIIPADDR()` macro provides a way for daemons to set a client's IP address.

`_SET_THLIIPADDR()` takes the following arguments:

ln

The length of the IP address as specified by *ipaddr*. The IP address length can be between 1 and 16 inclusive. The argument is specified as an unsigned int.

ipaddr

Pointer to the IP address.

Usage notes

The intent of the `_SET_THLIIPADDR()` macro is to provide a way for daemons to set the IP address of a client for Security Authorization Facility (SAF) exits when performing security related functions.

Restrictions

Results are unpredictable if `_SET_THLIIPADDR()` is issued outside of the z/OS UNIX environment.

Returned value

If the client's IP address is set, `_SET_THLIIPADDR()` returns nonzero.

`_SET_THLIIPADDR()` returns 0 and does not set the IP address of the client when:

- The base level of z/OS UNIX is not OS/390 R5.
- The setting of the IP address is not supported.
- The length of the IP address is less than 1 or greater than 16.

Related information

- [“sys/__ussos.h – Security facility authorization” on page 73](#)

setuid() – Set the effective user ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int setuid(uid_t uid);
```

General description

Sets the real, effective, or saved set user IDs (UIDs) for the current process to *uid*.

If *uid* is the same as the real UID or the saved set-user-ID of the process, `setuid()` always succeeds and sets the effective UID. the real user ID and saved set-user-ID will remain unchanged.

The `setuid()` function will not affect the supplementary group list in any way.

If *uid* is not the same as the real UID of the process, `setuid()` succeeds only if the process has appropriate privileges. If the process has such privileges, `setuid()` sets the real group ID (UID), effective UID, and saved set UID to *uid*.

The `setuid()` function is not supported from an address space running multiple processes, since it would cause all processes in the address space to have their security environment changed unexpectedly.

`setuid()` can be used by daemon processes to change the identity of a process in order for the process to be used to run work on behalf of a user. In z/OS UNIX, changing the identity of a process is done by changing the real and effective UIDs and the auxiliary groups. In order to change the identity of the process on MVS completely, it is necessary to also change the MVS security environment. The identity change will only occur if the EUID value is specified, changing just the real UID will have no effect on the MVS environment.

The `setuid()` function invokes MVS SAF services to change the MVS identity of the address space. The MVS identity that is used is determined as follows:

- If an MVS user ID is already known by the kernel from a previous call to a kernel function (for example, `getpwnam()`) and the UID for this user ID matches the UID specified on the `setuid()` call, then this user ID is used.
- For nonzero target UIDs, if there is no saved user ID or the UID for the saved user ID does not match the UID requested on the `setuid()` call, the `setuid()` function queries the security database (for example, using `getpwnam()`) to retrieve a user ID. The retrieved user ID is then used.
- If the target UID is 0 and a user ID is not known, the `setuid()` function always sets the MVS user ID to BPXROOT or the value specified on the SUPERUSER parm in sysparms. BPXROOT is set up during system initialization as a superuser with a UID=0. The BPXROOT user ID is not defined to the BPX.DAEMON FACILITY class profile. This special processing is necessary to prevent a superuser from gaining daemon authority.

Note: When running under UID=0, some servers will issue `setuid(0)` in order to test whether they are running UID=0. The problem with this is that the `setuid` function will change the userid to BPXROOT which will likely cause the daemon to fail on subsequent function requests.

- When changing from a nonzero UID to a UID=0, the MVS user ID is not changed. When using the `su` shell command without specifying user name to become a superuser, the new shell retains the original MVS user ID.
- A nond daemon superuser that attempts to set a user ID to a daemon superuser UID fails with an EPERM.

When the MVS identity is changed, the daemon must make a call to `initgroups()` to set the auxiliary list of groups to the list of groups for the new user ID.

If the `setuid()` function is issued from multiple tasks within one address space, use synchronization to ensure that the `setuid()` functions are not performed concurrently. The execution of `setuid()` function concurrently within one address space can yield unpredictable results.

Returned value

If successful, `setuid()` returns 0.

If unsuccessful, `setuid()` returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EAGAIN

The process is currently not able to change UIDs.

EINVAL

The value of *uid* is incorrect.

EPERM

The process does not have appropriate privileges to set the UID to *uid*.

Example**CELEBS11**

```
/* CELEBS11

   This example changes the effective UID.

   */
#define _POSIX_SOURCE
#include <sys/types.h>
#include <stdio.h>
#include <unistd.h>

main() {
    printf("prior to setuid(), uid=%d, effective uid=%d\n",
          (int) getuid(), (int) geteuid());
    if (setuid(25) != 0)
        perror("setuid() error");
    else
        printf("after setuid(), uid=%d, effective uid=%d\n",
              (int) getuid(), (int) geteuid());
}
```

Output

```
before setuid(), uid=0, effective uid=0
after setuid(), uid=25, effective uid=25
```

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“exec functions” on page 442](#)
- [“geteuid\(\) — Get the effective user ID” on page 708](#)
- [“getuid\(\) — Get the real user ID” on page 792](#)
- [“seteuid\(\) — Set the effective user ID” on page 1526](#)
- [“setgid\(\) — Set the group ID” on page 1532](#)
- [“setreuid\(\) — Set real and effective user IDs” on page 1566](#)

set_unexpected() — Register a function for unexpected()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ANSI/ISO C++ | C++ only | |

Format

```
#include <exception>

unexpected_handler set_unexpected(unexpected_handler ph) throw();
```

General description

The `set_unexpected()` function is part of the z/OS XL C++ error handling mechanism. The argument supplied to `set_unexpected()` is of type `unexpected_handler` as defined in the header `<exception>` (that is, a pointer to a function with a void return type and no arguments). The function specified will be called by the `unexpected()` function.

Note that the function registered for `unexpected()` must not return to its caller. It may terminate execution by:

- Throwing an object of a type listed in the exception specification (or an object of any type if the unexpected handler is called directly by the program).
- Throwing an object of type `bad_exception`.
- Calling `terminate()`, `abort()`, or `exit(int)`.

If `set_unexpected()` has not yet been called, then `unexpected()` calls `terminate()`.

In a multithreaded environment, the `unexpected()` function created by the issuance of a `set_unexpected()` call applies to all threads in the (POSIX) process.

Returned value

`set_unexpected()` returns the address of the previous `unexpected_handler`.

Refer to [z/OS XL C/C++ Language Reference](#) for more information about z/OS XL C++ exception handling, including the `set_unexpected()` function.

Related information

- [“exception — Exception handling” on page 87](#)
- [“unexpected\(\) — Handle exception not listed in exception specification” on page 1940](#)

setutxent() — Reset to start of utmpx database

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <utmpx.h>

void setutxent(void);
```

General description

The `setutxent()` function resets the input to the beginning of the `utmpx` database opened by previous calls to `getutxent()`/`getutxent64()`, `getutxid()`/`getutxid64()`, `getutxline()`/

`getutxline64()`, or `pututxline()/pututxline64()` calls from the current thread. This should be done before each `getutxid()` and `getutxline()` search for a new entry if it is desired that the entire database be examined.

Because the `setutxent()` function processes thread-specific data the `setutxent()` function can be used safely from a multithreaded application. If multiple threads in the same process open the database, then each thread opens the database with a different file descriptor. The thread's database file descriptor is closed when the calling thread terminates or the `endutxent()` function is called by the calling thread.

Returned value

`setutxent()` returns no values.

Related information

- [“utmpx.h — User accounting database” on page 78](#)
- [“endutxent\(\) — Close the utmpx database” on page 425](#)
- [“getutxent\(\), getutxent64\(\) — Read next entry in utmpx database” on page 794](#)
- [“getutxline\(\), getutxline64\(\) — Search by line utmpx database” on page 797](#)
- [“getutxid\(\), getutxid64\(\) — Search by ID utmpx database” on page 795](#)
- [“pututxline\(\), pututxline64\(\) — Write entry to utmpx database” on page 1359](#)
- [“__utmpxname\(\) — Change the utmpx database name” on page 1957](#)

setvbuf() — Control buffering

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

int setvbuf(FILE * __restrict__stream, char * __restrict__buf, int type, size_t
size);
```

General description

Controls the buffering strategy and buffer size for a specified stream. The *stream* pointer must refer to an open file, and `setvbuf()` must be the first operation on the file.

To provide an ASCII input/output format for applications using this function, define the feature test macro `__LIBASCII` as described in topic 2.1.

The location pointed to by *buf* designates an area that you provide that the z/OS XL C/C++ Runtime Library may choose to use as a buffer for the stream. A *buf* value of `NULL` indicates that no such area is supplied and that the z/OS XL C/C++ Runtime Library is to assume responsibility for managing its own buffers for the stream. If you supply a buffer, it must exist until the stream is closed.

If *type* is `_IOFBF` or `_IOLBF`, *size* is the size of the supplied buffer. If *buf* is `NULL`, the C library will take *size* as the suggested size for its own buffer. If *type* is `_IONBF`, both *buf* and *size* are ignored. Unbuffered I/O is allowed for memory files and z/OS UNIX files. However, it is not permitted for Hiperspace memory files. If the size of the supplied buffer for hiperspace memory files is greater than 4k, only the first 4k of the buffer will be used.

Value

Meaning

`_IONBF`

No buffer is used.

`_IOFBF`

Full buffering is used for input and output. Use *buf* as the buffer and *size* as the size of the buffer.

`_IOLBF`

Line buffering is used for text stream I/O and terminal I/O. The buffer is flushed when a newline character is used (text stream), when the buffer is full, or when input is requested (terminal). The value for *size* must be greater than 0.

The value for *size* must be greater than 0.

Note: If you use `setvbuf()` or `setbuf()` to define your own buffer for a stream, you must ensure that either the buffer is available after program termination, or the stream is closed or flushed, before you call `exit()`. This can be done by defining the array with file scope or by dynamically allocating the storage for the array using `malloc()`.

For example, if the buffer is declared within the scope of a function block, the *stream* must be closed before the function is terminated. This prevents the storage allocated to the buffer from being freed.

Returned value

If successful, even if it chooses not to use your buffer, `setvbuf()` returns 0.

If an invalid value was specified in the parameter list, or if the request cannot be performed, `setvbuf()` returns nonzero.

Example

```
/* This example sets up a buffer of buf for stream1 and specifies that
   input from stream2 is to be unbuffered.
*/
#include <stdio.h>
#define BUF_SIZE 1024

char buf[BUF_SIZE];

int main(void)
{
    FILE *stream1, *stream2;

    stream1 = fopen("myfile1.dat", "r");
    stream2 = fopen("myfile2.dat", "r");

    /* stream1 uses a user-assigned buffer of BUF_SIZE bytes */
    if (setvbuf(stream1, buf, _IOFBF, sizeof(buf)) != 0)
        printf("Incorrect type or size of buffer 1");

    /* stream2 is unbuffered */
    if (setvbuf(stream2, NULL, _IONBF, 0) != 0)
        printf("Incorrect type or size of buffer 2");

    ...
}
```

Related information

- One of the sections about I/O Operations in [z/OS XL C/C++ Programming Guide](#).
- [“stdio.h — Standard input and output” on page 63](#)

- “[fclose\(\)](#) — Close file” on page 482
- “[fflush\(\)](#) — Write buffer to file” on page 530
- “[fopen\(\)](#) — Open a file” on page 571
- “[setbuf\(\)](#) — Control buffering” on page 1518

setxattr(), lsetxattr(), fsetxattr() — Set an extended attribute value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/xattr.h>

int setxattr(const char *path, const char *name, const void *value, size_t size, int flags);
int lsetxattr(const char *path, const char *name, const void *value, size_t size, int flags);
int fsetxattr(int fd, const char *name, const void *value, size_t size, int flags);
```

General description

Extended attributes are extensions to the normal attributes that are associated with all inodes in the system. They are used as name: value pairs that are associated with files and directories to provide more functions to a file system.

`setxattr()` sets the value of the extended attribute that is identified by *name* and associated with the given *path* in the file system. The *size* argument specifies the size of value in bytes.

`lsetxattr()` is identical to `setxattr()` except that in the case of a symbolic link, the extended attribute is set on the link itself by `lsetxattr()`, not the file that it refers to.

`fsetxattr()` is identical to `setxattr()` except that the extended attribute is set on the open file that is referred to by *fd* by `fsetxattr()` in place of *path*.

If the value of *flags* is set to zero, the extended attribute is created if it does not exist, or the value is replaced if the attribute exists. To modify these semantics, one of the following values can be specified:

XATTR_CREATE

Perform a pure create, which fails if the named attribute exists.

XATTR_REPLACE

Perform a pure replace operation, which fails if the named attribute does not exist.

Table 56. Extended attribute name

| Extended attribute name | | Length | Value |
|--------------------------------|---------------------|--------|-----------|
| Modifiable extended attributes | trusted.apfauth | 0 | N/A |
| | trusted.sharelib | 0 | N/A |
| | trusted.progctl | 0 | N/A |
| | system.noshareas | 0 | N/A |
| | system.filefmt | 1 | Hex Value |
| | system.filetag | 4 | Hex Value |
| | system.seclabel | 8 | Character |
| | system.useraudit | 4 | Hex Value |
| | system.auditoraudit | 4 | Hex Value |
| Read-only extended attributes | system.auditid | 16 | Hex Value |
| | system.dmodelacl | 0 | N/A |
| | system.fmodelacl | 0 | N/A |
| | system.accessacl | 0 | N/A |
| | system.createtime | 8 | Hex value |

Restriction:

- trusted.apfauth, trusted.sharelib, trusted.progctl, and system.noshareas are general attributes. lsetxattr(), fsetxattr(), lremovexattr(), fremovexattr() cannot change the general attributes.
- The attributes system.filefmt, system.filetag, system.useraudit, system.auditoraudit cannot be set for symbolic links.

Returned value

If successful, 0 is returned.

If unsuccessful, -1 is returned and errno is set to one of the following values:

Error Code**Description****EEXIST**

XATTR_CREATE is specified and the attribute exists already.

EINVAL

The flag option is an invalid value.

Attempting to modify general attributes with fsetxattr().

ENAMETOOLONG

pathname is longer than PATH_MAX characters.

ENOATTR

XATTR_REPLACE is specified, and the attribute does not exist.

Attribute name is NULL or blank.

ENODATA

The specified attribute is not set.

Attribute name is NULL or blank.

ENOTSUP

Extended attributes are not supported by the file system.

Attempting to modify general attributes with `lsetxattr()`.

Attempting to modify a read only attribute.

ERANGE

The size of the value buffer is too small to hold the result.

The size of the value buffer is larger than 50000.

Attribute name is longer than `PATH_MAX` characters.

Related information

- [“sys/xattr.h — Extended attributes handling” on page 73](#)
- [“getxattr\(\), lgetxattr\(\), fgetxattr\(\) — Retrieve an extended attribute value” on page 804](#)
- [“listxattr\(\), llistxattr\(\), flistxattr\(\) — List extended attribute names” on page 978](#)
- [“removexattr\(\), lremovexattr\(\), fremovexattr\(\) — Remove an extended attribute” on page 1430](#)

shmat() — Shared memory attach operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <sys/shm.h>

void *shmat(int shmid, const void *shmaddr, int shmflg);
```

General description

The `shmat()` function attaches the shared memory segment associated with the shared memory identifier, `shmid`, to the address space of the calling process. The segment is attached at the address specified by one of the following criteria:

- If `shmaddr` is a NULL pointer, the segment is attached at the first available address as selected by the system.
- If `shmaddr` is not a NULL pointer, and the flag, **SHM_RND** was specified, the segment is attached at the address given by `(shmaddr - ((ptrdiff_t)shmaddr % SHMLBA))` where `%` is the 'C' language remainder operator.
- If `shmaddr` is not a NULL pointer, and the flag, **SHM_RND** was not specified, the segment is attached at the address given by `shmaddr`.
- The segment is attached for reading if the flag, **SHM_RDONLY**, is specified with `shmflg` and the calling process has read permission. If the flag is not set and the process has both read and write permission, the segment is attached for reading and writing.

The first attach of newly created `__IPC_MEGA` segment, as well as subsequent attaches, will have write access to the segment, regardless of the **SHM_RDONLY** option.

- All attaches to an **__IPC_MEGA** shared memory segment have the same Write or Read access authority. If a segment is enabled for writes then all attaches have the ability to read and write to the segment. If the segment is disabled for writes, then all attaches have the ability to read from the segment and cannot write to the segment

The first attach of newly created **__IPC_MEGA** segment, as well as subsequent attaches, will have write access to the segment, regardless of the SHM_RDONLY option. Write/Read access can be changed by the shmctl() function, Shared Memory Control Operations.

An **__IPC_MEGA** shared memory segment is attached as follows:

- If shmaddr is zero and **__IPC_MEGA** segment, then the segment will be attached at the first available address selected by the system on a segment boundary.
- If shmaddr is not zero and SHM_RND is specified and **__IPC_MEGA** segment, the segment address will be truncated to the segment boundary (last 20 bits zero).
- If shmaddr is not zero and SHM_RND is not specified and **__IPC_MEGA** segment, the segment address must be a megabyte multiple (segment boundary).

Returned value

If successful, shmat() increments the value of shm_nattach in the data structure associated with the shared memory ID of the attached shared memory segment and returns the segment's starting address.

If unsuccessful, shmat() returns -1 and sets errno to one of the following values:

Error Code

Description

EACCES

Operation permission is denied to the calling process.

EINVAL

The value of *shmid* is not a valid shared memory identifier; the *shmaddr* is not a NULL pointer and the value of (*shmaddr* - ((ptrdiff_t)*shmaddr* % SHMLBA)) is an illegal address for attaching shared memory segments; or the *shmaddr* is not a NULL pointer, **SHM_RND** was specified, and the value of *shmaddr* is an illegal address for attaching shared memory segments.

The shared memory address, *shmaddr, is not zero, is not on a megabyte boundary, and SHM_RND was not specified.

EMFILE

The number of shared memory segments attached to the calling process would exceed the system-imposed limit.

ENOMEM

The available data space is not large enough to accommodate the shared memory segment.

Related information

- [“sys/shm.h — Shared memory facility” on page 70](#)
- [“exit\(\) — End program” on page 449](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“shmctl\(\), shmctl64\(\) — Shared memory control operations” on page 1595](#)
- [“shmdt\(\) — Shared memory detach operation” on page 1596](#)
- [“shmget\(\) — Get a shared memory segment” on page 1597](#)

shmctl(), shmctl64() – Shared memory control operations

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

shmctl:

```
#define _XOPEN_SOURCE
#include <sys/shm.h>

int shmctl(int shmid, int cmd, struct shmid_ds *buf);
```

shmctl64:

```
#define _LARGE_TIME_API
#define _XOPEN_SOURCE
#include <sys/shm.h>

int shmctl64(int shmid, int cmd, struct shmid_ds64 * buf);
```

Compile requirement: Use of the shmctl64() function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The shmctl() or shmctl64() function provides a variety of shared memory control operations on the shared memory segment identified by the argument, *shmid*.

The argument *cmd* specifies the shared memory control operation and may be any of the following values:

IPC_STAT

This command obtains status information for the shared memory segment specified by the shared memory identifier, *shmid*. It places the current value of each member of the shmid_ds or shmid_ds64 data structure associated with *shmid* into the structure pointed to by *buf*. The contents of this structure is defined in <sys/shm.h>. This command requires read permission.

IPC_SET

Set the value of the following members of the shmid_ds or shmid_ds64 data structure associated with *shmid* to the corresponding value in the structure pointed to by *buf*:

```
shm_perm.uid
shm_perm.gid
shm_perm.mode (only the low-order 9 bits)
```

This command can only be executed by a process that has an effective user ID equal to either that of a process with appropriate privileges or to the value of shm_perm.cuid or shm_perm.uid in the shmid_ds or shmid_ds64 data structure associated with *shmid*.

Using the IPC_SET function to change the IPC_MODE for an __IPC_MEGA shared memory segment will have an immediate effect on all attaches to the target segment. That is, the read and write access of all current attachers is immediately affected by the permissions specified in the new IPC_MODE. To determine how the new mode affects access, you must consider the effect of all three parts of the mode field (the owner permissions, group permissions and other permissions). If all three read and all three write permissions in the new mode are set off, then the access for all attachers is changed to read. If any of the three read permission bits is set on but the corresponding write permission bit

is off, then the access for all attachors is changed to read. Otherwise, the access of all attachors is changed to write.

IPC_RMID

Remove the shared memory identified specified by *shmid* from the system and destroy the shared memory segment and *shmid_ds* or *shmid_ds64* data structure associated with *shmid*. This command can only be executed by a process that has an effective user ID equal to either that of a process with appropriate privileges or to the value of *shm_perm.cuid* or *shm_perm.uid* in the *shmid_ds* or *shmid_ds64* data structure associated with *shmid*. The remove will be completed asynchronous to the return from the *shmctl()* function, when the last attachment is detached. When **IPC_RMID** is processed, no further attaches will be allowed.

The *IPC_STAT* option of *shmctl()* or *shmctl64()* returns a structure named *shmid_ds* or *shmid_ds64* (mapped in *shm.h*). *shmid_ds* or *shmid_ds64* contains status information for the requested shared memory segment.

As part of its own dump priority support, the z/OS UNIX kernel will be adding a new field to *shmid_ds* or *shmid_ds64*. This field will contain the dump priority of the requested shared memory segment. The new field will be added to the *shmid_ds* or *shmid_ds64* structure in *shm.h*.

The *shmctl64()* function behaves exactly like *shmctl()* except *shmctl64()* uses struct *shmid_ds64* instead of struct *shmid_ds* to support time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, *shmctl()* or *shmctl64()* returns 0.

If unsuccessful, *shmctl()* or *shmctl64()* returns -1 and sets *errno* to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EACCES

The argument *cmd* is equal to **IPC_STAT** but the calling process does not have read permission.

EINVAL

The value of *shmid* is not a valid shared memory identifier or the value of *cmd* is not a valid command.

EPERM

The argument *cmd* is equal to either **IPC_RMID** or **IPC_SET** and the effective user ID of the calling process is not equal to that of a process with appropriate privileges and it is not equal to the value of *shm_perm.cuid* or *shm_perm.uid* in the data structure associated with *shmid*.

Related information

- [“sys/shm.h — Shared memory facility” on page 70](#)
- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“shmat\(\) — Shared memory attach operation” on page 1593](#)
- [“shmdt\(\) — Shared memory detach operation” on page 1596](#)
- [“shmget\(\) — Get a shared memory segment” on page 1597](#)

shmdt() — Shared memory detach operation

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <sys/shm.h>

int shmdt(const void *shmaddr);
```

General description

The `shmdt()` function detaches from the calling process's address space the shared memory segment located at the address specified by the argument *shmaddr*.

Storage in the user address space for a segment with the `__IPC_SHAREAS` attribute is not cleaned up unless the segment is no longer attached to by other processes in the address space.

Returned value

If successful, `shmdt()` decrements the value of `shm_nattach` in the data structure associated with the shared memory ID of the attached shared memory segment and returns 0.

If unsuccessful, `shmdt()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of *shmaddr* is not the data segment start address of a shared memory segment.

Related information

- [“sys/shm.h — Shared memory facility” on page 70](#)
- [“exit\(\) — End program” on page 449](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“shmat\(\) — Shared memory attach operation” on page 1593](#)
- [“shmctl\(\), shmctl64\(\) — Shared memory control operations” on page 1595](#)
- [“shmget\(\) — Get a shared memory segment” on page 1597](#)

shmget() — Get a shared memory segment

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <sys/shm.h>

int shmget(key_t key, size_t size, int shmflg);
```

General description

The `shmget()` function returns the shared memory identifier associated with *key*.

A shared memory identifier, associated data structure and shared memory segment of at least *size* bytes, see `<sys/shm.h>`, are created for *key* if one of the following is true:

1. Argument *key* has a value of **IPC_PRIVATE**
2. Argument *key* does not already have a shared memory identifier associated with it and the flag **IPC_CREAT** was specified

Specify **__IPC_MEGA** to request segment level sharing. The resulting shared memory segment will be allocated in units of segments instead of units of pages. The shared memory size parameter still reflects the number of bytes required but must be in megabyte multiples. A shared memory size parameter of 0 or one which is not a megabyte multiple will result in the request failing.

The first `shmget` to define the shared memory segment determines whether the segment has the **__IPC_MEGA** attribute or not. Subsequent `shmgets`, those that use existing shared memory segments, will use the **__IPC_MEGA** attribute defined by that segment. The **__IPC_MEGA** option will have no effect for these `shmgets` and will be ignored.

Specification of the **__IPC_MEGA** option for large segments will result in significant real storage savings and reduced ESQA usage, especially as the number of shares increases.

Valid values for the argument *shmflg* include any combination of the following constants defined in `<sys/ipc.h>` and `<sys/modes.h>`:

__IPC_SHAREAS

This flag enables the sharing of the same storage area from multiple processes in the same address space. When specified by an AMODE 31 application, this flag is only honored when **__IPC_MEGA** is also specified, otherwise it is ignored. When specified by an AMODE 64 application, this flag is honored for any type of shared memory segment that is obtained above the bar.

__IPC_BELOWBAR

Forces the memory object to be allocated from below the 2 gigabyte address range. This can be used to allow AMODE 64 applications to share objects with non-AMODE 64 applications. This option is mutually exclusive with the **__IPC_GIGA** option. If a 31-bit application specifies this option, then the request will be failed with `EINVAL`.

IPC_CREAT

Create a shared memory segment if the *key* specified does not already have an associated ID.

IPC_CREAT is ignored when **IPC_PRIVATE** is specified.

IPC_EXCL

Causes the `shmget()` function to fail if the *key* specified has an associated ID. **IPC_EXCL** is ignored when **IPC_CREAT** is not specified or **IPC_PRIVATE** is specified.

__IPC_GIGA

Requests a shared memory segment with a size in gigabyte multiples. Use of this option requires that the size parameter be specified as a gigabyte multiple. Failure to use a gigabyte multiple will result in a failure. [`EINVAL`] This option is mutually exclusive with the **__IPC_BELOWBAR** and **__IPC_MEGA** options.

__IPC_MEGA

Requests a shared memory segment with the size in megabyte multiples. Use of this option requires that the size parameter, *size_t*, be in a megabyte multiple. The **__IPC_MEGA** option is required to create the shared memory segment but the **__IPC_MEGA** option is not required to acquire access to a previously defined/created shared memory segment that has the **__IPC_MEGA** attribute. When specified by an AMODE 64 application, option **__IPC_BELOWBAR** is implied and megaroo sharing will be in effect. This option is mutually exclusive with the **__IPC_GIGA** option.

S_IRGRP

Permits read access when the effective group ID of the caller matches either `shm_perm.cgid` or `shm_perm.gid`.

S_IROTH

Permits other read access.

S_IRUSR

Permits read access when the effective user ID of the caller matches either `shm_perm.cuid` or `shm_perm.uid`.

S_IWGRP

Permits write access when the effective group ID of the caller matches either `shm_perm.cgid` or `shm_perm.gid`.

S_IWOTH

Permits other write access.

S_IWUSR

Permits write access when the effective user ID of the caller matches either `shm_perm.cuid` or `shm_perm.uid`.

When a shared memory segment associated with argument *key* already exists, setting **IPC_EXCL** and **IPC_CREAT** in argument *shmflg* will force `shmget()` to fail.

The following fields are initialized when a `shmid_ds` data structure is created:

- The fields `shm_perm.cuid` and `shm_perm.uid` are set equal to the effective user ID of the calling process
- The fields `shm_perm.cgid` and `shm_perm.gid` are set equal to the effective group ID of the calling process
- The low-order 9 bits of `shm_perm.mode` are set to the value in the low-order 9 bits of *shmflg*
- The field `shm_segsz` is set equal to the value of the argument *size*
- The field `shm_lpid`, `shm_nattach`, `shm_atime`, and `shm_dtime` are set equal to zero
- The value of `shm_ctime` is set equal to the current time

Usage notes

- Shared memory segments created with `__IPC_MEGA` will show this bit in `S_MODE` byte returned with `w_getipc`.

Special behavior for AMODE 64: Applications will not be allowed to change the address to which a shared memory segment allocated is attached, when it resides above the 2 gigabyte address range. The size parameter is rounded up to a megabyte multiple for AMODE 64 users.

Returned value

If successful, `shmget()` returns a nonnegative integer, namely a shared memory identifier.

If unsuccessful, `shmget()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCES**

A shared memory identifier exists for the argument *key*, but operation permission as specified by the low-order 9 bits of *shmflg* could not be granted

EEXIST

A shared memory identifier exists for the argument *key* and both **IPC_CREAT** and **IPC_EXCL** are specified in *shmflg*

EINVAL

A shared memory identifier does not exist for the argument *key* specified and the value of argument *size* is less than the system-imposed minimum or greater than the system-imposed maximum.

OR a shared memory identifier exists for the argument *key*, but the size of the segment associated with it is less than that specified by argument *size*.

OR `__IPC_MEGA` is specified and the segment size, `size_t`, is not in megabyte multiples.

ENOENT

A shared memory identifier does not exist for the argument, `key`, and **IPC_CREAT** is not specified.

ENOMEM

A shared memory identifier and associated shared memory segment are to be created but the amount of available system storage was insufficient to fill the request.

ENOSPC

A shared memory identifier is to be created but the system-imposed limit on the maximum number of allocated shared memory identifiers, system-wide, would be exceeded.

When `shmflg` equals 0, the following applies:

- If a shared memory identifier has already been created with `key` earlier, and the calling process of this `shmget()` has read and/or write permissions to it, then `shmget()` returns the associated shared memory identifier.
- If a shared memory identifier has already been created with `key` earlier, and the calling process of this `shmget()` does not have read and/or write permissions to it, then `shmget()` returns -1 and sets `errno` to `EACCES`.
- If a shared memory identifier has not been created with `key` earlier, then `shmget()` returns -1 and sets `errno` to `ENOENT`.

Related information

- [“sys/ipc.h — Interprocess communication access structure” on page 69](#)
- [“sys/shm.h — Shared memory facility” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“ftok\(\) — Generate an interprocess communication \(IPC\) key” on page 662](#)
- [“shmat\(\) — Shared memory attach operation” on page 1593](#)
- [“shmctl\(\), shmctl64\(\) — Shared memory control operations” on page 1595](#)
- [“shmdt\(\) — Shared memory detach operation” on page 1596](#)

shutdown() — Shut down all or part of a duplex connection

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int shutdown(int socket, int how);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/socket.h>

long shutdown(int *s, int how);
```

General description

The `shutdown()` function shuts down all or part of a duplex connection.

Parameter Description

socket

The socket descriptor.

how

The condition of the shutdown. The values 0, 1, or 2 set the condition. *how* sets the condition for shutting down the connection to the socket indicated by *socket*.

how can have a value of:

- **SHUT_RD**, which ends communication from the socket indicated by *socket*.
- **SHUT_WR**, which ends communication to the socket indicated by *socket*.
- **SHUT_RDWR**, which ends communication both to and from the socket indicated by *socket*.

Note: You should issue a `shutdown()` call before you issue a `close()` call for a socket.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, `shutdown()` returns 0.

If unsuccessful, `shutdown()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EBADF

socket is not a valid socket descriptor.

EINVAL

The *how* parameter was not set to one of the valid values.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOTCONN

The socket is not connected.

ENOTSOCK

The descriptor is for a file, not for a socket.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“close\(\) — Close a file” on page 293](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“socket\(\) — Create a socket” on page 1677](#)

__shutdown_registration() – Register OMVS shutdown options

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R3 |

Format

```
#define _OPEN_SYS
#include <signal.h>

int __shutdown_registration(int regtype, int regscope, int regoptions);
```

General description

The `__shutdown_registration()` function is used to register OMVS Shutdown characteristics for the process. The process can be registered as one of the following:

- a shutdown blocking process
- a permanent process
- a shutdown notification process

These types are mutually exclusive. A shutdown blocking process will prevent OMVS shutdown from proceeding until it either de-registers as a blocking process or ends. A permanent process will survive across an OMVS shutdown. Most OMVS process attributes will be checkpointed during the shutdown and restored during the Restart. A shutdown notification process will be informed when an OMVS shutdown is initiated. It neither blocks Shutdown nor survives shutdown. Blocking and permanent processes can also register to be informed when OMVS shutdown is initiated. For more information on OMVS shutdown see *z/OS UNIX System Services Planning*.

Registration can be done for the invoking process only, or for all of the tasks in the job. The process can also modify the behavior of OMVS requests issued by permanent processes while OMVS shutdown and restart is in progress.

Checkpointed permanent process attributes include the following:

- process user and group identity
- process, session and process group identities
- process file mode creation mask
- zombie child processes
- signal registration, signal actions, signal mask data and pending signals
- current working directory
- open file and socket descriptors

Zombie child process ending status is checkpointed so that the permanent process can retrieve it after the restart.

If the current working directory path name cannot be resolved after restart, then the current working directory is set to a dummy root which will cause relative path name lookup to fail.

All of the checkpointed file descriptors will be marked invalid after restart, and any I/O requests other than `close()` will cause EIO errors.

Timer events are not checkpointed. Timer events which expire before the restart completes are lost. Timer events which have not expired after restart is complete will still be in effect.

Non-checkpointable permanent process attributes include the following:

- semaphores
- shared library programs
- __map() shared memory blocks
- message queues
- memory mapped files
- all other UNIX System Services resources

If any non-checkpointable resources are being used by a permanent process, the shutdown request will fail.

Registration is at the process level, not the thread level. For multithreaded applications, the SIGDANGER signal is sent to the process and not to any particular thread.

If a process is registered as a blocking process or a permanent process, the process must de-register before attempting to register with a different registration type. For example, a blocking process must de-register as a blocking process before attempting to register as a permanent process.

Registration remains in effect for the life of the process, or until the process de-registers. Registration remains in place across an exec() syscall because the new program image runs in the same process. Registration does not propagate to child processes as a result of fork() and spawn() syscalls.

regtype defines the type of registration. The possible values are listed below. These values are all mutually exclusive.

regtype **Description**

_SDR_BLOCKING

The process will prevent OMVS Shutdown from proceeding for as long as it the process remains registered as a blocking process. If the process exits or de-registers as a blocking process then OMVS Shutdown can proceed.

_SDR_PERMANENT

The process will not be terminated during OMVS Shutdown and Restart processing.

_SDR_NOBLOCKING

The process will no longer block an OMVS Shutdown.

_SDR_NOPERMANENT

The process will no longer be a permanent process.

_SDR_NOTIFY

The process will be notified by SIGDANGER signal delivery once OMVS Shutdown is initiated.

_SDR_NONOTIFY

The process will no longer be notified by SIGDANGER signal delivery if OMVS Shutdown is initiated.

The _SDR_BLOCKING and _SDR_PERMANENT registrations are restricted. The invoker must meet one of the following criteria in order for these two registration types to succeed:

- The calling address space is a system started task address space.
- The caller is running authorized (APF Authorized, System Key (0-7) or Supervisor State).
- The caller is a privileged UNIX process. It must either have a superuser identity or have read permission to BPX.SHUTDOWN.

regscope defines the registration scope. The possible values are listed below. The two values are mutually exclusive.

regscope **Definition**

_SDR_REGJOB

All the processes in the Job are registered.

_SDR_REGPROCESS

Only the calling process is registered.

__shutdown_registration()

regoptions defines various options for the registered process. The possible values are listed below. Multiple options may be specified by or'ing the values together. The default behavior for kernel calls issued by permanent processes while z/OS UNIX is not up is to fail the request with `errno` set to `EMVSERR` and the reason code (`__errno2()` value) set to `JrKernelReady`. Those kernel calls which do not return a return code will end with an EC6 abend and reason code `xxxx8039`.

regoptions

Definition

_SDR_NOOPTIONS

No options are requested. This request code is not valid for `_SDR_NOTIFY` registration.

_SDR_BLOCKSYSCALLS

Kernel calls issued from permanent processes while OMVS is not up will hang, and return to the caller once z/OS UNIX System Services is back up. This request is mutually exclusive with `_SDR_ABENDSYSCALLS`, and is valid only for permanent process registration.

_SDR_ABENDSYSCALLS

Kernel calls issued from permanent processes while OMVS is not up will ABEND. This request is mutually exclusive with `_SDR_BLOCKSYSCALLS`, and is valid only for permanent process registration.

_SDR_SENDSIGDANGER

Kernel sends SIGDANGER signal to the process when OMVS Shutdown is initiated. This option MUST be specified on `_SDR_NOTIFY` registration. This option may be specified for `_SDR_BLOCKING` and `_SDR_PERMANENT` registration. It may be combined with either `_SDR_BLOCK_SYSCALLS` or `_SDR_ABENDSYSCALLS` on `_SDR_PERMANENT` registration.

Returned value

If successful, `__shutdown_registration()` returns 0. the service completes without error, otherwise it returns

There are no documented `errno`s for this function.

If unsuccessful, `__shutdown_registration()` returns -1 and sets `errno` and `__errno2()` to indicate the cause of the failure. The `__errno2()` values are documented as reason codes in [z/OS UNIX System Services Messages and Codes](#).

The values of `errno` are:

Error Code

Description

EINVAL

Failed for one of the following reasons:

- The callable service is rejected because the job step process must be registered before registering a lower process of the job step process.
- The request to register a blocking process or job, or a request to register a permanent process or job cannot be performed as a shutdown is currently in progress.
- The request to register a blocking process or job, or a request to register a permanent process or job cannot be performed as the job can not be de-registered while a lowerprocess is still registered.
- The request to deregister a blocking process or job, or a request to deregister a permanent process or job cannot be performed because the job or the current process is not registered.
- One of the parameters was invalid.

EPERM

Failed for one of the following reasons:

- Invoker does not have superuser or equivalent authority.
- Caller must be given read permission to BPX.SHUTDOWN facility class profile in order to use `__shutdown_registration()` successfully.

EMVSSAF2ERR

Internal Security product error. Hexadecimal Reason code value contains the two byte security product return code xx and reason code yy.

Example

```
/*
Register the process as a blocking process and request notification
of shutdown initiation by way of SIGDANGER signal.
*/
#define _OPEN_SYS
#include <signal.h>
...
if (-1 == (rc = __shutdown_registration(_SDR_BLOCKING, _SDR_REGPROCESS,
    _SDR_SENDSIGDANGER)))
    printf("Error during __shutdown_registration errno=%d,
        errno2=0x%08x\n", errno, __errno2())

/*
Register the process as a permanent process and don't ask for
SIGDANGER signals.
*/
#define _OPEN_SYS
#include <sys>
if (-1 == (rc = __shutdown_registration(_SDR_PERMANENT, _SDR_REGPROCESS,
    _SDR_NOOPTIONS)))
    printf("Error during __shutdown_registration errno=%d,
        errno2=0x%08x\n", errno, __errno2())
```

Related information

- [“signal.h — Exception handling” on page 58](#)

sigaction() — Examine or change a signal action

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _POSIX_SOURCE
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int sigaction(int sig, const struct sigaction *__restrict__ new,
    struct sigaction *__restrict__ old);
```

General description

Examines and changes the action associated with a specific signal.

int *sig* is the number of a recognized signal. `sigaction()` examines and sets the action to be associated with this signal. See [Table 57 on page 1606](#) for the values of *sig*, as well as the signals supported by z/OS UNIX services. The *sig* argument must be one of the macros defined in the `signal.h` header file.

`const struct sigaction *new` may be a NULL pointer. If so, `sigaction()` merely determines the action currently defined to handle `sig`. It does not change this action. If `new` is not NULL, it should point to a `sigaction` structure. The action specified in this structure becomes the new action associated with `sig`.

`struct sigaction *old` points to a memory location where `sigaction()` can store a `sigaction` structure. `sigaction()` uses this memory location to store a `sigaction` structure describing the action currently associated with `sig`. `old` can also be a NULL pointer, in which case `sigaction()` does not store this information.

This function is supported only in a POSIX program.

Special behavior for C++:

- The behavior when mixing signal-handling with C++ exception handling is undefined. Also, the use of signal-handling with constructors and destructors is undefined.
- C++ and C language linkage conventions are incompatible, and therefore `sigaction()` cannot receive C++ function pointers. If you attempt to pass a C++ function pointer to `sigaction()`, the compiler will flag it as an error. Therefore, to use the `sigaction()` function in the C++ language, you must ensure that signal handler routines established have C linkage, by declaring them as `extern "C"`.

Signals: Table 57 on page 1606 lists signal values and their default action and meaning.

Table 57. Signal values and signals supported by z/OS UNIX services

| Value | Default Action | Meaning |
|------------------|----------------|--|
| SIGABND | 1 | Abend. |
| SIGABRT | 1 | Abnormal termination (sent by <code>abort()</code>). |
| SIGALRM | 1 | A timeout signal (sent by <code>alarm()</code>). |
| SIGBUS | 1 | Bus error (available only when running on MVS 5.2 or higher). |
| SIGDSIOER | 1 | A data set file system I/O error occurred. |
| SIGFPE | 1 | Arithmetic exceptions that are not masked, for example, overflow, division by zero, and incorrect operation. |
| SIGHUP | 1 | A controlling terminal is suspended, or the controlling process ended. |
| SIGILL | 1 | Detection of an incorrect function image. |
| SIGINT | 1 | Interactive attention. |
| SIGKILL | 1 | A termination signal that cannot be caught or ignored. |
| SIGPIPE | 1 | A write to a pipe that is not being read. |
| SIGPOLL | 1 | Pollable event occurred (available only when running on MVS 5.2 or higher). |
| SIGPROF | 1 | Profiling timer expired (available only when running on MVS 5.2 or higher). |
| SIGQUIT | 1 | A quit signal for a terminal. |
| SIGSEGV | 1 | Incorrect access to memory. |
| SIGSYS | 1 | Bad system call issued (available only when running on MVS 5.2 or higher). |
| SIGTERM | 1 | Termination request sent to the program. |
| SIGTRAP | 1 | Internal for use by <code>dbx</code> or <code>ptrace</code> . |

Table 57. Signal values and signals supported by z/OS UNIX services (continued)

| Value | Default Action | Meaning |
|------------------|----------------|---|
| SIGURG | 2 | High bandwidth data is available at a socket (available only when running on MVS 5.2 or higher). |
| SIGUSR1 | 1 | Intended for use by user applications. |
| SIGUSR2 | 1 | Intended for use by user applications. |
| SIGVTALRM | 1 | Virtual timer has expired (available only when running on MVS 5.2 or higher). |
| SIGXCPU | 1 | CPU time limit exceeded (available only when running on MVS 5.2 or higher). If a process runs out of CPU time and SIGXCPU is caught or ignored, a SIGKILL is generated. |
| SIGXFSZ | 1 | File size limit exceeded. |
| SIGCHLD | 2 | An ended or stopped child process (SIGCLD is an alias name for this signal). |
| SIGIO | 2 | Completion of input or output. |
| SIGIOERR | 2 | A serious I/O error was detected. |
| SIGWINCH | 2 | Window size has changed (available only when running on MVS 5.2 or higher). |
| SIGSTOP | 3 | A stop signal that cannot be caught or ignored. |
| SIGTSTP | 3 | A stop signal for a terminal. |
| SIGTTIN | 3 | A background process attempted to read from a controlling terminal. |
| SIGTTOU | 3 | A background process attempted to write to a controlling terminal. |
| SIGCONT | 4 | If stopped, continue. |

The **Default Actions** in [Table 57 on page 1606](#) are:

- 1** Normal termination of the process.
- 2** Ignore the signal.
- 3** Stop the process.
- 4** Continue the process if it is currently stopped. Otherwise, ignore the signal.

If the main program abends in a way that is not caught or handled by the operating system or application, z/OS UNIX terminates the running application with a KILL -9. If z/OS UNIX gets control in EOT or EOM and the terminating status has not been set, z/OS UNIX sets it to appear as if a KILL -9 occurred.

If a signal catcher for a SIGABND, SIGFPE, SIGILL or SIGSEGV signal runs as a result of a program check or an ABEND, and the signal catcher executes a RETURN statement, the process will be terminated.

sigaction structure: The sigaction structure is defined as follows:

```
struct sigaction {
    void      (*sa_handler)(int);
    sigset_t  sa_mask;
    int       sa_flags;
```

```

        void      (*sa_sigaction)(int, siginfo_t *, void *);
    };

```

The following are members of the structure:

void (*)(int) sa_handler

A pointer to the function assigned to handle the signal. The value of this member can also be SIG_DFL (indicating the default action) or SIG_IGN (indicating that the signal is to be ignored).

Special behavior for XPG4.2: This member and sa_sigaction are mutually exclusive of each other. When the SA_SIGINFO flag is set in sa_flags then sa_sigaction is used. Otherwise, sa_handler is used.

sigset_t sa_mask

A signal set identifies a set of signals that are to be added to the signal mask of the calling process before the signal-handling function sa_handler or sa_sigaction (in XPG4.2) is invoked. For more on signal sets, see [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#). You cannot use this mechanism to block SIGKILL, SIGSTOP, or SIGTRACE. If sa_mask includes these signals, they will simply be ignored; sigaction() will not return an error.

sa_mask must be set by using one or more of the signal set manipulation functions: sigemptyset(), sigfillset(), sigaddset(), or sigdelset()

int sa_flags

A collection of flag bits that affect the behavior of signals. The following flag bits can be set in sa_flags:

_SA_IGNORE

This bit is output only and cannot be specified by the application. The handler value will be saved and returned on subsequent calls, but the signal is ignored.

SA_NOCLDSTOP

Tells the system not to issue a SIGCHLD signal when child processes stop. This is relevant only when the sig argument of sigaction() is SIGCHLD.

SA_NOCLDWAIT

Tells the system not to create 'zombie' processes when a child process dies. This is relevant only when the sig argument of sigaction() is SIGCHLD. If the calling process subsequently waits for its children, and the process has no unwaited for children that were transformed into zombie processes, it will block until all of its children terminate. The wait(), waitid(), or waitpid() will fail and set errno to **ECHILD**.

SA_NODEFER

Tells the system to bypass automatically blocking this signal when invoking a signal handler function.

_SA_OLD_STYLE

Tells the C runtime library to use ISO C/C++ signal delivery rules, instead of POSIX rules. It is supported for compatibility with applications that use signal() to set signal action. (See [“signal\(\) — Handle interrupts” on page 1635](#).) For a description of ISO C/C++ and POSIX.1 signal delivery rules, see [Handling error conditions, exceptions, and signals in z/OS XL C/C++ Programming Guide](#).

SA_ONSTACK

Tells the system to use the alternate signal stack (see [“sigaltstack\(\) — Set or get signal alternate stack context” on page 1622](#) or [“sigstack\(\) — Set or get signal stack context” on page 1652](#)) when invoking a signal handler function. If an alternate signal stack has not been declared, the signal handler function will be invoked with the current stack.

SA_RESETHAND

Tells the system to reset the signal's action to SIG_DFL and clear the SA_SIGINFO flag before invoking a signal handler function (Note: SIGILL and SIGTRAP cannot be automatically reset when delivered. However, no error will be generated should this situation exist). Otherwise, the disposition of the signal will not be modified on entry to the signal handler.

In addition, if this flag is set, sigaction() behaves as if the SA_NODEFER flag were also set.

SA_RESTART

Tells the system to restart certain library functions if they should be interrupted by a signal. The functions that this restartability applies to are all of those that are defined as interruptible by signals and set `errno` to **EINTR** (except `pause()`, `sigpause()`, and `sigsuspend()`).

Table 58 on page 1609 lists functions that are restartable if interrupted by a signal.

Table 58. Functions that are restartable if interrupted by a signal

| | | |
|-------------------|--------------------------|----------------------------|
| accept() | <code>fstatvfs()</code> | <code>recvmsg()</code> |
| catclose() | <code>fsync()</code> | <code>select()</code> |
| catgets() | <code>ftruncate()</code> | <code>semop()</code> |
| chmod() | <code>getgrgid()</code> | <code>send()</code> |
| chown() | <code>getgrnam()</code> | <code>sendmsg()</code> |
| close() | <code>getmsg()</code> | <code>sendto()</code> |
| closedir() | <code>getpass()</code> | <code>statvfs()</code> |
| connect() | <code>getpwnam()</code> | <code>tcdrain()</code> |
| creat() | <code>getpwuid()</code> | <code>tcflow()</code> |
| dup2() | <code>ioctl()</code> | <code>tcflush()</code> |
| endgrent() | <code>lchown()</code> | <code>tcgetattr()</code> |
| fchmod() | <code>lockf()</code> | <code>tcgetpgrp()</code> |
| fchown() | <code>mkfifo()</code> | <code>tcsendbreak()</code> |
| fclose() | <code>msgrcv()</code> | <code>tcsetattr()</code> |
| fcntl() | <code>msgxrcv()</code> | <code>tcsetpgrp()</code> |
| fflush() | <code>msgsnd()</code> | <code>tmpfile()</code> |
| fgetc() | <code>open()</code> | <code>umount()</code> |
| fgetwc() | <code>poll()</code> | <code>wait()</code> |
| fopen() | <code>putmsg()</code> | <code>waitid()</code> |
| fputc() | <code>read()</code> | <code>waitpid()</code> |
| fputwc() | <code>readv()</code> | <code>write()</code> |
| freopen() | <code>recv()</code> | |
| fseek() | <code>recvfrom()</code> | |

SA_SIGINFO

Tells the system to use the signal action specified by `sa_sigaction` instead of `sa_handler`.

When this flag is off and the action is to catch the signal, the signal handler function specified by `sa_handler` is invoked as:

```
void function(int signo);
```

where `signo` is the only argument to the signal handler and it specifies the type of signal that has caused the signal handler function to be invoked.

When this flag is on and the action is to catch the signal, the signal handler function specified by `sa_sigaction` is invoked as:

```
void function(int signo, siginfo_t *info, void *context);
```

where two additional arguments are passed to the signal handler function. If the second argument is not a NULL pointer, it will point to an object of type `siginfo_t` which provides additional information about the source of the signal. A `siginfo_t` object is a structure contains the following members:

si_signo

Contains the system-generated signal number

si_errno

Contains the implementation-specific error information (it is not used on this implementation)

si_code

Contains a code identifying the cause of the signal (refer to the `<signal.h>` include file for a list of these codes and for their meanings, see Table 59 on page 1637).

If `si_signo` contains `SIGPOLL` then `si_code` can be set to `SI_ASYNCIO`. Otherwise, if the value of `si_code` is less than or equal to zero then the signal was generated by another process and the `si_pid` and `si_uid` members respectively indicate the process ID and the real user ID of the sender of this signal.

If the value of `si_code` is less than or equal to zero, then the signal was generated by another process and the `si_pid` and `si_uid` members respectively indicate the process ID and the real user ID of the sender of this signal.

si_pid

If the value of `si_code` is less than or equal to zero, then this member will indicate the process ID of the sender of this signal. Otherwise, this member is meaningless.

si_uid

If the value of `si_code` is less than or equal to zero, then this member will indicate the real user ID of the sender of this signal. Otherwise, this member is meaningless.

si_value

If `si_code` is `SI_ASYNCIO`, `si_value` contains the application specified value. Otherwise, the contents of `si_value` are undefined

The third argument will point to an object of type `ucontext_t` (refer to the `<ucontext.h>` include file for a description of the contents of this object).

Note: The remaining flag bits are reserved for system use. There is no guarantee that the integer value of `int sa_flags` will be the same upon return from `sigaction()`. However, all flag bits defined above will remain unchanged.

void (*)(int, siginfo_t *, void *) sa_sigaction

A pointer to the function assigned to handle the signal, or `SIG_DFL`, or `SIG_IGN`. This function will be invoked passing three parameters. The first is of type `int` that contains the signal type for which this function is being invoked. The second is of type pointer to `siginfo_t` where the `siginfo_t` contain additional information about the source of the signal. The third is of type 'pointer to void' but will actually point to a `ucontext_t` containing the context information at the time of the signal interrupt.

Notes:

1. The user must cast `SIG_IGN` or `SIG_DFL` to match the `sa_sigaction` definition. (indicating that the signal is to be ignored).
2. **Special behavior for XPG4.2:** This member and `sa_handler` are mutually exclusive of each other. When the `SA_SIGINFO` flag is set in `sa_flags` then `sa_sigaction` is used. Otherwise, `sa_handler` is used.

When a signal handler installed by `sigaction()`, with the `_SA_OLD_STYLE` flag set off, catches a signal, the system calculates a new signal mask by taking the union of the current signal mask, the signals specified by `sa_mask`, and the signal that was just caught (if the `SA_NODEFER` flag is not set). This new mask stays in effect until the signal handler returns, or `sigprocmask()`, `sigsuspend()`, `siglongjmp()`, `sighold()`, `sigpause()`, or `sigrelse()` is called. When the signal handler ends, the original signal mask is restored.

After an action has been specified for a particular signal, using `sigaction()` or `signal()`, it remains installed until it is explicitly changed with another call to `sigaction()`, `signal()`, one of the `exec` functions, `bsd_signal()`, `sigignore()`, `sigset()`, or until the `SA_RESETHAND` flag causes it to be reset to `SIG_DFL`.

After an action has been specified for a particular signal, using `sigaction()` with the `_SA_OLD_STYLE` flag not set, it remains installed until it is explicitly changed with another call to `sigaction()`, `signal()`, or one of the `exec` functions.

After an action has been specified for a particular signal, using `sigaction()` with the `_SA_OLD_STYLE` flag set or using `signal()`, it remains installed until it is explicitly changed with another call to `sigaction()`, `signal()`, or one of the `exec` functions, or a signal catcher is driven, where it will be reset to `SIG_DFL`.

Successful setting of signal action to `SIG_IGN` for a signal that is pending causes the pending signal to be discarded, whether or not it is blocked. This provides the ability to discard signals that are found to be blocked and pending by `sigpending()`.

Special behavior for XPG4.2:

- If a process sets the action of the `SIGCHLD` signal to `SIG_IGN`, child processes of the calling process will not be transformed into 'zombie' processes when they terminate. If the calling process subsequently waits for its children, and the process has no unwaited for children that were transformed into 'zombie' processes, it will block until all of its children terminate. The `wait()`, `waitid()`, or `waitpid()` function will fail and set `errno` to **ECHILD**.
- If the **SA_SIGINFO** flag is set, the signal-catching function specified by `sa_sigaction` is invoked as:

```
void function(int signo, siginfo_t *info, void *context);
```

where *function* is the specified signal-catching function, *signo* is the signal number of the signal being delivered, *info* points to an object of type `siginfo_t` associated with the signal being delivered, and *context* points to an object of type `ucontext_t`.

Considerations for asynchronous signal-catching functions: Some of the functions have been restricted to be serially reusable with respect to asynchronous signals. That is, the library will not allow an asynchronous signal to interrupt the execution of one of these functions until it has completed.

This restriction needs to be taken into consideration when a signal-catching function is invoked asynchronously because it causes the behavior of some of the library functions to become unpredictable.

Thus, when you are producing a strictly compliant POSIX C or X/Open application, only the following functions should be assumed to be reentrant with respect to asynchronous signals. Use only these functions in your signal-catching functions:

| | | |
|----------------------|----------------------|----------------------|
| access() | alarm() | cfgetispeed() |
| cfgetospeed() | cfsetispeed() | cfsetospeed() |
| chdir() | chmod() | chown() |
| close() | creat() | dup() |
| dup2() | execle() | execve() |
| _exit() | fcntl() | fork() |
| fstat() | getegid() | geteuid() |
| getgid() | getgroups() | getpgrp() |
| getpid() | getppid() | getuid() |
| kill() | link() | lseek() |
| mkdir() | mkfifo() | open() |

| | | |
|---------------------------------|-----------------------|-------------------------|
| pathconf() | pause() | pipe() |
| pthread_cond_broadcast() | pthread_cond_signal() | pthread_mutex_trylock() |
| read() | rename() | rmdir() |
| setgid() | setpgid() | setsid() |
| setuid() | sigaction() | sigaddset() |
| sigdelset() | sigemptyset() | sigfillset() |
| sigismember() | sigpending() | sigprocmask() |
| sigsuspend() | sleep() | stat() |
| sysconf() | tcdrain() | tcflow() |
| tcflush() | tcgetattr() | tcgetpgrp() |
| tcsendbreak() | tcsetattr() | tcsetpgrp() |
| time() | times() | umask() |
| uname() | unlink() | utime() |
| utime64() | wait() | waitpid() |
| write() | | |

Special behavior for XPG4.2: Adds the following functions to the list of functions above that may be used in signal-catching functions in strictly compliant X/Open applications:

- `fpathconf()`
- `raise()`
- `signal()`

The macro versions of `getc()` and `putc()` are not reentrant, even though the library versions of these functions are.

For nonportable POSIX applications, most of the library functions can be used in a signal-catching function. However, do not use the following functions:

- `getenv()`
- `getgrent()`
- `getgrgid()`
- `getgrnam()`
- `getpwent()`
- `getpwnam()`
- `getpwuid()`
- `ttyname()`

Special behavior for XPLINK-compiled C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Language

Environment V2R10 and later headers define a shorter **jmp_buf**, **sigjmp_buf** or **ucontext_t** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **jmp_buf**, **sigjmp_buf** or **ucontext_t** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

4. The `sigaction()` function supersedes the `signal()` interface, and should be the preferred usage. In particular, `sigaction()` and `signal()` must not be used in the same process to control the same signal.

Usage notes

The use of the `SIGTHSTOP` and `SIGTHCONT` signal is not supported with this function.

Returned value

If successful, `sigaction()` returns 0.

If unsuccessful, no new signal handler is installed, `sigaction()` returns -1, and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of *sig* is not a valid signal for one of the following reasons:

- The *sig* is not recognized.
- The process tried to ignore a signal that cannot be ignored.
- The process tried to catch a signal that cannot be caught.

The default action for `SIGCHLD` and `SIGIO` is for the signal to be ignored. A `sigaction()` to set the action to `SIG_IGN` for `SIGIO` will result in an error, with `errno` equal to `EINVAL`.

Example

CELEBS13

```
/* CELEBS13

The first part of this example determines whether the SIGCHLD
signal is currently being ignored.
With a NULL pointer for the new argument, the current signal
handler action is not changed.

*/
#define _POSIX_SOURCE
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdio.h>
#include <signal.h>

void main(void) {
    struct sigaction info;

    if (sigaction(SIGCHLD, NULL, &info) != -1)
        if (info.sa_handler == SIG_IGN)
            printf("SIGCHLD being ignored.\n");
        else if (info.sa_handler == SIG_DFL)
            printf("SIGCHLD being defaulted.\n");
}
```

CELEBS14

```
/* CELEBS14

This fragment initializes a sigaction structure to specify
mysig as a signal handler and then sets the signal handler
for SIGCHLD.
Information on the previous signal handler for SIGCHLD is
```

```

    stored in info.

    */
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>
#include <stdio.h>
void mysig(int a) { printf("In mysig\n"); }

void main(void) {
    struct sigaction info, newhandler;

    if (sigaction(SIGCHLD, NULL, &info) != -1)
        if (info.sa_handler == SIG_IGN)
            printf("SIGCHLD being ignored.\n");
        else if (info.sa_handler == SIG_DFL)
            printf("SIGCHLD being defaulted.\n");

    newhandler.sa_handler = &mysig;
    sigemptyset(&(newhandler.sa_mask));
    newhandler.sa_flags = 0;
    if (sigaction(SIGCHLD, &newhandler, &info) != -1)
        printf("New handler set.\n"); }

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“exec functions” on page 442](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“makecontext\(\) — Modify user context” on page 1032](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“__sigactionset\(\) — Examine or change signal actions” on page 1615](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigaltstack\(\) — Set or get signal alternate stack context” on page 1622](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“siginterrupt\(\) — Allow signals to interrupt functions” on page 1630](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigstack\(\) — Set or get signal stack context” on page 1652](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)
- [“wait3\(\), wait4\(\) — Wait for child process to change state” on page 1984](#)

__sigactionset() — Examine or change signal actions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------------------|
| z/OS UNIX | both | POSIX(ON) OS/390 V2R6 |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int __sigactionset(size_t newct, const __sigactionset_t new[],
                  size_t *oldct, __sigactionset_t old[],
                  int options);
```

General description

Examines and changes the actions associated with one or more signals. This function is equivalent to using `sigaction()` one or more times.

The parameters are:

size_t newct

newct is the number of `__sigactionset_t` structures to be processed in the *new* array. The value of *newct* must be from 0 to 64. If this parameter is 0, the *new* parameter is ignored, and may be NULL. If the *newct* parameter is not 0, *new* must be an array containing at least *newct* `__sigactionset_t` structures.

const __sigactionset_t new[]

new is an optional array of `__sigactionset_t` structures. When *newct* is 0, *new* may be NULL, and no signal actions will be changed.

When *newct* is not 0, the data in the *new* array of `__sigactionset_t` structures will cause the actions associated with one or more signals to be changed. The system will change the signal actions as if `sigaction()` were called multiple times. The first *newct* `__sigactionset_t` structures in the *new* array are processed in order, and may cause the actions for one or more signals to be set. For each array entry, the effect is the same as calling `sigaction()` once for each signal whose bit is on in the `__sa_signals` signal set. The fields `__sa_handler`, `__sa_mask`, `__sa_flags`, and `__sa_sigaction` correspond to the `sa_handler`, `sa_mask`, `sa_flags`, and `sa_sigaction` fields in the `sigaction` structure for `sigaction()`.

If a signal appears in more than one `__sa_signals` signal set in the *new* array, the last action specified for that signal will be in effect when `__sigactionset()` returns. If all bits in all `__sa_signals` signal sets in the *new* parameter are off, no signal actions will be changed.

size_t*oldct

oldct is both an input and output parameter. It points to a word containing the number of output entries allowed, used, or needed in the *old* array.

When `__sigactionset()` is called, **oldct* is the maximum number of `__sigactionset_t` structures in the *old* array that the system can fill in. The value of **oldct* must be from 0 to 64. If this parameter is 0, the *old* parameter is ignored, and may be NULL. If the **oldct* parameter is not 0, *old* must be an array of `__sigactionset_t` structures that the system can fill in. The number of array entries in *old* must be at least **oldct*. If not 0, **oldct* must be large enough to allow the system to pass back all the unique actions currently associated with all signals. If **oldct* is not large enough, `__sigactionset()` will fail and the `errno` will be set to `ENOMEM`.

If `__sigactionset()` returns with no error and `*oldct` was not 0, `*oldct` is set to the number of `__sigactionset_t` array entries in `old` that are filled in. If `*oldct` was too small, causing an ENOMEM error, `*oldct` is set to the number of `__sigactionset_t` structures the system would need in order to fill in all the distinct current signal actions. If `*oldct` was 0 when `__sigactionset()` was called, it is not updated.

__sigactionset_t old[]

`old` is an optional array of `__sigactionset_t` structures.

When `*oldct` is not 0, the structures in the `old` array will be filled in with the signal actions currently in effect before any changes are made. The `__sigactionset_t` structure entries in `old` are filled in with all the distinct signal actions currently in effect, starting with the first array entry. Each `__sigactionset_t` structure in the array will contain information about one or more signals. Bits in the `__sa_signals` signal set in each array entry will indicate which signals that entry applies to. The system will try to use as few array entries as possible when passing back the different signal actions. The signal actions for SIGKILL, SIGSTOP, or SIGTRACE will not be returned.

The output information in each array entry is similar to that returned from `sigaction()`. In the `__sigactionset_t` structure, the fields `__sa_handler`, `__sa_mask`, `__sa_flags`, and `__sa_sigaction` correspond to the `sa_handler`, `sa_mask`, `sa_flags`, and `sa_sigaction` fields in the `sigaction` structure filled in by `sigaction()`. The signal action as described by these fields applies to all signals whose bits are on in the `__sa_signals` signal set in the array entry.

If `old` is not large enough to contain information about all distinct signal actions currently in effect, `__sigactionset()` fails, and ENOMEM is returned. There is no way to obtain the current signal actions for a specified subset of signals.

When `old` is NULL, the system does not return any information about the current signal actions.

int options

`options` is a collection of flag bits that affects the operation `__sigactionset()`. The following flag bit can be set in `options`:

__SSET_IGINVALID

Tells the system to ignore invalid bits in the `__sa_signals` field in all `__sigactionset_t` array entries in the `new` parameter. Also, the system will ignore attempts to set SIGKILL, SIGSTOP or SIGTRACE to an action other than SIG_DFL, or SIGIO to SIG_IGN.

If this option bit is off, the system will fail the `__sigactionset()` request if any invalid bits are found in any `__sa_signals` signal set in any `new` array entry. Also, `__sigactionset()` will fail if an attempt it made to set SIGKILL, SIGSTOP, or SIGTRACE to something other than SIG_DFL, or to set SIGIO to SIG_IGN.

This function is supported only in a POSIX(ON) program.

Special behavior for C++: The behavior when mixing signal-handling with C++ exception handling is undefined. Also, the use of signal-handling with constructors and destructors is undefined.

C++ and C language linkage conventions are incompatible, and therefore `__sigactionset()` cannot receive C++ function pointers. If you attempt to pass a C++ function pointer to `__sigactionset()`, the compiler will flag it as an error. Therefore to use the `__sigactionset()` function in the C++ language, you must ensure that signal handler routines have C linkage, by declaring them as `extern "C"`.

Special behavior for XPLINK-compiled C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **jmp_buf**, **sigjmp_buf** or **ucontext_t** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **jmp_buf**, **sigjmp_buf** or **ucontext_t** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.

3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Language Environment V2R10 and later headers define a shorter **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Usage note

The use of the `SIGTHSTOP` and `SIGTHCONT` signal is not supported with this function.

__sigactionset_t type

The `__sigactionset_t` type is defined as follows:

```
typedef struct __sigactionset_s
{
    sigset_t    __sa_signals;
    int         __sa_flags;
    void        (*__sa_handler)(int);
    sigset_t    __sa_mask;

    void        (*__sa_sigaction)(int, siginfo_t *, void *);
} __sigactionset_t;
```

The following are members of the structure:

sigset_t __sa_signals

This is a signal set. It contains the signals whose actions are described by the other members in this structure. For more information on signal sets, see [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#).

In the *new* array of `__sigactionset_t` structures, the caller sets bits in this signal set. The signal action for each signal in the signal set will be set as described by the other members of the structure.

`__sa_signals` must be set using one or more of the signal set manipulation functions: `sigaddset()`, `sigdelset()`, `sigemptyset()`, or `sigfillset()`.

In the *old* array of `__sigactionset_t` structures, the system sets the bits in the `__sa_signals` field. The current signal action for each member of the signal set is described by the other members of the structure. All signals in the set have the same signal action.

int __sa_flags

A collection of flag bits that affect the behavior of the specified signal.

The flag bits in the `__sa_flags` field are the same as those in the `sa_flags` member of the `sigaction` structure. See [“sigaction\(\) — Examine or change a signal action” on page 1605](#) for a detailed description of these flag bits.

void (* __sa_handler)(int)

A pointer to the function assigned to handle the signals in the `__sa_signals` signal set. This function will be invoked passing one parameter of type `int` that contains the signal type for which this function is being invoked. The value of this member can also be `SIG_DFL` (indicating the default action) or `SIG_IGN` (indicating that the signal is to be ignored).

Note: This member and `__sa_sigaction` are mutually exclusive. When the `SA_SIGINFO` flag is set in `__sa_flags`, `__sa_sigaction` is used. Otherwise, `__sa_handler` is used.

sigset_t __sa_mask

This signal set identifies a set of signals that are to be added to the signal mask of the calling thread before the signal-handling function `__sa_handler` or `__sa_sigaction` is invoked. For more information on signal sets, see [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#). You cannot use this mechanism to block `SIGKILL`, `SIGSTOP`, or `SIGTRACE`. If

__sa_mask includes these signals, they will simply be ignored; __sigactionset() will not return an error.

__sa_mask must be set by using one or more of the signal set manipulation functions: sigaddset(), sigdelset(), sigemptyset(), or sigfillset().

void (*__sa_sigaction)(int, siginfo_t *, void *)

A pointer to the function assigned to handle the signal, or SIG_DFL, or SIG_IGN. This function will be invoked passing three parameters. The first is of type int that contains the signal type for which this function is being invoked. The second is of type siginfo_t* where the siginfo_t contain additional information about the source of the signal. The third is of type void* but will actually point to a ucontext_t_t containing the context information at the of time the signal interrupt.

Notes:

1. The user must cast SIG_DFL or SIG_IGN to match the __sa_sigaction definition.
2. This member and sa_handler are mutually exclusive. When the SA_SIGINFO flag is set in __sa_flags, __sa_sigaction is used. Otherwise, __sa_handler is used.

When a signal handler installed by __sigactionset(), with the _SA_OLD_STYLE flag set off, catches a signal, the system calculates a new signal mask by taking the union of the current signal mask at the time of the signal interrupt, the signals specified by __sa_mask, and the signal that was just caught (if the SA_NODEFER flag is not set). This new mask stays in effect until the signal handler returns, or sigprocmask(), sigsuspend(), siglongjmp(), sighold(), sigpause(), or sigrelse() is called. When the signal handler ends, the original signal mask is restored.

After an action has been specified for a particular signal, using __sigactionset() with the _SA_OLD_STYLE flag not set, it remains installed until it is explicitly changed with another call to __sigactionset(), sigaction(), signal(), bsd_signal(), sigset(), sigignore(), one of the exec functions, or until the SA_RESETHAND flag causes it to be reset to SIG_DFL.

After an action has been specified for a particular signal, using __sigactionset() with the _SA_OLD_STYLE flag set or using signal(), it remains installed until it is explicitly changed with another call to __sigactionset(), sigaction(), bsd_signal(), sigset(), signal(), sigignore(), one of the exec functions, or a signal catcher is driven, where it will be reset to SIG_DFL.

Successful setting of a signal action to SIG_IGN for a signal that is pending causes the pending signal to be discarded, whether or not it is blocked. This provides the ability to discard signals that are found to be blocked and pending by sigpending(). A signal is discarded across a call to __sigactionset() if any __sigactionset_t structure in the *new* array causes the action for that signal to be set to SIG_IGN. This happens even if a later __sigactionset_t structure in the *new* array sets the signal action to something other than SIG_IGN before __sigactionset() returns.

If a process sets the action of the SIGCHLD signal to SIG_IGN, child processes of the calling process will not be transformed into zombie processes when they terminate. If the calling process subsequently waits for its children, and the process has no unwaited from children that were transformed into zombie processes, it will block until all of its children terminate. The wait(), waitid(), or waitpid() function will fail and set errno to ECHILD.

If the SA_SIGINFO flag is set, the signal catching function specified by __sa_sigaction is invoked as:

```
void function(int signo, siginfo_t *info, void * context);
```

where *function* is the specified signal-catching function, *signo* is the signal number of the signal being delivered, *info* points to an object of type siginfo_t associated with the signal being delivered, and *context* points to an object of type ucontext_t.

For a signal catcher that has been loaded by fetch() or fetchep(), the address returned by __sigactionset() in the __sa_handler or __sa_sigaction fields may be different than the value originally passed in to sigaction() or __sigactionset() (when the signal action was first set). This signal catcher address can be passed in again to sigaction() or __sigactionset() to reestablish the same signal catcher. The effect will be similar to passing in the original catcher address obtained from fetch() or fetchep(). However, this

address should not be used for any other purpose, such as directly calling the signal catcher. Always use the original address obtained from `fetch()` or `fetchep()` when calling the catcher directly.

Considerations for asynchronous signal-catching functions

Some of the functions have been restricted to be serially reusable with respect to asynchronous signals. For more information on these functions, see [“sigaction\(\) — Examine or change a signal action”](#) on page 1605.

Returned value

If successful, `__sigactionset()` returns 0.

If unsuccessful, no signal actions are changed, `__sigactionset()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

This error can occur if:

- An unsupported signal bit was on in the `__sa_signals` signal set in the *new* parameter. This error will not be reported if the `__SSET_IGINVALID` flag is set in *options*. To obtain more information in this case, use `__errno2()`.
- An attempt was made to set the signal action for SIGSTOP, SIGKILL, or SIGTRACE to something other than SIG_DFL. This error will not be reported if the `__SSET_IGINVALID` flag is set in *options*. To obtain more information in this case, use `__errno2()`.
- The *newct* or *oldct* parameters are not in the range from 0 to 64.
- *newct* was not 0 and *new* was NULL.
- *oldct* was not 0 and *old* was NULL.

EMVSERR

An MVS environmental or internal error has occurred. Use `__errno2()` to obtain more information about this error.

ENOMEM

The input value in *oldct* was not 0, and was too small to let the system pass back all distinct current signal actions. When `__sigactionset()` returns, **oldct* will be set to the number of array entries needed by the system.

Example

```
/*
 * Note: This is just a code fragment
 */

void catch_sigchld(int, siginfo_t *, void *);

...

__sigactionset_t new[2], old[64];
int options;
int rc;
size_t oldct = 64;

/*
 * Set SIGUSR1 and SIGUSR2 to SIG_IGN
 * Set SIGCHLD to new-style catcher catch_sigchld()
 * Save original signal setup in variable old
 */

bzero(new, sizeof new);

(void)sigemptyset(&(new[0].__sa_signals) );
```

```

(void)sigaddset (&(new[0].__sa_signals), SIGUSR1);
(void)sigaddset (&(new[0].__sa_signals), SIGUSR2);

(void)sigemptyset(&(new[1].__sa_signals) );
(void)sigaddset (&(new[1].__sa_signals), SIGCHLD);

new[0].__sa_handler = SIG_IGN;
new[1].__sa_sigaction = &catch_sigchld;
new[1].__sa_flags = SA_SIGINFO;

rc = __sigactionset((size_t)2, new, &oldct, old, __SSET_IGINVALID);

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“exec functions” on page 442](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“makecontext\(\) — Modify user context” on page 1032](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigaltstack\(\) — Set or get signal alternate stack context” on page 1622](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“siginterrupt\(\) — Allow signals to interrupt functions” on page 1630](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigstack\(\) — Set or get signal stack context” on page 1652](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)
- [“wait3\(\), wait4\(\) — Wait for child process to change state” on page 1984](#)

sigaddset() — Add a signal to the signal mask

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <signal.h>

int sigaddset(sigset_t *set, int signal);
```

General description

Adds a signal to the set of signals already recorded in *set*.

`sigaddset()` is part of a family of functions that manipulate signal sets. *Signal sets* are data objects that let a process keep track of groups of signals. For example, a process can create one signal set to record which signals it is blocking, and another signal set to record which signals are pending. In general, signal sets are used to manipulate groups of signals used by other functions (such as `sigprocmask()`) or to examine signal sets returned by other functions (such as `sigpending()`).

Applications should call either `sigemptyset()` or `sigfillset()` at least once for each object of type `sigset_t` prior to any other use of that object. If such an object is not initialized in this way, but is nonetheless supplied as an argument to any of `pthread_sigmask()`, `sigaction()`, `sigaddset()`, `sigdelset()`, `sigismember()`, `sigpending()`, `sigprocmask()`, `sigsuspend()`, `sigtimedwait()`, `sigwait()`, or `sigwaitinfo()`, the results are undefined.

Usage note

The use of the `SIGTHSTOP` and `SIGTHCONT` signal is not supported with this function.

Returned value

If the signal is successfully added to the signal set, `sigaddset()` returns 0.

If *signal* is not supported, `sigaddset()` returns -1 and sets `errno` to `EINVAL`.

Example

CELEBS15

```
/* CELEBS15
   This example adds a set of signals.
*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <signal.h>
#include <unistd.h>

void catcher(int signum) {
    puts("catcher() has gained control");
}
```

```
main() {
    struct sigaction sact;
    sigset_t sigset;

    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = catcher;
    sigaction(SIGUSR1, &sact, NULL);

    puts("before first kill()");
    kill(getpid(), SIGUSR1);
    puts("before second kill()");

    sigemptyset(&sigset);
    sigaddset(&sigset, SIGUSR1);
    sigprocmask(SIG_SETMASK, &sigset, NULL);

    kill(getpid(), SIGUSR1);
    puts("after second kill()");
}
```

Output

```
before first kill()
catcher() has gained control
before second kill()
after second kill()
```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigismember\(\) — Test if a signal is in a signal mask” on page 1631](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

sigaltstack() — Set or get signal alternate stack context

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int sigaltstack(const stack_t *__restrict__ ss, stack_t *__restrict__ oss);
```


General description

The `sigaltstack()` function allows a thread to define and examine the state of an alternate stack for signal handlers. Signals that have been explicitly declared to execute on the alternate stack will be delivered on the alternate stack.

Note: To explicitly declare that a signal catcher is to run on the alternate signal stack, the `SA_ONSTACK` flag must be set in the `sa_flags` when the signal action is set using `sigaction()`.

If `ss` is not a NULL pointer, it points to a `stack_t` structure that specifies the alternate signal stack that will take effect upon return from `sigaltstack()`. The `ss_flags` member specifies the new stack state. If it is set to `SS_DISABLE`, the stack is disabled and `ss_sp` and `ss_size` are ignored. Otherwise the stack will be enabled, and the `ss_sp` and `ss_size` members specify the new address and size of the stack.

AMODE 64 considerations: Storage for this stack must be above the 2GB bar. It may not be storage acquired with the `__malloc24()` or `__malloc31()` functions.

The range of addresses starting at `ss_sp`, up to but not including `ss_sp + ss_size`, is available to the implementation for use as the stack. This interface makes no assumptions regarding which end is the stack base and in which direction the stack grows as items are pushed.

If `oss` is not a NULL pointer, on successful completion it will point to a `stack_t` structure that specifies the alternate signal stack that was in effect before the call to `sigaltstack()`. The `ss_sp` and `ss_size` members specify the address and size of that stack. The `ss_flags` member specifies the stack's state, and may contain one of the following values:

SS_ONSTACK

The thread is currently executing on the alternate signal stack. Attempts to modify the alternate signal stack while the thread is executing on it fails. This flag must not be modified by threads.

SS_DISABLE

The alternate signal stack is currently disabled.

The value `SIGSTKSZ` is a system default specifying the number of bytes that would be used to cover the usual case when manually allocating an alternate stack area. The value `MINSIGSTKSZ` is defined to be the minimum stack size for a signal handler. In computing an alternate signal stack size, a program should add that amount to its stack requirements to allow for the system implementation overhead. The constants `SS_ONSTACK`, `SS_DISABLE`, `SIGSTKSZ`, and `MINSIGSTKSZ` are defined in `<signal.h>`.

After a successful call to one of the `exec` functions, there are no alternate signal stacks in the new process image.

Notes:

1. If a signal handler is enabled to run on an alternate stack, then all functions called by that signal handler must be compiled with the same linkage. For example, if the signal handler is compiled with `XPLINK`, then all functions it calls must also be compiled `XPLINK`. Since only one alternate stack can be supplied, no mixing of linkages (which would require both upward and downward-growing alternate stacks) is allowed. The type of stack created will be based on the attributes of the signal handler to be given control. If the signal handler has been compiled with `XPLINK`, then a downward-growing stack will be created in the alternate stack, including, in `AMODE 31`, using enough storage in the user stack to create a 4k read-only guard page (aligned on a 4k boundary).
2. If a new signal is received while a signal handler is running on an alternate stack, and that new signal specified a signal handler that also runs on the alternate stack, then both signal handlers must have been compiled with the same linkage (`XPLINK` versus non-`XPLINK`).

Returned value

If successful, `sigaltstack()` returns 0.

If unsuccessful, `sigaltstack()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

ss argument is not a NULL pointer, and the ss_flags member pointed to by ss contains flags other than SS_DISABLE.

ENOMEM

The size of the alternate stack area is less than MINSIGSTKSZ.

EPERM

An attempt was made to modify an active stack.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)
- [“sigstack\(\) — Set or get signal stack context” on page 1652](#)

sigdelset() — Delete a signal from the signal mask

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <signal.h>

int sigdelset(sigset_t *set, int signal);
```

General description

Removes the specified *signal* from the list of signals recorded in *set*.

The sigdelset() function is part of a family of functions that manipulate signal sets. *Signal sets* are data objects that let a process keep track of groups of signals. For example, a process can create one signal set to record which signals it is blocking, and another signal set to record which signals are pending. In general, signal sets are used to manipulate groups of signals used by other functions (such as sigprocmask()) or to examine signal sets returned by other functions (such as sigpending()).

Applications should call either sigemptyset() or sigfillset() at least once for each object of type sigset_t prior to any other use of that object. If such an object is not initialized in this way, but is nonetheless supplied as an argument to any of pthread_sigmask(), sigaction(), sigaddset(), sigdelset(), sigismember(), sigpending(), sigprocmask(), sigsuspend(), sigtimedwait(), sigwait(), or sigwaitinfo(), the results are undefined.

Usage note

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If the signal is successfully deleted from the signal set, sigdelset() returns 0.

If *signal* is not supported, `sigdelset()` returns -1 and sets `errno` to `EINVAL`.

Example

CELEBS16

```
/* CELEBS16

   This example deletes specific signals.

   */
#define _POSIX_SOURCE
#include <stdio.h>
#include <signal.h>
#include <unistd.h>

void catcher(int signum) {
    puts("catcher() has gained control");
}

main() {
    struct sigaction sact;
    sigset_t sigset;

    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = catcher;
    sigaction(SIGUSR1, &sact, NULL);

    sigfillset(&sigset);
    sigprocmask(SIG_SETMASK, &sigset, NULL);

    puts("before kill()");
    kill(getpid(), SIGUSR1);

    puts("before unblocking SIGUSR1");
    sigdelset(&sigset, SIGUSR1);
    sigprocmask(SIG_SETMASK, &sigset, NULL);
    puts("after unblocking SIGUSR1");
}
```

Output

```
before kill()
before unblocking SIGUSR1
catcher() has gained control
after unblocking SIGUSR1
```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigismember\(\) — Test if a signal is in a signal mask” on page 1631](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

sigemptyset() — Initialize a signal mask to exclude all signals

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <signal.h>

int sigemptyset(sigset_t *set);
```

General description

Initializes a signal set *set* to the empty set. All recognized signals are excluded.

`sigemptyset()` is part of a family of functions that manipulate signal sets. *Signal sets* are data objects that let a process keep track of groups of signals. For example, a process can create one signal set to record which signals it is blocking, and another signal set to record which signals are pending. Signal sets are used to manipulate groups of signals used by other functions (such as `sigprocmask()`) or to examine signal sets returned by other functions (such as `sigpending()`).

Returned value

If successful, `sigemptyset()` returns 0.

There are no documented `errno` values.

Example

CELEBS17

```
/* CELEBS17

   This example initializes a set of signals to an empty set.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <signal.h>
#include <unistd.h>

main() {
    struct sigaction sact;

    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = SIG_IGN;

    sigaction(SIGUSR2, &sact, NULL);

    puts("before kill()");
    kill(getpid(), SIGUSR2);
    puts("after kill()");
}
```

Output

```
before kill()
after kill()
```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigismember\(\) — Test if a signal is in a signal mask” on page 1631](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

sigfillset() — Initialize a signal mask to include all signals

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <signal.h>

int sigfillset(sigset_t *set);
```

General description

Initializes a signal set *set* to the complete set of supported signals.

`sigfillset()` is part of a family of functions that manipulate signal sets. *Signal sets* are data objects that let a process keep track of groups of signals. For example, a process can create one signal set to record which signals it is blocking, and another signal set to record which signals are pending. Signal sets are used to manipulate groups of signals used by other functions (such as `sigprocmask()`) or to examine signal sets returned by other functions (such as `sigpending()`).

Returned value

If successful, `sigfillset()` returns 0.

There are no documented `errno` values.

Example

CELEBS18

```
/* CELEBS18

   This example initializes a set of signals to a complete set.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <signal.h>
#include <unistd.h>

main() {
    sigset_t sigset;

    sigfillset(&sigset);

    sigprocmask(SIG_SETMASK, &sigset, NULL);

    puts("before kill()");
    kill(getpid(), SIGSEGV);
    puts("after kill()");
}
```

Output

```
before kill()
after kill()
```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigismember\(\) — Test if a signal is in a signal mask” on page 1631](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

sighold() — Add a signal to a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int sighold(int sig);
```

General description

The sighold() function provides a simplified method for adding the signal specified by the argument *sig* to the calling thread's signal mask.

Usage note

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If successful, sighold() returns 0.

If unsuccessful, sighold() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

The value of the argument *sig* is not a valid signal type or it is SIGKILL, SIGSTOP, or SIGTRACE.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigrelse\(\) — Remove a signal from a thread” on page 1647](#)

sigignore() — Set disposition to ignore a signal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int sigignore(int sig);
```

General description

The sigignore() function provides a simplified method for setting the signal action of the signal specified by the argument *sig* to SIG_IGN.

Usage note

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If successful, sigignore() returns 0.
If unsuccessful, sigignore() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
| EINVAL | |

The value of the argument *sig* is not a valid signal type or it is SIGKILL, SIGSTOP, or SIGTRACE.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)

siginterrupt() — Allow signals to interrupt functions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int siginterrupt(int sig, int flag);
```

General description

The siginterrupt() function provides a simplified method for changing the restart behavior when a function is interrupted by the signal specified in the argument *sig*.
The argument *flag* serves as a binary switch to enable or disable restart behavior. When *flag* is nonzero, restart behavior will be disabled. Otherwise it is enabled.

Returned value

If successful, siginterrupt() returns 0.
If unsuccessful, siginterrupt() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
| EINVAL | |

The value of the argument *sig* is not a valid signal type.

Related information

- “[signal.h — Exception handling](#)” on page 58
- “[sigaction\(\) — Examine or change a signal action](#)” on page 1605

sigismember() — Test if a signal is in a signal mask

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <signal.h>

int sigismember(const sigset_t *set, int signal);
```

General description

Tests whether a specified signal number *signal* is a member of a signal set *set*.

`sigismember()` is part of a family of functions that manipulate signal sets. *Signal sets* are data objects that let a process keep track of groups of signals. For example, a process can create one signal set to record which signals it is blocking, and another signal set to record which signals are pending. Signal sets are used to manipulate groups of signals used by other functions (such as `sigprocmask()`) or to examine signal sets returned by other functions (such as `sigpending()`).

Applications should call either `sigemptyset()` or `sigfillset()` at least once for each object of type `sigset_t` prior to any other use of that object. If such an object is not initialized in this way, but is nonetheless supplied as an argument to any of `pthread_sigmask()`, `sigaction()`, `sigaddset()`, `sigdelset()`, `sigismember()`, `sigpending()`, `sigprocmask()`, `sigsuspend()`, `sigtimedwait()`, `sigwait()`, or `sigwaitinfo()`, the results are undefined.

Usage note

The use of the `SIGTHSTOP` and `SIGTHCONT` signal is not supported with this function.

Returned value

`sigismember()` returns 1 if *signal* is in *set*, and it returns 0 if it is not.

If unsuccessful, `sigismember()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of *signal* is not one of the supported signals.

Example

CELEBS19

```

/* CELEBS19

   This example tests signals.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <signal.h>

void check(sigset_t set, int signum, char *signame) {
    printf("%-8s is ", signame);
    if (!sigismember(&set, signum))
        printf("not ");
    puts("in the set");
}

main() {
    sigset_t sigset;

    sigemptyset(&sigset);
    sigaddset(&sigset, SIGUSR1);
    sigaddset(&sigset, SIGKILL);
    sigaddset(&sigset, SIGCHLD);

    check(sigset, SIGUSR1, "SIGUSR1");
    check(sigset, SIGUSR2, "SIGUSR2");
    check(sigset, SIGFPE, "SIGFPE");
    check(sigset, SIGKILL, "SIGKILL");
}

```

Output

```

SIGUSR1  is in the set
SIGUSR2  is not in the set
SIGFPE   is not in the set
SIGKILL  is in the set

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

siglongjmp() — Restore the stack environment and signal mask

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <setjmp.h>

void siglongjmp(sigjmp_buf env, int val);
```

General description

For a stack environment previously saved in *env* by `sigsetjmp()`, the `siglongjmp()` function restores all the stack environment and, optionally, the signal mask, depending on whether it was saved by `sigsetjmp()`. The `sigsetjmp()` and `siglongjmp()` functions provide a way to perform a nonlocal goto.

env is an address for a `sigjmp_buf` structure.

val is the return value from `siglongjmp()`.

`siglongjmp()` is similar to `longjmp()`, except for the optional capability of restoring the signal mask. The `sigsetjmp()`—`siglongjmp()` pair, the `setjmp()`—`longjmp()` pair, the `_setjmp()`—`_longjmp()` pair, and the `getcontext()`—`setcontext()` pair cannot be intermixed. A stack environment and signal mask saved by `sigsetjmp()` can be restored only by `siglongjmp()`.

A call to `sigsetjmp()` causes the current stack environment including, optionally, the signal mask to be saved in *env*. A subsequent call to `siglongjmp()` restores the saved environment and signal mask (if saved by `sigsetjmp()`) and returns control to a point in the program corresponding to the `sigsetjmp()` call. Execution resumes as if the `sigsetjmp()` call had just returned the given *value*. All variables (except register variables) that are accessible to the function that receives control contain the values they had when you called `siglongjmp()`. The values of register variables are unpredictable. Nonvolatile auto variables that are changed between calls to `sigsetjmp()` and `siglongjmp()` are also unpredictable.

Notes:

1. If you call `siglongjmp()`, the function in which the corresponding call to `sigsetjmp()` was made must not have returned first. After the function calling `sigsetjmp()` returns, calling `siglongjmp()` causes unpredictable program behavior.
2. If `siglongjmp()` is used to jump back into an XPLINK routine, any `alloca()` requests issued by the XPLINK routine after the earlier `sigsetjmp()` (or `getcontext()`, and so on.) was called and before `siglongjmp()` is called are backed out. All storage obtained by these `alloca()` requests is freed before the XPLINK routine is resumed.
3. If `siglongjmp()` is used to jump back into a non-XPLINK routine, `alloca()` requests made after `sigsetjmp()` and before `siglongjmp()` are not backed out.

The *value* argument passed to `siglongjmp()` must be nonzero. If you give a zero argument for *value*, `siglongjmp()` substitutes the value 1 in its place.

`siglongjmp()` does not use the normal function call and return mechanisms. `siglongjmp()` restores the saved signal mask only if the *env* parameter was initialized by a call to `sigsetjmp()` with a nonzero *savemask* argument.

Special behavior for C++: If `sigsetjmp()` and `siglongjmp()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. Additionally, if any automatic objects would be destroyed by a thrown exception transferring control to another (destination) point in the program, then a call to `siglongjmp()` at the throw point that transfers control to the same (destination) point has undefined behavior. The use of `sigsetjmp()` and `siglongjmp()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Special behavior for XPLINK-compiled C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Language Environment V2R10 and later headers define a shorter **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

`siglongjmp()` returns no values.

There are no documented `errno` values.

Example

This example saves the stack environment and signal mask at the statement:

```
if(sigsetjmp(mark,1) != 0) ...
```

When the system first performs the `if` statement, it saves the environment and signal mask in *mark* and sets the condition to false, because `sigsetjmp()` returns 0 when it saves the environment. The program prints the message: `sigsetjmp() has been called`

The subsequent call to function `p()` tests for a local error condition, which can cause it to perform `siglongjmp()`. Then control returns to the original `sigsetjmp()` function using the environment saved in *mark* and restores the signal mask. This time the condition is true because -1 is the return value from `siglongjmp()`. The example then performs the statements in the block and prints: `siglongjmp() has been called` Then it performs your `recover()` function and leaves the program.

```
#define _POSIX_SOURCE
#include <stdio.h>
#include <setjmp.h>

sigjmp_buf mark;

void p(void);
void recover(void);

int main(void)
{
    if (sigsetjmp(mark) != 0) {
        printf("siglongjmp() has been called\n");
        recover();
        exit(1);
    }
    printf("sigsetjmp() has been called\n");
    :
    p();
```

```

:
}

void p(void) {
    int error = 0;
:
    error = 9;
:
    if (error != 0)
        siglongjmp(mark, -1);
:
}

void recover(void) {
:
:
}

```

Related information

- [“setjmp.h — Manipulate program state” on page 58](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“setjmp\(\) — Preserve stack environment” on page 1542](#)
- [“_setjmp\(\) — Set jump point for a nonlocal goto” on page 1544](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)
- [“swapcontext\(\) — Save and restore user context” on page 1784](#)

signal() — Handle interrupts

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 POSIX.4a XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <signal.h>

void(*signal(int sig, void(*func)(int)))(int);

```

General description

Allows a process to choose one of several ways to handle an interrupt signal *sig* from the operating system or from the `raise()` function.

The *sig* argument must be one of the macros defined in the `signal.h` header file. See [Table 59 on page 1637](#).

The *func* argument must be one of the macros, `SIG_DFL` or `SIG_IGN`, defined in the `signal.h` header file, or a function address.

If the value of *func* is `SIG_DFL`, default handling for that signal will occur. If the value of *func* is `SIG_IGN`, the signal will be ignored. Otherwise, *func* points to a function to be called when that signal occurs. Such a function is called a *signal handler*.

When a signal occurs, if *func* points to a function:

1. First the equivalent of `signal(sig, SIG_DFL)`; is executed or an implementation-defined blocking of the system is performed. (If the value of *sig* is `SIGILL`, the occurrence of the reset to `SIG_DFL` is implementation-defined.)
2. Next, the equivalent of `(*func)(sig)`; is executed. The function *func* may terminate by executing a `return` statement or by calling the `abort()`, `exit()`, or `longjmp()` function. If *func* executes a `return` statement and the value of *sig* was `SIGFPE` or any other implementation-defined value corresponding to a computational exception, the behavior is undefined. Otherwise, the program will resume execution at the point it was interrupted.

If a signal occurs for a reason other than having called the `abort()` or `raise()` function, the behavior is undefined if the signal handler calls any function in the standard library other than the `signal()` function itself (with a first argument of the signal number corresponding to the signal that caused the invocation of the handler). Behavior is also undefined if the signal handler refers to any object with static storage duration other than by assigning a value to a static storage duration variable of type `volatile sig_atomic_t`. Furthermore, if such a call to the `signal()` function returns `SIG_ERR`, the value of `errno` is indeterminate.

At program startup, the equivalent of `signal(sig, SIG_IGN)`; may be executed for some selected signals. The equivalent of `signal(sig, SIG_DFL)`; is executed for all other signals.

The action taken when the interrupt signal is received depends on the value of *func*.

Value

Meaning

SIG_DFL

Default handling for the signal will occur.

SIG_IGN

The signal is to be ignored.

As of Language Environment Release 3, the defaults for `SIGUSR1`, `SIGUSR2`, `SIGINT`, and `SIGTERM` are changed from the signal being ignored to abnormal termination. To compensate for this change, you would explicitly register that the signal is to be ignored, using a call sequence such as:

```
signal(SIGUSR1, SIG_IGN);
signal(SIGUSR2, SIG_IGN);
signal(SIGINT, SIG_IGN);
signal(SIGTERM, SIG_IGN);
```

These calls may be made either in the source or they can be made from the HLL user exit `CEEBCINT`, which will require a re-link.

Special behavior for POSIX: For a z/OS UNIX C application running `POSIX(ON)`, the interrupt signal can also come from `kill()` or from another process. A program can use `sigaction()` to establish a signal handler; `sigaction()` blocks the signal while the signal handler has control. If you use `signal()` to establish a signal handler, the signal reverts back to the default action. If you want the signal handler to get control for the next signal of this type, you must reissue `signal()`.

`signal(sig, func)` is equivalent to `sigaction(sig, &act, NULL)`, where *act* points to a `sigaction` structure containing an `sa_action` of *func*, an `sa_mask` by `sigemptyset()`, and an `sa_flags` containing `_SA_OLD_STYLE`.

Note: The `sigaction()` function supersedes the `signal()` interface, and should be the preferred usage. In particular, `sigaction()` and `signal()` must not be used in the same process to control the same signal.

For a list of considerations for coding signal-catching functions that will support asynchronous signals, refer to “[sigaction\(\) — Examine or change a signal action](#)” on page 1605.

The `sig` argument must be one of the macros defined in the `signal.h` header file.

Special behavior for C++:

- The behavior when mixing signal-handling with C++ exception handling is undefined. Also, the use of signal-handling with constructors and destructors is undefined.
- C++ and C language linkage conventions are incompatible, and therefore `signal()` cannot receive C++ function pointers. If you attempt to pass a C++ function pointer to `signal()`, the compiler will flag it as an error. Therefore, to use the `signal()` function in the C++ language, you must ensure that signal handler routines established have C linkage, by declaring them as `extern "C"`.

The signals supported are listed below.

Table 59. Signals Supported by C or C++ — POSIX(OFF)

| Value | Default Action | Meaning |
|----------|----------------|---|
| SIGABND | 1 | Abend |
| SIGABRT | 1 | Abnormal termination (sent by <code>abort()</code>) |
| SIGFPE | 1 | Arithmetic exceptions that are not masked, for example, overflow, division by zero, and incorrect operation |
| SIGILL | 1 | Detection of an incorrect function image |
| SIGINT | 1 | Interactive attention |
| SIGSEGV | 1 | Incorrect access to memory |
| SIGTERM | 1 | Termination request sent to the program |
| SIGUSR1 | 1 | Intended for use by user applications |
| SIGUSR2 | 1 | Intended for use by user applications |
| SIGIOERR | 2 | A serious I/O error was detected. |

In [Table 59 on page 1637](#), the **Default Actions** are:

- 1 Normal termination of the process.
- 2 Ignore the signal.

When the runtime option `POSIX(ON)` is specified, if a signal catcher for a `SIGABND`, `SIGFPE`, `SIGILL` or `SIGSEGV` signal runs as a result of a program check or an `ABEND`, and the signal catcher executes a `RETURN` statement, the process will be terminated.

Returned value

If successful, `signal()` returns the most recent value of *func*.

If unsuccessful, `signal()` returns a value of `SIG_ERR` and a positive value in `errno`.

There are no documented `errno` values. If an error occurs, issue `perror()` using the `errno` value.

Example

CELEBS20

```

/* CELEBS20

   This example shows you how to establish a signal handler.

   */
#include <signal.h>
#include <stdio.h>
#include <stdlib.h>
#define ONE_K 1024

#define OUT_OF_STORAGE      (SIGUSR1)

/* The SIGNAL macro does a signal() checking the return code */
#define SIGNAL(handler, StrCln) { \
    if (signal((handler), (StrCln)) == SIG_ERR) { \
        perror("Could not signal user signal"); \
        abort(); \
    } \
}

#ifdef __cplusplus          /* the __cplusplus macro      */
extern "C" void StrCln(int); /* is automatically defined */
#else                      /* by the C++/MVS compiler  */
void StrCln(int);
#endif

void DoWork(char **, int);

int main(int argc, char *argv[]) {
    int size;
    char *buffer;

    signal(OUT_OF_STORAGE, StrCln);

    if (argc != 2) {
        printf("Syntax: %s size \n", argv[0]);
        return(-1);
    }

    size = atoi(argv[1]);

    DoWork(&buffer, size);
    return(0);
}

void StrCln(int SIG_TYPE) {
    printf("Failed trying to malloc storage\n");
    signal(SIG_TYPE, SIG_DFL);
    exit(0);
}

void DoWork(char **buffer, int size) {
    int rc;

    while (*buffer != NULL)
        *buffer = (char *)malloc(size*ONE_K);
    if (*buffer == NULL) {
        if (raise(OUT_OF_STORAGE)) {
            perror("Could not raise user signal");
            abort();
        }
    }
    return;
}

```

Related information

- [Signal-handling in z/OS XL C/C++ Programming Guide.](#)
- [“signal.h — Exception handling” on page 58](#)
- [“abort\(\) — Stop a program” on page 103](#)
- [“atexit\(\) — Register program termination function” on page 197](#)

- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“exit\(\) — End program” on page 449](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“pthread_kill\(\) — Send a signal to a thread” on page 1293](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)
- [“waitid\(\) — Wait for child process to change state” on page 1980](#)
- [“wait3\(\), wait4\(\) — Wait for child process to change state” on page 1984](#)

signbit() — Determines whether the sign of its argument is negative

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 | both | z/OS V1R8 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

int signbit(real-floating x);

#define __STDC_WANT_DEC_FP__
#include <math.h>

int signbit(real-floating x); /* C only */
int signbit(decimal-floating x); /* C only */
bool signbit(real-floating x); /* C++ only */
bool signbit(decimal-floating x); /* C++ only */

#define _TR1_C99
#include <math.h>

bool signbit(real-floating x); /* C++ only */
```

General description

The `signbit()` macro or function template determines whether the sign of its argument value is negative.

| Function | Hex | IEEE |
|----------|-----|------|
| signbit | X | X |

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. This function works in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The `signbit()` macro returns 1 if the sign of its argument value is negative, else returns 0. The C++ function template returns true if the sign of its argument value is negative, else returns false.

Related information

- [“math.h — Floating-point math functions” on page 40](#)

`__signgam()` — Return `signgam` reference

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XOPEN_SOURCE
#include <math.h>

int *__signgam(void);
#define signgam (*__signgam())
```

General description

The `__signgam()` function returns the address of the calling thread's storage for the `signgam` external variable used by the `gamma()` and `lgamma()` functions. This extended mechanism is necessary for multithreaded processes which use either of these two functions, since each thread has its own instance of `signgam`. The `<math.h>` header defines `signgam` to an invocation of `__signgam()`, so generally, all references to `signgam` will be mapped to calls to `__signgam()`. If the user eliminates this definition, either by not including the header, or by using `#undef`, then references to `signgam` will refer to the actual `signgam` external variable, which contains the `signgam` value for the IPT only. In the absence of the definition of `signgam` to a call to `__signgam()`, `signgam` values in threads other than the IPT are inaccessible.

Returned value

`__signgam()` is always successful.

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“gamma\(\) — Calculate gamma function” on page 683](#)
- [“lgamma\(\), lgammaf\(\), lgammal\(\) — Log gamma function” on page 968](#)

`sigpause()` — Unblock a signal and wait for a signal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int sigpause(int sig);
```

General description

The `sigpause()` function provides a simplified method for removing a signal, specified by the argument *sig*, from the calling thread's signal mask and suspending this thread until a signal is received whose action is either to execute a signal catcher function or to terminate the process.

Usage notes

The use of the `SIGTHSTOP` and `SIGTHCONT` signal is not supported with this function.

Returned value

If successful, `sigpause()` returns -1 and sets `errno` to `EINTR`.

If unsuccessful, `sigpause()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of the argument *sig* is not a valid signal type or it is `SIGKILL`, or `SIGTRACE`.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

sigpending() — Examine pending signals

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <signal.h>

int sigpending(sigset_t *set);
```

General description

Returns the union of the set of signals that are blocked from delivery and pending for the calling thread and the set that are pending for the process. If there is only one thread, it does the same for the calling

process. This information is represented as a signal set stored in *set*. For more information on examining the signal set pointed to by *set*, see [“sigismember\(\) — Test if a signal is in a signal mask”](#) on page 1631.

Usage notes

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If successful, sigpending() returns 0.

If unsuccessful, sigpending() returns -1.

There are no documented errno values.

Example

CELEBS22

```
/* CELEBS22

   This example returns blocked or pending signals.

*/
#define _POSIX_SOURCE
#include <signal.h>
#include <stdio.h>
#include <unistd.h>

void catcher(int signum) {
    puts("inside catcher!");
}

void check_pending(int signum, char *signame) {
    sigset_t sigset;

    if (sigpending(&sigset) != 0)
        perror("sigpending() error");
    else if (sigismember(&sigset, signum))
        printf("a %s signal is pending\n", signame);
    else
        printf("no %s signals are pending\n", signame);
}

main() {
    struct sigaction sigact;
    sigset_t sigset;

    sigemptyset(&sigact.sa_mask);
    sigact.sa_flags = 0;
    sigact.sa_handler = catcher;
    if (sigaction(SIGUSR1, &sigact, NULL) != 0)
        perror("sigaction() error");
    else {
        sigemptyset(&sigset);
        sigaddset(&sigset, SIGUSR1);
        if (sigprocmask(SIG_SETMASK, &sigset, NULL) != 0)
            perror("sigprocmask() error");
        else {
            puts("SIGUSR1 signals are now blocked");
            kill(getpid(), SIGUSR1);
            printf("after kill: ");
            check_pending(SIGUSR1, "SIGUSR1");
            sigemptyset(&sigset);
            sigprocmask(SIG_SETMASK, &sigset, NULL);
            puts("SIGUSR1 signals are no longer blocked");
            check_pending(SIGUSR1, "SIGUSR1");
        }
    }
}
```

Output

```
SIGUSR1 signals are now blocked
after kill: a SIGUSR1 signal is pending
inside catcher!
SIGUSR1 signals are no longer blocked
no SIGUSR1 signals are pending
```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigismember\(\) — Test if a signal is in a signal mask” on page 1631](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)

sigprocmask() — Examine or change a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <signal.h>

int sigprocmask(int option, const sigset_t *__restrict__ new_set,
                sigset_t *__restrict__ old_set);
```

General description

Examines, changes, or examines and changes the signal mask of the calling thread. If there is only one thread, it does the same for the calling process.

Typically, `sigprocmask(SIG_BLOCK, ..., ...)` is used to block signals during a critical section of code. At the end of the critical section of code, `sigprocmask(SIG_SETMASK, ..., ...)` is used to restore the mask to the previous value returned by `sigprocmask(SIG_BLOCK, ..., ...)`.

option

Indicates the way in which the existing set of blocked signals should be changed. The following are the possible values for *option*, defined in the `signal.h` header file:

SIG_BLOCK

Indicates that the set of signals given by *new_set* should be blocked, in addition to the set currently being blocked.

SIG_UNBLOCK

Indicates that the set of signals given by *new_set* should not be blocked. These signals are removed from the current set of signals being blocked.

SIG_SETMASK

Indicates that the set of signals given by *new_set* should replace the old set of signals being blocked.

new_set

Points to a signal set giving the new signals that should be blocked or unblocked (depending on the value of *option*) or it points to the new signal mask if the option was *sig_setmask*. Signal sets are

described in “sigemptyset() — Initialize a signal mask to exclude all signals” on page 1626. If *new_set* is a NULL pointer, the set of blocked signals is not changed. sigprocmask() determines the current set and returns this information in **old_set*. If *new_set* is NULL, the value of *option* is not significant.

The signal set manipulation functions: sigemptyset(), sigfillset(), sigaddset(), and sigdelset() must be used to establish the new signal set pointed to by *new_set*.

old_set

Points to a memory location where sigprocmask() can store a signal set. If *new_set* is NULL, *old_set* returns the current set of signals being blocked. When *new_set* is not NULL, the set of signals pointed to by *old_set* is the previous set.

If there are any pending unblocked signals, either at the process level or at the current thread's level after sigprocmask() has changed the signal mask, then at least one of those signals is delivered to the thread before sigprocmask() returns.

The signals SIGKILL, SIGSTOP, or SIGTRACE cannot be blocked. If you attempt to use sigprocmask() to block these signals, the attempt is simply ignored. sigprocmask() does not return an error status.

SIGFPE, SIGILL, and SIGSEGV signals that are not artificially generated by kill(), killpg(), raise(), sigqueue(), or pthread_kill() (that is, were generated by the system as a result of a hardware or software exception) will not be blocked.

If an artificially raised SIGFPE, SIGILL, or SIGSEGV signal is pending and blocked when an exception causes another SIGFPE, SIGILL, or SIGSEGV signal, both the artificial and exception-caused signals may be delivered to the application.

If sigprocmask() fails, the signal mask of the thread is not changed.

Usage notes

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If successful, sigprocmask() returns 0.

If unsuccessful, sigprocmask() returns -1 and sets errno to one of the following values:

Error Code**Description****EINVAL**

option does not have one of the recognized values.

Example**CELEBS23**

```
/* CELEBS23
   This example changes the signal mask.
*/
#define _POSIX_SOURCE
#include <signal.h>
#include <stdio.h>
#include <time.h>
#include <unistd.h>

void catcher(int signum) {
    puts("inside catcher");
}

main() {
    time_t start, finish;
    struct sigaction sact;
    sigset_t new_set, old_set;
    double diff;
```

```

sigemptyset(&sact.sa_mask);
sact.sa_flags = 0;
sact.sa_handler = catcher;
if (sigaction(SIGALRM, &sact, NULL) != 0)
    perror("sigaction() error");
else {
    sigemptyset(&new_set);
    sigaddset(&new_set, SIGALRM);
    if (sigprocmask(SIG_BLOCK, &new_set, &old_set) != 0)
        perror("1st sigprocmask() error");
    else {
        time(&start);
        printf("SIGALRM signals blocked at %s", ctime(&start));
        alarm(1);

        do {
            time(&finish);
            diff = difftime(finish, start);
        } while (diff < 10);
        if (sigprocmask(SIG_SETMASK, &old_set, NULL) != 0)
            perror("2nd sigprocmask() error");
        else
            printf("SIGALRM signals unblocked at %s", ctime(&finish));
    }
}
}

```

Output

```

SIGALRM signals blocked at Fri Jun 16 12:24:19 2006
inside catcher
SIGALRM signals unblocked at Fri Jun 16 12:24:29 2006

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“killpg\(\) — Send a signal to a process group” on page 933](#)
- [“pthread_kill\(\) — Send a signal to a thread” on page 1293](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“sigismember\(\) — Test if a signal is in a signal mask” on page 1631](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigrelse\(\) — Remove a signal from a thread” on page 1647](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

sigqueue() – Queue a signal to a process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R9 |

Format

```
#define _XOPEN_SOURCE 500
#include <sys/types.h>
#include <signal.h>

int sigqueue(pid_t pid, int signo, const union sigval value);
```

General description

Causes the signal specified by *signo* to be sent with the value specified by *value* to the process specified by *pid*. If *signo* is zero (the null signal), error checking is performed but no signal is actually sent. The null signal can be used to check the validity of *pid*. The conditions required for a process to have permission to queue a signal to another process are the same as for the `kill()` function.

The `sigqueue()` function returns immediately. If the resources were available to queue the signal, the signal is queued and sent to the receiving process. The fact that `SA_SIGINFO` is not set for *signo* does not effect this processing and queueing of the signal.

If the value of *pid* causes *signo* to be generated for the sending process, and if *signo* is not blocked for the calling thread and if no other thread has *signo* unblocked or is waiting in a `sigwait()` function for *signo*, either *signo* or at least the pending, unblocked signal will be delivered to the calling thread before `sigqueue()` returns.

Usage notes

The use of the `SIGTHSTOP` and `SIGTHCONT` signal is not supported with this function.

Since in AMODE 64 programs, `sigval` is 64 bits long, and in AMODE 31 programs `sigval` is only 32 bits long, when passing signal data between an AMODE 31 and AMODE 64 process, there are the following restrictions:

- In AMODE 64, the `sival_int` field covers only the first 4 bytes of the `sigval` field -- only the `sival_ptr` field can access all 8 bytes of the `sigval` field.
- When an AMODE 64 program passes a `sival_ptr` value to an AMODE 31 program, the AMODE 31 program receives only the low 32 bits of the original `sival_ptr`.
- When an AMODE 31 program passes a `sival_ptr` value to an AMODE 64 program, the original `sival_ptr` value is received in the low 32 bits of the AMODE 64 `sival_ptr`.
- When an AMODE 64 program tries to pass a value to an AMODE 31 program using the `sival_int` field, the AMODE 31 program will receive 0 in `sigval`.
- When an AMODE 31 program sends a value to an AMODE 64 program using `sival_int`, the AMODE 64 program will receive a 0 value in `sival_int`, but it can access the original value as the low 32 bits of the AMODE 64 `sival_ptr` field.

Returned value

If successful, `sigqueue()` returns 0.

If unsuccessful, `sigqueue()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EAGAIN
No resources available to queue the signal or the system-wide resource limit, defined by `MAXQUEUEDSIGS`, has been exceeded.

EINVAL
The value of the *signo* argument is an invalid or unsupported signal number.

EPERM
The process does not have the appropriate privilege to send the signal to the receiving process.

ESRCH
The process *pid* does not exist.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)

sigrelse() — Remove a signal from a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int sigrelse(int sig);
```

General description

The `sigrelse()` function provides a simplified method for removing the signal specified by the argument *sig* from the calling thread's signal mask.

Usage notes

The use of the `SIGTHSTOP` and `SIGTHCONT` signal is not supported with this function.

Returned value

If successful, `sigrelse()` returns 0.

If unsuccessful, `sigrelse()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EINVAL
The value of the argument *sig* is not a valid signal type or it is `SIGKILL`, `SIGSTOP`, or `SIGTRACE`.

Related information

- “[signal.h — Exception handling](#)” on page 58
- “[sighold\(\) — Add a signal to a thread](#)” on page 1628
- “[sigpause\(\) — Unblock a signal and wait for a signal](#)” on page 1640
- “[sigprocmask\(\) — Examine or change a thread](#)” on page 1643

sigset() — Change a signal action or a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

void (*sigset(int sig, void (*disp)(int)))(int);
```

General description

The `sigset()` function provides a simplified method for changing the action associated with a specific signal and unblock the signal, or to block this signal.

sig

The number of a recognized signal. `sigset()` sets the action associated with this signal and unblock this signal, or adds this signal to the calling thread's signal mask (thus blocking this signal). Refer to [Table 57 on page 1606](#) for a list of the supported values of *sig*.

The value of *sig* can be any valid signal type except SIGKILL, SIGSTOP, or SIGTRACE.

disp

There are four possible value that *disp* can have. Three are actions that can be associated with the signal, *sig*: SIG_DFL, SIG_IGN, or a pointer to a function. The fourth value is not a signal action, but a flag to `sigset()` that affects whether the signal action is changed.

The values that *disp* is permitted to have are:

SIG_DFL

Set the signal action to the signal-specific default.

- The default actions for each signal is shown in [Table 57 on page 1606](#).
- If *disp* is set to SIG_DFL, `sigset()` will change the signal action associated with *sig* and remove this signal from the calling thread's signal mask (thus unblocking this signal).
- If the default action is to stop the process, the execution of that process is temporarily suspended. When a process stops, a SIGCHLD signal will be generated for its parent process, unless the parent process has set the **SA_NOCLDSTOP** flag. While a process is stopped, any additional signals that are sent to the process will not be delivered until the process is continued, except SIGKILL which always terminates the receiving process. A process that is a member of an orphaned process group will not be allowed to stop in response to the SIGTSTP, SIGTTIN, or SIGTTOU signals. In cases where delivery of one of these signals would stop such a process, the signal will be discarded.

- Setting a signal action to SIG_DFL for a signal that is pending, and whose default action is to ignore the signal (for example SIGCHLD), will cause the pending signal to be discarded.

SIG_IGN

Set the signal action to ignore the signal.

- Delivery of the signal will have no effect on the process.
- If *disp* is set to SIG_IGN, sigset() will change the signal action associated with *sig* and remove this signal from the calling thread's signal mask (thus unblocking this signal).
- Setting a signal action to SIG_IGN for a signal that is pending will cause the pending signal to be discarded. This provides the ability to discard signals that are found to be blocked and pending by sigpending().
- If *sig* is SIGCHLD, child processes of the calling process will not be transformed into 'zombie' processes when they terminate. If the calling process subsequently waits for its children, and the process has no unwaited from children that were transformed into 'zombie' processes, it will block until all of its children terminate. The wait(), waitid(), or waitpid() function will fail and set errno to **ECHILD**.

SIG_HOLD

Set the calling thread's signal mask to block signal, *sig*.

- The signal action associated with *sig* is not changed.

Pointer to function

Set the signal action to catch the signal.

- sigset() will change the signal action associated with *sig* and remove this signal from the calling thread's signal mask (thus unblocking this signal).
- On delivery of the signal, the receiving process is to execute the signal-catching function at the specified address. After returning from the signal-catching function, the receiving process will resume execution at the point at which it was interrupted.
- The signal-catching function specified by *disp* is invoked as:

```
void function(int signo);
```

Where *function* is the specified signal-catching function and *signo* is the signal number of the signal being delivered.

After an action has been specified for a particular signal, using sigset(), it remains installed until it is explicitly changed with another call to sigset(), sigaction(), signal(), one of the exec functions, bsd_signal(), or sigignore().

Special behavior for C++:

- The behavior when mixing signal-handling with C++ exception handling is undefined. Also, the use of signal-handling with constructors and destructors is undefined.
- C++ and C language linkage conventions are incompatible, and therefore sigaction() cannot receive C++ function pointers. If you attempt to pass a C++ function pointer to sigaction(), the compiler will flag it as an error. Therefore, to use the sigaction() function in the C++ language, you must ensure that signal handler routines established have C linkage, by declaring them as `extern "C"`.

Usage notes

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If successful, sigset() returns SIG_HOLD if the signal had been blocked and the signal's previous action if it had not been blocked.

If unsuccessful, sigset() returns SIG_ERR and sets errno to one of the following values:

Error Code
Description

EINVAL
The value of the argument *sig* was not a valid signal type, or it was SIGKILL, SIGSTOP, or SIGTRACE.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sighold\(\) — Add a signal to a thread” on page 1628](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)

sigsetjmp() — Save stack environment and signal mask

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <setjmp.h>

int sigsetjmp(sigjmp_buf env, int savemask);
```

General description

Saves the current stack environment including, optionally, the current signal mask. The stack environment and signal mask saved by sigsetjmp() can subsequently be restored by siglongjmp().

env is an address for a sigjmp_buf structure. *savemask* is a flag used to determine if the signal mask is to be saved. If it has a value of 0, the current signal mask is not to be saved or restored as part of the environment. Any other value means the current signal mask is saved and restored.

sigsetjmp() is similar to setjmp() and _setjmp(), except for the optional capability of saving the signal mask. Like setjmp() and longjmp(), the sigsetjmp() and siglongjmp() functions provide a way to perform a nonlocal goto.

The sigsetjmp()—siglongjmp() pair, the setjmp()—longjmp() pair, the _setjmp()—_longjmp() pair and the getcontext()—setcontext() pair cannot be intermixed. A stack environment and signal mask saved by sigsetjmp() can be restored only by siglongjmp().

A call to sigsetjmp() causes it to save the current stack environment in *env*. If the value of the *savemask* parameter is nonzero, it will also save the current signal mask in *env*. A subsequent call to siglongjmp() restores the saved environment and signal mask (if saved by sigsetjmp()), and returns control to a point corresponding to the sigsetjmp() call. The values of all variables (except register variables) accessible to the function receiving control contain the values they had when siglongjmp() was called. The values of register variables are unpredictable. Nonvolatile auto variables that are changed between calls to sigsetjmp() and siglongjmp() are also unpredictable.

Note: Ensure that the function that calls `sigsetjmp()` does not return before you call the corresponding `siglongjmp()` function. Calling `siglongjmp()` after the function calling `sigsetjmp()` returns causes unpredictable program behavior.

Special behavior for C++: If `sigsetjmp()` and `siglongjmp()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. The use of `sigsetjmp()` and `siglongjmp()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Special behavior for XPLINK-compiled C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Language Environment V2R10 and later headers define a shorter **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

`sigsetjmp()` returns 0 when it is invoked to save the stack environment and signal mask.

`sigsetjmp()` returns the value *val*, specified on `siglongjmp()` (or 1 if the value of *val* is zero), when `siglongjmp()` causes control to be transferred to the place in the user's program where `sigsetjmp()` was issued.

There are no documented `errno` values.

Example

The following saves the stack environment and signal mask at the statement:

```
if(sigsetjmp(mark,1) != 0) ...
```

When the system first performs the `if` statement, it saves the environment and signal mask in *mark* and sets the condition to false because `sigsetjmp()` returns 0 when it saves the environment. The program prints the message:

```
sigsetjmp() has been called
```

The subsequent call to function `p()` tests for a local error condition, which can cause it to perform `siglongjmp()`. Then control returns to the original `sigsetjmp()` function using the environment saved in *mark* and the restored signal mask. This time the condition is true because -1 is the return value from `siglongjmp()`. The program then performs the statements in the block and prints:

```
siglongjmp() has been called
```

Then the program performs the `sample_recover()` function and exits.

```
#define _POSIX_SOURCE
#include <stdio.h>
#include <setjmp.h>

sigjmp_buf mark;
```

```
void p(void);
void recover(void);

int main(void)
{
    if (sigsetjmp(mark,1) != 0) {
        printf("siglongjmp() has been called\n");
        recover();
        exit(1);
    }
    printf("sigsetjmp() has been called\n");
    :
    p();
    :
    :
}

void p(void)
{
    int error = 0;
    :
    error = 9;
    :
    if (error != 0)
        siglongjmp(mark, -1);
    :
    :
}

void recover(void)
{
    :
    :
}
```

Related information

- [“setjmp.h – Manipulate program state” on page 58](#)
- [“getcontext\(\) – Get user context” on page 695](#)
- [“longjmp\(\) – Restore stack environment” on page 1009](#)
- [“_longjmp\(\) – Nonlocal goto” on page 1011](#)
- [“setcontext\(\) – Restore user context” on page 1520](#)
- [“setjmp\(\) – Preserve stack environment” on page 1542](#)
- [“_setjmp\(\) – Set jump point for a nonlocal goto” on page 1544](#)
- [“sigaction\(\) – Examine or change a signal action” on page 1605](#)
- [“siglongjmp\(\) – Restore the stack environment and signal mask” on page 1633](#)
- [“sigprocmask\(\) – Examine or change a thread” on page 1643](#)
- [“sigsuspend\(\) – Change mask and suspend the thread” on page 1654](#)
- [“swapcontext\(\) – Save and restore user context” on page 1784](#)

sigstack() – Set or get signal stack context

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <signal.h>

int sigstack(struct sigstack *ss, struct sigstack *oss);
```

General description

The `sigstack()` function allows the calling thread to indicate, to the system, an area of its address space to be used for processing signals received by this thread.

Note: To explicitly declare that a signal catcher is to run on the alternate signal stack, the `SA_ONSTACK` flag must be set in the `sa_flags` when the signal action is set using `sigaction()`.

If the `ss` argument is not a NULL pointer, it must point to a `sigstack` structure. The length of the application-supplied stack must be at least `SIGSTKSZ` bytes. If the alternate signal stack overflows, the resulting behavior is undefined.

- The value of the `ss_onstack` member indicates whether the thread wants the system to use an alternate signal stack when delivering signals.
- The value of the `ss_sp` member indicates the desired location of the alternate signal stack area in the process's address space.

AMODE 64: Storage for this stack must be above the 2GB bar. It may not be storage acquired with the `__malloc24()` or `__malloc31()` functions.

- If the `ss` argument is a NULL pointer, the current alternate signal stack context is not changed.

If the `oss` argument is not a NULL pointer, it must point to a `sigstack` structure into which the current alternate signal stack context is placed. The value stored in the `ss_onstack` member of this `sigstack` structure will be nonzero if the thread is currently executing on the alternate signal stack. If the `oss` argument is a NULL pointer, the current alternate signal stack context is not returned.

When a signal's action indicates its handler should execute on the alternate signal stack (specified by calling `sigaction()`), the implementation checks to see if the thread is currently executing on the alternate signal stack. If it is not, the system will switch to the alternate signal stack for the duration of the signal handler's execution.

After a successful call to one of the `exec` functions, there are no alternate signal stacks in the new process image.

Notes:

1. If a signal handler is enabled to run on an alternate stack, then all functions called by that signal handler must be compiled with the same linkage. For example, if the signal handler is compiled with `XPLINK`, then all functions it calls must also be compiled `XPLINK`. Since only one alternate stack can be supplied, no mixing of linkages (which would require both upward and downward-growing alternate stacks) is allowed. The type of stack created will be based on the attributes of the signal handler to be given control. If the signal handler has been compiled with `XPLINK`, then a downward-growing stack will be created in the alternate stack, including, in `AMODE 31`, using enough storage in the user stack to create a 4k read-only guard page (aligned on a 4k boundary).
2. If a new signal is received while a signal handler is running on an alternate stack, and that new signal specified a signal handler that also runs on the alternate stack, then both signal handlers must have been compiled with the same linkage (`XPLINK` versus non-`XPLINK`).
3. This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. New applications should use `sigaltstack()` instead of `sigstack()`.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `sigstack()` returns 0.

If unsuccessful, `sigstack()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

EPERM
An attempt was made to modify an active stack.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaltstack\(\) — Set or get signal alternate stack context” on page 1622](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)

sigsuspend() — Change mask and suspend the thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _POSIX_SOURCE
#include <signal.h>

int sigsuspend(const sigset_t *mask);
```

General description

Replaces the current signal mask of a thread with the signal set given by **mask* and then suspends execution of the calling thread. The thread does not resume running until a signal is delivered whose action is either to execute a signal-handling function or to end the process. (Signal sets are described in more detail in [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626.](#))

The signal mask indicates a set of signals that should be blocked. Such signals do not “wake up” the suspended function. The signals SIGKILL, SIGSTOP, or SIGTRACE cannot be blocked or ignored; they are delivered to the thread no matter what the *mask* argument specifies.

If an incoming unblocked signal ends the thread, sigsuspend() never returns to the caller. If an incoming signal is handled by a signal-handling function, sigsuspend() returns after the signal-handling function returns. The signal mask of the thread is restored to whatever it was before sigsuspend() was called, unless the signal-handling functions explicitly changed the mask.

This function is supported only in a POSIX program.

Usage notes

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If sigsuspend() returns, it always returns -1.

If unsuccessful, sigsuspend() sets errno to one of the following values:

Error Code

Description

EINTR

A signal was received and handled successfully.

Example

CELEBS25

```

/* CELEBS25

   This example replaces the signal mask and then suspends execution.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <signal.h>
#include <time.h>
#include <unistd.h>

void catcher(int signum) {
    switch (signum) {
        case SIGUSR1: puts("catcher caught SIGUSR1");
                     break;
        case SIGUSR2: puts("catcher caught SIGUSR2");
                     break;
        default:      printf("catcher caught unexpected signal %d\n",
                           signum);
    }
}

main() {
    sigset_t sigset;
    struct sigaction sact;
    time_t t;

    if (fork() == 0) {
        sleep(10);
        puts("child is sending SIGUSR2 signal - which should be blocked");
        kill(getppid(), SIGUSR2);
        sleep(5);
        puts("child is sending SIGUSR1 signal - which should be caught");
        kill(getppid(), SIGUSR1);
        exit(0);
    }

    sigemptyset(&sact.sa_mask);
    sact.sa_flags = 0;
    sact.sa_handler = catcher;
    if (sigaction(SIGUSR1, &sact, NULL) != 0)
        perror("1st sigaction() error");

    else if (sigaction(SIGUSR2, &sact, NULL) != 0)
        perror("2nd sigaction() error");

    else {
        sigfillset(&sigset);
        sigdelset(&sigset, SIGUSR1);
        time(&t);
        printf("parent is waiting for child to send SIGUSR1 at %s",
               ctime(&t));
        if (sigsuspend(&sigset) == -1)
            perror("sigsuspend() returned -1 as expected");
        time(&t);
        printf("sigsuspend is over at %s", ctime(&t));
    }
}

```

Output

```

parent is waiting for child to send SIGUSR1 at Fri Jun 16 12:30:57 2006
child is sending SIGUSR2 signal - which should be blocked
child is sending SIGUSR1 signal - which should be caught
catcher caught SIGUSR2
catcher caught SIGUSR1

```

```
sigsuspend() returned -1 as expected: Interrupted function call
sigsuspend is over at Fri Jun 16 12:31:12 2006
```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“killpg\(\) — Send a signal to a process group” on page 933](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“pthread_kill\(\) — Send a signal to a thread” on page 1293](#)
- [“raise\(\) — Raise signal” on page 1375](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigaddset\(\) — Add a signal to the signal mask” on page 1621](#)
- [“sigdelset\(\) — Delete a signal from the signal mask” on page 1624](#)
- [“sigemptyset\(\) — Initialize a signal mask to exclude all signals” on page 1626](#)
- [“sigfillset\(\) — Initialize a signal mask to include all signals” on page 1627](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)

sigtimedwait() — Wait for queued signals

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R7 |

Format

```
#define _XOPEN_SOURCE 500
#include <signal.h>

int sigtimedwait(const sigset_t *set, siginfo_t *info
                 const struct timespec *timeout);
```

General description

The `sigtimedwait()` function selects a pending signal from the `sigset_t` object (signal set) pointed to by `set`, automatically clearing it from the system's set of pending signals, and returning that signal number. If there are multiple pending signals, the lowest numbered signal will be selected.

If no signal in the signal set is pending at the time of the call to `sigtimedwait()`, the thread is suspended until one or more of the signals specified in the signal set become pending or until it is interrupted by an unblocked, caught signal. The signals defined in the `sigset_t` object (signal set) pointed to by `set` may

be unblocked during the call to this routine and will be blocked when the thread returns from the call unless some other thread is currently waiting for one of those signals.

If more than one thread is using sigtimedwait() to wait for the same signal, only one of these threads will return from this routine with the signal number, until a second signal of the same type is received.

The function sigtimedwait() behaves the same as the sigwait() function if the *info* argument is NULL. If the *info* argument is not NULL, then in addition to behaving the same as sigwait(), sigtimedwait() places the selected signal number in the *si_signo* member, places the cause of the signal in the *si_code* member, and, if any value is queued to the selected signal, sigtimedwait() will place it in the *si_value* member of *info*. However, if there is no value queued for the selected signal then the content of *si_value* is undefined.

If the sigtimedwait() function finds that none of the signals specified by *set* are pending, it waits for the time interval specified in the *timespec* structure referenced by *timeout*. If the *timespec* structure pointed to by *timeout* is zero-valued and if none of the signals specified by *set* are pending, then sigtimedwait() returns immediately with an error. A *timespec* with the *tv_sec* field set with *INT_MAX*, as defined in <limits.h>, will cause the sigtimedwait() service to wait until a signal is received. If *timeout* is the NULL pointer, the behavior is not necessarily the same on all platforms but for this platform it will be treated the same as when *timespec* structure was supplied with the *tv_sec* field set with *INT_MAX*.

Usage notes

The use of the SIGTHSTOP and SIGTHCONT signal is not supported with this function.

Returned value

If successful, sigtimedwait() returns the signal number.

If unsuccessful, sigtimedwait() returns -1 and sets *errno* to one of the following values:

Error Code

Description

EAGAIN

No signal specified by *set* was generated within the specified time out period.

EINTR

The wait was interrupted by an unblocked, caught signal. No further waiting will occur for this call. sigtimedwait() can be reissued to begin waiting again.

EINVAL

set points to a **sigset_t** that contains a signal number that is either not valid or not supported.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“time.h — Time and date” on page 75](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)
- [“sigwait\(\) — Wait for an asynchronous signal” on page 1658](#)

sigwait() — Wait for an asynchronous signal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 Single UNIX Specification, Version 3 | both | |

Format

```
#define _OPEN_THREADS
#include <signal.h>

int sigwait(sigset_t *set);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <signal.h>
int sigwait(const sigset_t *__restrict__ set, int *__restrict__ sig);
```

General description

Causes a thread to wait for an asynchronous signal by choosing a pending signal from *set*, automatically clearing it from the system's set of pending signals, and returning that signal number in the return code.

If no signal in *set* is pending at the time of the call, the thread is suspended until one or more of the signals in *set* become pending. The signals defined by *set* may be unblocked during the call to this routine, and will be blocked when the thread returns from the call unless some other thread is currently waiting for one of those signals.

If more than one thread is using this routine to wait for the same signal, only one of these threads will return from this routine with the signal number.

Special behavior for SUSV3: The `sigwait()` function selects a pending signal from *set*, atomically clear it from the system's set of pending signals, and return that signal number in the location referenced by *sig*.

| Argument | Description |
|------------|--|
| <i>sig</i> | location reference where the signal number is stored |

Usage notes

The use of the `SIGTHSTOP` and `SIGTHCONT` signal is not supported with this function.

Returned value

If successful, `sigwait()` returns the signal number.

If unsuccessful, `sigwait()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The *set* argument contains an invalid or unsupported signal number.

Special behavior for SUSV3: Upon successful completion, `sigwait()` stores the signal number of the received signal at the location referenced by `sig` and return 0. Otherwise, an error number is returned to indicate the error.

Example

CELEBS26

```
/* CELEBS26 */
#define _OPEN_THREADS

#include <stdio.h>
#include <errno.h>
#include <signal.h>
#include <pthread.h>
#include <unistd.h>

void          *threadfunc(void *parm)
{
    int          threadnum;
    int          *tnum;
    sigset_t      set;

    tnum = parm;
    threadnum = *tnum;

    printf("Thread %d executing\n", threadnum);
    sigemptyset(&set);
    if(sigaddset(&set, SIGUSR1) == -1) {
        perror("Sigaddset error");
        pthread_exit((void *)1);
    }

    if(sigwait(&set) != SIGUSR1) {
        perror("Sigwait error");
        pthread_exit((void *)2);
    }

    pthread_exit((void *)0);
}

main() {
    int          status;
    int          threadparm = 1;
    pthread_t      threadid;
    int          thread_stat;

    status = pthread_create( &threadid, NULL,
                            threadfunc,
                            (void *)&threadparm);

    if ( status < 0 ) {
        perror("pthread_create failed");
        exit(1);
    }

    sleep(5);

    status = pthread_kill( threadid, SIGUSR1);
    if ( status < 0 )
        perror("pthread_kill failed");

    status = pthread_join( threadid, (void *)&thread_stat);
    if ( status < 0 )
        perror("pthread_join failed");

    exit(0);
}
```

CELEBP73

```
/* CELEBS73

This example demonstrates the use of the sigwait() function.
The program will wait until a SIGINT signal is received from the
command line.
```

```
Expected output:
SIGINT was received

*/

#define _POSIX_C_SOURCE 200112L
#include <signal.h>
#include <stdio.h>
#include <errno.h>

void main() {
    sigset_t set;
    int sig;
    int *sigptr = &sig;
    int ret_val;
    sigemptyset(&set);
    sigaddset(&set, SIGINT);
    sigprocmask( SIG_BLOCK, &set, NULL );

    printf("Waiting for a SIGINT signal\n");

    ret_val = sigwait(&set,sigptr);
    if(ret_val == -1)
        perror("sigwait failed\n");
    else {
        if(*sigptr == 2)
            printf("SIGINT was received\n");
        else
            printf("sigwait returned with sig: %d\n", *sigptr);
    }
}
```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“sigpause\(\) — Unblock a signal and wait for a signal” on page 1640](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

sigwaitinfo() — Wait for queued signals

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R7 |

Format

```
#define _XOPEN_SOURCE 500
#include <signal.h>

int sigwaitinfo(const sigset_t *set, siginfo_t *info);
```

General description

The `sigwaitinfo()` function selects a pending signal from the `sigset_t` object (signal set) pointed to by *set*, automatically clearing it from the system's set of pending signals, and returning that signal number. If there are multiple pending signals, the lowest numbered signal will be selected.

If no signal in the signal set is pending at the time of the call to `sigwaitinfo()`, the thread is suspended until one or more of the signals specified in the signal set become pending or until it is interrupted by an unblocked, caught signal. The signals defined in the `sigset_t` object (signal set) pointed to by *set* may be unblocked during the call to this routine and will be blocked when the thread returns from the call unless some other thread is currently waiting for one of those signals.

If more than one thread is using `sigwaitinfo()` to wait for the same signal, only one of these threads will return from this routine with the signal number, until a second signal of the same type is received.

The function `sigwaitinfo()` behaves the same as the `sigwait()` function if the *info* argument is `NULL`. If the *info* argument is not `NULL`, then in addition to behaving the same as `sigwait()`, `sigwaitinfo()` places the selected signal number in the `si_signo` member, places the cause of the signal in the `si_code` member, and, if any value is queued to the selected signal, `sigwaitinfo()` will place it in the `si_value` member of *info*. However, if there is no value queued for the selected signal then the content of *si_value* is undefined.

Usage notes

The use of the `SIGTSTOPS` and `SIGTCONT` signal is not supported with this function.

Returned value

If successful, `sigwaitinfo()` returns the signal number.

If unsuccessful, `sigwaitinfo()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINTR

The wait was interrupted by an unblocked, caught signal. No further waiting will occur for this call. `sigwaitinfo()` can be reissued to begin waiting again.

EINVAL

set points to a `sigset_t` that contains a signal number that is either not valid or not supported.

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“time.h — Time and date” on page 75](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)
- [“sigwait\(\) — Wait for an asynchronous signal” on page 1658](#)

sin(), sinf(), sinl() – Calculate sine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double sin(double x);
float sin(float x);           /* C++ only */
long double sin(long double x); /* C++ only */
float sinf(float x);
long double sinl(long double x);
```

General description

Calculates the sine of x, with x expressed in radians.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

If successful, the function returns the calculated value, expressed as a double, float, or long double. Otherwise, if the result is an underflow, the function returns 0 and sets the errno to ERANGE.

Special Behavior for XPG4.2: The following error is added:

Error Code

Description

EDOM

The argument exceeded an internal limit for the function (approximately 2⁵⁰).

Example

CELEBS27

```
/* CELEBS27

   This example computes y as the sine of &pi.&slr.2.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double pi, x, y;

    pi = 3.1415926535;
    x = pi/2;
    y = sin(x);
```



```
printf("sin( %lf ) = %lf\n", x, y);
}
```

Output

```
sin( 1.570796 ) = 1.000000
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“atanh\(\), atanhf\(\), atanh\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)
- [“sinh\(\), sinh\(\), sinhl\(\) — Calculate hyperbolic sine” on page 1664](#)
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent” on page 1809](#)
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent” on page 1812](#)

sind32(), sind64(), sind128() — Calculate sine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 sind32(_Decimal32 x);
_Decimal64 sind64(_Decimal64 x);
_Decimal128 sind128(_Decimal128 x);
_Decimal32 sin(_Decimal32 x); /* C++ only */
_Decimal64 sin(_Decimal64 x); /* C++ only */
_Decimal128 sin(_Decimal128 x); /* C++ only */
```

General description

Calculates the sine of x, with x expressed in radians.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, the function returns the calculated value, expressed as a _Decimal32, _Decimal64, or _Decimal128.

If x is outside prescribed limits, the value is not calculated. Instead, the function returns 0 and sets errno to EDOM.

Example

```
/* CELEBS69

   This example illustrates the sind32() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal32 pi, x, y;

    pi = 3.141593DF;
    x = pi/2.0DF;
    y = sind32(x);

    printf("sind32(%Hf) = %Hf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)

sinh(), sinhf(), sinhl() — Calculate hyperbolic sine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double sinh(double x);
float sinh(float x);
long double sinh(long double x);
float sinhf(float x);
long double sinhl(long double x);

/* C++ only */
/* C++ only */
```

General description

Calculates the hyperbolic sine of x , with x expressed in radians.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

If successful, the function returns the calculated value.

Otherwise, if the result is too large, the function sets `errno` to `ERANGE` and returns $\pm\text{HUGE_VAL}$, depending on the value of x . If the value underflows, the function returns 0 and sets `errno` to `ERANGE`.

Special behavior for IEEE: If successful, the function returns the hyperbolic sine of x with x expressed in radians.

If the result would overflow, the function returns $\pm\text{HUGE_VAL}$, according to the value of x , and sets `errno` to `ERANGE`. No other errors can occur.

Example

CELEBS28

```
/* CELEBS28
   This example computes y as the hyperbolic sine of &pi.&slr.2.
*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double pi, x, y;

    pi = 3.1415926535;
    x = pi/2;
    y = sinh(x);

    printf("sinh( %lf ) = %lf\n", x, y);
}
```

Output

```
sinh( 1.570796 ) = 2.301299
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“atanh\(\), atanhf\(\), atanh\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent” on page 1809](#)
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent” on page 1812](#)

sinhd32(), sinhd64(), sinhd128() - Calculate hyperbolic sine

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 sinhd32(_Decimal32 x);
_Decimal64 sinhd64(_Decimal64 x);
_Decimal128 sinhd128(_Decimal128 x);
_Decimal32 sinh(_Decimal32 x);    /* C++ only */
_Decimal64 sinh(_Decimal64 x);    /* C++ only */
_Decimal128 sinh(_Decimal128 x);  /* C++ only */
```

General description

Calculates the hyperbolic sine of x , with x expressed in radians.

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

If successful, the function returns the hyperbolic sine of x with x expressed in radians.

If the result would overflow, the function returns $\pm\text{HUGE_VAL_D32}$, $\pm\text{HUGE_VAL_D64}$, or $\pm\text{HUGE_VAL_D128}$ according to the value of x , and sets `errno` to `ERANGE`. No other errors can occur.

Example

CELEBS75

```
/* CELEBS75

   This example illustrates the sinhd64() function.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 pi, x, y;

    pi = 3.1415926535DD;
    x = pi/2.0DD;
    y = sinhd64(x);

    printf("sinhd64( %Df ) = %Df\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)

- “[atanh\(\), atanhf\(\), atanhf\(\) — Calculate hyperbolic arctangent](#)” on page 194
- “[acosd32\(\), acosd64\(\), acosd128\(\) - Calculate arccosine](#)” on page 139
- “[acoshd32\(\), acoshd64\(\), acoshd128\(\) - Calculate hyperbolic arccosine](#)” on page 142
- “[asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine](#)” on page 184
- “[asinh32\(\), asinh64\(\), asinh128\(\) - Calculate hyperbolic arcsine](#)” on page 187
- “[atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent](#)” on page 192
- “[atanhd32\(\), atanhd64\(\), atanhd128\(\) - Calculate hyperbolic arctangent](#)” on page 195
- “[cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine](#)” on page 332
- “[coshd32\(\), coshd64\(\), coshd128\(\) - Calculate hyperbolic cosine](#)” on page 334
- “[sind32\(\), sind64\(\), sind128\(\) — Calculate sine](#)” on page 1663
- “[tand32\(\), tand64\(\), tand128\(\) - Calculate tangent](#)” on page 1810
- “[tanhd32\(\), tanhd64\(\), tanhd128\(\) - Calculate hyperbolic tangent](#)” on page 1813

__sinpid32(), __sinpid64(), __sinpid128() — Calculate sine of $\pi * x$

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 __sinpid32(_Decimal32 x);
_Decimal64 __sinpid64(_Decimal64 x);
_Decimal128 __sinpid128(_Decimal128 x);
```

General description

Calculates the sine of $\pi * x$, with x expressed in radians.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, the function returns the calculated value, expressed as a `_Decimal32`, `_Decimal64`, or `_Decimal128` number.

If x is outside prescribed limits, the value is not calculated. Instead, the function returns 0 and sets `errno` to `EDOM`.

Example

```
/* CELEBS70
   This example illustrates the __sinpid64() function.
```

```
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 x, y;

    x = 0.5DD;
    y = __sinpid64(x);

    printf("__sinpid64(%Df) = %Df\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“__cospid32\(\), __cospid64\(\), __cospid128\(\) — Calculate cosine of pi *x ” on page 335](#)

sleep() — Suspend execution of a thread

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

unsigned int sleep(unsigned int seconds);
```

General description

Suspends thread execution for a specified number of *seconds*. Because of processor delays, the thread can sleep slightly longer than this specified time. An unblocked signal received during this time (for which the action is to invoke a signal handler function or to end the thread) “wakes up” the thread prematurely. When that function returns, sleep() returns immediately even if there is sleep time remaining.

This function is supported only in a POSIX program.

Returned value

If the thread slept for the full specified time, sleep() returns 0.

If the thread awoke prematurely because of a signal whose action is to invoke a signal-handling function or to end the thread, sleep() returns the number of seconds remaining in its sleep time (that is, the value of *seconds* minus the actual number of seconds that the thread was suspended).

sleep() always succeeds, so there is no failure return. An abend is generated when any failures are encountered that prevent this function from completing successfully.

There are no documented errno values.

Example

CELEBS29

```

/* CELEBS29

   This example suspends execution for a specified time.

   */
#define _POSIX_SOURCE
#include <stdio.h>
#include <time.h>
#include <unistd.h>

main() {
    unsigned int ret;
    time_t t;
    time(&t);
    printf("starting sleep at %s", ctime(&t));
    ret = sleep(10);
    time(&t);
    printf("naptime over at %s", ctime(&t));
    printf("sleep() returned %d\n", ret);
}

```

Output

```

starting sleep at Fri Jun 16 07:44:47 2006
naptime over at Fri Jun 16 07:44:58 2006
sleep() returned 0

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“bsd_signal\(\) — BSD version of signal\(\)” on page 220](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“killpg\(\) — Send a signal to a process group” on page 933](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“pthread_kill\(\) — Send a signal to a thread” on page 1293](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sigignore\(\) — Set disposition to ignore a signal” on page 1629](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“sigset\(\) — Change a signal action or a thread” on page 1648](#)
- [“sigsuspend\(\) — Change mask and suspend the thread” on page 1654](#)

__smf_record() — Record an SMF record

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <unistd.h>

int __smf_record(int smf_record_type,
                 int smf_record_subtype,
                 int smf_record_length,
                 char *smf_record);
```

General description

The `__smf_record()` function writes an SMF record pointed to by `smf_record` of length `smf_record_length` for SMF record type `smf_record_type` and subtype `smf_record_subtype` to the SMF data set.

The service can also be used to determine if a particular type or subtype of SMF record is being recorded to avoid the overhead of data collection if the SMF record is not going to be recorded. See [z/OS MVS System Management Facilities \(SMF\)](#) for more information on SMF record types and layout.

The caller of this service must be APF-authorized or permitted to either the BPX.SMF facility class profile or the BPX.SMF.type.subtype resource profile in the FACILITY class where type is the SMF record type to be written and subtype is the SMF record subtype to be written. For more information about creating and using these profiles and the restrictions on their use, refer to [z/OS UNIX System Services Planning](#).

Returned value

If successful, `__smf_record()` returns 0.

If unsuccessful, `__smf_record()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value specified on the length operand was incorrect. Use `__errno2()` to retrieve the reason code that is associated with the error. The following reason codes can accompany the return code: JRSMFBadRecordLength, JrSMFTypeSubtypeMismatch, or JrSMFRecordLenMismatch.

EMVSERR

The SMF service returned a nonzero return code. Use `__errno2()` to determine why the error occurred. The following reason codes can accompany the return code: JRSMFNotAccepting, JRSMFError, JRBadAddress, or JRInternalError.

ENOMEM

Not enough storage.

EPERM

The calling process is not permitted to the BPX.SMF resource in the FACILITY class and the calling processes are not APF-authorized, or the calling process is permitted to the BPX.SMF.xxx.yyy FACILITY class resource but the environment is dirty. The following reason codes can accompany the return code: JRSMFNotAuthorized and JREnvDirty.

Related information

None.

__smf_record2() – Record an SMF record with exit control

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1.12 |

Format

```
#include <unistd.h>

int __smf_record2 (int smf_record_type,
                  int smf_record_subtype,
                  int smf_record_length,
                  char *smf_record
                  unsigned int smf_exit );
```

General description

The `__smf_record2()` function writes an SMF record pointed to by `smf_record` of length `smf_record_length` for SMF record type `smf_record_type` and subtype `smf_record_subtype` to the SMF data set.

The `smf_exit` argument defines which user exit is to take control when the SMF record is written. Acceptable values for this argument are as follows:

`_SMF_IUFU83` Cause SMF exit IEFU83 to gain control.
`_SMF_IUFU84` Cause SMF exit IEFU84 to gain control.

and are defined in `<unistd.h>`

The service can also be used to determine if a particular type or subtype of SMF record is being recorded to avoid the overhead of data collection if the SMF record is not going to be recorded. See [z/OS MVS System Management Facilities \(SMF\)](#) for more information on SMF record types and layout.

The caller of this service must be APF-authorized or permitted to either the BPX.SMF facility class profile or the BPX.SMF.type.subtype resource profile in the FACILITY class where type is the SMF record type to be written and subtype is the SMF record subtype to be written. For more information about creating and using these profiles and the restrictions on their use, see [z/OS UNIX System Services Planning](#).

This function is supported under CICS Transaction Server for z/OS only when run in an open transaction environment (OTE).

Note: To determine if a particular SMF record type or subtype is being recorded, specify NULL for the `smf_record` argument. If the return value is 0, the type or subtype is being recorded. If the return value is -1 and `errno` is EMVSERR with a reason code of JRSMFNotAccepting, SMF is not recording this type or subtype.

Returned value

If successful, `__smf_record2()` returns 0.

If unsuccessful, `__smf_record2()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value that was specified for an argument was incorrect. Use `__errno2()` to retrieve the reason code that is associated with the error. The following reason codes can accompany the return code: JRSMFBadRecordLength, JrSMFTypeSubtypeMismatch, or JrSMFRecordLenMismatch.

EMVSERR

The SMF service returned a nonzero return code. Use `__errno2()` to retrieve the reason code associated with the error. The following reason codes can accompany the return code: JRSMFNotAccepting, JRSMFError, JRBadAddress, or JRInternalError.

ENOMEM

Not enough storage is available.

EPERM

The calling process is not permitted to the BPX.SMF resource in the FACILITY class and the calling processes are not APF-authorized, or the calling process is permitted to the BPX.SMF.xxx.yyy

FACILITY class resource but the environment is dirty. The following reason codes can accompany the return code: JRSMFNotAuthorized and JREnvDirty.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“__smf_record\(\) — Record an SMF record” on page 1669](#)

snprintf() — Format and write data

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R6 |

Format

```
#define _ISOC99_SOURCE
#include <stdio.h>

int snprintf(char *__restrict__ s, size_t n, const char *__restrict__ format, ...);
```

Note: The snprintf() function is also available under the alternate name __snprtf(). The __snprtf() function is accessible in the open name space.

```
#include <stdio.h>

int __snprtf(char *__restrict__ s, size_t n, const char *__restrict__ format, ...);
```

General description

Equivalent to fprintf(), except that the output is written into an array (specified by argument s) rather than to a stream. If n is zero, nothing is written, and s may be a null pointer. Otherwise, output characters beyond the n-1st are discarded rather than being written to the array, and a null character is written at the end of the characters actually written into the array. If copying takes place between objects that overlap, the behavior is undefined.

Returned value

Returns the number of characters that would have been written had n been sufficiently large, not counting the terminating null character, or a negative value if an encoding error occurred. Thus, the null-terminated output has been completely written if and only if the returned value is nonnegative and less than n.

Errors

Function fails if:

- The value of n is greater than {INT_MAX} or the number of bytes needed to hold the output excluding the terminating null is greater than {INT_MAX}. In this case, the function returns a negative value and sets errno to EOVERFLOW

socketmark() — Determine whether a socket is at the out-of-band mark

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R9 |

Format

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <sys/socket.h>

int socketmark(int s);
```

General description

The `socketmark()` function determines whether the socket specified by the descriptor `s` is at the out-of-band data mark. If the protocol for the socket supports out-of-band data by marking the stream with an out-of-band data mark, the `socketmark()` function returns 1 when all data preceding the mark has been read and the out-of-band data mark is the first element in the receive queue. The `socketmark()` function does not remove the mark from the stream.

| Argument | Description |
|----------------|--|
| <code>s</code> | The descriptor used to determine if the socket is at the out-of-band data mark |

Returned value

Upon successful completion, the `socketmark()` function returns a value indicating whether the socket is at an out-of-band data mark. If the protocol has marked the data stream and all data preceding the mark has been read, the return value is 1; if there is no mark, or if data precedes the mark in the receive queue, the `socketmark()` function returns 0. Otherwise, it returns a value of -1 and set `errno` to indicate the error.

Error Code

Description

EBADF

The `s` argument is not a valid file descriptor.

ENOTTY

The `s` argument does not specify a descriptor for a socket.

Example

CELEBS74

```
/* CELEBS74

This example demonstrates the use of the socketmark() function.

Expected output:
C: Sending regular data
C: Sending OOB data
S: Received "123a"
S: At the mark
S: Received "b"
```

```

*/

#define _POSIX_C_SOURCE 200112L
#include <sys/socket.h>
#include <netinet/in.h>
#include <unistd.h>
#include <stdlib.h>
#include <string.h>
#include <stdio.h>

int main(int argc, char **argv) {
    struct sockaddr_in saddr;
    socklen_t addr_len = sizeof(saddr);
    int port = 12121, n, ld, connfd, servfd;
    char buffer[25];
    pid_t pid;

    if((ld = socket(AF_INET,SOCK_STREAM,0)) == -1){
        printf("socket error\n");
        return 0;
    }

    saddr.sin_family = AF_INET;
    saddr.sin_port = 12121;

    if(bind(ld,(struct sockaddr *)&saddr,addr_len) == -1){
        printf("bind error\n");
        return 0;
    }

    if(listen(ld,5) == -1){
        printf("listen error\n");
        return 0;
    }

    pid = fork();
    if(pid==0){
        if((connfd = socket(AF_INET,SOCK_STREAM,0)) == -1){
            printf("socket error\n");
            exit(0);
        }

        if(connect(connfd,(struct sockaddr *)&saddr,addr_len) == -1){
            printf("connect error\n");
            exit(0);
        }

        printf("C: Sending regular data\n");
        send(connfd,"123",3,0);
        printf("C: Sending OOB data\n");
        send(connfd,"ab",2,MSG_OOB);

        close(connfd);
        exit(0);
    }
    else {
        servfd = accept(ld,(struct sockaddr *)&saddr,&addr_len);
        if(servfd == -1) {
            printf("accept error\n");
            exit(0);
        }

        sleep(5);
        memset(buffer,0,sizeof(buffer));
        recv(servfd,&buffer,sizeof(buffer),0);
        printf("S: Received \"%s\"\n",buffer);

        memset(buffer,0,sizeof(buffer));

        n = socketmark(servfd);
        if(n == 1) printf("S: At the mark\n");
        recv(servfd,&buffer,sizeof(buffer),MSG_OOB);
        printf("S: Received \"%s\"\n",buffer);

        close(servfd);
        close(ld);
    }
}

```

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

sock_debug() — Provide syscall tracing facility

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCKET_EXT
#include <sys/socket.h>

void sock_debug(int onoff);
```

General description

Bulk mode sockets are not supported. This function has no effect.

Returned value

sock_debug() returns no values.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

sock_debug_bulk_perf0() — Produce a report when a socket is configured

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCKET_EXT
#include <sys/socket.h>

void sock_debug_bulk_perf0(int onoff);
```

General description

Restriction: This function is not supported in AMODE 64.

Bulk mode sockets are not supported. This function has no effect.

Returned value

sock_debug_bulk_perf0() returns no values.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

sock_do_bulkmode() — Use bulk mode for messages read by a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>

void sock_do_bulkmode(int onoff);
```

General description

Restriction: This function is not supported in AMODE 64.

Bulk mode sockets are not supported. This function has no effect.

Returned value

sock_do_bulkmode() returns no values.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

sock_do_teststor() — Check for attempt to access storage outside

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>

void sock_do_teststor(int onoff);
```

General description

The sock_do_teststor call is used to check for calls that attempt to access storage outside the caller's address space.

Parameter Description

onoff

A parameter that can be set to zero or nonzero.

If *onoff* is set to a nonzero value, for either inbound or outbound sockets, both the address of the message buffer and the message buffer are checked for addressability for each bulk mode socket call. The EFAULT error condition is set if there is an addressing problem. If *onoff* is set to 0, address checking is not done by the socket library program. If an error occurs when *onoff* is 0, normal runtime error handling reports the exception condition.

To improve response time, you can disable this checking when your program has been tested.

As an alternative to calling `sock_do_teststor`, with *onoff* set to a nonzero value, you can include the statement `SOCKTESTSTOR` in the file `/etc/resolv.conf` or data set `tcpip.TCPIP.DATA`. When the process is started, all the programs using bulk mode sockets for this process will validate the storage for the caller's parameters.

Returned value

`sock_do_teststor()` returns no values.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)

socket() — Create a socket

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format**X/Open:**

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int socket(int domain, int type, int protocol);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/socket.h>

int socket(int *domain, int type, int protocol);
```

General description

The `socket()` function creates an endpoint for communication and returns a socket descriptor representing the endpoint. Different types of sockets provide different communication services.

Parameter**Description*****domain***

The address domain requested, either `AF_INET`, `AF_INET6`, `AF_UNIX`, or `AF_RAW`.

type

The type of socket created, either `SOCK_STREAM`, `SOCK_DGRAM`, or `SOCK_RAW`. With the `_XPLATFORM_SOURCE` feature test macro, the bitwise OR of the `SOCK_NONBLOCK` flag and `SOCK_CLOEXEC` flag can be specified with the socket type.

protocol

The protocol requested. Some possible values are 0, `IPPROTO_UDP`, or `IPPROTO_TCP`.

The *domain* parameter specifies a communication domain within which communication is to take place. This parameter selects the address family (format of addresses within a domain) that is used. The families supported are `AF_INET` and `AF_INET6`, which is the Internet domain, and `AF_UNIX`, which is the local socket domain. These constants are defined in the **sys/socket.h** include file.

The *type* parameter specifies the type and flags of the created socket. The type is analogous with the semantics of the communication requested. These socket type constants are defined in the `sys/socket.h` include file. The types supported are:

Socket Type**Description****SOCK_DGRAM**

Provides datagrams, which are connectionless messages of a fixed maximum length whose reliability is not guaranteed. Datagrams can be corrupted, received out of order, lost, or delivered multiple times. This type is supported in the `AF_INET`, `AF_INET6`, and `AF_UNIX` domains.

SOCK_RAW

Provides the interface to internal protocols (such as IP and ICMP). This type is supported in the `AF_INET` and `AF_INET6` domains. You must be a superuser to use this type.

SOCK_STREAM

Provides sequenced, two-way byte streams that are reliable and connection-oriented. They support a mechanism for out-of-band data. This type is supported in the `AF_INET`, `AF_INET6`, and `AF_UNIX` domains.

Socket Flag**Description****SOCK_NONBLOCK**

Set the `O_NONBLOCK` file status flag on the open file description.

SOCK_CLOEXEC

Provides the interface to internal protocols (such as IP and ICMP). This type is supported in the `AF_INET` and `AF_INET6` domains. You must be a superuser to use this type.

Understanding the socket() parameters: The *protocol* parameter specifies a particular protocol to be used with the socket. In most cases, a single protocol exists to support a particular type of socket in a particular address family. If the *protocol* parameter is set to 0, the system selects the default protocol number for the domain and socket type requested. Protocol numbers are found in the *tcpip.ETC.PROTO* data set. Alternatively, the `getprotobyname()` call can be used to get the protocol number for a protocol with a known name.

Note: The *protocol* field *must* be set to 0, if the *domain* parameter is set to `AF_UNIX`.

`SOCK_STREAM` sockets model duplex-byte streams. They provide reliable, flow-controlled connections between peer application programs. Stream sockets are either active or passive. Active sockets are used by clients who start connection requests with `connect()`. By default, `socket()` creates active sockets. Passive sockets are used by servers to accept connection requests with the `connect()` call. You can transform an active socket into a passive socket by binding a name to the socket with the `bind()` call and by indicating a willingness to accept connections with the `listen()` call. After a socket is passive, it cannot be used to start connection requests.

In the `AF_INET` and `AF_INET6` domains, the `bind()` call applied to a stream socket lets the application program specify the networks from which it is willing to accept connection requests. The application program can fully specify the network interface by setting the *Internet address* field in the **address** structure to the Internet address of a network interface. Alternatively, the application program can use a *wildcard* to specify that it wants to receive connection requests from any network. For `AF_INET` sockets,

this is done by setting the *Internet address* field in the **address** structure to the constant `INADDR_ANY`, as defined in `<netinet/in.h>`. For `AF_INET6` sockets, this is done by setting the *Internet address* field in the address structure to `in6addr_any` as defined in `<netinet/in.h>`.

After a connection has been established between stream sockets, any of the data transfer calls can be used: `read()`, `readv()`, `recv()`, `recvfrom()`, `recvmsg()`, `send()`, `sendmsg()`, `sendto()`, `write()`, and `writev()`. Usually, the `read()`-`write()` or `send()`-`recv()` pairs are used for sending data on stream sockets. If out-of-band data is to be exchanged, the `send()`-`recv()` pair is normally used.

`SOCK_DGRAM` sockets model datagrams. They provide connectionless message exchange without guarantees of reliability. Messages sent have a maximum size. Datagram sockets are supported in the `AF_UNIX` domain.

There is no active or passive analogy to stream sockets with datagram sockets. Servers must still call `bind()` to name a socket and to specify from which network interfaces it wishes to receive packets. Wildcard addressing, as described for stream sockets, applies for datagram sockets also. Because datagram sockets are connectionless, the `listen()` call has no meaning for them and must not be used with them.

After an application program has received a datagram socket, it can exchange datagrams using the `sendto()` and `recvfrom()`, or `sendmsg()` and `recvmsg()` calls. If the application program goes one step further by calling `connect()` and fully specifying the name of the peer with which all messages will be exchanged, then the other data transfer calls `read()`, `write()`, `readv()`, `writev()`, `send()`, and `recv()` can also be used. For more information on placing a socket into the connected state, see [“connect\(\) — Connect a socket” on page 312](#).

Datagram sockets allow messages to be broadcast to multiple recipients. Setting the destination address to be a broadcast address is network-interface-dependent (it depends on the class of address and whether *subnets*—logical networks divided into smaller physical networks to simplify routing—are used). The constant `INADDR_BROADCAST`, defined in `netinet/in.h`, can be used to broadcast to the primary network if the primary network configured supports broadcast.

Outgoing packets have an IP header prefixed to them. IP options can be set and inspected using the `setsockopt()` and `getsockopt()` calls, respectively. Incoming packets are received with the IP header and options intact.

Sockets are deallocated with the `close()` call.

Note: For `AF_UNIX`, when closing sockets that were bound, you should also use `unlink()` to delete the file created at `bind()` time.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, `socket()` returns a nonnegative socket descriptor.

If unsuccessful, `socket()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Permission to create a socket of the specified type or protocol is denied.

EAFNOSUPPORT

The address family is not supported (it is not `AF_UNIX`, `AF_INET`, or `AF_INET6`).

EAGAIN

Resource temporarily unavailable.

EINVAL

The request is invalid or not supported.

EIO

There has been a network or transport failure.

ENOBUFS

Insufficient system resources are available to complete the call.

ENOENT

There was no NETWORK statement in the parmlib member to match the specified domain.

EPROTONOSUPPORT

The protocol is not supported in this domain or this protocol is not supported for this socket type.

EPROTOTYPE

The socket type is not supported by the protocol.

Example

The following are examples of the socket() call.

```
int s;
char *name;
int socket(int domain, int type, int protocol);
:
/* Get stream socket in Internet
domain with default protocol */
s = socket(AF_INET, SOCK_STREAM, 0);
:
/* Get stream socket in local socket
domain with default protocol */
s = socket(AF_UNIX, SOCK_STREAM, 0);
```

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“accept\(\) — Accept a new connection on a socket” on page 106](#)
- [“bind\(\) — Bind a name to a socket” on page 213](#)
- [“close\(\) — Close a file” on page 293](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getprotobyname\(\) — Get a protocol entry by name” on page 757](#)
- [“getsockname\(\) — Get the name of a socket” on page 777](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“shutdown\(\) — Shut down all or part of a duplex connection” on page 1600](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)
- [“writev\(\) — Write data on a file or socket from an array” on page 2076](#)

socketpair() — Create a pair of sockets

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/socket.h>

int socketpair(int *domain, int type, int protocol, int socket_vector[2]);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/socket.h>

int socketpair(int *domain, int type, int protocol, int sv[2]);
```

General description

The `socketpair()` function acquires a pair of sockets of the type specified that are unnamed and connected in the specified domain and using the specified protocol. For socket pairs in the `AF_UNIX` domain, the protocol *must* be 0.

Parameter

Description

domain

The domain in which to open the socket. Although socket pairs can be obtained for `AF_INET` domain sockets, it is recommended that `AF_UNIX` domain sockets be used for socket pairs.

type

The type of socket created, either `SOCK_STREAM`, or `SOCK_DGRAM`. With the `_XPLATFORM_SOURCE` feature test macro, the bitwise OR of the `SOCK_NONBLOCK` flag and `SOCK_CLOEXEC` flag can be specified with the socket type.

protocol

The protocol requested *must* be 0.

sv

The descriptors used to refer to the obtained sockets.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Returned value

If successful, `socketpair()` returns a nonnegative socket descriptor.

If unsuccessful, `socketpair()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Permission to create a socket of the specified type or protocol is denied.

EFAULT

sv is not in the writable part of the user's address space.

EINVAL

The request is invalid or not supported.

EMFILE

Too many files are open for this process.

ENFILE

Too many files are open in the system.

ENOBUFS

Insufficient system resources are available to complete the call.

EOPNOSUPPORT

The protocol does not allow for the creation of socket pairs.

EPROTONOSUPPORT

The protocol is not supported in this domain or this protocol is not supported for this socket type.

EPROTOTYPE

The socket type is not supported by the protocol.

Example

The following are examples of the socketpair() call.

```
#include <types.h>
#include <sys/socket.h>

int sv[2];
...
/* Get stream socket in UNIX
domain with default protocol */
if (socketpair(AF_UNIX, SOCK_STREAM, 0, sv) < 0)
printf ("Error occurred while trying to get a socket pair.\n");
else
...
;
```

Related information

- [“sys/socket.h – Sockets definitions” on page 70](#)
- [“socket\(\) – Create a socket” on page 1677](#)

spawn(), spawnp() – Spawn a new process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------|----------|--------------|
| POSIX.4b z/OS UNIX | both | |

Format

```
#define _POSIX_SOURCE
#include <spawn.h>

pid_t spawn(const char *path,
            const int fd_count,
            const int fd_map[],
            const struct inheritance *inherit,
            const char *argv[],
            const char *envp[]);
```

```
pid_t spawnp(const char *file,
             const int fd_count,
             const int fd_map[],
             const struct inheritance *inherit,
             const char *argv[],
             const char *envp[]);
```

General description

The `spawn()` and `spawnp()` functions create a new process from the specified process image. `spawn()` and `spawnp()` create the new process image from a regular executable file called the new process image file.

To execute a C program as a result of this call, enter the function call as follows:

```
int main (int argc, char *argv[]);
```

Where *argc* is the argument count and *argv* is an array of character pointers to the arguments themselves. In addition, the following variable:

```
extern char **environ;
```

is initialized as a pointer to an array of character pointers to the environment strings. The *argv* and *environ* arrays are each terminated by a NULL pointer. The NULL pointer terminating the *argv* array is not counted in *argc*.

Supported parameters are:

Parameter Description

path

Path name used by `spawn()` that identifies the new process image file to execute.

file

Used by `spawnp()` to construct path name that identifies the new process image file. If the file parameter contains a slash character, `spawnp()` uses the file parameter as a path name for the new process image file. Otherwise, `spawnp()` obtains the path prefix for this file by a search of the directories passed as the environment variable `PATH`.

fd_count

Specifies the number of file descriptors the child process inherits. It may take values from zero to **OPEN_MAX**. Except for those file descriptors designated by `SPAWN_FDCLOSED`, each of the child's file descriptors, *x*, in the range zero to *fd_count*-1 inherits descriptor *fd_map*[*x*] from the parent process.

The files from *fd_count* through **OPEN_MAX** are closed in the child process, as are any elements of *fd_map* designated as `SPAWN_FDCLOSED`.

fd_map

If the *fd_map* parameter is NULL, *fd_count* and *fd_map* are ignored. All file descriptors except those with the `FD_CLOEXEC` or `FD_CLOFORK` attribute are inherited without reordering. File descriptors with the `FD_CLOEXEC` or `FD_CLOFORK` attribute are closed under simple inheritance.

For those file descriptors that remain open, all other attributes of the associated file descriptor object and open file description remain unchanged by this operation.

Directory streams open in the calling process are closed in the new process image.

If an element of *fd_map* refers to an invalid file descriptor, then the (EBADF) `spawn()` or `spawnp()` posts the error status.

The `FD_CLOEXEC` and `FD_CLOFORK` file descriptor attributes are never inherited.

The `FD_CLOEXEC` and `FD_CLOFORK` file descriptor attributes have no effect on inheritance when the *fd_map* parameter is not NULL.

Note: For XTI endpoints, *fd_map* must not map to a number greater than 65535 in the child process.

inherit

The name of a data area that contains the inheritance structure.

The 'struct inheritance' is defined as follows:

```
struct inheritance {
    short flags;           //Flags
    pid_t pgroup;         //Process group
    sigset_t sigmask;      //Signal mask
    sigset_t sigdefault;   //Signals set to SIG_DFL
    int ctltyfd;          //Cntl tty FD for tcsetpgrp()
}
```

The `inherit.flags` effect `spawn()` and `spawnp()` as follows:

SPAWN_SETGROUP

If the `SPAWN_SETGROUP` flag is set in `inherit.flags`, then the child's process group is as specified in `inherit.pgroup`.

If the `SPAWN_SETGROUP` flag is set in `inherit.flags` and `inherit.pgroup` is set to `SPAWN_NEWPGROUP`, then the child is in a new process group with a process group ID equal to its process ID.

If the `SPAWN_SETGROUP` flag is not set in `inherit.flags`, the new child process inherits the parent's process group ID.

SPAWN_SETSIGMASK

If the `SPAWN_SETSIGMASK` flag is set in `inherit.flags`, the child process initially has the signal mask specified in `inherit.sigmask`.

SPAWN_SETSIGDEF

If the `SPAWN_SETSIGDEF` flag is set in `inherit.flags`, the signals specified in `inherit.sigdefault` are set to their default actions in the child process. Signals set to the default action in the parent process, are set to the default action in the new process.

Signals set to be caught by the calling process are set to the default action in the child process.

Signals set to be ignored by the calling process are set to be ignored by the new process, unless otherwise specified by the `SPAWN_SETSIGDEF` flag being set in `inherit.flags` and the signal being indicated in `inherit.sigdefault`.

SPAWN_SETTCPGRP

If the `SPAWN_SETTCPGRP` flag is set in `inherit.flags`, the file descriptor specified in `inherit.ctltyfd` is used to set the controlling terminal file descriptor (`tcsetpgrp()`) for the child's foreground process group. The child's foreground process group is inherited from the parent, unless the `SPAWN_SETGROUP` flag in `inherit.flags` is set, indicating that the value specified in `inherit.pgroup` is to be used to determine the child's process group.

SPAWN_PROCESS_INITTAB

If this flag is set, `spawn` attempts to read the `/etc/inittab` file and process the entries found there. This processing involves the spawning of child shell processes to run each of the commands identified in the file. Only the `SPAWN_SETSIGMASK` flag can be set in combination with this flag. All other flags will be ignored. Use of this flag implies that only file descriptors 0, 1, and 2 will be initially opened in the child process. File descriptor 0 will be initially opened as `/dev/null`, while file descriptors 1 and 2 will initially opened as `/etc/log`. The `fd_count` and `fd_map` parameters will be ignored. This flag is currently restricted to the `/usr/sbin/init` process. See [z/OS UNIX System Services Planning](#) for more information on the `/etc/inittab` support.

argv

The value in the first element of `argv` should point to a file name that is associated with the process being started by the `spawn()` or `spawnp()` operation.

The number of bytes available for the new process's combined argument and environment lists is **ARG_MAX**.

envp

The value *envp* contains the list of environmental variables that is to be passed to the specified program.

If the `set-user-ID` mode bit of the new process image file is set, the effective user ID of the new process image is set to the owner id of the new process image file. Similarly, if the `set-group-ID` mode bit of the new process image file is set, the effective group ID of the new process image is set to the group id of the new process image file. The real user ID, real group ID, and supplementary group IDs of the new process image remain the same as those of the calling process image. The effective user ID and effective group ID of the new process image are saved (as the saved `set-user-ID` and the saved `set-group-ID`) for use by the `setuid()` function.

The new process image inherits the following attributes from the calling process image:

- Process group ID (unless the **SPAWN_SETGROUP** flag is set in `inherit.flags`)
- Session membership
- Real user ID
- Real group ID
- Supplementary group IDs
- Priority
- Current working directory
- Root directory
- File creation mask
- Signal mask (unless the **SPAWN_SETSIGMASK** flag is set in `inherit.flags`)
- Signal actions specified as default (`SIG_DFL`)
- Signal actions specified as ignore (`SIG_IGN`) (except as modified by `inherit.sigdefault` and the **SPAWN_SETSIGDEF** flag set in `inherit.flags`)

The following are differences between the parent process and the child process:

- Signals set to be caught by the calling process are set to the default action (`SIG_DFL`).
- The process and system utilization times for the child are set to zero.
- Any file locks previously set by the parent are not inherited by the child.
- The child process has no alarms set.
- The child process has no interval timers set.
- The child has no pending signals.
- Memory mappings established by the parent are not inherited by the child.

If the process image was read from a writable file system, then upon successful completion, the `spawn()` or `spawnp()` function mark for update the `st_atime` field of the new process image file.

If the `spawn()` or `spawnp()` function is successful, the new child process image file is opened, with all the effects of the `open()` function.

Special behavior for z/OS UNIX Services:

Note: If an application spawns a shell command or utility that performs terminal I/O, the command may fail due to the fact that the shell file descriptors are not initialized. The Shell file descriptors must be defined. An example of how these can be defined in a C application are as follows:

```
stdin = fopen("/tmp/sys.stdin","r");
stdout = fopen("/tmp/sys.stdout","w");
stderr = fopen("/tmp/sys.stderr","w");
```

Aspects of `spawn` processing are controlled by environment variables. The environment variables that affect `spawn` processing are the ones that are passed into the `spawn` syscall and not the environment

variables of the calling process. The environment variables of the calling process do not affect spawn processing unless they are the same as those that are passed in *envp*.

The `_BPXK_JOBLOG` environment variable can be used to specify that WTO messages are to be written to an open job log file. The following are the allowable values:

Value

Description

nn

Job log messages are to be written to open file descriptor nn.

STDERR

Job log messages are to be written to the standard error file descriptor, 2.

None

Job log messages are not to be written. This is the default.

The file that is used to capture messages can be changed at any time by calling the `oe_env_np` service (BPX1ENV) and specifying `_BPXK_JOBLOG` with a different file descriptor.

Message capturing is turned off if the specified file descriptor is marked for close on a fork or exec.

Message capturing is process-related. All threads under a given process share the same job log file. Message capturing may be initiated by any thread under that process.

Multiple processes in a single address space can each have different files active as the JOBLOG file; some or all of them can share the same file; and some processes can have message capturing active while others do not.

Only files that can be represented by file descriptors may be used as job log files; MVS data sets are not supported.

Message capturing will be propagated on a `fork()` or `spawn()`. In the case where a file descriptor was specified, the physical file must be the same for message capturing to continue in the forked or spawned process. If `STDERR` was specified, the file descriptor may be re-mapped to a different physical file.

Message capturing may be overridden on `exec()` or `spawn()` by specifying the `_BPXK_JOBLOG` environment variable as a parameter to the `exec()` or `spawn()`.

Message capturing will only work in forked (BPXAS) address spaces.

Note: This is not true joblog support, messages that would normally go to the JESYSMSG data set are captured, but messages that go to JESMSGLOG are not captured.

For more information on the use of environment variables, see [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

Security information from the parent's address space is propagated to the child's address space, unless the `_BPX_USERID` environment variable specifies otherwise. As a result, the child has a security environment equivalent to that of the parent.

The TASKLIB, STEPLIB, or JOBLIB DD data set allocations that are active for the current task are propagated to the child's address space, unless the STEPLIB environment variable specifies otherwise. This causes the child address space to have the same exact MVS program search order as the calling parent task.

The accounting information of the parent's address space is propagated to the child's address space. See [z/OS UNIX System Services Planning](#).

The jobname of the parent is propagated to the child and appended with a numeric value in the range of 1-9 if the jobname is 7 characters or less. If the jobname is 8 characters, then it is propagated as-is. When a jobname is appended with a numeric value, the count wraps back to 1 when it exceeds 9.

If the calling parent task is in a WLM enclave, the child is joined to the same WLM enclave. This allows WLM to manage the parent and child as one "business unit of work" entity for system accounting and management purposes.

To allow the caller to control whether the spawned child process runs in a separate address space from the parent address space or in the same address space, the spawn service allows for the specification of the `_BPX_SHAREAS` environment variable. The following are the accepted values for the `_BPX_SHAREAS` environment variable, and the actions taken for each value:

1. `_BPX_SHAREAS=YES` - Indicates that the child process that is to be created is to run in the same address space as the parent. In the following circumstances, the `_BPX_SHAREAS=YES` value cannot be honored, and the child process is created in its own address space:
 - If the program to be run is a set-user-ID or set-group-ID program that would cause the effective user-ID or group-ID of the child process to be different from that of the parent process.
 - If the program to be run is an APF-authorized z/OS UNIX or MVS program and the caller is not running APF authorized.
 - If the program to be run is an unauthorized z/OS UNIX or MVS program and the caller is running APF authorized.
 - If the specified file name represents an external link or a sticky bit file. However, if the program that is to be run is a shell script and `_BPX_SPAWN_SCRIPT=YES` is set, the process runs in the same address space. `_BPX_SPAWN_SCRIPT` only has an effect while running in the z/OS shell (`/bin/sh...` NOT `/bin/tcsh`).
 - If the address space of the parent lacks the necessary resources to create another process within the address space.

Note that only one local spawned process per TSO address space is supported at a given time. This is done to reduce conflict among multiple shells running in the same address space.

2. `_BPX_SHAREAS=MUST` - Indicates that the child process that is to be created must run in the same address space as the parent, or the spawn request will fail. In the following circumstances, the `_BPX_SHAREAS=MUST` value cannot be honored, and the spawn invocation fails:
 - If the program to be run is a set-user-ID or set-group-ID program that would cause the effective user ID or group ID of the child process to be different from that of the parent process.
 - If the program to be run is an APF-authorized z/OS UNIX or MVS program and the caller is not running APF authorized.
 - If the program to be run is an unauthorized z/OS UNIX or MVS program and the caller is running APF authorized.
 - If the address space of the parent lacks the necessary resources to create another process within the address space.
3. `_BPX_SHAREAS=REUSE` - Indicates that the child process to be created is to run in the same address space as the parent; also, that it will be created as a medium-weight process. Specifying `REUSE` allows the caller to indicate that it wants to reuse the existing process structure for locally spawned processes.

The same rules that apply to the creation of a local spawn process apply to the specification of a local spawn medium-weight process. In addition, in the following circumstances, the `_BPX_SHAREAS=REUSE` value cannot be honored, and the child process will be created as a non-medium weight local spawn process:

- If `PTRACE` is active for the process.
- If the program to execute is a REXX exec.

For performance reasons, the `STEPLIB` that is specified for each medium-weight process that is created for the address space should be the same.

4. `_BPX_SHAREAS=NO` - Indicates that the child process that is to be created is to run in a separate address space from the address space of the parent. This is the default behavior for the spawn service if the `_BPX_SHAREAS` environment variable is not specified, or if it contains an unsupported value.

If you specify the `_BPX_USERID` environment variable, then `spawn()` creates the new address space and image with the specified userid's identity. The invoker of `spawn()` must be authorized to change MVS

identity. The resulting spawn() image will emerge as if a program had done a fork(), setgid(), initgroups(), setuid(), and exec.

The value of _BPX_USERID can be any 1-to-8-character XPG4 compliant username. If you specify both _BPX_USERID and _BPX_SHAREAS, then spawn() ignores _BPX_SHAREAS, and creates a new address space with the new identity.

If the caller of the spawn() function is the z/OS UNIX shell (that is, /bin/sh), then the setting of the _BPX_SPAWN_SCRIPT= environment variable to YES is recommended. The setting of this variable to YES provides a more efficient mechanism to invoke z/OS UNIX shell scripts.

To support the creation and propagation of a STEPLIB environment to the new process image, spawn() and spawnp() allow for the specification of a STEPLIB environment variable. The following are the accepted values for the STEPLIB environment variable and the actions taken for each:

- STEPLIB=NONE. No Steplib DD is to be created for the new process image.
- STEPLIB=CURRENT. The TASKLIB, STEPLIB, or JOBLIB DD data set allocations that are active for the calling task at the time of the call to spawn() and spawnp() are propagated to the new process image, if found to be cataloged. Uncataloged data sets are not propagated to the new process image.
- STEPLIB=Dsn1:Dsn2;...DsnN. The specified data sets, Dsn1:Dsn2:...DsnN, are built into a STEPLIB DD in the new process image.

Note: The actual name of the DD is not STEPLIB, but is a system-generated name that has the same effect as a STEPLIB DD.

The data sets are concatenated in the order specified. The specified data sets must follow standard MVS data set naming conventions. Data sets found to be in violation of this standard are ignored. If the data sets do follow the standard, but:

- The caller does not have the proper security access to a data set.
- A data set is uncataloged or is not in load library format.

then the data set is ignored. Because the data sets in error are ignored, the executable file may run without the proper STEPLIB environment. If a data set is in error due to improper security access a X'913' abend is generated. The dump for this abend can be suppressed by your installation.

If the STEPLIB environment variable is not specified, spawn() and spawnp() default behavior is the same as if STEPLIB=CURRENT were specified.

If the program to be invoked is a set-user-ID or set-group-ID file and the user-ID or group-ID of the file is different from that of the current process image, then the data sets to be built into the STEPLIB environment for the new process image must be found in the system sanction list for set-user-id and set-group-id programs. Only those data sets that are found in the sanction list are built into the STEPLIB environment for the new process image. For detailed information regarding the sanction list, and for information on STEPLIB performance considerations, see *z/OS UNIX System Services Planning*.

Notes:

1. A prior loaded copy of an HFS program in the same address space is reused under the same circumstances that apply to the reuse of a prior loaded MVS unauthorized program from an unauthorized library by the MVS XCTL service with the following exceptions:
 - If the calling process is in Ptrace debug mode, a prior loaded copy is not reused.
 - If the calling process is not in Ptrace debug mode, but the only prior loaded usable copy found of the HFS program is in storage modifiable by the caller, the prior copy is not reused.
2. If the specified file name represents an external link or a sticky bit file, the program is loaded from the caller's MVS load library search order. For an external link, the external name is only used if the name is eight characters or less, otherwise the caller receives an error from the loadhfs service. For a sticky bit program, the file name is used if it is eight characters or less. Otherwise, the program is loaded from the z/OS UNIX file system and the following restriction exists for sticky bit programs that have the set-user-ID or set-group-ID attribute:

If the program is found in the MVS program search order, the MVS program name must have a BPX.STICKYSUG.program_name resource profile defined in the RACF FACILITY class. See [z/OS UNIX System Services Planning](#) for details on defining the resource profile. Failure to follow this restriction will cause the abend EC6 with code xxxxEO55.

3. If the calling task is in a WLM enclave, the resulting task in the new process image is joined to the same WLM enclave. This allows WLM to manage the old and new process images as one "business unit of work" entity for system accounting and management purposes.

Note: If you are expecting this function to take advantage of the z/OS UNIX magic number support, the Language Environment runtime option to POSIX(ON) must have been set when the process was initialized. Attempting to use magic number support with a process initialized with POSIX(OFF) may produce undesirable effects. See [z/OS UNIX System Services Planning](#) and [z/OS UNIX System Services User's Guide](#) for details and uses of the z/OS UNIX magic number.

Returned value

If successful, `spawn()` and `spawnp()` return the value of the process ID of the child process to the parent process.

If unsuccessful, `spawn()` and `spawnp()` return -1, no child process is created, and they set `errno` to one of the following values:

Error Code

Description

E2BIG

The number of bytes used by the argument and environment list of the new process image is greater than the system-imposed limit of **ARG_MAX** bytes.

EACCES

Search permission is denied for a directory in the path of the new process image file or the new process image file denies execution permission, or the new process image file is not a regular file and the implementation does not support execution of files of its type.

EAGAIN

The system lacked the necessary resources to create another process or the system-imposed limit on the total number of processes or UIDs under execution by a single user would be exceeded.

EBADF

An entry in the `fd_map` array refers to an invalid file descriptor or the controlling terminal file descriptor specified in the `inherit.ctltyfd` is not valid.

EFAULT

The system detected an invalid address in attempting to use a parameter of the call.

EINVAL

One or more of the following conditions were detected:

- The username that was specified on the `_BPX_USERID` environment variable has an incorrect length.
- An attribute that was specified in the inheritance structure (BPXYINHE) is not valid or contains an unsupported value.
- The version number that was specified for the inheritance structure (BPXYINHE) is not valid.
- The inheritance structure length that was specified by the `Inherit_area_len` parameter or within the inheritance structure does not contain a length that is appropriate for the BPXYINHE version.
- The process group ID that was specified in the inheritance structure is less than zero or has some other unsupported value.

The following reason codes can accompany the return code: JR0K, JRUserNameLenError, JRJsRacXtr, JRInheUserid, JRInheRegion, JRInheCPUTime, JRInheDynamber, JRInheAccountData, JRInheCWD, JRInheSetPgrp, JRInheVersion, and JRInheLength.

ELOOP

A loop exists in symbolic links encountered during resolution *file* argument. This error is issued if more than 8 symbolic links are detected in the resolution of file name.

EMVSERR

An MVS internal error has occurred. This may indicate a problem with security permissions for the user calling spawn() or spawnp().

EMVSSAF2ERR

The executable file is a set-user-ID or set-group-ID file and the file owner's UID or GID is not defined to the Security Authorization Facility (SAF), or _BPX_USERID was specified and the specified username was not defined to SAF with a z/OS UNIX segment.

ENAMETOOLONG

The length of the *path* or *file* arguments, or an element of the environment variable PATH prefixed to *file* exceeds PATH_MAX, or a path name component is longer than NAME_MAX and {_POSIX_NO_TRUNC} is in effect for that file.

ENOENT

One or more components of the path name of the new process image file do not exist or the *path* or *file* argument is empty.

ENOEXEC

The new process image file has the appropriate access permission but is not in the proper format.

Note: Reason codes further qualify the errno. For most of the reason codes, see [z/OS UNIX System Services Messages and Codes](#).

For ENOEXEC, the reason codes are:

| Reason Code | Explanation |
|-------------|---|
| X'xxxx0C27' | The target file is not in the correct format to be an executable file. |
| X'xxxx0C31' | The target file is built at a level that is higher than that supported by the running system. |

ENOMEM

The new process requires more memory than is permitted by the hardware or the operating system.

ENOTDIR

A component of the path prefix of the new process image file is not a directory.

ENOTTY

The tcsetpgrp() failed for the specified controlling terminal file descriptor in inherit.ctltyfd. The failure occurred because the calling process does not have a controlling terminal, or the specified file descriptor is not associated with the controlling terminal, or the controlling terminal is no longer associated with the session of the calling process.

EPERM

The spawn failed for one of the following reasons:

- The spawned process is not a process group leader.
- The _BPX_USERID environment variable was specified, but the invoker does not have appropriate privileges to change the MVS identity.
- The invoker does not have the appropriate privileges to change one or more of the attributes specified in the inheritance structure (BPXYINHE).

The following reason codes can accompany the return code: JROK, JRNoChangeIdentity, JRInheUserid, JRInheRegion, JRInheCPUTime, JRInheUmask, and JRInheCWD.

ESRCH

The process group ID specified in inherit.pgroup is not that of a process group in the session of the calling process.

Example of a parent program that uses spawn to create a child process

The following is an example of a parent program that uses spawn to create a child process.

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>
#include <spawn.h>
#include <stdio.h>
#include <errno.h>
#include <sys/types.h>

/* This program uses spawn instead of fork/exec to create a child
 * process and uses unnamed pipes to allow the parent and child to
 * exchange communication.
 */

void main(int argc, char *argv[]) {
    pid_t child;
    int fd_count, fd_map[10];
    struct inheritance inherit;
    const char *c_argv[10], *c_envp[10];
    char buf[256];
    int nbytes;

    int c_stdin[2], c_stdout[2], c_stderr[2]; /* Pipes for child
        * communication */

    /* Create pipes to communicate with child via stdin/stdout/stderr */
    if(pipe(c_stdin) ||
        pipe(c_stdout) ||
        pipe(c_stderr) ) {
        perror("Bad pipe");
        exit(-1);
    }

    /* Set up file descriptor map for child process */
    fd_map[0]=dup(c_stdin[0]); /* child stdin is read end of pipe */
    fd_map[1]=dup(c_stdout[1]); /* child stdout is write end of pipe */
    fd_map[2]=dup(c_stderr[1]); /* child stderr is write end of pipe */
    fd_count=3;

    /* Close unused end of pipes for the parent */
    close(c_stdin[0]); close(c_stdout[1]); close(c_stderr[1]);

    /* Build the argument structure for child arguments.
     * [0] is the program name */
    c_argv[0]="spawnc";
    c_argv[1]="arg1"; c_argv[2]="arg2"; c_argv[3]=NULL;

    /* Build the environment structure which defines the child's
     * environment variables */
    c_envp[0]="TEST_ENV=YES"; c_envp[1]="BPX_SHAREAS=NO"; c_envp[2]=NULL;

    /* Spawn the child process */
    child=spawnp("spawnc", fd_count, fd_map, &inherit, c_argv, c_envp);
    if(child==-1) {
        perror("Error on spawn");
        exit(-1);
    }
    else printf("Spawned %i\n", child);

    /* Test interaction with the child process */
    printf("parent: Asking child, \"what are you doing?\\n\\n\\n");
    strcpy(buf, "child from parent: what are you doing?\\n");
    if(write(c_stdin[1], buf, sizeof(buf))== -1) {
        perror("write stdout");
        exit(-1);
    }

    memset(buf, 0, 255); /* Just zeroing out the buffer */
    printf("parent: reading from child now\\n");
    if((nbytes=read(c_stdout[0], buf, 255))== -1) {
        perror("read error:");
        exit(-1);
    }
    printf("parent: child says, \"%s\\n\\n", buf);

    /* Cleanup pipes before exiting */
    close(c_stdin[1]); close(c_stdout[0]); close(c_stderr[0]);
}
```

```

    exit(0);
}

```

Example of a child program used by spawn

The following is an example of a child program used by spawn.

```

#include <stdlib.h>
#include <stdio.h>

/* This is a sample child program used by spawn. This program will
 * work stand-alone as well as from spawn or fork/exec. */

extern char ** environ; /* External used to access the environment
                        directly instead of using getenv */

void main(int argc, char *argv[]) {
    char *e, **env=environ; /* Used to step through the environment
                           * to write out to file. */
    char buf[256]={0};
    FILE *fp=fopen("spawntest.out","w");
    int i;

    /* Print out the environment variables */
    i=0;
    fprintf(fp, "Environment:\n");
    while(e=env[i++]) fprintf(fp, "%s\n", e);
    fprintf(fp, "\n\n");

    /* Just to prove getenv works */
    fprintf(fp, "TEST_ENV envvar = %s", getenv("TEST_ENV"));

    /* Print out the command line arguments */
    i=0;
    fprintf(fp, "Args:\n");
    while(e=argv[i++]) fprintf(fp, "%s\n", e);
    fprintf(fp, "\n\n");

    /* Print out what was sent on stdin */
    fprintf(fp, "Child/parent\n");
    if(!gets(buf)) {
        perror(stdin);
        exit(-1);
    }
    fprintf(fp, "child from parent: %i bytes, [%s]\n", strlen(buf), buf);

    /* Send something to stdout */
    printf("nothing");

    fclose(fp);
    exit(0);
}

```

Related information

- [“spawn.h — spawn\(\) constants and inheritance structure” on page 59](#)
- [“sys/wait.h — Hold processes” on page 73](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“exit\(\) — End program” on page 449](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)

- “[__spawn2\(\), __spawnp2\(\)](#) — Spawn a new process using enhanced inheritance structure” on page 1693
- “[stat\(\), stat64\(\)](#) — Get file information” on page 1706
- “[times\(\)](#) — Get process and child process times” on page 1867
- “[wait\(\)](#) — Wait for a child process to end” on page 1978
- “[waitpid\(\)](#) — Wait for a specific child process to end” on page 1981

__spawn2(), __spawnp2() — Spawn a new process using enhanced inheritance structure

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | POSIX(ON) |

Format

```
#include <spawn.h>

pid_t __spawn2(const char *path,
               const int fd_count,
               const int fd_map[],
               const struct __inheritance *inherit,
               const char *argv[],
               const char *envp[]);

pid_t __spawnp2(const char *file,
                const int fd_count,
                const int fd_map[],
                const struct __inheritance *inherit,
                const char *argv[],
                const char *envp[]);
```

General description

The `__spawn2()` and `__spawnp2()` functions create a new process from the specified process image. The new process image is constructed from a regular executable file called the new process image file.

To execute a C program as a result of this call, enter the function call as follows:

```
int main (int argc, char *argv[]);
```

Where `argc` is the argument count and `argv` is an array of character pointers to the arguments themselves. In addition, the following variable:

```
extern char **environ;
```

is initialized as a pointer to an array of character pointers to the environment strings. The `argv` and `environ` arrays are each terminated by a NULL pointer. The NULL pointer terminating the `argv` array is not counted in `argc`.

Supported parameters are:

Parameter Description

path

Path name used by `__spawn2()` that identifies the new process image file to execute.

file

Used by __spawnp2() to construct a path name that identifies the new process image file. If the file parameter contains a slash character, the file parameter shall be used as a path name for the new process image file. Otherwise, the path prefix for this file shall be obtained by a search of the directories passed as the environment variable PATH.

fd-count

Specifies the number of file descriptors the child process shall inherit. It may take values from zero to **OPEN_MAX**. Except those file descriptors designated by SPAWN_FDCLOSED, each of the child's file descriptors, x, in the range zero to *fd_count*-1 shall inherit descriptor *fd_map*(x) from the parent process.

The files from *fd_count* through **OPEN_MAX** are closed in the child process, as are any elements of *fd_map* designated as SPAWN_FDCLOSED.

fd-map

If the *fd_map* parameter is NULL, *fd_count* and *fd_map* are ignored. All file descriptors except those with the FD_CLOEXEC or FD_CLOFORK attribute are inherited without reordering. File descriptors with the FD_CLOEXEC or FD_CLOFORK attribute are closed under simple inheritance.

For those file descriptors that remain open, all other attributes of the associated file descriptor object and open file description shall remain unchanged by this operation.

Directory streams open in the calling process image shall be closed in the new process image, with the effect of the closedir() operation.

If an element of *fd_map* refers to an invalid file descriptor, then the (EBADF) error status shall be posted by __spawn2() or __spawnp2().

The FD_CLOEXEC and FD_CLOFORK file descriptor attributes are never inherited.

The FD_CLOEXEC and FD_CLOFORK file descriptor attributes have no effect on inheritance when the *fd_map* parameter is not NULL.

Note: For XTI endpoints, *fd_map* must not map to a number greater than 65535 in the child process.

inherit

The name of a data area that contains the inheritance structure.

The 'struct __inheritance' is defined as follows:

```
struct __inheritance {
    short    flags;           -- Flags
    pid_t    pgroup;         -- Process group
    sigset_t sigmask;        -- Signal mask
    sigset_t sigdefault;     -- Signals set to SIG_DFL
    int      ctltyfd;        -- Cntl tty FD for tcsetpgrp()
    char     *cwdptr;        -- Pointer to the users CWD
    int      cwdlen;         -- Length of the users CWD
    int      acctdatalen;    -- Length of account data area
    char     *acctdataptr;   -- Ptr to account data area
    int      umask;          -- Users UMASK
    char     userid[9];      -- New A.S. user identity
    char     jobname[9];     -- New A.S. jobname
    int      regionsize;     -- New A.S. region size
    int      timelimit;      -- New A.S. time limit
    union {
        #ifdef _LP64
        unsigned long    memlimit;
        #define __memlimit    memlimit_u.memlimit
        #endif
        #ifdef __LL
        unsigned long long    memlimit_ll;
        #define __memlimit_ll    memlimit_u.memlimit_ll
        #endif
        unsigned int        memlimit_i[2];
        #define __memlimit_h    memlimit_u.memlimit_i[0]
        #define __memlimit_l    memlimit_u.memlimit_i[1]
        double              memlimit_d;
    } memlimit_u;
}
```


The `inherit.flags` effect `spawn()` and `spawnp()` as follows:

SPAWN_SETGROUP

If the `SPAWN_SETGROUP` flag is set in *inherit.flags*, then the child's process group shall be as specified in *inherit.pgroup*.

If the `SPAWN_SETGROUP` flag is set in *inherit.flags* and *inherit.pgroup* is set to `SPAWN_NEWPGROUP`, then the child shall be in a new process group with a process group ID equal to its process ID.

If the `SPAWN_SETGROUP` flag is not set in *inherit.flags*, the new child shall inherit the parent's process group ID.

SPAWN_SETSIGMASK

If the `SPAWN_SETSIGMASK` flag is set in *inherit.flags*, the child process shall initially have the signal mask specified in *inherit.sigmask*.

SPAWN_SETSIGDEF

If the `SPAWN_SETSIGDEF` flag is set in *inherit.flags*, the signals specified in *inherit.sigdefault* shall be set to their default actions in the child process. Signals set the default action in the parent process shall be set to the default action in the new process.

Signals set to be caught by the calling process shall be set to the default action in the child process.

Signals set to be ignored by the calling process shall be set to be ignored by the new process, unless otherwise specified by the `SPAWN_SETSIGDEF` flag being set in *inherit.flags* and the signal being indicated *inherit.sigdefault*.

SPAWN_SETCPPGRP

If the `SPAWN_SETCPPGRP` flag is set in *inherit.flag*, the file descriptor specified in *inherit.clttyfd* is used to set the controlling terminal file descriptor (`tcsetpgrp()`) for the child's foreground process group. The child's foreground process group is inherited from the parent, unless the `SPAWN_SETGROUP` flag in *inherit.flags* is set, indicating that the value specified in *inherit.pgroup* is to be used to determine the child's process group.

argv

The value in the first element of *argv* should point to a file name that is associated with the process being started by the `spawn2()` or `spawnp2()` operation.

The number of bytes available for the new process's combined argument and environment lists is **ARG_MAX**.

envp

The value *envp* contains the list of environmental variables that is to be passed to the specified program.

If the set-user-ID mode bit of the new process image file is set, the effective user ID of the new process image shall be set to the owner ID of the new process image file. Similarly, if the set-group-ID mode bit of the new process image file is set, the effective group ID of the new process image shall be set to the group ID of the new process image file. The real user ID, real group ID, and supplementary group IDs of the new process image shall remain the same as those of the calling process image. The effective user ID and effective group ID of the new process image shall be saved (as the saved set-user-ID and set-group-ID) for use by the `setuid()` function.

The new process image shall inherit the following attributes of the calling process image:

- Process group ID (unless the `SPAWN_SETGROUP` flag is set in *inherit.flags*).
- Session membership.
- Real user ID.
- Real group ID.
- Supplementary group IDs.
- Priority.

- Current working directory.
- File creation mask.
- Signal mask (unless the SPAWN_SETSIGMASK flag is set in *inherit.flags*).
- Signal actions specified as default (SIG_DFL).
- Signal actions specified as ignore (SIG_IGN) (except as modified by *inherit.sigdefault* and the SPAWN_SETSIGDEF flag set in *inherit.flags*).

The following are differences between the parent process and child:

- Signals set to be caught by the calling process shall be set to the default action (SIG_DFL).
- The process and system utilization times for the child are set to zero.
- Any file locks previously set by the parent are not inherited by the child.
- The child process has no alarms set and has no interval timers set.
- The child has no pending signals.
- Memory mappings established by the parent are not inherited by the child.

If the process image was read from a writable file system, then upon successful completion, the `__spawn2()` and `__spawnp2()` functions will mark for update the *st_time* field of the new process image file.

If the `__spawn2()` or `__spawnp2()` function is successful, the new child process image file shall be opened with all the effects of the `open()` function.

All the following inherit flags are used by `__spawn2()` and `__spawnp2()`:

SPAWN_SETCWD

Specifies the Current Working Directory that the child process will run when first created. This will override the CWD that would normally be set up or propagated by the child process.

SPAWN_SETUMASK

Specifies the UMASK that the child process will run when first created. This will override the UMASK that would normally be set up in the child process. The invoker must have superuser privileges to specify UMASK.

SPAWN_SETUSERID

When this flag is set, this attribute will be the equivalent of the `_BPX_USERID` environment variable. If specified, the invoking userid will be checked for daemon authority. If the invoker is authorized and the userid is valid, the child process will be created with RACF identity and POSIX permissions associated with the input USERID. If not authorized or the userid is invalid, the `__spawn2()` or `__spawnp2()` function will fail. If the USERID value is specified, any value in `_BPX_USERID` will be ignored.

SPAWN_SETREGIONSZ

Specifies the number of megabytes the child process will have available for private storage. The authority/ranges required will be as per RLIMIT_AS rules. Unless the invoker has superuser privileges, the region size range will be checked and if it exceeds the hard limit, the `__spawn2()` or `__spawnp2()` function will fail. This value will override RLIMIT_AS or the normal spawn propagation rules.

SPAWN_SETTIMELIMIT

Specifies the number of seconds of CPU time that is allowed by the child process before receiving a SIGXCPU signal. Unless the invoker has superuser privileges, the time limit range will be checked and if it exceeds the hard limit, the `__spawn2()` or `__spawnp2()` function will fail. This value will override the RLIMIT_CPU or the normal spawn propagation rules.

SPAWN_SETACCTDATA

Specifies account data of the child process. The format and length will be as per the `_BPX_ACCT_DATA` environmental variable. No special authority is needed to change account data. This will override the target userid's default account data and any value specified on the `_BPX_ACCT_DATA` will be ignored.

SPAWN_SETJOBNAME

When this flag is set, it is the equivalent of the `_BPX_JOBNAME` environment variable. If specified, the invoking userid will be checked for superuser authority. If the invoker is authorized and the jobname is valid, the child process will be created with the specified jobname. If not authorized or the jobname is invalid, `__spawn2()` or `__spawnp2()` will ignore the `JOBNAME` attribute and continue. If the `JOBNAME` value is specified, any value in `_BPX_JOBNAME` will be ignored.

SPAWN_MUSTBELOCAL

When this flag is set, it is the equivalent of the `_BPX_SHAREAS=MUST` environment variable. If specified, the system will attempt a local spawn, otherwise the request will fail.

SPAWN_SETMEMLIMIT

When this flag is set and not doing a local spawn, `inherit.memlimit_u` determines the maximum amount of bytes the child address space is allowed to obtain above the 2-gigabyte bar. If the specified value exceeds the current hard limit, the invoking userid must have appropriate privileges, otherwise the request will fail.

SPAWN_PROCESS_INITTAB

If this flag is set, spawn attempts to read the `/etc/inittab` file and process the entries found there. This processing involves the spawning of child shell processes to run each of the commands identified in the file. Only the `SPAWN_SETSIGMASK` flag can be set in combination with this flag. All other flags will be ignored. Use of this flag implies that only file descriptors 0, 1, and 2 will be initially opened in the child process. File descriptor 0 will be initially opened as `/dev/null`, while file descriptors 1 and 2 will initially be opened as `/etc/log`. The `fd_count` and `fd_map` parameters will be ignored. This flag is currently restricted to the `/usr/sbin/init` process. See *z/OS UNIX System Services Planning* for more information on the `/etc/inittab` support.

For more information on the use of inheritance structure flags, see *z/OS UNIX System Services Programming: Assembler Callable Services Reference*.

Returned value

If successful, `__spawn2()` or `__spawnp2()` returns the process ID of the child process to the parent.

If unsuccessful, `__spawn2()` or `__spawnp2()` returns -1 to the parent process, no child is created, and they set `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

E2BIG

The number of bytes used by the argument and environment list of the new process image is greater than the system-imposed limit of **ARG_MAX** bytes.

EACCES

Search permission is denied for a directory in the path of the new process image file or the new process image file denies execution permission, or the new process image file is not a regular file and the implementation does not support execution of files of its type.

EAGAIN

The system lacked the necessary resources to create another process, or the system-imposed limit on the total number of processes under execution by a single user would be exceeded. The resources required to let another process be created are not available, or you have already reached the maximum number of processes or UIDs you are allowed to create. This error will also be generated if `_BPX_USERID` or `INHEUSERID` was specified and the username was not defined to SAF with a segment.

EBADF

An entry in the `fd_map` array refers to an invalid file descriptor or the controlling terminal file descriptor specified in the `__inheritance` structure.

EFAULT

The system detected an invalid address while attempting to use a parameter of the call.

EINVAL

One or more of the following conditions were detected:

- The username that was specified on the `_BPX_USERID` environment variable has an incorrect length.
- An attribute that was specified in the inheritance structure (BPXYINHE) is not valid or contains an unsupported value.
- The version number that was specified for the inheritance structure (BPXYINHE) is not valid.
- The inheritance structure length that was specified by the `Inherit_area_len` parameter or within the inheritance structure does not contain a length that is appropriate for the BPXYINHE version.
- The process group ID that was specified in the inheritance structure is less than zero or has some other unsupported value.

The following reason codes can accompany the return code: JR0K, JRUserNameLenError, JRJsRacXtr, JRInheUserid, JRInheRegion, JRInheCPUTime, JRInheDynamber, JRInheAccountData, JRInheCWD, JRInheSetPgrp, JRInheVersion, and JRInheLength.

ELOOP

A loop exists in symbolic links encountered during resolution of the file name argument. This error is issued if more than 8 symbolic links are detected.

EMVSERR

The spawn failed for the following reason: Local spawn not allowed. Either the environment variable `_BPX_SHAREAS` was set to MUST (`_BPX_SHAREAS=MUST`), or the `__inheritance` structure specified `SPAWN_MUSTBELOCAL`.

The following reason code can accompany the return code: JRLocalSpawnNotAllowed.

EMVSSAF2ERR

The executable file is a set-user-ID or set-group-ID file and the owner's UID or GID is not defined to the Security Authorization Facility (SAF).

ENAMETOOLONG

The length of the path or file parameter, or an element of the environmental variable `PATH` prefixed to a file, exceeds **PATH_MAX**, or a path name component is longer than **NAME_MAX** and `{_POSIX_N_TRUNC_}` is in effect for that file.

ENOENT

One or more components of the path name of the new process image file do not exist or the path or file parameter is empty.

ENOEXEC

The new process image file has the appropriate access permission, but is not in the proper format.

Note:

Reason codes further qualify the `errno`. For most of the reason codes, see [z/OS UNIX System Services Messages and Codes](#).

For ENOEXEC, the reason codes are:

| Reason Code | Explanation |
|-------------|---|
| X'xxxx0C27' | The target file is not in the correct format to be an executable file. |
| X'xxxx0C31' | The target file is built at a level that is higher than that supported by the running system. |

ENOMEM

The new process requires more memory than is permitted by the hardware or operating system.

ENOTDIR

A component of the path prefix of the new process image file is not a directory.

ENOTTY

tcsetpgrp() failed for the specified controlling terminal file descriptor in `__inheritance` structure. The failure occurred because the calling process does not have a controlling terminal, or the specified file descriptor is not associated with the controlling terminal, or the controlling terminal is no longer associated with the session of the calling process.

EPERM

The spawn failed for one of the following reasons:

- The spawned process is not a process group leader.
- The `_BPX_USERID` environment variable was specified, and the invoker does not have appropriate privileges to change the MVS identity.
- The invoker does not have the appropriate privileges to change one or more of the attributes specified in the inheritance structure (BPXYINHE).

The following reason codes can accompany the return code: JROK, JRNoChangeIdentity, JRInheUserid, JRInheRegion, JRInheCPUTime, JRInheUmask, JRInheCWD and JRInheMemLimit.

ESRCH

The process group ID specified in the `__inheritance` structure is not that of a process group in the calling process's session.

Related information

- [“spawn.h — spawn\(\) constants and inheritance structure” on page 59](#)
- [“sys/wait.h — Hold processes” on page 73](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“exit\(\) — End program” on page 449](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“kill\(\) — Send a signal to a process” on page 930](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“setuid\(\) — Set the effective user ID” on page 1585](#)
- [“spawn\(\), spawnp\(\) — Spawn a new process” on page 1682](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“times\(\) — Get process and child process times” on page 1867](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)
- [“waitpid\(\) — Wait for a specific child process to end” on page 1981](#)

sprintf() — Format and write data to buffer

The information for this function is included in [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data” on page 593](#).

sqrt(), sqrtf(), sqrtl() – Calculate square root

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double sqrt(double x);
float sqrt(float x);           /* C++ only */
long double sqrt(long double x); /* C++ only */
float sqrtf(float x);
long double sqrtl(long double x);
```

General description

Calculates the square root of x .

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

Returned value

If successful, returns the square root of x .

If x is negative, the function sets `errno` to `EDOM`, and returns 0. If the correct value would cause underflow, zero is returned and the value `ERANGE` is stored in `errno`.

Special behavior for IEEE

If $x < -0$, the function returns `NaNQ` and sets `errno` to `EDOM`.

If x is a NaN, a NaN will be returned.

If x is ± 0 or $+\text{INF}$, x will be returned.

If x is $-\text{INF}$, a `EDOM` will be set, and `NaNQ` will be returned.

Example

CELEBS30

```
/* CELEBS30

   This example computes the square root of the quantity passed
   as the first argument to main.
   It prints an error message if you pass a negative value.

*/
#include <stdio.h>
#include <stdlib.h>
#include <math.h>
```

```
int main(int argc, char ** argv)
{
    char * rest;
    double value;

    if ( argc != 2 )
        printf( "Usage: %s value\n", argv[0] );
    else
    {
        value = strtod( argv[1], &rest );
        if ( value < 0.0 )
            printf( "sqrt of a negative number\n" );
        else
            printf("sqrt( %f ) = %f\n", value, sqrt( value ));
    }
}
```

Output

If the input is 45, then the output should be:

```
sqrt( 45.000000 ) = 6.708204
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“exp\(\), expf\(\), expl\(\) — Calculate exponential function” on page 453](#)
- [“hypot\(\), hypotf\(\), hypotl\(\) — Calculate the square root of the squares of two arguments” on page 821](#)
- [“log\(\), logf\(\), logl\(\) — Calculate natural logarithm” on page 995](#)
- [“log10\(\), log10f\(\), log10l\(\) — Calculate base 10 logarithm” on page 1005](#)
- [“pow\(\), powf\(\), powl\(\) — Raise to power” on page 1204](#)

sqrtd32(), sqrtd64(), sqrtd128() — Calculate square root

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 sqrtd32(_Decimal32 x);
_Decimal64 sqrtd64(_Decimal64 x);
_Decimal128 sqrtd128(_Decimal128 x);
_Decimal32 sqrt(_Decimal32 x);          /* C++ only */
_Decimal64 sqrt(_Decimal64 x);          /* C++ only */
_Decimal128 sqrt(_Decimal128 x);        /* C++ only */
```

General description

Calculates the square root of x.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

If successful, returns the square root of x .

If the correct value would cause underflow, zero is returned and the value ERANGE is stored in `errno`.

If $x < -0$, the function returns NaNQ and sets `errno` to EDOM.

If x is a NaN, a NaN will be returned.

If x is ± 0 or $+\text{INF}$, x will be returned.

If x is $-\text{INF}$, the function returns NaNQ and sets `errno` to EDOM.

Example

```
/* CELEBS71

   This example illustrates the sqrt32() function, along with
   the strtod32() function.

   This example computes the square root of the quantity passed
   as the first argument to main.
   It prints an error message if you pass a negative value.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>
#include <stdlib.h>

int main(int argc, char ** argv)
{
    char      *rest;
    _Decimal32 value;

    if (argc != 2)
    {
        printf("Usage: %s value\n", argv[0]);
    }
    else
    {
        value = strtod32(argv[1], &rest);

        if (value < 0.0DF)
            printf("sqrt of a negative number\n");
        else
            printf("sqrt(%Hf) = %Hf\n", value, sqrt32(value));
    }
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“expd32\(\), expd64\(\), expd128\(\) — Calculate exponential function ” on page 454](#)
- [“logd32\(\), logd64\(\), logd128\(\) — Calculate natural logarithm” on page 999](#)
- [“log10d32\(\), log10d64\(\), log10d128\(\) — Calculate base 10 logarithm” on page 1006](#)
- [“powd32\(\), powd64\(\), powd128\(\) — Raise to power” on page 1205](#)
- [“sqrt\(\), sqrtf\(\), sqrtl\(\) — Calculate square root” on page 1700](#)

srand() — Set seed for rand() function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

void srand(unsigned int seed);
```

General description

srand() uses its argument *seed* as a seed for a new sequence of pseudo-random numbers to be returned by subsequent calls to rand(). If srand() is not called, the rand() seed is set as if srand(1) was called at program start. Any other value for *seed* sets the generator to a different starting point. The rand() function generates pseudo-random numbers.

Some people find it convenient to use the return value of the time() function as the argument to srand(), as a way to ensure random sequences of random numbers.

Returned value

srand() returns no values.

Example

CELEBS31

```
/* CELEBS31

   This example first calls &srand. with a value other than 1 to
   initiate the random value sequence.
   Then the program computes 5 random values for the array of
   integers called ranvals.
   If you repeat this code exactly, then the same sequence of
   random values will be generated.

*/
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    int i, ranvals[5];

    srand(17);
    for (i = 0; i < 5; i++)
    {
        ranvals[i] = rand();
        printf("Iteration %d ranvals [%d] = %d\n", i+1, i, ranvals[i]);
    }
}
```

Output

```
Iteration 1 ranvals [0] = 24107
Iteration 2 ranvals [1] = 16552
Iteration 3 ranvals [2] = 12125
```

```
Iteration 4 ranvals [3] = 9427
Iteration 5 ranvals [4] = 13152
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“rand\(\) — Generate random number” on page 1377](#)
- [“rand_r\(\) — Pseudo-random number generator” on page 1378](#)

srandom() — Use seed to initialize generator for random()

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

void srandom(unsigned seed);
```

General description

The `srandom()` function initializes the calling thread's current state array for the `random()` function using the value of *seed*.

Returned value

`srandom()` returns no values.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“drand48\(\) — Pseudo-random number generator” on page 403](#)
- [“initstate\(\) — Initialize generator for random\(\)” on page 866](#)
- [“rand\(\) — Generate random number” on page 1377](#)
- [“rand_r\(\) — Pseudo-random number generator” on page 1378](#)
- [“random\(\) — A better random-number generator” on page 1379](#)
- [“setstate\(\) — Change generator for random\(\)” on page 1583](#)

srand48() – Pseudo-random number initializer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <stdlib.h>

void srand48(long int seedval);
```

General description

The drand48(), erand48(), jrand48(), lrand48(), mrand48() and nrand48() functions generate uniformly distributed pseudo-random numbers using a linear congruential algorithm and 48-bit integer arithmetic.

The lcong48(), seed48(), and srand48() functions are initialization functions, one of which should be invoked before either the drand48(), lrand48() or mrand48() function is called.

The drand48(), lrand48() and mrand48() functions generate a sequence of 48-bit integer values, X(i), according to the linear congruential formula:

$$X(n+1) = (aX(n) + c) \bmod (2^{**}48) \qquad n \geq 0$$

The initial values of X, a, and c are:

```
X(0)= 1
a  = 5deece66d (base 16)
c  = b          (base 16)
```

C/370 provides storage to save the most recent 48-bit integer value of the sequence, X(i). This storage is shared by the drand48(), lrand48() and mrand48() functions. The srand48() function is used to reinitialize the most recent 48-bit value in this storage. The srand48() function replaces the high-order (leftmost) 32 bits of this storage with *seedval* argument value. The srand48() function replaces the low-order 16 bits of this storage with the value **330E** (base 16).

The values a and c, may be changed by calling the lcong48() function. The srand48()function restores the initial values of a and c.

Special behavior for z/OS UNIX Services: You can make the srand48() function and other functions in the drand48 family thread-specific by setting the environment variable `_RAND48` to the value `THREAD` before calling any function in the drand48 family.

If you do not request thread-specific behavior for the drand48 family, C/370 serializes access to the storage for X(n), a and c by functions in the drand48 family when they are called by a multithreaded application.

If thread-specific behavior is requested, calls to the drand48(), lrand48() and mrand48() functions from thread *t* generate a sequence of 48-bit integer values, X(t,i), according to the linear congruential formula:

$$X(t,n+1) = (a(t)X(t,n) + c(t)) \bmod (2^{**}48) \qquad n \geq 0$$

C/370 provides thread-specific storage to save the most recent 48-bit integer value of the sequence, X(t,i). When the srand48()function is called from thread *t*, it reinitializes the most recent 48-bit value in this storage. The srand48() function replaces the high-order (leftmost) 32 bits of this storage with *seedval*

argument value. The `srand48()` function replaces the low-order 16 bits of this storage with the value **330E** (base 16).

The values of `a(t)` and `c(t)` may be changed by calling the `lcong48()` function from thread `t`. When the `srand48()` function is called from this thread it restores the initial values of `a(t)` and `c(t)` for the thread which are:

```
a(t) = 5deece66d (base 16)
c(t) = b         (base 16)
```

Returned value

`srand48()` returns no values.

`srand48()` returns after it has used the value of the argument *seedval* to reinitialize storage for the most recent 48-bit integer value in the sequence, `X(i)`, and has restored the initial values of `a` and `c`.

Special behavior for z/OS UNIX Services: If thread-specific behavior is requested for the `drand48` family and the `srand48()` function is called on thread `t`, it uses the value of the argument *seedval* to reinitialize storage for the most recent 48-bit integer value in the sequence, `X(t,i)`, for the thread. It also restores the initial values of `a(t)` and `c(t)` for the thread. Then it returns.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“drand48\(\) – Pseudo-random number generator” on page 403](#)
- [“erand48\(\) – Pseudo-random number generator” on page 430](#)
- [“jrand48\(\) – Pseudo-random number generator” on page 927](#)
- [“lcong48\(\) – Pseudo-random number initializer” on page 939](#)
- [“lrand48\(\) – Pseudo-random number generator” on page 1013](#)
- [“mrand48\(\) – Pseudo-random number generator” on page 1108](#)
- [“nrand48\(\) – Pseudo-random number generator” on page 1153](#)
- [“seed48\(\) – Pseudo-random number initializer” on page 1470](#)

sscanf() – Read and format data from buffer

The information for this function is included in [“fscanf\(\), scanf\(\), sscanf\(\) – Read and format data” on page 626](#).

stat(), stat64() – Get file information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

stat:

```
#define _POSIX_SOURCE
#include <sys/stat.h>
```

```
int stat(const char *__restrict__ pathname, struct stat *__restrict__ info);
```

stat64:

```
#define _LARGE_TIME_API
#define _POSIX_SOURCE
#include <sys/stat.h>

int stat64(const char *__restrict__ pathname, struct stat64 *__restrict__ info);
```

Compile requirement: Use of the `stat64()` function requires the `long long` data type. For more information on how to make the `long long` data type available, see [z/OS XL C/C++ Language Reference](#).

General description

Gets status information about a specified file that is pointed to by the *pathname* argument and places it in the area of memory pointed to by the *info* argument. The process does not need permissions on the file itself, but must have search permission on all directory components of the *pathname*. If the named file is a symbolic link, `stat()` resolves the symbolic link. It also returns information about the resulting file.

The `stat64()` function behaves exactly like `stat()` except `stat64()` uses structure `stat64` instead of `struct stat` to support time beyond 03:14:07 UTC on January 19, 2038.

The information is returned as shown in the following table for the `stat` and `stat64` structures, as defined in the `sys/stat.h` header file.

| Table 60. Values Returned in stat and stat64 Structures | | |
|---|-------------------|---|
| Value for stat | Value for stat64 | Description |
| mode_t st_mode | mode_t st_mode | A bit string indicating the permissions and privileges of the file. Symbols are defined in the <code>sys/stat.h</code> header file to refer to bits in a <code>mode_t</code> value; these symbols are listed in “ chmod() – Change the mode of a file or directory ” on page 274. |
| ino_t st_ino | ino_t st_ino | The serial number of the file. |
| dev_t st_dev | dev_t st_dev | The numeric ID of the device containing the file. |
| nlink_t st_nlink | nlink_t st_nlink | The number of links to the file. |
| uid_t st_uid | uid_t st_uid | The numeric user ID (UID) of the file's owner. |
| gid_t st_gid | gid_t st_gid | The numeric group ID (GID) of the file's group. |
| off_t st_size | long long st_size | For regular files, the file's size in bytes. For other kinds of files, the value of this field is unspecified. |
| time_t st_atime | time64_t st_atime | The most recent time the file was accessed. |
| time_t st_ctime | time64_t st_ctime | The most recent time the status of the file was changed. |
| time_t st_mtime | time64_t st_mtime | The most recent time the contents of the file were changed. |

Values for `time_t` and `time64_t` are given in terms of seconds since epoch.

`stat()` updates the time-related fields before putting information in the `stat` structure.

You can examine properties of a `mode_t` value from the `st_mode` field using a collection of macros defined in the `sys/modes.h` header file. If *mode* is a `mode_t` value, and *genvalue* is an unsigned `int` value from the `stat` structure, then:

S_ISBLK(*mode*)

Is nonzero for block special files.

S_ISCHR(*mode*)

Is nonzero for character special files.

S_ISDIR(*mode*)

Is nonzero for directories.

S_ISEXTL(*mode*,*genvalue*)

Is nonzero for external links.

S_ISFIFO(*mode*)

Is nonzero for pipes and FIFO special files.

S_ISLNK(*mode*)

Is nonzero for symbolic links.

S_ISREG(*mode*)

Is nonzero for regular files.

S_ISSOCK(*mode*)

Is nonzero for sockets.

If `stat()` successfully determines this information, it stores it in the area indicated by the *info* argument. The size of the buffer determines how much information is stored; data that exceeds the size of the buffer is truncated.

Large file support for z/OS UNIX files: `stat64()` automatically supports large z/OS UNIX files for both AMODE 31 and AMODE 64 C/C++ applications, which means there is no need for `_LARGE_FILES` feature test macro to be defined. As for `stat()`, the automatic support is only for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable `stat()` to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `stat()` returns 0.

If unsuccessful, `stat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have search permission on some component of the *pathname* prefix.

EINVAL

info is a NULL pointer.

EIO

Added for XPG4.2: An error occurred while reading from the file system.

ELOOP

A loop exists in symbolic links encountered during resolution of the *pathname* argument. This error is returned if more than `POSIX_SYMLINK` (defined in the `limits.h` header file) symbolic links are encountered during resolution of the *pathname* argument.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters, or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the path name string substituted for a symbolic link exceeds `PATH_MAX`. The `PATH_MAX` and `NAME_MAX` values can be determined with `pathconf()`.

ENOENT

There is no file named *pathname*, or *pathname* is an empty string.

ENOTDIR

A component of the *pathname* prefix is not a directory.

EOverflow

The file size in bytes or the number of blocks allocated to the file or the file serial number cannot be represented correctly in the structure pointed to by *info*.

Note: Environment variable `_EDC_EOverflow` can be used to control behavior of the `stat()` function with respect to detecting an `EOverflow` condition for z/OS UNIX files. By default, the `stat()` function will not set `EOverflow` when the file size can not be represented correctly in structure pointed to by *buf*. When `_EDC_EOverflow` is set to YES, the `stat()` function will check for an overflow condition.

Example**CELEBS33**

```
/* CELEBS33

   This example gets status information about a file.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <sys/stat.h>
#undef _POSIX_SOURCE
#include <stdio.h>
#include <time.h>

main() {
    struct stat info;

    if (stat("/", &info) != 0)
        perror("stat() error");
    else {
        puts("stat() returned the following information about root f/s:");
        printf("  inode:   %d\n",    (int) info.st_ino);
        printf(" dev id:  %d\n",    (int) info.st_dev);
        printf("  mode:   %08x\n",    info.st_mode);
        printf(" links:  %d\n",    info.st_nlink);
        printf("   uid:   %d\n",    (int) info.st_uid);
        printf("   gid:   %d\n",    (int) info.st_gid);
        printf("created:  %s",      ctime(&info.st_createtime));
    }
}
```

Output

`stat()` returned the following information about root `f/s`:

```
inode:   0
dev id:  1
mode:    010001ed
links:   11
uid:     0
gid:     500
created:  Fri Jun 16 10:07:55 2006
```

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)

- [“fstat\(\), fstat64\(\) — Get status information about a file” on page 649](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“lstat\(\), lstat64\(\) — Get status of file or symbolic link” on page 1025](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“mkfifo\(\) — Make a FIFO special file” on page 1075](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readlink\(\) — Read the value of a symbolic link” on page 1390](#)
- [“remove\(\) — Delete file” on page 1429](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)
- [“utime\(\), utime64\(\) — Set file access and modification times” on page 1952](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

statfs() — Get file system statistics

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFOM_SOURCE
#include <sys/statfs.h>

int statfs(const char *path, struct statfs *buf);
```

General description

The `statfs()` system call returns information about a mounted file system. *path* is the path name of any file within the mounted file system. *buf* is a pointer to a structure of `statfs` as defined in the `sys/statfs.h` header file.

Values that are returned in the `statfs` structure are summarized in the following table. Fields that are undefined for a particular file system are set to 0.

Table 61. Values that are returned in the *statfs* structure

| Value | Description |
|-------------------------------------|--|
| unsigned long <code>f_type</code> | Type of file system ¹ |
| unsigned long <code>f_bsize</code> | Optimal transfer block size |
| unsigned long <code>f_blocks</code> | Total data blocks in file system |
| unsigned long <code>f_bfree</code> | Free blocks in file system |
| unsigned long <code>f_bavail</code> | Free blocks available to unprivileged user |

Table 61. Values that are returned in the *statfs* structure (continued)

| Value | Description |
|---------------------------------|---------------------------------------|
| unsigned long <i>f_files</i> | Total inodes in file system |
| unsigned long <i>f_ffree</i> | Free inodes in file system |
| unsigned long <i>f_fsid</i> | File system ID |
| unsigned long <i>f_namelen</i> | Maximum length of file names |
| unsigned long <i>f_frsize</i> | Fragment size |
| unsigned long <i>f_flags</i> | Mount flags of file system |
| 2 | |
| unsigned long <i>f_spare[4]</i> | Padding bytes reserved for future use |

Notes:

1. *f_type* supports the following file system types:

Table 62. *f_type* value and file system type

| f_type value | File system type |
|---------------------|-------------------------|
| ZOSDSFS_SUPER_MAGIC | /* zOS DSFS */ |
| ZOSHFS_SUPER_MAGIC | /* zOS UNIX */ |
| NFS_SUPER_MAGIC | /* NFS */ |
| PROC_SUPER_MAGIC | /* /proc FS */ |
| ZOSUFS_SUPER_MAGIC | /* zOS UFS */ |
| ZOSZFS_SUPER_MAGIC | /* zOS ZFS */ |

2. The *f_flags* field is a bit mask indicating mount options for the file system. It contains zero or more of the following bits:

ST_NOSUID

The set-user-ID and set-group-ID bits are ignored by exec.

ST_RDONLY

This file system is mounted read-only.

ST_OEEXPORTED

The file system is exported.

ST_NOSECURITY

Security checks are not enforced for files in this file system.

Returned value

If successful, *statfs()* returns 0.

If unsuccessful, *statfs()* returns -1 and sets *errno* to one of the following values:

Error Code**Description****EACCES**

The process does not have search permission on some components of the *pathname* prefix.

EINTR

A signal is caught during the function execution.

EIO

An I/O error occurs while reading the file system.

ELOOP

A loop exists in symbolic links that are encountered during resolution of the *pathname* argument.

ENAMETOOLONG

The length of *pathname* exceeds PATH_MAX or a component of *pathname* is longer than NAME_MAX.

ENOENT

There is no file that is named *pathname*, or *pathname* is an empty string.

ENOTDIR

A component of the *pathname* prefix is not a directory.

EINVAL

A parameter is specified incorrectly.

ERANGE

The result is too large to fit in the available buffer space.

Related information

- [“sys/statfs.h — File system status” on page 71](#)

statvfs() – Get file system information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/statvfs.h>

int statvfs(const char *_restrict_ pathname, struct statvfs *_restrict_ fsinfo);
```

General description

The statvfs() function obtains information about the file system containing the file named by *pathname* and stores it in the area of memory pointed to by the *fsinfo* argument. The process does not need permissions on the file itself, but must have search permission on all directory components of the *pathname*.

The information is returned in the following statvfs structure, as defined in the sys/statvfs.h header file.

| Table 63. Values Returned in statvfs Structure | |
|--|--------------------------------------|
| Value | Description |
| char f_OEcbid[4] | The structure acronym (eye catcher). |
| int f_OEcblen | The length of the structure. |
| unsigned long f_bsize | The file system block size. |

Table 63. Values Returned in statvfs Structure (continued)

| Value | Description |
|---------------------------------|--|
| unsigned long f_blocks | The total number of blocks on the file system in units of f_frsize. |
| unsigned long f_OEusedspace | The allocated space in block size units. |
| unsigned long f_bavail | The number of free blocks available to non-privileged process. |
| unsigned long f_fsid | The file system ID. |
| unsigned long f_flag | A bit string indicating file system status. |
| int f_OEmaxfilesizehw | The high word of maximum file size. |
| unsigned long f_OEmaxfilesizelw | The low word of maximum file size. |
| unsigned long f_frsize | The fundamental file system block size. |
| unsigned long f_bfree | The total number of free blocks. |
| unsigned long f_files | The total number of file serial numbers. |
| unsigned long f_ffree | The total number of free file serial numbers. |
| unsigned long f_favail | The number of file serial numbers available to non-privileged process. |
| unsigned long f_namemax | The maximum file name length. |
| unsigned long f_OEinvarsec | The number of seconds the file system will remain unchanged. |

The following flags can be returned in the `f_flag` member:

ST_RDONLY

read-only file system

ST_NOSUID

setuid/setgid bits ignored by exec

ST_OEEXPORTED

file system is exported

If `statvfs()` successfully determines this information, it stores in the area indicated by the *fsinfo* argument. The size of the buffer determines how much information is stored; data that exceeds the size of the buffer is truncated.

Returned value

If successful, `statvfs()` returns 0.

If unsuccessful, `statvfs()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCES**

The process does not have search permission on some component of the *pathname* prefix.

EINTR

A signal was caught during the execution of the function.

EIO

An I/O error has occurred while reading the file system.

ELOOP

A loop exists in symbolic links encountered during resolution of the *pathname* argument. This error is issued if more than the system-defined limit of symbolic links, 8, are detected in the resolution of *pathname*.

ENAMETOOLONG

The length of the *pathname* exceeds **PATH_MAX** or a component of *pathname* is longer than **NAME_MAX**.

ENOENT

There is no file named *pathname*, or *pathname* is an empty string.

ENOTDIR

A component of the *pathname* prefix is not a directory.

Example

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/statvfs.h>
#include <stdio.h>

main() {
    int fd;
    struct statvfs buf;

    if (statvfs(".", &buf) == -1)
        perror("statvfs() error");
    else {
        printf("each block is %d bytes big\n", fs,
            buf.f_frsize);
        printf("there are %d blocks available out of a total of %d\n",
            buf.f_bavail, buf.f_blocks);
        printf("in bytes, that's %.0f bytes free out of a total of %.0f\n",
            ((double)buf.f_bavail * buf.f_frsize),
            ((double)buf.f_blocks * buf.f_frsize));
    }
}
```

Output

```
each block is 4096 bytes big
there are 2089 blocks available out of a total of 2400
in bytes, that's 8556544 bytes free out of a total of 9830400
```

Related information

- [“sys/statvfs.h — File system status” on page 71](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“chown\(\) — Change the owner or group of a file or directory” on page 277](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“exec functions” on page 442](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“mknod\(\) — Make a directory or file” on page 1078](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“time\(\),time64\(\) — Determine current UTC time” on page 1865](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

- “[utime\(\), utime64\(\)](#) — Set file access and modification times” on page 1952
- “[write\(\)](#) — Write data on a file or socket” on page 2070

step() — Pattern match with regular expression

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4 XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE
#include <regex.h>

int step(const char *string, const char *expbuf);

extern char *loc1, *loc2;
```

General description

Restriction: This function is not supported in AMODE 64.

The `step()` function attempts to match an input string of characters with the compiled regular expression which was obtained by an earlier call to `compile()`.

The first parameter *string* is a pointer to a string of characters to be checked for a match.

expbuf is the pointer to the regular expression which was previously obtained by a call to `compile()`.

Usage notes

1. The external variables *cirf*, *sed*, and *nbra* are reserved.
2. The application must provide the proper serialization for the `compile()`, `step()`, and `advance()` functions if they are run under a multithreaded environment.
3. The `compile()`, `step()` and `advance()` functions are provided for historical reasons. These functions were part of the Legacy Feature in Single UNIX Specification, Version 2. They have been withdrawn and are not supported as part of Single UNIX Specification, Version 3. New applications should use the newer functions `fnmatch()`, `glob()`, `regcomp()`, and `regexexec()`, which provide full internationalized regular expression functionality compatible with ISO POSIX.2 standard.

Returned value

If some substring of *string* matches the regular expression in *expbuf*, `step()` returns nonzero.

If there is no match, `step()` returns 0.

If there is a match, `step()` sets two external pointers, as follows:

- The variable *loc1* points to the first character that matched the regular expression.
- The variable *loc2* points to the character after the last character that matched the regular expression.

For example, if the regular expression matches the entire input *loc1* will point to the first character of *string* and *loc2* will point to the NULL at the end of *string*.

Related information

- [“regex.h — Regular expression declarations” on page 57](#)
- [“advance\(\) — Pattern match given a compiled regular expression” on page 143](#)
- [“compile\(\) — Compile regular expression” on page 305](#)
- [“fnmatch\(\) — Match file name or path name” on page 569](#)
- [“glob\(\) — Generate path names matching a pattern” on page 808](#)
- [“regcomp\(\) — Compile regular expression” on page 1416](#)
- [“regexexec\(\) — Execute compiled regular expression” on page 1421](#)

stpcpy() — Copy string, returning pointer to its end

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | Both | z/OS 3.2 |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <string.h>

char *stpcpy(char *__restrict__ string1, const char *__restrict__ string2);
```

General description

The `stpcpy()` function copies *string2*, including the terminating NULL character (`\0`), to the location that is specified by *string1*.

The string that is pointed to by *string1* must have the space of at least `strlen(string2)+1` characters to receive the copy.

You cannot use a string literal for a *string1* value, although *string2* may be a string literal.

string2 and *string1* must not overlap. Otherwise, the behavior is undefined.

Returned value

`stpcpy()` returns a pointer to the end of *string1*.

Note: No return values are reserved to indicate an error. To check for error situations, set `errno` to 0, call this function, then check `errno`.

Example

```
/* This example copies the contents of source to dest,
   returning a pointer to the end of dest.
*/

#define _POSIX_C_SOURCE 200809L
#include <stdio.h>
#include <string.h>

#define SIZE    40

int main(void)
```

```

{
    char source[ SIZE ] = "test string";
    char dest[ SIZE ];
    char * result;

    result = stpcpy( dest, source );

    /* use strlen() to calculate length of source string */
    printf( "result: \"%s\\", result - strlen(source): \"%s\\\"\\n",
           result, result - strlen(source) );
}

```

Output

```
result: "", result - strlen(source): "test string"
```

stpncpy() — Copy fixed-size string, returning pointer to its end

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | z/OS 3.2 |

Format

```

#define _POSIX_C_SOURCE 200809L
#include <string.h>

char *stpncpy(char *__restrict__ string1, const char *__restrict__ string2, size_t n);

```

General description

The `stpncpy()` function copies at most *n* characters (bytes) before and including the terminating NULL character (`\0`) from the string that is pointed to by *string2* to the location that is specified by *string1*.

If the string that is pointed to by *string2* is smaller than *n* characters, the remaining characters in the string that is pointed to by *string1* are filled with terminating NULL characters (`\0`).

You cannot use a string literal for a *string1* value, although *string2* may be a string literal.

string2 and *string1* must not overlap. Otherwise, the behavior is undefined.

Returned value

`stpncpy()` returns a pointer to the terminating NULL character (`\0`) in *string1* if *string1* is null-terminated. Otherwise, `stpncpy()` returns `&string1[n]`.

Note: No return values are reserved to indicate an error. To check for error situations, set `errno` to 0, call this function, then check `errno`.

Example

```

/*
 * This example copies at most max_len characters from source to dest,
 * returning a pointer to the end of dest.
 */

#define _POSIX_C_SOURCE
#include <stdio.h>
#include <string.h>

```

```

#define SIZE    40

int main(void)
{
    char source[ SIZE ] = "test string";
    char dest[ SIZE ];
    size_t max_len = 9;
    char * result;

    result = stpncpy( dest, source, max_len );

    /* use strlen() to calculate length of source string */
    printf( "result: \"%s\\", "
            "result - strlen(source, max_len): \"%s\\\"\\n",
            result, result - strlen(source, max_len) );
}

```

Output

```

result: "", result - strlen(source, max_len): "test stri"

```

strcasecmp() – Case-insensitive string comparison

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _XOPEN_SOURCE_EXTENDED 1
#include <strings.h>

int strcasecmp(const char *string1, const char *string2);

```

General description

The `strcasecmp()` function compares, while ignoring differences in case, the string pointed to by *string1* to the string pointed to by *string2*.

The string arguments to the function must contain a NULL character (`\0`) marking the end of the string.

The `strcasecmp()` function is locale-sensitive.

Returned value

`strcasecmp()` returns a value indicating the relationship between the strings, while ignoring case, as follows:

Value**Meaning****< 0**

String pointed to by *string1* is less than string pointed to by *string2*.

= 0

String pointed to by *string1* is equal to string pointed to by *string2*.

> 0

String pointed to by *string1* is greater than string pointed to by *string2*.

There are no `errno` values defined.

Related information

- [“strings.h — String operations” on page 67](#)
- [“setlocale\(\) — Set locale” on page 1547](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strncasecmp\(\) — Case-insensitive string comparison” on page 1742](#)

strcat() — Concatenate strings

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

char *strcat(char * __restrict__string1, const char * __restrict__string2);
```

General description

The `strcat()` built-in function concatenates *string2* with *string1* and ends the resulting string with the NULL character. In other words, `strcat()` appends a copy of the string pointed to by *string2*—including the terminating NULL byte—to the end of a string pointed to by *string1*, with its last byte (that is, the terminating NULL byte of *string1*) overwritten by the first byte of the appended string.

Do not use a literal string for a *string1* value, although *string2* may be a literal string.

If the storage of *string1* overlaps the storage of *string2*, the behavior is undefined.

Returned value

Returns the value of *string1*, the concatenated string.

Example

CELEBS34

```
/* CELEBS34

   This example creates the string "computer program" using strcat().

*/
#include <stdio.h>
#include <string.h>

#define SIZE 40

int main(void)
{
    char buffer1[SIZE] = "computer";
    char * ptr;

    ptr = strcat( buffer1, " program" );
```

```
printf( "buffer1 = %s\n", buffer1 );
}
```

Output

```
buffer1 = computer program
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“strchr\(\) — Search for character” on page 1720](#)
- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“strcpy\(\) — Copy string” on page 1725](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strncat\(\) — Concatenate strings” on page 1743](#)

strchr() — Search for character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

C:

```
#include <string.h>

char *strchr(const char *string, int c);
```

C++:

```
#include <string.h>

const char *strchr(const char *string, int c);
char *strchr(char *string, int c);
```

General description

The `strchr()` built-in function finds the first occurrence of `c` converted to `char`, in the string **string*. The character `c` can be the NULL character (`\0`); the ending NULL character of *string* is included in the search.

The `strchr()` function operates on NULL-terminated strings. The string argument to the function *must* contain a NULL character (`\0`) marking the end of the string.

Returned value

If successful, `strchr()` returns a pointer to the first occurrence of `c` (converted to a character) in *string*.

If the character is not found, `strchr()` returns a NULL pointer.

Example

CELEBS35

```

/* CELEBS35

   This example finds the first occurrence of the character p in
   "computer program".

   */
#include <stdio.h>
#include <string.h>

#define SIZE 40

int main(void)
{
    char buffer1[SIZE] = "computer program";
    char * ptr;
    int    ch = 'p';

    ptr = strchr( buffer1, ch );
    printf( "The first occurrence of %c in '%s' is '%s'\n",
           ch, buffer1, ptr );
}

```

Output

```
The first occurrence of p in 'computer program' is 'puter program'
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“memchr\(\) — Search buffer” on page 1063](#)
- [“strcat\(\) — Concatenate strings” on page 1719](#)
- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“strcpy\(\) — Copy string” on page 1725](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strncmp\(\) — Compare strings” on page 1744](#)
- [“strpbrk\(\) — Find characters in string” on page 1748](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) — Search string” on page 1755](#)

strchrnul() — Find first occurrence of character in string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#define _XPLATFROM_SOURCE 1
#include <string.h>

char * strchrnul(const char *string, int c);

```

General description

The `strchrnul()` function finds the first occurrence of `c`, which is converted to a `char` in the string `*string`. The character `c` can be the NULL character (`\0`). The ending NULL character of `string` is included in the search.

The `strchrnul()` function operates on NULL-terminated strings. The string argument to the function must contain a NULL character (`\0`) that represents the end of the string.

Returned value

If successful, `strchrnul()` returns a pointer to the first occurrence of `c`, which is converted to a `char` in the string `*string`.

If the character is not found, `strchrnul()` returns a pointer to the null byte at the end of `string`.

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memchr\(\) – Search buffer” on page 1063](#)
- [“strchr\(\) – Search for character” on page 1720](#)
- [“strcat\(\) – Concatenate strings” on page 1719](#)
- [“strcmp\(\) – Compare strings” on page 1722](#)
- [“strcpy\(\) – Copy string” on page 1725](#)
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- [“strncmp\(\) – Compare strings” on page 1744](#)
- [“strpbrk\(\) – Find characters in string” on page 1748](#)
- [“strrchr\(\) – Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) – Search string” on page 1755](#)

strcmp() – Compare strings

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

int strcmp(const char *string1, const char *string2);
```

General description

The `strcmp()` built-in function compares the string pointed to by `string1` to the string pointed to by `string2`. The string arguments to the function must contain a NULL character (`\0`) marking the end of the string.

The relation between the strings is determined by subtracting: $string1[i] - string2[i]$, as i increases from 0 to $strlen$ of the smaller string. The sign of a nonzero return value is determined by the sign of the difference between the values of the first pair of bytes (both interpreted as type unsigned char) that differ in the strings being compared. This function is *not* locale-sensitive.

Returned value

strcmp() returns a value indicating the relationship between the strings, as listed below.

Value

Meaning

< 0

String pointed to by *string1* less than string pointed to by *string2*

= 0

String pointed to by *string1* equivalent to string pointed to by *string2*

> 0

String pointed to by *string1* greater than string pointed to by *string2*

Example

CELEBS36

```
/* CELEBS36

   This example compares the two strings passed to main using
   &strcmp..

   */
#include <stdio.h>
#include <string.h>

int main(int argc, char ** argv)
{
    int result;

    if ( argc != 3 )
    {
        printf( "Usage: %s string1 string2\n", argv[0] );
    }
    else
    {
        result = strcmp( argv[1], argv[2] );

        if ( result == 0 )
            printf( "\"%s\" is identical to \"%s\"\n", argv[1], argv[2] );
        else if ( result < 0 )
            printf( "\"%s\" is less than \"%s\"\n", argv[1], argv[2] );
        else
            printf( "\"%s\" is greater than \"%s\"\n", argv[1], argv[2] );
    }
}
```

Output

If the input is the strings "is this first?" and "is this before that one?" then the expected output is:

```
"is this first?" is greater than "is this before that one?"
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“memcmp\(\) — Compare bytes” on page 1065](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strncmp\(\) — Compare strings” on page 1744](#)

- [“strpbrk\(\) — Find characters in string” on page 1748](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) — Search string” on page 1755](#)
- [“strcasecmp\(\) — Case-insensitive string comparison” on page 1718](#)
- [“strncasecmp\(\) — Case-insensitive string comparison” on page 1742](#)

strcoll() — Compare strings

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

int strcoll(const char *string1, const char *string2);
```

General description

Compares the string pointed to by *string1* against the string pointed to by *string2*, both interpreted according to the information in the LC_COLLATE category of the current locale.

Returned value

strcoll() returns a value indicating the relationship between the strings, as listed below.

Value

Meaning

< 0

string pointed to by *string1* less than string pointed to by *string2*

= 0

string pointed to by *string1* equivalent to string pointed to by *string2*

> 0

string pointed to by *string1* greater than string pointed to by *string2*

Notes:

1. The strcoll() function may need to allocate additional memory to perform the comparison algorithm specified in the LC_COLLATE. If the memory request cannot be satisfied (by malloc()), strcoll() fails.
2. If the locale supports double-byte characters (MB_CUR_MAX specified as 4), the strcoll() function validates the multibyte characters, whereas previously the strcoll() function did not validate the string. The strcoll() function will fail if the string contains invalid multibyte characters.
3. If MB_CUR_MAX is specified as 4, but the charmap file does not specify the DBCS characters, the DBCS characters will collate after the single-byte characters.

Example

CELEBS37

```

/* CELEBS37

   This example compares the two strings passed to main.

*/
#include <stdio.h>
#include <string.h>

int main(int argc, char ** argv)
{
    int result;

    if ( argc != 3 ) {
        printf( "Usage: %s string1 string2\n", argv[0] );
    }
    else {
        result = strcoll( argv[1], argv[2] );

        if ( result == 0 )
            printf( "\"%s\" is identical to \"%s\"\n", argv[1], argv[2] );
        else if ( result < 0 )
            printf( "\"%s\" is less than \"%s\"\n", argv[1], argv[2] );
        else
            printf( "\"%s\" is greater than \"%s\"\n", argv[1], argv[2] );
    }
}

```

Output

If the input is the strings “firststring” and “secondstring”, then the expected output is:

```
"firststring" is less than "secondstring"
```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“setlocale\(\) – Set locale” on page 1547](#)
- [“strcmp\(\) – Compare strings” on page 1722](#)
- [“strncmp\(\) – Compare strings” on page 1744](#)

strcpy() – Copy string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <string.h>

char *strcpy(char * __restrict__string1, const char * __restrict__string2);

```

General description

The `strcpy()` built-in function copies *string2*, including the ending NULL character, to the location specified by *string1*. The *string2* argument to `strcpy()` must contain a NULL character (`\0`) marking the end of the string. You cannot use a literal string for a *string1* value, although *string2* may be a literal string. If the two objects overlap, the behavior is undefined.

Returned value

`strcpy()` returns the value of *string1*.

Example

CELEBS38

```
/* CELEBS38

   This example copies the contents of source to destination.

*/
#include <stdio.h>
#include <string.h>

#define SIZE    40

int main(void)
{
    char source[ SIZE ] = "This is the source string";
    char destination[ SIZE ] = "And this is the destination string";
    char * return_string;

    printf( "destination is originally = \"%s\\n", destination );
    return_string = strcpy( destination, source );
    printf( "After strcpy, destination becomes \"%s\\n", destination );
}
```

Output

```
destination is originally = "And this is the destination string"
After strcpy, destination becomes "This is the source string"
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“memcpy\(\) — Copy buffer” on page 1066](#)
- [“strcat\(\) — Concatenate strings” on page 1719](#)
- [“strchr\(\) — Search for character” on page 1720](#)
- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strncpy\(\) — Copy string” on page 1746](#)
- [“strpbrk\(\) — Find characters in string” on page 1748](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) — Search string” on page 1755](#)

strcspn() — Compare strings

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

size_t strcspn(const char *string1, const char *string2);
```

General description

Computes the length of the initial portion of the string pointed to by *string1* that contains no characters from the string pointed to by *string2*.

Returned value

strcspn() returns the calculated length of the initial portion found.

Example

CELEBS39

```
/* CELEBS39

   This example uses &strcspn. to find the first occurrence of
   any of the characters a, x, l or e in string.

*/
#include <stdio.h>
#include <string.h>

#define SIZE    40

int main(void)
{
    char string[ SIZE ] = "This is the source string";
    char * substring = "axle";

    printf( "The first %i characters in the string \"%s\"\\
are not in the " "string \"%s\" \\n",
           strcspn(string, substring), string, substring);
}
```

Output

```
The first 10 characters in the string "This is the source string"
are not in the string "axle"
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“strcat\(\) — Concatenate strings” on page 1719](#)
- [“strchr\(\) — Search for character” on page 1720](#)

- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“strcpy\(\) — Copy string” on page 1725](#)
- [“strncmp\(\) — Compare strings” on page 1744](#)
- [“strpbrk\(\) — Find characters in string” on page 1748](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) — Search string” on page 1755](#)

strdup() — Duplicate a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <string.h>

char *strdup(const char *string);
```

General description

The `strdup()` function creates a duplicate of the string pointed to by *string*.

Returned value

If successful, `strdup()` returns a pointer to a new string which is a duplicate of *string*.

Otherwise, `strdup()` returns a NULL pointer.

Note: The caller of `strdup()` should free the storage obtained for the string.

Error Code

Description

ENOMEM

Insufficient storage space is available.

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“free\(\) — Free a block of storage” on page 620](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)

strerror() — Get pointer to runtime error message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

char *strerror(int errnum);
```

General description

Maps the error number in *errnum* to an error message string. The *errnum* must be a valid *errno* value. This function does not produce a locale-dependent error message string.

Returned value

`strerror()` returns a pointer to the string, which may be overwritten by a subsequent call to `strerror()`.

Note: Do not allow the content of this string to be modified by the program.

Example

```
/* This example opens a file and prints a runtime error message if an
   error occurs.
   */
#include <stdio.h>
#include <string.h>
#include <errno.h>

int main(void)
{
    FILE *stream;
    :
    if ((stream = fopen("myfile.dat", "r")) == NULL)
        printf(" %s \n", strerror(errno));
}
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“clearerr\(\) — Reset error and end of file \(EOF\)” on page 285](#)
- [“ferror\(\) — Test for read and write errors” on page 512](#)
- [“perror\(\) — Print error message” on page 1184](#)

strerror_r() – Get copy of runtime error message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, Version 3 | both | z/OS V1R7 |

Format

```
#define _UNIX03_SOURCE
#include <string.h>

int strerror_r(int errnum, char *strerrbuf, size_t buflen);
```

General description

`strerror_r()` maps the error number in *errnum* to an error message string and copies the message string into the buffer pointed to by *strerrbuf* with length *buflen*. If the length of the message string is greater than or equal to *buflen*, `strerror_r()` copies the first *buflen*-1 characters of the message string into *strerrbuf*, terminates *strerrbuf* with a null character (`\0`) and returns `ERANGE`. The error number must be a valid `errno` value.

This function does not produce a locale-dependent error message string.

Returned value

If successful, `strerror_r()` returns 0.

If unsuccessful, `strerror_r()` returns an error number to indicate the error.

- `EINVAL` – The value of *errnum* is not a valid error number.
- `ERANGE` – Insufficient storage was supplied via *strerrbuf* and *buflen* to contain the generated message string.

Related information

- `errno.h`
- `string.h`
- `clearerr()`
- `ferror()`
- `perror()`
- `strerror()`
- `unsetenv()`

strfmon() – Convert monetary value to string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <monetary.h>

ssize_t strfmon(char * __restrict__ s, size_t maxsize,
                const char * __restrict__ format, ...);
```

General description

strfmon() produces a formatted monetary output string from a double argument. It has been extended to determine floating-point argument format (hexadecimal floating-point or IEEE Binary Floating-Point) using the __isBFP() function.

Note: In IEEE Binary Floating-Point mode, denormal, infinity and NaN argument values are out of range.

Places characters into the array pointed to by *s* as controlled by the string pointed to by *format*. No more than *maxsize* characters are placed into the array.

The character string *format* contains two types of objects: plain characters, which are copied to the output array, and directives, each of which results in the fetching of zero or more arguments that are converted and formatted. The results are undefined if there are insufficient arguments for the *format*. If the *format* is exhausted while arguments remain, the excess arguments are simply ignored. If objects pointed to by *s* and *format* overlap, the behavior is undefined.

The directive (conversion specification) consists of the following sequence:

1. A % character
2. Optional flags: =f, ^, !, then +, C, or (
3. Optional field width (may be preceded by w
4. Optional left precision: #n
5. Optional right precision: .p
6. Required conversion character to indicate what conversion should be performed: i or n

Each directive is replaced by the appropriate characters, as described in the following list:

%i

The double argument is formatted according to the locale's international currency format (for example, in USA: USD 1,234.56). An @euro codeset modifier can be used to request "EUR" instead of a national 4-character monetary string.

%n

The double argument is formatted according to the locale's national currency format (for example, in USA: \$1,234.56). An @euro codeset modifier can be used to get <euro-sign> instead of <currency>.

%% is replaced by %. No argument is converted.

The following optional conversion specifications may immediately follow the initial % of a directive:

=f

A flag, used in conjunction with the maximum digits specification #n (see below), specifies that the character *f* should be used as the numeric fill character. The default numeric fill character is the space character. This option does not affect the other fill operations that always use space as the fill character.

^

A flag. Do not format the currency amount with thousands grouping characters. The default is to insert the grouping characters if defined for the current locale.

Note: The code point for the ^ character will be determined according to the current LC_SYNTAX category.

+ | C | (

A flag, specifies the style of representing positive and negative currency amounts. Only one of +, C, or (may be specified. If + is specified, the locale's equivalent of + and - are used (for example, in USA: the empty (NULL) string if positive and - if negative). If C is specified, the locale's equivalent of DB for negative and CR for positive are used. If (is specified, the locale's equivalent of enclosing negative amounts within parentheses is used. If this option is not included, a default specified by the current locale is used.

[-]w

The field width. The decimal digit string *w* specifies a minimum field width in which the result of the conversion is right-justified (or left-justified if the optional flag “-” is specified).

#n

The left precision. The decimal digit string *n* specifies the maximum number of digits expected to be formatted to the left of the radix character. This option can be used to keep the formatted output from multiple calls to the strfmon() aligned in the same columns. It can also be used to fill unused positions with a special character as in \$***123.45. This option causes an amount to be formatted as if it has the number of digits specified by *n*. If more digit positions are required than the number specified, conversion specification is ignored. Digit positions in excess of those actually required are filled with the numeric fill character. (See the =f specification above.)

If the thousands grouping is enabled, the behavior is:

1. Format the number as if it is an *n* digit number.
2. Insert fill characters to the left of the leftmost digit (for example, \$0001234.56 or \$***1234.56)
3. Insert the separator character (for example, \$0,001,234.56 or \$*,**1,234.56)
4. If the fill character is not the digit zero, the separators are replaced by the fill character (for example, \$****1,234.56).

To ensure alignment, any characters appearing before or after the number in the formatted output such as currency or sign symbols are padded as necessary with space characters to make their positive and negative formats an equal length.

Note: The code point for the # character (in #n) will be determined according to the current LC_SYNTAX category.

.p

The right precision. The decimal digit string *p* specifies the number of digits after the radix character. If the value of the precision *p* is zero, no radix character appears. If this option is not included, a default specified by the current locale is used. The amount being formatted is rounded to the specified number of digits before formatting.

!

A flag used to suppress the currency symbol from the output conversion.

Note: The code point for the ! character is determined according to the current LC_SYNTAX category.

The LC_MONETARY category of the program's locale affects the behavior of this function including the monetary radix character (which is different from the numeric radix character affected by the LC_NUMERIC category), the thousands (or alternative grouping) separator, the currency symbols and formats. The international currency symbol must be in accordance with those specified in ISO4217 Codes for the representation of currencies and funds.

Formatting choices are indicated in the LC_MONETARY category for the output of both national and international monetary quantities. The national format is determined by the settings of p_cs_precedes, n_cs_precedes, p_sign_posn, n_sign_posn, p_sep_by_space, and n_sep_by_space. An equivalent set of members for international formats are added to conform with the ISO/IEC standard. See [“locale.h — Locale settings” on page 36](#) for more information on international formats.

The following tables show expected results for the various combinations of sep_by_space and sign_posn. All examples are based on a positive monetary quantity of 123.00, positive sign of '+', and currency

symbol of '\$'. Note that formatting rules are equivalent for negative and non-negative values as well as for national and international formats.

| Table 64. Monetary formats when <i>cs_precedes</i> = 1 | | | | | |
|--|-------------|------------|------------|------------|------------|
| sep_by_space | sign_posn | | | | |
| | 0 | 1 | 2 | 3 | 4 |
| 0 | (\$123.00) | +\$123.00 | \$123.00+ | +\$123.00 | \$+123.00 |
| 1 | (\$ 123.00) | +\$ 123.00 | \$ 123.00+ | +\$ 123.00 | \$+ 123.00 |
| 2 | (\$123.00) | + \$123.00 | \$123.00 + | + \$123.00 | \$ +123.00 |

| Table 65. Monetary formats when <i>cs_precedes</i> = 0 | | | | | |
|--|-------------|------------|------------|------------|------------|
| sep_by_space | sign_posn | | | | |
| | 0 | 1 | 2 | 3 | 4 |
| 0 | (123.00\$) | +123.00\$ | 123.00\$+ | 123.00+\$ | 123.00\$+ |
| 1 | (123.00 \$) | +123.00 \$ | 123.00 \$+ | 123.00 +\$ | 123.00 \$+ |
| 2 | (123.00\$) | + 123.00\$ | 123.00\$ + | 123.00+ \$ | 123.00\$ + |

cs_precedes

0

The currency symbol follows the value.

1

The currency symbol precedes the value.

sep_by_space

0

No space separates the currency symbol and value.

1

If the currency symbol and sign string are adjacent, a space separates them from the value; otherwise, a space separates the currency symbol from the value.

2

If the currency symbol and sign string are adjacent, a space separates them; otherwise, a space separates the sign string from the value.

sign_posn

0

Parentheses surround the quantity and currency_symbol or int_curr_symbol.

1

The sign string precedes the quantity and currency_symbol or int_curr_symbol.

2

The sign string succeeds the quantity and currency_symbol or int_curr_symbol.

3

The sign string immediately precedes the currency_symbol or int_curr_symbol.

4

The sign string immediately succeeds the currency_symbol or int_curr_symbol.

Returned value

If the total number of resulting bytes including the terminating NULL character is not more than *maxsize*, strfmon() returns the number of bytes placed into the array pointed to by *s*, not including the terminating NULL character.

If unsuccessful, the contents of the array are indeterminate, strfmon() returns -1, and sets *errno* to one of the following values:

Error Code

Description

E2BIG

Conversion stopped due to lack of space in the buffer

Example

CELEBS41

```
/* CELEBS41 */
#include <localdef.h>
#include <monetary.h>
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    char    string[100];    /* hold the string returned from strfmon() */
    double money = 1234.56;

    if (setlocale(LC_ALL, "En_US") == NULL) {
        printf("Unable to setlocale().\n");
        exit(1);
    }

    strfmon(string, 100, "%i", money);
    printf("%s\n", string);
    strfmon(string, 100, "%n", money);
    printf("%s\n", string);
}
```

Example

The following example shows euro currency support:

```
/* EUROSAMP
   This example sets the locale to Fr_BE.IBM-1148
   and Fr_BE.IBM-1148@euro and prints a value with
   the locales national and international currency
   format.
*/

#include <localdef.h>
#include <locale.h>
#include <stdio.h>
#include <stdlib.h>

int main(void)
{
    char string[100];
    double money = 1234.56;

    if (setlocale(LC_ALL, "Fr_BE.IBM-1148") == NULL) {
        printf("Unable to setlocale().\n");
        exit(1);
    }

    strfmon(string, 100, "%i", money);
    printf("%s\n", string);
    strfmon(string, 100, "%n", money);
    printf("%s\n", string);

    if (setlocale(LC_ALL, "Fr_BE.IBM-1148@euro") == NULL) {
        printf("Unable to setlocale().\n");
        exit(1);
    }
}
```



```
strfmon(string,100,"%i",money);
printf("%s\n",string);
strfmon(string,100,"%n",money);
printf("%s\n",string);
}
```

Output

```
1.234,56 BEF
1.234,56 BF
1.234,56 EUR
1.234,56 <euro-sign>
```

Related information

- [“monetary.h — strfmon\(\) function” on page 45](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)

strftime() — Convert to formatted time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | Both | |

Format

```
#include <time.h>

size_t strftime(char * __restrict__ dest, size_t maxsize,
                const char * __restrict__ format, const struct tm * __restrict__ timeptr);
```

General description

Places characters into the array pointed to by *dest* according to the string pointed to by *format*. The format string is a multibyte character string which contains:

- Conversion specification characters
- Ordinary multibyte characters, which are copied into an array unchanged.

The characters that are converted are determined by the LC_CTYPE category of the current locale and by the values in the time structure pointed to by *timeptr*. The time structure pointed to by *timeptr* is usually obtained by calling the `gmtime()` or `localtime()` function.

Table 66. Conversion Specifiers Used by strftime()

| Specifier | Meaning |
|-----------|--|
| %a | Replace with abbreviated weekday name of locale. |
| %A | Replace with full weekday name of locale. |
| %b | Replace with abbreviated month name of locale. |

Table 66. Conversion Specifiers Used by *strptime()* (continued)

| Specifier | Meaning |
|------------------|--|
| %B | Replace with full month name of locale. |
| %c | Replace with date and time of locale. |
| %C | Replace with locale's century number (year divided by 100 and truncated). |
| %d | Replace with day of the month (01-31). |
| %D | Insert date in mm/dd/yy form, regardless of locale. |
| %e | Insert day of the month as a decimal number (01–31). Under C POSIX only, it's a 2-character, right-justified, blank-filled field. |
| %E[cCxyY] | If the alternative date/time format is not available, the %E descriptors are mapped to their unextended counterparts. For example, %EC is mapped to %C. |
| %Ec | Replace with the locale's alternative date and time representation. |
| %EC | Replace with the name of the base year (period) in the locale's alternative representation. |
| %Ex | Replace with the locale's alternative date representation. |
| %EX | Replace with the locale's alternative time representation. |
| %Ey | Replace with the offset from %EC (year only) in the locale's alternative representation. |
| %EY | Replace with the full alternative year representation. |
| %F | Replace with the ISO 8601:2000 standard date format, equivalent to %Y-%m-%d. Values are taken from struct tm members, tm_year, tm_mon, and tm_mday. |
| %g | Replace with the last two digits of the week-based year as a decimal number (00-99). |
| %G | Replace with the week-based year as a four digit decimal. |
| %h | Replace with locale's abbreviated month name. This is the same as %b. %b. |
| %H | Replace with hour (24-hour clock) as a decimal number (00-23). |
| %I | Replace with hour (12-hour clock) as a decimal number (01-12). |
| %j | Replace with day of the year (001-366). |
| %m | Replace with month (01-12). |
| %M | Replace with minute (00-59). |
| %n | Replace with a newline. |
| %O[deHIImMSUwWy] | If the alternative date/time format is not available, the %E descriptors are mapped to their unextended counterparts. For example, %Od is mapped to %d. |
| %Od | Replace with the day of month, using the locale's alternative numeric symbols, filled as needed with leading zeros if there is any alternative symbol for zero, otherwise with leading spaces. |

Table 66. Conversion Specifiers Used by `strftime()` (continued)

| Specifier | Meaning |
|-----------|--|
| %Oe | Replace with the day of the month, using the locale's alternative symbols, filled as needed with leading spaces. |
| %OH | Replace with the hour (24-hour clock) using the locale's alternative symbols. |
| %OI | Replace with the hour (12-hour clock) using the locale's alternative symbols. |
| %Om | Replace with the month using the locale's alternative numeric symbols. |
| %OM | Replace with the minutes using the locale's alternative numeric symbols. |
| %OS | Replace with the seconds using the locale's alternative numeric symbols. |
| %Ou | Replace with the weekday as a number in the locale's alternative representation (Monday=1). |
| %OU | Replace with the week number of the year (Sunday as the first day of the week, rules corresponding to %U) using the locale's alternative numeric symbols. |
| %OV | Replace with the week number of the year (Monday as the first day of the week, rules corresponding to %V) using the locale's alternative numeric symbols. |
| %Ow | Replace with the weekday (Sunday=0) using the locale's alternative numeric symbols. |
| %OW | Replace with the week number of the year (Monday as the first day of the week) using the locale's alternative numeric symbols. |
| %Oy | Replace with the year (offset from %C) in the locale's alternative representation and using the locale's alternative numeric symbols. |
| %p | Replace with the locale's equivalent of AM or PM. |
| %r | Replace with a string equivalent to %I:%M:%S %p; or use <code>t_fmt_ampm</code> from <code>LC_TIME</code> , if present. |
| %R | Replace with time in 24 hour notation (%H:%M). |
| %s | Replace with the number of seconds since the Epoch, 1970-01-01 00:00:00 +0000 (UTC). (Calculated from <code>mktime64(tm)</code> .) |
| %S | Replace with seconds as a decimal number (00-60). |
| %t | Replace with a tab. |
| %T | Replace with a string equivalent to %H:%M:%S. |
| %u | Replace with the weekday as a decimal number (1 to 7), with 1 representing Monday. |
| %U | Replace with week number of the year (00-53) where Sunday is the first day of the week. The first Sunday of January is the first day of week 1; days in the new year before this are in week 0. |
| %V | Replace with week number of the year (01-53) where Monday is the first day of the week. If the week containing 1 January has four or more days in the new year, then it is considered week 1. Otherwise, it is the last week of the previous year, and the next week is week 1. Both January 4th and the first Thursday of January are always in week 1. |

Table 66. Conversion Specifiers Used by *strptime()* (continued)

| Specifier | Meaning |
|-----------|--|
| %w | Replace with weekday (0-6) where Sunday is 0. |
| %W | Replace with week number of the year (00-53) where Monday is the first day of the week. |
| %x | Replace with date representation of locale. |
| %X | Replace with time representation of locale. |
| %y | Replace with year without the century (00-99). |
| %Y | Replace with year with century. |
| %z | Replace with the offset from UTC in ISO8601:2000 standard format (+hhmm or -hhmm). For example, "-0430" means 4 hours 30 minutes behind UTC (west of Greenwich). If tm_isdst is zero, the standard time offset is used. If tm_isdst is greater than zero, the daylight savings time offset is used. If tm_isdst is negative, or if no timezone can be determined, then no characters are returned. |
| %Z | Replace with name of time zone, or no characters if time zone is not available. |
| %% | Replace with %. |

If data has the form of a directive, but is not one of the above, the characters following the % are copied to the output.

The behavior is undefined when objects being copied overlap. *maxsize* specifies the maximum number of characters that can be copied into the array.

If *strptime()* is called by a non-POSIX application, it obtains appropriate time zone name information from LC_TOD locale category. Time zone name defaults to STD for Standard time name, DST for Daylight Savings time name, or UTC for Coordinated Universal Time (UTC), name, as appropriate, if time zone name information is unspecified in the current LC_TOD locale category.

Note: The *strptime()* function requires time zone name information to convert the %Z conversion specifier. It is obtained as follows:

- The *strptime()* functions calls the *tzset()* function to obtain time zone information by parsing the TZ (POSIX) or _TZ (non_POSIX) environment variable or from the current LC_TOD locale category. If the tm structure input to *strptime()* was produced by calling *localtime()*, *strptime()* converts %Z to the Standard or Daylight Savings name characters specified by the TZ environment variable or LC_TOD category (if TZ cannot be found or parsed).
- When neither TZ nor _TZ is defined, the current locale is interrogated for time zone information. If neither TZ nor _TZ is defined and LC_TOD time zone information is not present in the current locale, a default value is applied to local time. POSIX programs simply default to Coordinated Universal Time (UTC), while non-POSIX programs establish an offset from UTC based on the setting of the system clock. For more information about customizing a time zone to work with local time, see “Customizing a time zone” in [z/OS XL C/C++ Programming Guide](#).

The *tm_isdst* flag in the time structure input to *strptime()* determines whether %Z is replaced by the Standard or Daylight Savings name characters. If Standard or Daylight Savings name characters are not available in the current LC_TOD locale category or from parsing TZ, *strptime()* uses the characters STD for Standard or DST for Daylight Savings time name.

If the tm structure input to *strptime()* was produced by the *gmtime()* function, *strptime()* replaces %Z by UCTNAME characters specified in the current LC_TOD locale category or by UTC if UCTNAME is not specified.

Returned value

If successful, `strptime()` returns the number of characters (bytes) placed into the array, not including the terminating NULL character.

If unsuccessful, `strptime()` returns 0 and the content of the string is indeterminate.

Example

CELEBS42

```
/* CELEBS42

   This example places characters into the array dest and prints
   the resulting string.

*/
#include <stdio.h>
#include <time.h>

int main(void)
{
    char dest[70];
    int ch;
    time_t temp;
    struct tm *timeptr;

    temp = time(NULL);
    timeptr = localtime(&temp);
    ch = strptime(dest, sizeof(dest)-1, "Today is %A,"
                  " %b %d. \n Time: %I:%M %p", timeptr);
    printf("%d characters placed in string to make: \n \n %s", ch, dest);
}
```

Output

```
44 characters placed in string to make:

Today is Friday, Jun 16.
Time: 03:07 PM
```

Related information

- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) — Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“time\(\), time64\(\) — Determine current UTC time” on page 1865](#)
- [“tzset\(\) — Set the time zone” on page 1918](#)

strlen() — Determine string length

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

size_t strlen(const char *string);
```

General description

The `strlen()` built-in function determines the length of string pointed to by *string*, excluding the terminating NULL character.

Returned value

`strlen()` returns the length of *string*.

Example

CELEBS43

```
/* CELEBS43

   This example determines the length of the string that is
   passed to main.

*/
#include <stdio.h>
#include <string.h>

int main(int argc, char **argv)
{
    if ( argc != 2 )
        printf( "Usage: %s string\n", argv[0] );
    else
        printf( "Input string has a length of %i\n", strlen( argv[1] ) );
}
```

Output

If the input is the string: "How long is this string?", then the expected output is:

```
Input string has a length of 24
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“mblen\(\) — Calculate length of multibyte character” on page 1044](#)
- [“strncat\(\) — Concatenate strings” on page 1743](#)

- [“strncmp\(\) — Compare strings” on page 1744](#)
- [“strncpy\(\) — Copy string” on page 1746](#)
- [“wcslen\(\) — Calculate length of wide-character string” on page 2000](#)

strnlen() — Determine fixed-size string length

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | z/OS 3.2 |

Format

```
#define _POSIX_C_SOURCE 200809L
#include
<string.h>

size_t strnlen(const char *string, size_t n);
```

General description

The `strnlen()` function computes the number of characters (bytes) in the string that is pointed to by *string*, not including the terminating NULL character (`\0`), up to a maximum of *n* characters.

Returned value

`strnlen()` returns the smaller value between *n* and the number of characters that precede the terminating NULL character (`\0`) in the string that is pointed to by *string*.

Example

```
/* This example determines the length of a string, up to SIZE bytes. */

#define _POSIX_C_SOURCE 200809L
#include <stdio.h>
#include <string.h>

#define SIZE 40
int main(void)
{
    char string[ SIZE ] = "abcdefghijklmnopqrstuvwxyz";
    size_t result;

    result = strnlen( string, SIZE );

    printf( "String \"%s\" has a length of %d\n", string, result );
}
```

Output

```
String "abcdefghijklmnopqrstuvwxyz" has a length of 26
```

strncasecmp() — Case-insensitive string comparison

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <strings.h>

int strncasecmp(const char *string1, const char *string2, size_t n);
```

General description

The `strncasecmp()` function compares, while ignoring differences in case, the string pointed to by *string1* to the string pointed to by *string2*. At most *n* characters will be compared.

The string arguments to the function should contain a NULL character (`\0`) marking the end of the string.

The `strncasecmp()` function is locale-sensitive.

Returned value

`strncasecmp()` returns a value indicating the relationship between the strings, while ignoring case, as follows:

Value

Meaning

< 0

String pointed to by *string1* is less than string pointed to by *string2*.

= 0

String pointed to by *string1* is equal to string pointed to by *string2*.

> 0

String pointed to by *string1* is greater than string pointed to by *string2*.

There are no `errno` values defined.

Related information

- [“strings.h — String operations” on page 67](#)
- [“strcasecmp\(\) — Case-insensitive string comparison” on page 1718](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strncmp\(\) — Compare strings” on page 1744](#)

strncat() — Concatenate strings

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

char *strncat(char * __restrict__string1, const char * __restrict__string2, size_t count);
```

General description

The `strncat()` built-in function appends the first *count* characters of *string2* to *string1* and ends the resulting string with a NULL character (`\0`). If *count* is greater than the length of *string2*, `strncat()` appends only the maximum length of *string2* to *string1*. The first character of the appended string overwrites the terminating NULL character of the string pointed to by *string1*.

If copying takes place between overlapping objects, the behavior is undefined.

Returned value

`strncat()` returns the value *string1*, the concatenated string.

Example

CELEBS44

```
/* CELEBS44

   This example demonstrates the difference between &strcat. and
   &strncat..
   &strcat. appends the entire second string to the first,
   whereas &strncat. appends only the specified number of
   characters in the second string to the first.

   */
#include <stdio.h>
#include <string.h>

#define SIZE 40

int main(void)
{
    char buffer1[SIZE] = "computer";
    char * ptr;

    /* Call strcat with buffer1 and " program" */

    ptr = strcat( buffer1, " program" );
    printf( "strcat : buffer1 = \"%s\"\n", buffer1 );

    /* Reset buffer1 to contain just the string "computer" again */

    memset( buffer1, '\0', sizeof( buffer1 ) );
    ptr = strcpy( buffer1, "computer" );
```

```
/* Call strncat with buffer1 and " program" */
ptr = strncat( buffer1, " program", 3 );
printf( "strncat: buffer1 = \"%s\\n\", buffer1 );
}
```

Output

```
strncat : buffer1 = "computer program"
strncat: buffer1 = "computer pr"
```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“strcat\(\) – Concatenate strings” on page 1719](#)
- [“strncmp\(\) – Compare strings” on page 1744](#)
- [“strncpy\(\) – Copy string” on page 1746](#)
- [“strpbrk\(\) – Find characters in string” on page 1748](#)
- [“strrchr\(\) – Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) – Search string” on page 1755](#)

strncmp() – Compare strings

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

int strncmp(const char *string1, const char *string2, size_t count);
```

General description

The strncmp() built-in function compares at most the first *count* characters of the string pointed to by *string1* to the string pointed to by *string2*.

The string arguments to the function should contain a NULL character (\0) marking the end of the string.

The relation between the strings is determined by the sign of the difference between the values of the leftmost first pair of characters that differ. The values depend on character encoding. This function is *not* locale sensitive.

Returned value

strncmp() returns a value indicating the relationship between the substrings, as follows:

| Value | Meaning |
|-------|---------|
|-------|---------|

< 0

String pointed to by *substring1* less than string pointed to by *substring2*

= 0

String pointed to by *substring1* equivalent to string pointed to by *substring2*

> 0

String pointed to by *substring1* greater than string pointed to by *substring2*

Example

CELEBS45

```

/* CELEBS45

   This example demonstrates the difference between &strcmp.
   and &strncmp..

*/
#include <stdio.h>
#include <string.h>

#define SIZE 10

int index = 3;

int main(void)
{
    int result;
    char buffer1[SIZE] = "abcdefg";
    char buffer2[SIZE] = "abcfg";
    void print_result( int, char *, char * );

    result = strcmp( buffer1, buffer2 );
    printf( " strcmp: compares each character\n");
    print_result( result, buffer1, buffer2 );

    result = strncmp( buffer1, buffer2, index);
    printf( "\nstrncmp: compares only the first %i characters\n", index );
    print_result( result, buffer1, buffer2 );
}

void print_result( int res, char * p_buffer1, char * p_buffer2 )
{
    if ( res == 0 )
        printf( "first %i characters of \"%s\" is identical to \"%s\"\n",
                index, p_buffer1, p_buffer2 );
    else if ( res < 0 )
        printf( "\"%s\" is less than \"%s\"\n", p_buffer1, p_buffer2 );
    else
        printf( "\"%s\" is greater than \"%s\"\n", p_buffer1, p_buffer2 );
}

```

Output

```

strcmp: compares each character
"abcdefg" is less than "abcfg"

strncmp: compares only the first 3 characters
first 3 characters of "abcdefg" is identical to "abcfg"

```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memcmp\(\) – Compare bytes” on page 1065](#)
- [“strcmp\(\) – Compare strings” on page 1722](#)
- [“strcspn\(\) – Compare strings” on page 1727](#)
- [“strncat\(\) – Concatenate strings” on page 1743](#)
- [“strncpy\(\) – Copy string” on page 1746](#)

- [“strpbrk\(\) — Find characters in string” on page 1748](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) — Search string” on page 1755](#)

strncpy() — Copy string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

char *strncpy(char * __restrict__string1, const char * __restrict__string2, size_t count);
```

General description

The `strncpy()` built-in function copies at most *count* characters of *string2* to *string1*. If *count* is less than or equal to the length of *string2*, a NULL character (`\0`) is *not* appended to the copied string. If *count* is greater than the length of *string2*, the *string1* result is padded with NULL characters (`\0`) up to length *count*.

If copying takes place between objects that overlap, the behavior is undefined.

Returned value

`strncpy()` returns *string1*.

Example

CELEBS46

```
/* CELEBS46

   This example demonstrates the difference between &strcpy.
   and &strncpy..

*/
#include <stdio.h>
#include <string.h>

#define SIZE    40

int main(void)
{
    char source[ SIZE ] = "123456789";
    char source1[ SIZE ] = "123456789";
    char destination[ SIZE ] = "abcdefg";
    char destination1[ SIZE ] = "abcdefg";
    char * return_string;
    int    index = 5;

    /* This is how strcpy works */
    printf( "destination is originally = '%s'\n", destination );
    return_string = strcpy( destination, source );
    printf( "After strcpy, destination becomes '%s'\n\n", destination );
```

```

/* This is how strncpy works */
printf( "destination1 is originally = '%s'\n", destination1 );
return_string = strncpy( destination1, source1, index );
printf( "After strncpy, destination1 becomes '%s'\n", destination1 );
}

```

Output

```

destination is originally = 'abcdefg'
After strcpy, destination becomes '123456789'

destination1 is originally = 'abcdefg'
After strncpy, destination1 becomes '12345fg'

```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memcpy\(\) – Copy buffer” on page 1066](#)
- [“strcpy\(\) – Copy string” on page 1725](#)
- [“strncat\(\) – Concatenate strings” on page 1743](#)
- [“strncmp\(\) – Compare strings” on page 1744](#)
- [“strpbrk\(\) – Find characters in string” on page 1748](#)
- [“strrchr\(\) – Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) – Search string” on page 1755](#)

strlen() – Determine fixed-size string length

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| POSIX.1-2008 | both | z/OS 3.2 |
| Single UNIX Specification, Version 4 | | |

Format

```

#define _POSIX_C_SOURCE 200809L
#include
<string.h>

size_t strlen(const char *string, size_t n);

```

General description

The `strlen()` function computes the number of characters (bytes) in the string that is pointed to by *string*, not including the terminating NULL character (`\0`), up to a maximum of *n* characters.

Returned value

`strlen()` returns the smaller value between *n* and the number of characters that precede the terminating NULL character (`\0`) in the string that is pointed to by *string*.

Example

```
/* This example determines the length of a string, up to SIZE bytes. */
#define _POSIX_C_SOURCE 200809L
#include <stdio.h>
#include <string.h>

#define SIZE    40
int main(void)
{
    char string[ SIZE ] = "abcdefghijklmnopqrstuvwxyz";
    size_t result;

    result = strlen( string, SIZE );

    printf( "String \"%s\" has a length of %d\n", string, result );
}
```

Output

String "abcdefghijklmnopqrstuvwxyz" has a length of 26

strpbrk() — Find characters in string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

char *strpbrk(const char *string1, const char *string2);
```

General description

Locates the first occurrence in the string pointed to by *string1* of any character from the string pointed to by *string2*.

Returned value

If successful, strpbrk() returns a pointer to the character.
If *string1* and *string2* have no characters in common, strpbrk() returns a NULL pointer.

Example

CELEBS47

```
/* CELEBS47

   This example returns a pointer to the first occurrence in the
   array string of either a or b.

*/
```

```
#include <stdio.h>
#include <string.h>

int main(void)
{
    char *result, *string = "A Blue Danube";
    char *chars = "ab";

    result = strpbrk(string, chars);
    printf("The first occurrence of any of the characters \"%s\" in \"
          \"%s\" is \"%s\"\\n", chars, string, result);
}
```

Output

```
The first occurrence of any of the characters "ab" in "A Blue Danube"
is "anube"
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“strchr\(\) — Search for character” on page 1720](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strncmp\(\) — Compare strings” on page 1744](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) — Search string” on page 1755](#)

strptime() — Date and time conversion

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <time.h>

char *strptime(const char * __restrict__ buf, const char * __restrict__ fmt,
               struct tm * __restrict__ tm);
```

General description

The `strptime()` function converts the character string pointed to by *buf* to values that are stored in the `tm` structure pointed to by *tm*, using the format specified by *fmt*. Only the fields in the `tm` structure for which there is a corresponding format item in *fmt* are updated by the `strptime()` function. Therefore, for a valid and conforming `tm` structure, provide `strptime()` with a format and data that completely specify the date and time being converted.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The format is composed of zero or more directives. Each directive is composed of one of the following: one or more white space characters (as specified by the `isalnum()` to `isdigit()` function), an ordinary character other than a percent sign (%) or white space character, or a conversion specification. Each conversion specification is composed of a percent sign followed by a conversion character that specifies the replacement required. There must be a white space character or other nonalphanumeric character between any two conversion specifications.

Table 67. Conversion Specifiers Used by `strptime()`

| Specifier | Meaning |
|-----------|--|
| %a | Day of week, using locale's abbreviated or full weekday name. |
| %A | Day of week, using locale's abbreviated or full weekday name. |
| %b | Month, using locale's abbreviated or full month name. |
| %B | Month, using locale's abbreviated or full month name. |
| %c | Date and time, using locale's date and time. |
| %C | Century number (year divided by 100 and truncated to an integer). |
| %d | Day of the month (1 - 31; leading zeros permitted but not required; day will not be checked for correctness for the month specified). |
| %D | Date as %m/%d/%y. |
| %e | Day of the month (1 - 31; leading zeros permitted but not required; day will not be checked for correctness for the month specified). |
| %h | Month, using locale's abbreviated or full month name. |
| %H | Hour (0 - 23; leading zeros permitted but not required). |
| %I | Hour (0 - 12; leading zeros permitted but not required). |
| %j | Day number of the year (001 - 366). |
| %m | Month number (1 - 12; leading zeros are permitted but not required). |
| %M | Minute (0 - 59; leading zeros are permitted but not required). |
| %n | Newline character. |
| %p | Locale's equivalent of AM or PM. |
| %r | 12-hour clock time using the AM/PM notation if <code>t_fmt_ampm</code> is not an empty string in the <code>LC_TIME</code> portion of the current locale; in the POSIX locale, this is equivalent to %I : %M : %S %p. |
| %R | Time in 24 hour notation (11/19/01M). |
| %S | Seconds (0 - 60; leading zeros are permitted but not required). |
| %t | Tab character. |
| %T | Time as %H:%M:%S. |
| %U | Week number of the year (0 - 53; where Sunday is the first day of the week; leading zeros are permitted but not required). |
| %w | Weekday (0 - 6; where Sunday is 0; leading zeros are permitted but not required). |
| %W | Week number of the year (0 - 53; where Monday is the first day of the week; leading zeros are permitted but not required). |
| %x | Date, using locale's date format. |

Table 67. Conversion Specifiers Used by `strptime()` (continued)

| Specifier | Meaning |
|-----------|--|
| %X | Time, using locale's time format. |
| %y | Year within century. When a century is not otherwise specified, values in the range 69 - 99 refer to years in the twentieth century (1969 to 1999 inclusive); values in the range 00 - 68 refer to years in the twenty-first century (2000 to 2068 inclusive). Leading zeros are permitted but not required. |
| %Y | Year, including century. When the value of the <code>_EDC_STRPTM_STD</code> environment variable is set to 1, at most 4 digits will be consumed. When the value of <code>_EDC_STRPTM_STD</code> is set to other values or unset, more than 4 digits might be consumed, and if the generated value is greater than 9999, this function fails. |
| %Z | Time zone name. |
| %% | Replace with %. |

Modified directives: Some directives can be modified by the E or O modifier characters to indicate that an alternative format or specification should be used rather than the one normally used by the unmodified directive. If the alternative format or specification does not exist in the current locale, the behavior will be as if the unmodified directive were used.

Table 68. Modified Directives Used by `strptime()`

| Specifier | Meaning |
|-----------|--|
| %Ec | Replace with the locale's alternative date and time representation. |
| %EC | Replace with the name of the base year (period) in the locale's representation. |
| %Ex | Replace with the locale's alternative date representation. |
| %EX | Replace with the locale's alternative time representation. |
| %Ey | Replace with the offset from %EC (year only) in the locale's representation. |
| %EY | Replace with the full alternative year representation. |
| %Od | Replace with the day of month, using the locale's alternative numeric symbols, filled as needed with leading zeros if there is any alternative symbol for zero, otherwise with leading spaces. |
| %Oe | Replace with the day of the month, using the locale's alternative numeric symbols, filled as needed with leading spaces. |
| %OH | Replace with the hour (24-hour clock) using the locale's alternative numeric symbols. |
| %OI | Replace with the hour (12-hour clock) using the locale's alternative numeric symbols. |
| %Om | Replace with the month using the locale's alternative numeric symbols. |
| %OM | Replace with the minutes using the locale's alternative numeric symbols. |
| %OS | Replace with the seconds using the locale's alternative numeric symbols. |
| %OU | Replace with the week number of the year (Sunday as the first rules corresponding to %U) using the locale's alternative numeric symbols. |
| %Ow | Replace with the weekday (Sunday=0) using the locale's alternative numeric symbols. |
| %OW | Replace with the week number of the year (Monday as the first day of the week) using the locale's alternative numeric symbols. |

Table 68. Modified Directives Used by *strptime()* (continued)

| Specifier | Meaning |
|-----------|---|
| %Oy | Replace with the year (offset from %C) in the locale's alternative representation and using the locale's alternative numeric symbols. |

A directive composed of white space characters is executed by scanning input up to the first character that is not white space (which remains unscanned) or until no more characters can be scanned.

A directive that is an ordinary character is executed by scanning the next character from the buffer. If the character scanned from the buffer differs from the one comprising the directive, the directive fails, and the differing and subsequent characters remain unscanned.

A series of directives composed or %n, %t, white space characters or any combination is executed by scanning up to the first character that is not white space (which remains unscanned), or until no more characters can be scanned.

Any other conversion specification is executed by scanning characters until a character matching the next directive is scanned, or until no more characters can be scanned. These characters, excepting the one matching the next directive, are then compared to the locale values associated with the conversion specifier. If a match is found, values for the appropriate *tm* structure members are set to values corresponding to the locale information. Case is ignored when matching items in *buf*, such as month or weekday names. If no match is found, *strptime()* fails and no more characters are scanned.

Returned value

If successful, *strptime()* returns a pointer to the character following the last character parsed.

If unsuccessful, *strptime()* returns a NULL pointer.

Example

CELEBS48

```
/* CELEBS48 */
#include <stdio.h>
#include <stdlib.h>
#include <time.h>
#include <localdef.h>

int main(void)
{
    struct tm xmas;

    if (strptime("12/25/93 13:30:00", "%D %T", &xmas) == NULL) {
        printf("strptime() failed.\n");
        exit(1);
    }

    printf("tm_sec  =%3d\n", xmas.tm_sec );
    printf("tm_min  =%3d\n", xmas.tm_min );
    printf("tm_hour  =%3d\n", xmas.tm_hour );
    printf("tm_mday =%3d\n", xmas.tm_mday );
    printf("tm_mon   =%3d\n", xmas.tm_mon );
    printf("tm_year  =%3d\n", xmas.tm_year );
    printf("tm_wday  =%3d\n", xmas.tm_wday );
    printf("tm_yday  =%3d\n", xmas.tm_yday );
}
```

Output

```
tm_sec  = 0
tm_min  = 30
tm_hour  = 13
tm_mday = 25
tm_mon   = 11
tm_year  = 93
```

```
tm_wday = 0
tm_yday =358
```

Related information

- [“time.h — Time and date” on page 75](#)

strchr() – Find last occurrence of character in string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

char *strchr(const char *string, int c);
```

General description

The `strchr()` function finds the last occurrence of `c` (converted to a `char`) in *string*. The ending NULL character is considered part of the *string*.

Returned value

If successful, `strchr()` returns a pointer to the last occurrence of `c` in *string*.

If the given character is not found, `strchr()` returns a NULL pointer.

Example

CELEBS49

```
/* CELEBS49

   This example compares the use of &strchr. and &strrchr..
   It searches the string for the first and last occurrence of
   p in the string.

*/
#include <stdio.h>
#include <string.h>

#define SIZE 40

int main(void)
{
    char buf[SIZE] = "computer program";
    char * ptr;
    int   ch = 'p';

    /* This illustrates strchr */
    ptr = strchr( buf, ch );
    printf( "The first occurrence of %c in '%s' is '%s'\n", ch, buf, ptr );

    /* This illustrates strrchr */
```

```
ptr = strrchr( buf, ch );
printf( "The last occurrence of %c in '%s' is '%s'\n", ch, buf, ptr );
}
```

Output

```
The first occurrence of p in 'computer program' is 'puter program'
The last occurrence of p in 'computer program' is 'program'
```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“memchr\(\) – Search buffer” on page 1063](#)
- [“strchr\(\) – Search for character” on page 1720](#)
- [“strcspn\(\) – Compare strings” on page 1727](#)
- [“strncmp\(\) – Compare strings” on page 1744](#)
- [“strpbrk\(\) – Find characters in string” on page 1748](#)
- [“strspn\(\) – Search string” on page 1755](#)

strsignal() – Return string describing signal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| POSIX.1-2008 | both | z/OS 3.2 |
| Single UNIX Specification, Version 4 | | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <string.h>

char *strsignal(int signal);
```

General description

The `strsignal()` function maps the signal number *signal* to an implementation-defined string and returns a pointer to it. `strsignal()` uses the same set of messages as `psignal()`.

The application must not modify the string that is returned by `strsignal()`. The returned string might be invalidated or the string content might be overwritten by subsequent calls to `strsignal()` or `setlocale()`. The returned string might also be invalidated if the calling thread is terminated.

The content of the message string that is returned by `strsignal()` is determined by the setting of the `LC_MESSAGES` category in the current locale.

Returned value

`strsignal()` returns a pointer to the appropriate description string if *signal* is a valid signal number. Otherwise, `strsignal()` returns the string: `Unknown signal signal`.

Note: No return values are reserved to indicate an error. To check for error situations, set `errno` to 0, call this function, then check `errno`.

Example

```
/* This example calls strsignal() with valid
   and invalid signal values.
*/

#define _POSIX_C_SOURCE 200809L
#include <stdio.h>
#include <string.h>

int main(void)
{
    int first_signum = 14; /* timeout */
    int second_signum = -5; /* INVALID value */

    char * first_signal;
    first_signal = strsignal( first_signum );

    printf( "strsignal(14): \"%s\"\n", first_signal);

    char * second_signal;
    second_signal = strsignal( second_signum );

    printf( "strsignal(-5): \"%s\"\n", second_signal );
}
```

Output

```
strsignal(14): "Timeout"
strsignal(-5): "Unknown signal -5"
```

strspn() – Search string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Language Environment ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

size_t strspn(const char *string1, const char *string2);
```

General description

Calculates the length of the maximum initial portion of the string pointed to by *string1* that consists entirely of the characters contained in the string pointed to by *string2*.

Returned value

strspn() returns the length of the substring found.

Example

CELEBS50

```
/* CELEBS50

This example finds the first occurrence in the array string
of a character that is neither an a, b, nor c. Because the
string in this example is cabbage, &strspn. returns 5, the
length of the segment of cabbage before a character that is
not an a, b or c.

*/
#include <stdio.h>
#include <string.h>

int main(void)
{
    char * string = "cabbage";
    char * source = "abc";
    int index;

    index = strspn( string, "abc" );
    printf( "The first %d characters of \"%s\" are found in \"%s\"\\n",
            index, string, source );
}
```

Output

The first 5 characters of "cabbage" are found in "abc"

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“strcat\(\) — Concatenate strings” on page 1719](#)
- [“strchr\(\) — Search for character” on page 1720](#)
- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“strcpy\(\) — Copy string” on page 1725](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strpbrk\(\) — Find characters in string” on page 1748](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)

strstr() — Locate substring

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

char *strstr(const char *string1, const char *string2);
```

General description

Finds the first occurrence of the string pointed to by *string2* (excluding the NULL character) in the string pointed to by *string1*.

Returned value

If successful, `strstr()` returns a pointer to the beginning of the first occurrence of *string2* in *string1*.

If *string2* does not appear in *string1*, `strstr()` returns NULL.

If *string2* points to a string with zero length, `strstr()` returns *string1*.

Example

CELEBS51

```
/* CELEBS51

   This example locates the string haystack in the string "needle in a
   haystack".

   */
#include <stdio.h>
#include <string.h>

int main(void)
{
    char *string1 = "needle in a haystack";
    char *string2 = "haystack";
    char *result;

    result = strstr(string1, string2);
    /* Result = a pointer to "haystack" */
    printf("%s\n", result);
}
```

Output

```
haystack
```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“strchr\(\) – Search for character” on page 1720](#)
- [“strcmp\(\) – Compare strings” on page 1722](#)
- [“strcspn\(\) – Compare strings” on page 1727](#)
- [“strncmp\(\) – Compare strings” on page 1744](#)
- [“strpbrk\(\) – Find characters in string” on page 1748](#)
- [“strrchr\(\) – Find last occurrence of character in string” on page 1753](#)
- [“strspn\(\) – Search string” on page 1755](#)

strtolcoll() – Return collating element for string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <collate.h>

collat_t strtocoll(char *s);
```

General description

Determines whether the string pointed to by *s* represents the valid element as defined in the LC_COLLATE category of the current locale.

If a string pointed to by *s* contains only one character, the collating element representing this character always exists. Otherwise, a valid collating element exists if the LC_COLLATE category contains the definition of a sequence of characters that collate as one for the purpose of culture-sensitive string comparison. This many-characters-to-one-collating element relation is also called *many-to-one* mapping.

Returned value

The type `collat_t` represents the collating elements.

If many-to-one mapping is not defined in the LC_COLLATE of the current locale, `strtolcoll()` returns `(collat_t)-1`.

Also, if the string is not a valid collating element or is of zero length, `strtolcoll()` returns `(collat_t)-1`.

Example

CELEBS52

```
/* CELEBS52

   This example uses the strtocoll() function to get the
   collat_t value for the start and end collating-elements for
   the collrange() function.

*/
#include <stdio.h>
#include <stdlib.h>
#include <locale.h>
#include <collate.h>
#include <wchar.h>
#include <wctype.h>

main(int argc, char *argv[]) {
    collat_t s, e, *rp;
    int i;

    setlocale(LC_ALL, "");
    if ((s = strtocoll(argv[1])) == (collat_t)-1) {
        printf("%s collating element not defined\n", argv[1]);
        exit(1);
    }
    if ((e = strtocoll(argv[2])) == (collat_t)-1) {
        printf("%s collating element not defined\n", argv[2]);
        exit(1);
    }
    if ((i = collrange(s, e, &rp)) == -1) {
        printf("Invalid range for %s to %s\n", argv[1], argv[2]);
        exit(1);
    }
    for (; i-- > 0; rp++) {
        if (ismccollat(*rp))
            printf("%s' ", colltostr(*rp));
        else if (iswprint(*rp))
            printf("%lc' ", *rp);
        else
            printf("%x' ", *rp);
    }
}
```


Related information

- [“collate.h — Current locale's collating properties” on page 17](#)
- [“cclass\(\) — Return characters in a character class” on page 243](#)
- [“collequiv\(\) — Return a list of equivalent collating elements” on page 300](#)
- [“collorder\(\) — Return list of collating elements” on page 301](#)
- [“collrange\(\) — Calculate the range list of collating elements” on page 303](#)
- [“colltostr\(\) — Return a string for a collating element” on page 304](#)
- [“getmccoll\(\) — Get next collating element from string” on page 736](#)
- [“getwmccoll\(\) — Get next collating element from wide string” on page 803](#)
- [“ismccollet\(\) — Identify a multicharacter collating element” on page 915](#)
- [“maxcoll\(\) — Return maximum collating element” on page 1043](#)

strtod() — Convert character string to double

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

double strtod(const char * __restrict__nptr, char ** __restrict__endptr);
```

General description

Converts a part of a character string, pointed to by *nptr*, to a double. The parameter *nptr* points to a sequence of characters that can be interpreted as a numerical value of the type *double*.

See the “*fscanf* Family of Formatted Input Functions” on [fscanf\(\)](#), [scanf\(\)](#), [sscanf\(\)](#) — Read and format data for a description of special infinity and NaN sequences recognized by z/OS formatted input functions, including [atof\(\)](#) and [strtod\(\)](#) in IEEE Binary Floating-Point mode.

The [strtod\(\)](#) function breaks the string into three parts:

1. A sequence of white space characters (as specified for the current locale, see [isspace\(\)](#))
2. A subject sequence interpreted as a floating-point constant or representing infinity or a NaN.
3. A sequence of unrecognized characters (including a NULL character).

The subject string is the longest string that matches the expected form.

The expected form of the subject sequence is an optional plus or minus sign, then one of the following:

- A non-empty sequence of decimal digits optionally containing a radix character, then an optional exponent part. Where radix character is the character that separates the integer part of a number from the fractional part.

- A 0x or 0X, then a non-empty sequence of hexadecimal digits optionally containing a radix character, then an optional binary exponent part. Where radix character is the character that separates the integer part of a number from the fractional part.
- One of INF or INFINITY, ignoring case.
- One of NANQ or NANQ(n-char-sequence), ignoring case.
- One of NANS or NANS(n-char-sequence), ignoring case.
- One of NAN or NAN(n-char-sequence), ignoring case.

The pointer to the last string successfully converted is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer. If the subject string is empty or it does not have the expected form, then no conversion is performed. The value of *nptr* is stored in the object pointed to by *endptr*.

Returned value

If successful, `strtod()` returns the value of the floating-point number.

The double value is hexadecimal floating-point or IEEE Binary Floating-Point format depending on the floating-point mode of the thread invoking the `strtod()` function. This function uses `__isBFP()` to determine the floating-point mode of the invoking thread.

In an overflow, `strtod()` returns \pm HUGE_VAL. In an underflow, it returns 0. If no conversion is performed, `strtod()` returns 0. In both cases, `errno` is set to `ERANGE`, depending on the base of the value.

Example

CELEBS53

```
/* CELEBS3

   This example converts a string to a double value.
   It prints out the converted value and the substring that
   stopped the conversion.

*/
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    char *string, *stopstring;
    double x;

    string = "3.1415926This stopped it";
    x = strtod(string, &stopstring);
    printf("string = %s\n", string);
    printf("    strtod = %f\n", x);
    printf("    Stopped scan at %s\n\n", stopstring);

    string = "100ergs";
    x = strtod(string, &stopstring);
    printf("string = \"%s\"\n", string);
    printf("    strtod = %f\n", x);
    printf("    Stopped scan at \"%s\"\n\n", stopstring);
}
```

Output

```
string = 3.1415926This stopped it
    strtod = 3.141593
    Stopped scan at This stopped it

string = 100ergs
    strtod = 100.000000
    Stopped scan at ergs
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“atof\(\) — Convert character string to double” on page 201](#)
- [“atoi\(\) — Convert character string to integer” on page 202](#)
- [“atol\(\) — Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“strtof\(\) — Convert character string to float ” on page 1763](#)
- [“strtol\(\) — Convert character string to long” on page 1768](#)
- [“strtold\(\) — Convert character string to long double ” on page 1770](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)

strtod32(), strtod64(), strtod128() — Convert character string to decimal floating point

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <stdlib.h>

_Decimal32 strtod32(const char * __restrict__ nptr, char ** __restrict__ endptr);
_Decimal64 strtod64(const char * __restrict__ nptr, char ** __restrict__ endptr);
_Decimal128 strtod128(const char * __restrict__ nptr, char ** __restrict__ endptr);
```

General description

The `strtod32()`, `strtod64()`, and `strtod128()` functions convert the initial portion of the string pointed to by *nptr* to `_Decimal32`, `_Decimal64`, and `_Decimal128` representation, respectively.

First, they decompose the input string into three parts:

1. An initial, possibly empty, sequence of white-space characters (as specified by the `isspace()` function) .
2. A subject sequence resembling a floating-point constant or representing an infinity or NaN.
3. A final string of one or more unrecognized characters, including the terminating null character of the input string.

Then, they attempt to convert the subject sequence to a floating-point number, and return the result.

The expected form of the subject sequence is an optional plus or minus sign, then one of the following:

- a nonempty sequence of decimal digits optionally containing a decimal-point character, then an optional exponent part
- INF or INFINITY, ignoring case
- NAN, NAN(n-char-sequence), NANQ, NANQ(n-char-sequence), NANS, or NANS(n-char-sequence), ignoring case in the NAN, NANQ, or NANS part, where n-char-sequence is one or more decimal numeric digits.

Note: If the input string is not one of these forms (for example "INFINITE"), the output results are undefined.

The subject sequence is defined as the longest initial subsequence of the input string, starting with the first non-white-space character, that is of the expected form. The subject sequence contains no characters if the input string is not of the expected form.

A character sequence NAN, NANQ, NAN(n-char-sequence), or NANQ(n-char-sequence) is interpreted as a quiet NaN. A character sequence of NANS, or NANS(n-char-sequence), is interpreted as a signalling NaN. A character sequence INF or INFINITY is interpreted as an infinity. A character sequence NAN, NAN(), or NAN(n-char-sequence) is interpreted as a quiet NaN. A character sequence of NANS, NANS(), or NANS(n-char-sequence), is interpreted as a signalling NaN.

A pointer to the final string is stored in the object pointed to by *endptr*, provided that *endptr* is not a null pointer.

The converted value keeps the same precision as the input if possible, and the value may be denormalized. Otherwise, rounding may occur. Rounding happens after any negation.

In other than the "C" locale, additional locale-specific subject sequence forms are accepted.

If the subject sequence is empty or does not have the expected form, no conversion is performed; the value of *nptr* is stored in the object pointed to by *endptr*, provided that *endptr* is not a null pointer.

| Argument | Description |
|---------------|--|
| <i>nptr</i> | Input pointer to start of the string to be converted |
| <i>endptr</i> | NULL, or a pointer to a output pointer field that is filled in with the address of the first character in the input string that is not used in the conversion. |

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

These functions return the converted value, if any. If no conversion could be performed, the value +0.E0DF, +0.E0DD, or +0.E0DL is returned. If the correct value is outside the range of representable values, plus or minus HUGE_VAL_D32, HUGE_VAL_D64, or HUGE_VAL_D128 is returned (according to the return type and sign of the value), and *errno* is set to ERANGE. If the result underflows, these functions return a value whose magnitude is no greater than the smallest normalized positive number in the return type. No signal is raised at the point of returning a signaling NaN.

| errno | Description |
|--------|---|
| ERANGE | The input string represents a value too large to fit in the output Decimal Floating Point type. |

Example

See [“strtod\(\) — Convert character string to double”](#) on page 1759 for an example.

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data”](#) on page 626
- [“strtod\(\) — Convert character string to double”](#) on page 1759
- [“wcstod32\(\), wcstod64\(\), wcstod128\(\) — Convert wide-character string to decimal floating point”](#) on page 2016

strtouf() – Convert character string to float

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <stdlib.h>

float strtouf(const char *__restrict__ nptr, char **__restrict__ endptr);
```

General description

strtouf() converts a part of a character string, pointed to by *nptr*, to float. The parameter *nptr* points to a sequence of characters that can be interpreted as a numerical value of the type float.

The strtouf() function breaks the string into three parts:

1. An initial, possibly empty, sequence of white-space characters (as specified by isspace()).
2. A subject sequence interpreted as a floating-point constant or representing infinity or a NaN.
3. A final string of one or more unrecognized characters, including the terminating null byte of the input string.

The function then attempts to convert the subject string into the floating-point number, and returns the result.

The expected form of the subject sequence is an optional plus or minus sign, then one of the following:

- A non-empty sequence of decimal digits optionally containing a radix character, then an optional exponent part. A radix character is the character that separates the integer part of a number from the fractional part.
- A 0x or 0X, a non-empty sequence of hexadecimal digits optionally containing a radix character, then a base 2 decimal exponent part with a p or P as prefix, a plus or minus sign, then a sequence of at least one decimal digit. (Example [-]0xh.hhhhp+/-d). A radix character is the character that separates the integer part of a number from the fractional part.
- One of INF or INFINITY, ignoring case.
- One of NANQ or NANQ(n-char-sequence), ignoring case.
- One of NANS or NANS(n-char-sequence), ignoring case.
- One of NAN or NAN(n-char-sequence), ignoring case.

See the "scanf Family of Formatted Input Functions" for a description of special infinity and NaN sequences recognized by z/OS formatted input functions in IEEE Binary Floating-Point mode.

The pointer to the last string successfully converted is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer. If the subject string is empty or it does not have the expected form, then no conversion is performed. The value of *nptr* is stored in the object pointed to by *endptr*.

Returned value

If successful, strtouf() returns the value of the floating-point number.

The float value is hexadecimal floating-point or IEEE Binary Floating-Point format depending on the floating-point mode of the thread invoking the strtod() function. This function uses __isBFP() to determine the floating-point mode of the invoking thread.

In an overflow, strtod() returns +/-HUGE_VALF. In an underflow, it returns 0. If no conversion is performed, strtod() returns 0. In both cases, errno is set to ERANGE, depending on the base of the value.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“atof\(\) — Convert character string to double” on page 201](#)
- [“atoi\(\) — Convert character string to integer” on page 202](#)
- [“atol\(\) — Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“strtod\(\) — Convert character string to double” on page 1759](#)
- [“strtold\(\) — Convert character string to long double” on page 1770](#)
- [“strtol\(\) — Convert character string to long” on page 1768](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)

strtoimax() — Convert character string to intmax_t integer type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <inttypes.h>

intmax_t strtoimax(const char * __restrict__ nptr, char ** __restrict__ endptr, int
base);
```

Compile requirement: Function strtoimax() requires LONGLONG to be available.

General description

The strtoimax() function converts the string nptr to an intmax_t integer type. Valid input values for base are 0 and in the range 2-36. The strtoimax() function is equivalent to strtol() and strtoll() with the only difference being that the return value is of type intmax_t. See strtoll() for more information.

Returned value

If successful, strtoimax() returns the converted intmax_t value represented in the string.

If unsuccessful, strtoimax() returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, strtoimax() returns INTMAX_MAX or INTMAX_MIN, according to the sign of the value. If the value of base is not supported, strtoimax() returns 0.

If unsuccessful strtoimax() sets errno to one of the following values:

Error Code Description

EINVAL

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    intmax_t j;
    int base = 10;
    char *nptr, *endptr;
    nptr = "10345134932abc";
    printf("nptr = %s\n", nptr);
    j = strtoumax(nptr, &endptr, base);
    printf("strtoumax = %jd (base %d)\n", j, base);
    printf("Stopped scan at %s\n\n", endptr);
}
```

Output

```
nptr = 10345134932abc
strtoumax = 10345134932(base 10)
Stopped scan at abc
```

Related information

- `inttypes.h`
- [“strtol\(\) — Convert character string to long” on page 1768](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)
- [“strtoll\(\) — Convert string to signed long long” on page 1772](#)
- [“strtoull\(\) — Convert string to unsigned long long” on page 1775](#)
- [“strtoumax\(\) — Convert character string to uintmax_t integer type” on page 1777](#)
- `wcstoimax()`
- `wcstoumax()`

strtok() — Tokenize string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

char *strtok(char * __restrict__string1, const char * __restrict__string2);
```

General description

Breaks a character string, pointed to by *string1*, into a sequence of tokens. The tokens are separated from one another by the characters in the string pointed to by *string2*.

The token starts with the first character not in the string pointed to by *string2*. If such a character is not found, there are no tokens in the string. `strtok()` returns a NULL pointer. The token ends with the first character contained in the string pointed to by *string2*. If such a character is not found, the token ends at the terminating NULL character. Subsequent calls to `strtok()` will return the NULL pointer. If such a character *is* found, then it is overwritten by a NULL character, which terminates the token.

If the next call to `strtok()` specifies a NULL pointer for *string1*, the tokenization resumes at the first character following the found and overwritten character from the previous call. For example:

```
/* Here are two calls */
strtok(string, " ")
strtok(NULL, " ")

/* Here is the string they are processing */
      abc defg hij
first call finds  ↑
                  ↑ second call starts
```

Returned value

The first time `strtok()` is called, it returns a pointer to the first token in *string1*. In later calls with the same token string, `strtok()` returns a pointer to the next token in the string. A NULL pointer is returned when there are no more tokens. All tokens are NULL-terminated.

Example

CELEBS54

```
/* CELEBS54
 *
 * strtok() example:
 *
 * This example parses tokens separated by commas, blanks and semicolons,
 * from a string until no tokens are left. As the string is parsed,
 * pointers to the the following tokens are returned by strtok(),
 * and these tokens are written to stdout:
 *
 * a
 * string
 * of
 * tokens
 *
 * The final call to strtok() returns NULL indicating that
 * there are no more tokens.
 *
 * Note that as the string is tokenized, it will be overwritten.
 *
 */

#include <stdio.h>
#include <string.h>

int main(void)
{
    char *token, string[] = "a string, of,; ,,,;tokens\0,after null terminator";

    token = strtok(string, ", ;");
    do
```



```
{
    printf("token: \"%s\"\n", token);
}
while (token = strtok(NULL, " ;"));
}
```

Output

```
token: "a string"
token: " of"
token: " "
token: "tokens"
```

Related information

- [“string.h — String manipulation functions” on page 66](#)
- [“strcat\(\) — Concatenate strings” on page 1719](#)
- [“strchr\(\) — Search for character” on page 1720](#)
- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“strcpy\(\) — Copy string” on page 1725](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“strspn\(\) — Search string” on page 1755](#)
- [“strtok_r\(\) — Split string into tokens” on page 1767](#)

strtok_r() — Split string into tokens

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <string.h>

char *strtok_r(char *s, const char *sep, char **lasts);
```

General description

The function `strtok_r()` considers the NULL-terminated string `s` as a sequence of zero or more text tokens separated by spans of one or more characters from the separator string `sep`. The argument `lasts` points to a user-provided pointer which points to stored information necessary for `strtok_r()` to continue scanning the same string.

In the first call to `strtok_r()`, `s` points to a NULL-terminated string, `sep` to a NULL-terminated string of separator characters and the value pointed to by `lasts` is ignored. The function `strtok_r()` returns a pointer to the first character of the first token, writes a NULL character into `s` immediately following the returned token, and updates the pointer to which `lasts` points.

In subsequent calls, `s` is a NULL pointer and `lasts` will be unchanged from the previous call so that subsequent calls will move through the string `s`, returning successive tokens until no tokens remain. The separator string `sep` may be different from call to call. When no token remains in `s`, a NULL pointer is returned.

Returned value

If successful, strtok_r() returns a pointer to the token found.
When no token is found, strtok_r() returns a NULL pointer.

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“strcat\(\) – Concatenate strings” on page 1719](#)
- [“strchr\(\) – Search for character” on page 1720](#)
- [“strcmp\(\) – Compare strings” on page 1722](#)
- [“strcpy\(\) – Copy string” on page 1725](#)
- [“strcspn\(\) – Compare strings” on page 1727](#)
- [“strspn\(\) – Search string” on page 1755](#)
- [“strtok\(\) – Tokenize string” on page 1765](#)

strtol() – Convert character string to long

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

long int strtol(const char * __restrict__nptr, char ** __restrict__endptr, int base);
```

General description

Converts *nptr*, a character string, to a long int value.

The function decomposes the entire string into three parts:

1. A sequence of characters, which in the current locale are defined as white space characters. This part may be empty.
2. A sequence of characters interpreted as integer in some base notation. This is the *subject sequence*.
3. A sequence of unrecognized characters.

The base notation is determined by *base*, if *base* is greater than zero. If *base* is zero, the base notation is determined by the format of the sequence of characters that follow an optional plus—or optional minus—sign.

10

Sequence starts with nonzero decimal digit.

8

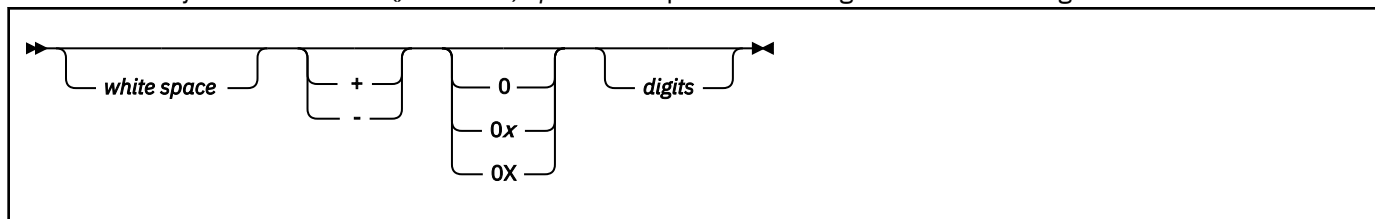
Sequence starts with 0, followed by a sequence of digits with values from 0 to 7.

16

Sequence starts with either 0x or 0X, followed by digits, and letters A through F or a through f.

If the base is greater than zero, the subject sequence contains decimal digits and letters, possibly preceded by either a plus or a minus sign. The letters a (or A) through z (or Z) represent values from 10 through 36, but only those letters whose value is less than the value of the base are allowed.

When you use the `strtol()` function, *nptr* should point to a string with the following form:



The pointer to the converted characters, even if conversion was unsuccessful, is stored in the object pointed to by *endptr*, as long as *endptr* is not a NULL pointer.

Returned value

If successful, `strtol()` returns the converted long int value.

If unsuccessful, `strtol()` returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, `strtol()` returns `LONG_MAX` or `LONG_MIN`, according to the sign of the value. If the value of base is not supported, `strtol()` returns 0.

If unsuccessful `strtol()` sets `errno` to one of the following values:

Error Code**Description****EINVAL**

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Example**CELEBS55**

```

/* CELEBS55

This example converts the strings to a long.
It prints out the converted value and the substring that
stopped the conversion.

*/
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    char *string, *stopstring;
    long l;
    int bs;

    string = "10110134932";
    printf("string = %s\n", string);
    for (bs = 2; bs <= 8; bs *= 2)
    {
        l = strtol(string, &stopstring, bs);
        printf("    strtol = %ld (base %d)\n", l, bs);
        printf("    Stopped scan at %s\n\n", stopstring);
    }
}

```

Output

```
string = 10110134932
  strtol = 45 (base 2)
  Stopped scan at 34932

  strtol = 4423 (base 4)
  Stopped scan at 4932

  strtol = 2134108 (base 8)
  Stopped scan at 932
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“atof\(\) — Convert character string to double” on page 201](#)
- [“atoi\(\) — Convert character string to integer” on page 202](#)
- [“atol\(\) — Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“strtod\(\) — Convert character string to double” on page 1759](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)

strtold() — Convert character string to long double

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <stdlib.h>

long double strtold(const char *__restrict__ nptr, char **__restrict__ endptr);
```

General description

strtold() converts a part of a character string, pointed to by *nptr*, to long double. The parameter *nptr* points to a sequence of characters that can be interpreted as a numerical value of the type long double.

The strtold() function breaks the string into three parts:

1. An initial, possibly empty, sequence of white-space characters (as specified by isspace()).
2. A subject sequence interpreted as a floating-point constant or representing infinity or NaN.
3. A final string of one or more unrecognized characters, including the terminating null byte of the input string.

The function then attempts to convert the subject string into the floating-point number, and returns the result.

The expected form of the subject sequence is an optional plus or minus sign, then one of the following:

- A non-empty sequence of decimal digits optionally containing a radix character, then an optional exponent part. A radix character is the character that separates the integer part of a number from the fractional part.
- A 0x or 0X, a non-empty sequence of hexadecimal digits optionally containing a radix character, then a base 2 decimal exponent part with a p or P as prefix, a plus or minus sign, then a sequence of at least one decimal digit. (Example [-]0xh.hhhhp+/-d). A radix character is the character that separates the integer part of a number from the fractional part.
- One of INF or INFINITY, ignoring case.
- One of NANQ or NANQ(n-char-sequence), ignoring case.
- One of NANS or NANS(n-char-sequence), ignoring case.
- One of NAN or NAN(n-char-sequence), ignoring case.

See the "scanf Family of Formatted Input Functions" for a description of special infinity and NaN sequences recognized by z/OS formatted input functions in IEEE Binary Floating-Point mode.

The pointer to the last string successfully converted is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer. If the subject string is empty or it does not have the expected form, then no conversion is performed. The value of *nptr* is stored in the object pointed to by *endptr*.

Returned value

If successful, strtold() returns the value of the floating-point number.

The long double value is hexadecimal floating-point or IEEE Binary Floating-Point format depending on the floating-point mode of the thread invoking the strtold() function. This function uses __isBFP() to determine the floating-point mode of the invoking thread.

In an overflow, strtold() returns +/-HUGE_VALL. In an underflow, it returns 0. If no conversion is performed, strtold() returns 0. In both cases, errno is set to ERANGE, depending on the base of the value.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“atof\(\) – Convert character string to double” on page 201](#)
- [“atoi\(\) – Convert character string to integer” on page 202](#)
- [“atol\(\) – Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) – Read and format data” on page 626](#)
- [“__isBFP\(\) – Determine application floating-point format” on page 905](#)
- [“strtod\(\) – Convert character string to double” on page 1759](#)
- [“strtof\(\) – Convert character string to float ” on page 1763](#)
- [“strtoul\(\) – Convert character string to long” on page 1768](#)
- [“strtoul\(\) – Convert string to unsigned integer” on page 1773](#)

strtoll() – Convert string to signed long long

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Language Environment C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | OS/390 V2R9 |

Format

```
#include <stdlib.h>

long long strtoll(const char * __restrict__ nptr, char ** __restrict__ endptr, int
base);
```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

Converts *nptr*, a character string, to a signed long long value.

The function decomposes the entire string into three parts:

- 1. A sequence of characters, which in the current locale are defined as white space characters. This part may be empty.
- 2. A sequence of characters interpreted as an unsigned integer in some base notation. This is the *subject sequence*.
- 3. A sequence of unrecognized characters.

The base notation is determined by *base*, if *base* is greater than zero. If *base* is zero, the base notation is determined by the format of the sequence of characters that follow an optional plus or optional minus sign.

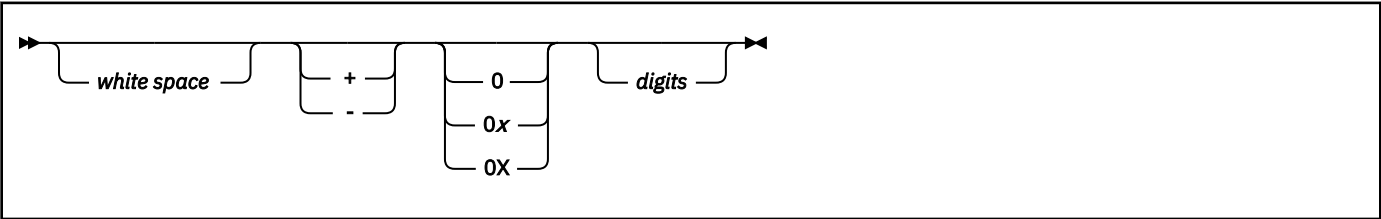
10 Sequence starts with nonzero decimal digit.

8 Sequence starts with 0, followed by a sequence of digits with values from 0 to 7.

16 Sequence starts with either 0x or 0X, followed by digits, and letters A through F or a through f.

If the base is greater than zero, the subject sequence contains decimal digits and letters, possibly preceded by either a plus or a minus sign. The letters a (or A) through z (or Z) represent values from 10 through 36, but only those letters whose value is less than the value of the base are allowed.

When you are using strtoll(), *nptr* should point to a string with the following form:



The pointer to the converted characters, even if conversion was unsuccessful, is stored in the object pointed to by *endptr*, as long as *endptr* is not a NULL pointer.

Returned value

If successful, `strtoll()` returns the converted signed long long value, represented in the string.

If unsuccessful, `strtoll()` returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, `strtoll()` returns `LLONG_MAX` (`LONGLONG_MAX`) or `LLONG_MIN` (`LONGLONG_MIN`), according to the sign of the value. If the value of *base* is not supported, `strtoll()` returns 0.

If unsuccessful `strtoll()` sets `errno` to one of the following values:

Error Code Description

EINVAL

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“atof\(\) – Convert character string to double” on page 201](#)
- [“atoi\(\) – Convert character string to integer” on page 202](#)
- [“atol\(\) – Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) – Read and format data” on page 626](#)
- [“strtod\(\) – Convert character string to double” on page 1759](#)
- [“strtoul\(\) – Convert string to unsigned integer” on page 1773](#)

strtoul() – Convert string to unsigned integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Language Environment ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

unsigned long int strtoul(const char * __restrict__ string1,
                        char ** __restrict__ string2, int base);
```

General description

Converts *string1*, a character string, to an unsigned long int value.

The function decomposes the entire string into three parts:

- 1. A sequence of characters, which in the current locale are defined as white space characters. This part may be empty.
- 2. A sequence of characters interpreted as an unsigned integer in some base notation. This is the *subject sequence*.
- 3. A sequence of unrecognized characters.

The base notation is determined by *base*, if *base* is greater than zero. If *base* is zero, the base notation is determined by the format of the sequence of characters that follow an optional plus or optional minus sign.

10

Sequence starts with nonzero decimal digit.

8

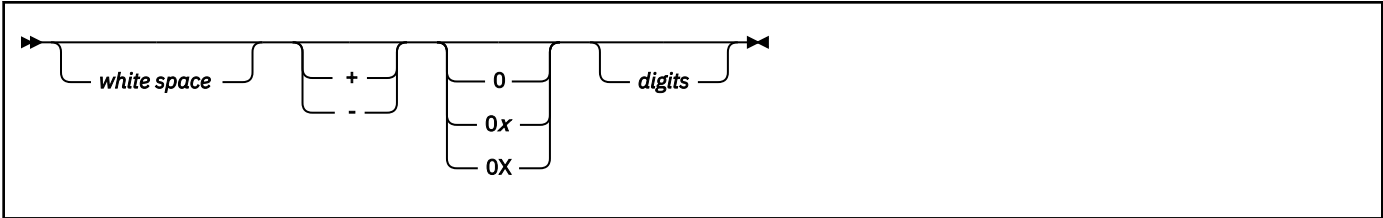
Sequence starts with 0, followed by a sequence of digits with values from 0 to 7.

16

Sequence starts with either 0x or 0X, followed by digits, and letters A through F or a through f.

If the base is greater than zero, the subject sequence contains decimal digits and letters, possibly preceded by either a plus or a minus sign. The letters a (or A) through z (or Z) represent values from 10 through 36, but only those letters whose value is less than the value of the base are allowed. The function stops reading the string at the first character that it cannot recognize as part of a number. This character can be the first numeric character greater than or equal to the *base*. The strtoul() function sets *string2* to point to the end of the resulting output string if a conversion is performed and provided that *string2* is not a NULL pointer.

When you are using the strtoul() function, *string1* should point to a string with the following form:



If *base* is in the range of 2-36, it becomes the base of the number. If *base* is 0, the prefix determines the base (8, 16, or 10): the prefix 0 means base 8; the prefix 0x or 0X means base 16; using any other digit without a prefix means decimal.

The pointer to the converted characters, even if conversion was unsuccessful, is stored in the object pointed to by *string2*, as long as *string2* is not a NULL pointer.

Returned value

If successful, strtoul() returns the converted unsigned long int value, represented in the string.

If unsuccessful, strtoul() returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, strtoul() returns ULONG_MAX. If the value of base is not supported, strtoul() returns 0.

If unsuccessful strtoul() sets errno to one of the following values:

Error Code

Description

EINVAL

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Example

CELEBS56

```

/* CELEBS56

   This example converts the string to an unsigned long value.
   It prints out the converted value and the substring that
   stopped the conversion.

*/
#include <stdio.h>
#include <stdlib.h>

#define BASE 2

int main(void)
{
    char *string, *stopstring;
    unsigned long ul;

    string = "1000e13 e";
    printf("string = %s\n", string);
    ul = strtoul(string, &stopstring, BASE);
    printf("    strtoul = %ld (base %d)\n", ul, BASE);
    printf("    Stopped scan at %s\n\n", stopstring);
}

```

Output

```

string = 1000e13 e
    strtoul = 8 (base 2)
    Stopped scan at e13 e

```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“atof\(\) — Convert character string to double” on page 201](#)
- [“atoi\(\) — Convert character string to integer” on page 202](#)
- [“atol\(\) — Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“strtod\(\) — Convert character string to double” on page 1759](#)
- [“strtol\(\) — Convert character string to long” on page 1768](#)

strtoull() — Convert string to unsigned long long

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| Language Environment C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | OS/390 V2R9 |

Format

```

#include <stdlib.h>

unsigned long long strtoull(register const char * __restrict__ nptr,
                           char ** __restrict__ endptr, int base);

```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

Converts *nptr*, a character string, to an unsigned long long value.

The function decomposes the entire string into three parts:

- 1. A sequence of characters, which in the current locale are defined as white space characters. This part may be empty.
- 2. A sequence of characters interpreted as an unsigned integer in some base notation. This is the *subject sequence*.
- 3. A sequence of unrecognized characters.

The base notation is determined by *base*, if *base* is greater than zero. If *base* is zero, the base notation is determined by the format of the sequence of characters that follow an optional plus or optional minus sign.

10

Sequence starts with nonzero decimal digit.

8

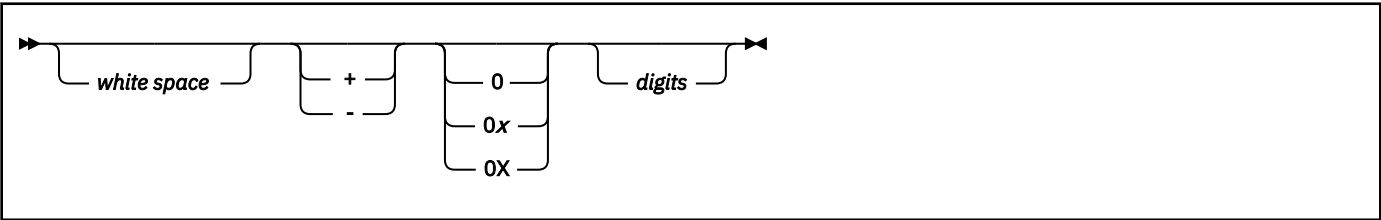
Sequence starts with 0, followed by a sequence of digits with values from 0 to 7.

16

Sequence starts with either 0x or 0X, followed by digits, and letters A through F or a through f.

If the base is greater than zero, the subject sequence contains decimal digits and letters, possibly preceded by either a plus or a minus sign. The letters a (or A) through z (or Z) represent values from 10 through 36, but only those letters whose value is less than the value of the base are allowed. The function stops reading the string at the first character that it cannot recognize as part of a number. This character can be the first numeric character greater than or equal to the *base*. The strtoull() function sets *endptr* to point to the end of the resulting output string if a conversion is performed and provided that *endptr* is not a NULL pointer.

When you are using the strtoull() function, *nptr* should point to a string with the following form:



If *base* is in the range of 2-36, it becomes the base of the number. If *base* is 0, the prefix determines the base (8, 16 or 10): the prefix 0 means base 8; the prefix 0x or 0X means base 16; using any other digit without a prefix means decimal.

The pointer to the converted characters, even if conversion was unsuccessful, is stored in the object pointed to by *endptr*, as long as *endptr* is not a NULL pointer.

Returned value

If successful, strtoull() returns the converted unsigned long long value, represented in the string.

If unsuccessful, strtoull() returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, strtoull() returns ULLONG_MAX (ULONGLONG_MAX). If the value of *base* is not supported, strtoull() returns 0.

If unsuccessful strtoull() sets *errno* to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EINVAL

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“atof\(\) — Convert character string to double” on page 201](#)
- [“atoi\(\) — Convert character string to integer” on page 202](#)
- [“atol\(\) — Convert character string to long” on page 203](#)
- [“fscanf\(\), scanf\(\), sscanf\(\) — Read and format data” on page 626](#)
- [“strtod\(\) — Convert character string to double” on page 1759](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)

strtoumax() — Convert character string to uintmax_t integer type

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <inttypes.h>

uintmax_t strtoumax(const char * __restrict__ nptr,
                    char ** __restrict__ endptr, int base);
```

Compile requirement: Function strtoumax() requires long long to be available.

General description

The strtoumax() function converts the string nptr to an uintmax_t integer type. Valid input values for base are 0 and in the range 2-36. The strtoumax() function is equivalent to strtoul() and strtoull(). The only difference being that the return value is of type uintmax_t. See strtoull for more information.

Returned value

If successful, strtoumax() returns the converted uintmax_t value, represented in the string.

If unsuccessful, strtoumax() returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, strtoumax() returns UINTMAX_MAX. If the value of base is not supported, strtoumax() returns 0.

If unsuccessful strtoumax() sets errno to one of the following values:

Error Code**Description****EINVAL**

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdlib.h>
#include <stdio.h>

int main(void)
{
    uintmax_t j;
    int base = 10;
    char *nptr, *endptr;
    nptr = "20690239864abc";
    printf("string = %s\n", nptr);
    j = strtoumax(nptr, &endptr, base);
    printf("strtoumax = %ju (base %d)\n", j, base);
    printf("Stopped scan at %s\n", endptr);
}
```

Output

```
string = 20690239864abc
strtoumax = 20690239864 (base 10)
Stopped scan at abc
```

Related information

- inttypes.h
- strtoumax()
- strtol()
- strtoul()
- strtoll()
- strtoull()
- wcstoimax()
- wcstoumax()

strxfrm() – Transform string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <string.h>

size_t strxfrm(char * __restrict__ s1, const char * __restrict__ s2, size_t n);
```

General description

Transforms the string pointed to by *s2* and places the resulting string into the array pointed to by *s1*. The transformation is determined by the program's locale. The transformed string is not necessarily readable, but can be used with the `strcmp()` or `strncmp()` functions.

The transformation is such that, if `strcmp()` or `strncmp()` were applied to the two transformed strings, the results would be the same as applying the `strcoll()` function to the two corresponding untransformed strings.

No more than *n* bytes are placed into the area pointed to by *s1*, including the terminating NULL byte. If *n* is zero, *s1* is allowed to be a NULL pointer.

Returned value

If successful, `strxfrm()` returns the length of the transformed string (excluding the NULL byte). When *n* is zero and *s1* is a NULL pointer, the length returned is the number of bytes minus one required to contain the transformed string.

If unsuccessful, `strxfrm()` returns `(size_t)-1` and sets `errno` to indicate the error.

Notes:

1. The string returned by `strxfrm()` contains the weights for each order of the characters within the string. As a result, the string returned may be longer than the input string, and does not contain printable characters.
2. `strxfrm()` issues a `malloc()` when the `LC_COLLATE` category specifies *backward* on the *order_start* keyword, the *substitute* keyword is specified, or the locale has one-to-many mapping. The `strxfrm()` function will fail if the `malloc()` fails.
3. If the locale supports double-byte characters (`MB_CUR_MAX` specified as 4), the `strxfrm()` function validates the multibyte characters, whereas previously the `strxfrm()` function did not validate the string. The `strxfrm()` function will fail if the string contains invalid multibyte characters.
4. If `MB_CUR_MAX` is defined as 4, and no collation is defined for DBCS chars in the current locale, the DBCS characters will collate after the single-byte characters.

Example

CELEBS57

```
/* CELEBS57

   This example prompts the user to input a string of characters, then
   uses strxfrm() to transform the string and return its length.

*/
#include <collate.h>
#include <stdlib.h>
#include <stdio.h>
#include <string.h>
int main(void)
{
    char *string1="string1", *string2="string2";
    char *newstring1, *newstring2;
    int length1, length2;

    length1=strxfrm(NULL, string1, 0);
    length2=strxfrm(NULL, string2, 0);
    if (((newstring1=(char *)calloc(length1+1, 1))==NULL) ||
        ((newstring2=(char *)calloc(length2+1, 1))==NULL))
    {
        printf("insufficient memory\n");
        exit(99);
    }
    if ((strxfrm(newstring1, string1, length1+1) != length1) ||
        (strxfrm(newstring2, string2, length2+1) != length2))
    {
        printf("error in string processing\n");
        exit(99);
    }
}
```

```

    }
    if (strcoll(string1, string2) != strcmp(newstring1, newstring2))
    {
        printf("wrong results\n");
        exit(99);
    }
    printf("correct results\n");
    exit(0);
}

```

Related information

- [“string.h – String manipulation functions” on page 66](#)
- [“localeconv\(\) – Query numeric conventions” on page 988](#)
- [“setlocale\(\) – Set locale” on page 1547](#)
- [“strcmp\(\) – Compare strings” on page 1722](#)
- [“strcoll\(\) – Compare strings” on page 1724](#)
- [“strncmp\(\) – Compare strings” on page 1744](#)

__superkill() – Sends "super" SIGKILL to terminate target process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|---------------------|
| z/OS UNIX | both | z/OS V1R6 POSIX(ON) |

Format

```

#define _POSIX_SOURCE
#include <signal.h>

int __superkill(pid_t pid);

```

General description

The `__superkill()` function generates a more robust version of the SIGKILL signal to the process with `pid` as the process ID. The SIGKILL will be able to break through almost all of the current signal deterrents that can be an obstacle to the normal delivery of a SIGKILL and the resulting termination of the target process.

Function restrictions include:

- Cannot do a `__superkill()` to a group or specifying PID -1. An attempt to do so will result in a EINVAL/JrNoGroups.
- The superkill will be ignored if the target process has blocked all signals, in which case the `__superkill()` will not fail but simply be ignored (refer to BPX1SDD syscall in Chapter 2 . Callable services descriptions, *z/OS UNIX System Services Programming: Assembler Callable Services Reference*). Under a multithread environment, as long as BPX1SDD is called on the initial thread, `__superkill()` will be ignored. The `sigprocmask()` function cannot be used to block `__superkill()`.
- A regular SIGKILL must be sent, at least 3 seconds, to a process before a superkill. Otherwise the attempt will result in EINVAL/JRSigkillNotSent.
- Runtime option POSIX(ON) is required to be set for this function to work properly.

If the environment is valid, then the target process will be abended with a '422'x abend reason code x'0109' reason code. The abend code will be sent to the first dubbed thread in the process. Under Language Environment, this is almost always the initial processing thread (IPT).

Returned value

When successful, the target process is terminated. Upon failure, `__superkill()` returns -1 and sets `errno` to one of the following values:

Value

Description

ENIVAL

PID is -1 or a group process ID or the superkill was not sent 3 seconds after the regular SIGKILL.

EPERM

The caller does not have the permission to send the signal to any process that was specified by the process ID parameter.

ESRCH

No process or process groups that correspond to the process ID are found.

svc99() — Access supervisor call

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdio.h>

int svc99(__S99parms *string);
```

General description

Provides access to SVC99 on z/OS, which provides ability to:

- Dynamically allocate or deallocate a resource
- Dynamically concatenate or deconcatenate data sets
- Dynamically retrieve information on data sets

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The `__S99parms` structure must be in 31-bit addressable storage. A call to `svc99()` with 64-bit addressable storage will result in -1 return code.

The `__S99TXTPP` element needs to be a 32-bits wide pointer to 31-bit addressable storage containing an array of text unit pointers. Each of the text unit pointers must be a 32-bits wide pointer, each pointing to 31-bit addressable storage containing a text unit, or can be a NULL pointer. The last text unit pointer must have its high bit (traditional 31-bit amode high bit) turned on to denote the end of text units has been reached.

The `__S99S99X` element needs to be a 32-bits wide pointer to 31-bit addressable storage containing the `__S99rbx` structure, when needed. This is consistent with the `__dyn_t` structure element `__rbx` requirement outlined above.

The `__S99parms` structure is defined in `stdio.h`. It has been changed to include the address of the Request Block Extension. The Request Block Extension and the Error Message Parameter list can be used to process the messages returned by SVC99 when an error occurs. To use this feature, you must allocate and initialize these structures.

Table 69. Elements Contained by __S99parms Structure

| Field | Type | Value Stored |
|------------|----------------|---|
| __S99RBLN | unsigned char | SVC99 length of request block |
| __S99VERB | unsigned char | SVC99 verb code |
| __S99FLAG1 | unsigned short | SVC99 Flags 1 field |
| __S99ERROR | unsigned short | SVC99 error code field |
| __S99INFO | unsigned short | SVC99 information code |
| __S99TXTPP | void * __ptr32 | SVC99 pointer to a list of text unit pointers |
| __S99S99X | void * __ptr32 | SVC99 pointer to the Request Extension Block |
| __S99FLAG2 | unsigned int | SVC99 Flags 2 field for APF authorized programs |

Returned value

If the input pointer is NULL, svc99() returns 0 if running under CICS and nonzero otherwise. The nonzero value indicates that svc99() is supported under the current operating system (that is, z/OS non-CICS). If the input is not NULL, svc99() returns -1 if running under CICS (to indicate an error), otherwise it returns a code that results from svc99().

If the input is not NULL, and svc99() is not supported on the system, it returns -1.

Example

CELEBS58

```

/* CELEBS58

   This example uses the svc99() function to dynamically allocate a data
   set called USERID.EXAMPLE.

   */
#define MASK 0x80000000
#define _EXT

#include <stdio.h>
#include <string.h>

int main(void)
{
    int rc;
    struct __S99struc parmlist;
    char *s[10] = {                /* array of text pointers */
        /* text units follow */
        "\0\02\0\01\0\0E" "USERID.EXAMPLE", /* DSN=EXAMPLE */
        "\0\05\0\01\0\01\02",              /* DISP=(,CATLG) */
        "\0\07\0\0",                          /* SPACE=(TRK,.. */
        "\0\0A\0\01\0\03\0\0\014",          /* primary=20 */
        "\0\0B\0\01\0\03\0\0\01",           /* secondary=1 */
        "\0\015\0\01\0\05SYSDA",             /* UNIT=SYSDA */
        "\0\030\0\01\0\02\0\050",           /* BLKSIZE=80 */
        "\0\03C\0\01\0\02\040",             /* DSORG=PS */
        "\0\042\0\01\0\02\0\050",           /* LRECL=80 */
        "\0\049\0\01\0\01\080"};            /* RECFM=F */

    memset(&parmlist, 0, sizeof(parmlist));
    parmlist.__S99RBLN = 20;
    parmlist.__S99VERB = 1;                  /* verb for dsname allocation */
    parmlist.__S99FLAG1 = 0x4000;           /* do not use existing allocation */
    parmlist.__S99TXTPP = s;                /* pointer to pointer to text units */
    s[9] = (char *)((long unsigned) (s[9]) | MASK);

```



```

rc = svc99(&parmlist);
if (rc != 0)
    printf(" Error code = %d    Information code = %d\n",
           parmlist.__S99ERROR, parmlist.__S99INFO);
}

```

If your user ID starts with one of the letters A-F, you must add two double quotation marks (") before the user ID so that the first letter of the user ID is interpreted as a character rather than as a hexadecimal digit.

The preceding example can be made more readable by using symbolic names and data structures as demonstrated in the example below. The members IEFZB4DB, IEFZB4D0 and IEFZB4D2 of SYS1.MACLIB contain symbolic names that will be familiar to most assembler language programmers.

This next example uses symbolic names taken from these members to define, in z/OS XL C/C++ the text unit representing primary=20 or s[3]. Similar definitions can be made for the remaining text units but will not be given here.

```

#include <stdio.h>
#include <string.h>

#define MASK 0x80000000
#define CHAR_BIT 4
/* Defines one text unit with an integer of size 'bytes' */

#define __S99TUNIT_INT(bytes) struct {
    short unsigned __S99TUKEY;      /* KEY */
    short unsigned __S99TUNUM;      /* NO. OF LENGTH+PARM ENTRIES */
    struct {
        short unsigned __S99TULNG; /* LENGTH OF 1ST (ONLY) PARM */
        unsigned int __S99TUPAR :   /* PARAMETER */
            (bytes) * CHAR_BIT;
    } __S99TUENT;
}

/* initialize by: __S99TUNUM = 1; */
/* __S99TUENT.__S99TULNG = <bytes>; */
/* __S99TUENT.__S99TUPAR = <value>; */

#define __DALPRIME 0x000A /*PRIMARY SPACE QUANTITY */

static const __S99TUNIT_INT(3) primary = {__DALPRIME, 1, 3, 20};

int main(void)
{
    int rc;
    struct __S99struc parmlist;
    memset(&parmlist, 0, sizeof(parmlist));
    void *s[10] = { /* array of text pointers */
        /* text units follow */
        ., /* DSN=EXAMPLE */
        ., /* DISP=(,CATLG)*/
        ., /* SPACE=(TRK,..)*/
        &primary, /* primary=20 */
        ., /* secondary=1 */
        ., /* UNIT=SYSDA */
        ., /* BLKSIZE=80 */
        ., /* DSORG=PS */
        ., /* LRECL=80 */
        ., /* RECFM=F */
    };

    parmlist.__S99RBLN = 20;
    parmlist.__S99VERB = 01; /* verb for dsname allocation */
    parmlist.__S99FLAG1 = 0x4000; /* do not use existing allocation */
    parmlist.__S99TXTPP = s; /* pointer to pointer to text units */
    s[9] = (char *)((long unsigned) (s[9]) | MASK);

    rc = svc99(&parmlist);
    if (rc != 0)
        printf(" Error code = %d    Information code = %d\n",
               parmlist.__S99ERROR, parmlist.__S99INFO);
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)

- “[dynalloc\(\)](#) — Allocate a data set” on page 409
- “[dynfree\(\)](#) — Deallocate a data set” on page 415
- “[dyninit\(\)](#) — Initialize `__dyn_t` structure” on page 416
- Requesting dynamic allocation functions, SMS reason code (S99ERSN), and S99RBX fields in *z/OS MVS Programming: Authorized Assembler Services Guide*

swab() — Copy and swap bytes

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <unistd.h>

void swab(const void *__restrict__src, void *__restrict__dest, ssize_t nbytes);
```

General description

The `swab()` function copies *nbytes* bytes, which are pointed to by *src* to the object pointed to by *dest*, exchanging adjacent bytes. The *nbytes* argument should be even. If *nbytes* is odd, `swab()` copies and exchanges *nbytes*-1 bytes and the disposition of the last byte is left unchanged in the target area. If *nbytes* is zero or negative, no copying is performed.

Returned value

`swab()` returns no values.

Related information

- “[unistd.h — Implementation-specific functions](#)” on page 77

swapcontext() — Save and restore user context

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <ucontext.h>

int swapcontext(ucontext_t *__restrict__ oucp, const ucontext_t *__restrict__ ucp);
```

General description

The `swapcontext()` function saves the current user context in the context structure pointed to by *oucp* and restores the user context structure pointed to by *ucp*. `swapcontext()` is equivalent to `getcontext()` with the *oucp* argument followed by `setcontext()` with the *ucp* argument.

Control does not return from the initial invocation of `swapcontext()`. However, if the saved context is not modified using `makecontext()`, and a subsequent `setcontext()` or `swapcontext()` is issued using the saved context, `swapcontext()` returns with a 0 return value.

Notes:

1. If the *ucontext* pointed to by *ucp* that is input to `swapcontext()`, has not been modified by `makecontext()`, you must ensure that the function that saved that context by calling either `getcontext()` or `swapcontext()` does not return before you call `swapcontext()` to restore that context. Calling `swapcontext()` after the function that saved the context returns causes unpredictable program behavior.
2. If `swapcontext()` is used to jump back into an XPLINK routine, any `alloca()` requests issued by the XPLINK routine after the earlier `getcontext()` was called and before `swapcontext()` is called are backed out. All storage obtained by these `alloca()` requests is freed before the XPLINK routine is resumed.
3. If `swapcontext()` is used to jump back into a non-XPLINK routine, `alloca()` requests made after `getcontext()` and before `swapcontext()` are not backed out.
4. Do not issue `swapcontext()` from any type of condition handling routine (for example, a signal catcher, a Language Environment user condition handler or an exception handler).
5. If *ucp* is pointing to a user context of a different execution stack from the current, the user context should be either a freshly modified one (by `makecontext()`) or the most recently saved one (by `getcontext()` or `swapcontext()`) when running on its stack.
6. If *ucp* is pointing to a user context of a different execution stack from the current, the current stack is never collapsed and any resource associated with it is never freed after `swapcontext()` being called.

This function is supported only in a POSIX program.

The `<ucontext.h>` header file defines the `ucontext_t` type as a structure that includes the following members:

| | | |
|-------------------------|--------------------------|--|
| <code>mcontext_t</code> | <code>uc_mcontext</code> | A machine-specific representation of the saved context. |
| <code>ucontext_t</code> | <code>*uc_link</code> | Pointer to the context that will be resumed when this context returns. |
| <code>sigset_t</code> | <code>uc_sigmask</code> | The set of signals that are blocked when this context is active. |
| <code>stack_t</code> | <code>uc_stack</code> | The stack used by this context. |

Special behavior for C++: If `getcontext()` and `swapcontext()` are used to transfer control, the behavior is undefined whether the destruction of automatic C++ objects is done. The use of `getcontext()` and `swapcontext()` in conjunction with `try()`, `catch()`, and `throw()` is also undefined.

Do not issue `getcontext()` in a C++ constructor or destructor, since the saved context would not be usable in a subsequent `setcontext()` or `swapcontext()` after the constructor or destructor returns.

Special behavior for XPLINK-compiled C/C++: Restrictions concerning `setjmp.h` and `ucontext.h`:

1. All XPLINK programs compiled with the V2R10 or later C compilers that are to run with Language Environment V2R10 or later libraries and use the **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** types must not be compiled with C headers from Language Environment V2R9 or earlier.
2. Non-XPLINK functions compiled with any level of Language Environment headers must not define **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** data items and pass them to XPLINK functions that call `getcontext()`, `longjmp()`, `_longjmp()`, `setjmp()`, `_setjmp()`, `setcontext()`, `sigsetjmp()`, or `swapcontext()` with these passed-in data items.
3. When `__XPLINK__` is defined, the Language Environment V2R10 and later headers define a larger **`jmp_buf`**, **`sigjmp_buf`** or **`ucontext_t`** area that is required by `setjmp()`, `getcontext()`, and related functions when they are called from an XPLINK routine. If `__XPLINK__` is not defined, the Language

Environment V2R10 and later headers define a shorter **jmp_buf**, **sigjmp_buf** or **ucontext_t** area. The Language Environment headers before V2R10 also define the shorter version of these data areas. If an XPLINK function calls `setjmp()`, `getcontext()` or similar functions with a short **jmp_buf**, **sigjmp_buf** or **ucontext_t** area, a storage overlay or program check may occur when the C library tries to store past the end of the passed-in (too short) data area.

Returned value

If successful, `swapcontext()` does not return from the initial invocation. If the unmodified saved context is later restored, `swapcontext()` returns 0.

If unsuccessful, `swapcontext()` returns -1.

There are no `errno` values defined.

Example

This example uses two contexts. It creates the first, *fcontext*, in `main` with the `getcontext()` statement, and invokes the function *func*. It invokes the function with the `swapcontext()` statement, saving the context at that point in the second context, *mcontext*. The function returns to the point of the `swapcontext()` using the `setcontext()` statement and specifying *mcontext* as the context.

```
/* This example shows the usage of swapcontext(). */

#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>
#include <stdio.h>
#include <ucontext.h>
#include <errno.h>

#ifdef _LP64
#define STACK_SIZE 2097152+16384 /* large enough value for AMODE 64 */
#else
#define STACK_SIZE 16384 /* AMODE 31 addressing*/
#endif
void func(int);

ucontext_t fcontext,mcontext;
int x = 0;

int main(void) {
    int value = 1;

    getcontext(&fcontext);
    if ((fcontext.uc_stack.ss_sp = (char *) malloc(STACK_SIZE)) != NULL) {
        fcontext.uc_stack.ss_size = STACK_SIZE;
        fcontext.uc_stack.ss_flags = 0;
        errno = 0;
        makecontext(&fcontext,func,1,value);
        if (errno != 0){
            perror("Error reported by makecontext()");
            return -1; /* Error occurred exit */
        }
    }
    else {
        perror("not enough storage for stack");
        abort();
    }
    printf("context has been built\n");
    swapcontext(&mcontext,&fcontext);
    if (!x) {
        perror("incorrect return from swapcontext");
        abort();
    }
    else {
        printf("returned from function\n");
    }
}

void func(int arg) {
    printf("function called with value %d\n",arg);
```

```

x++;
printf("function returning to main\n");
setcontext(&mcontext);

}

```

Output

```

context has been built
function called with value 1
function returning to main
returned from function

```

Related information

- [“ucontext.h — Context related functions” on page 76](#)
- [“getcontext\(\) — Get user context” on page 695](#)
- [“longjmp\(\) — Restore stack environment” on page 1009](#)
- [“_longjmp\(\) — Nonlocal goto” on page 1011](#)
- [“makecontext\(\) — Modify user context” on page 1032](#)
- [“setcontext\(\) — Restore user context” on page 1520](#)
- [“setjmp\(\) — Preserve stack environment” on page 1542](#)
- [“_setjmp\(\) — Set jump point for a nonlocal goto” on page 1544](#)
- [“siglongjmp\(\) — Restore the stack environment and signal mask” on page 1633](#)
- [“sigsetjmp\(\) — Save stack environment and signal mask” on page 1650](#)

swprintf() — Format and write wide characters

The information for this function is included in [“fwprintf\(\), swprintf\(\), wprintf\(\) — Format and write wide characters” on page 674](#).

swscanf() — Read a wide-character string

The information for this function is included in [“fwscanf\(\), swscanf\(\), wscanf\(\) — Convert formatted wide-character input” on page 681](#) section .

symlink() — Create a symbolic link to a path name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1a XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _POSIX1_SOURCE 2
#include <unistd.h>

int symlink(const char *pathname, const char *slink);

```

General description

Creates the symbolic link named by *slink* with the file specified by *pathname*. File access checking is not performed on the file *pathname*, and the file need not exist. In addition, a symbolic link can cross file system boundaries.

A symbolic link path name is resolved in this fashion:

- When a component of a path name refers to a symbolic link rather than to a directory, the path name contained in the symbolic link is resolved.
- If the path name in the symbolic link begins with / (slash), the symbolic link path name is resolved relative to the process root directory.

If the path name in the symbolic link does not start with / (slash), the symbolic link path name is resolved relative to the directory that contains the symbolic link.

- If the symbolic link is the last component of a path name, it may or may not be resolved. Resolution depends on the function using the path name. For example, `rename()` does not resolve a symbolic link when it appears as the final component of either the new or old path name. However, `open` does resolve a symbolic link when it appears as the last component.
- If the symbolic link is not the last component of the original path name, remaining components of the original path name are resolved relative to the symbolic link.
- When a / (slash) is the last component of a path name and it is preceded by a symbolic link, the symbolic link is always resolved.

Because the mode of a symbolic link cannot be changed, its mode is ignored during the lookup process. Any files and directories to which a symbolic link refers are checked for access permission.

Returned value

If successful, `symlink()` returns 0.

If unsuccessful, `symlink()` returns -1, does not affect any file it names, and sets `errno` to one of the following values:

Error Code

Description

EACCES

A component of the *slink* path prefix denies search permission, or write permission is denied in the parent directory of the symbolic link to be created.

EEXIST

The file named by *slink* already exists.

EINVAL

There is a NULL character in *pathname*.

EIO

Added for XPG4.2: An I/O error occurred while reading from the file system.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLINK_LOOP` symbolic links are encountered during resolution of the *slink* argument.

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters, or some component of *pathname* is longer than **NAME_MAX** characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the path name string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined with `pathconf()`.

ENOENT

Added for XPG4.2: A component of *slink* does not name an existing file or *slink* is an empty string. This might be also returned for the following reason:

slink has a slash as its last component, which indicates that the preceding component is a directory. A symbolic link cannot be a directory.

ENOSPC

The new symbolic link cannot be created because there is no space left on the file system that will contain the symbolic link.

ENOTDIR

A component of the path prefix of *slink* is not a directory.

EROFS

The file *slink* cannot reside on a read-only system.

Example

```
/* This example works only under z/OS XL C, not z/OS XL C++ */
#define _POSIX1_SOURCE 2
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#include <stdlib.h>
#include <stdio.h>

main() {
    char fn[]="test.file";
    char sln[]="test.symlink";
    int fd;

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        close(fd);
        puts("before symlink()");
        system("ls -il test.*");
        if (symlink(fn, sln) != 0) {
            perror("symlink() error");
            unlink(fn);
        }
        else {
            puts("after symlink()");
            system("ls -il test.*");
            unlink(fn);
            puts("after first unlink()");
            system("ls -il test.*");
            unlink(sln);
        }
    }
}
```

Output

```
before symlink()
4030 --w----- 1 MVSUSR1 SYS1    0 Apr 20 13:57 test.file

after symlink()
4030 --w----- 1 MVSUSR1 SYS1    0 Apr 20 13:57 test.file
4031 l----- 1 MVSUSR1 SYS1    9 Apr 20 13:57 test.symlink -> test.file
after first unlink()
4031 l----- 1 MVSUSR1 SYS1    9 Apr 20 13:57 test.symlink -> test.file
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“readlink\(\) — Read the value of a symbolic link” on page 1390](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

symlinkat() – Create a symbolic link to a path name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <unistd.h>

int symlinkat(const char *pathname, int newdirfd, const char *slink);
```

General description

symlinkat() operates in the same way as symlink() except for the following differences.

- If the path name that is given in *slink* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *newdirfd* (rather than relative to the current working directory of the calling process, as is done by symlink() for a relative path name).
- If *slink* is relative and *newdirfd* is the special value AT_FDCWD, *slink* is interpreted relative to the current working directory of the calling process (like symlink()).
- If *slink* is absolute, *newdirfd* is ignored.

Returned value

If successful, symlinkat() returns 0.

If unsuccessful, symlinkat() returns -1 and sets errno to one of the following values:

Error Code

Description

EACCES

A component of the *slink* path prefix denies search permission, or write permission is denied in the parent directory of the symbolic link to be created.

EEXIST

The file that is named by *slink* exists.

EINVAL

There is a NULL character in *pathname*.

EIO

Added for XPG4.2: An I/O error occurs while reading from the file system.

ELOOP

A loop exists in symbolic links. This error is issued if more than POSIX_SYMLINK_MAX symbolic links are encountered during the resolution of the *slink* argument.

ENAMETOOLONG

pathname is longer than PATH_MAX characters, or some component of *pathname* is longer than NAME_MAX characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the path name string that is substituted for a symbolic link exceeds PATH_MAX. The PATH_MAX and NAME_MAX values can be determined with pathconf().

ENOENT

Added for XPG4.2: A component of *slink* does not name an existing file or *slink* is an empty string.

slink has a slash as its last component, which indicates that the preceding component is a directory. A symbolic link cannot be a directory.

ENOSPC

The new symbolic link cannot be created because there is no space left on the file system to contain the symbolic link.

ENOTDIR

slink is relative and *newdirfd* is a file descriptor that refers to a file other than a directory.

EROFS

The file *slink* cannot reside on a read-only system.

EBADF

newdirfd is not a valid file descriptor.

EFBIG

A request to create a symbolic link is prohibited because the file size limit for the process is set to 0.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“readlink\(\) — Read the value of a symbolic link” on page 1390](#)
- [“symlink\(\) — Create a symbolic link to a path name” on page 1787](#)

sync() — Schedule file system updates

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

void sync(void);
```

General description

The `sync()` function causes all information in memory that updates file systems to be scheduled for writing out to all file systems.

The writing, although scheduled, is not necessarily complete upon return from `sync()`.

Returned value

`sync()` returns no values.

No errors are defined.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“fsync\(\) — Write changes to direct-access storage” on page 655](#)

syncfs() – Schedule specific file system updates

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <unistd.h>

int syncfs(int fd);
```

General description

`syncfs()` is similar to `sync()` but synchronizes the file system that contains the files that are referred to by the open file descriptor `fd`.

Returned value

If successful, `syncfs()` returns 0.

If unsuccessful, `syncfs()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

`fd` is not a valid file descriptor.

EIO

An error occurs during synchronization. This error might relate to data that is written to any file on the file system or on metadata that is related to the file system itself.

ENOSPC

Disk space is exhausted while synchronizing.

Related information

- [“unistd.h – Implementation-specific functions” on page 77](#)
- [“fsync\(\) – Write changes to direct-access storage” on page 655](#)
- [“sync\(\) – Schedule file system updates” on page 1791](#)

syscall() – Invokes indirect system calls

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX __XPLAT | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <unistd.h>
```

```
long syscall(long number, ...);
```

General description

The `syscall()` invokes the system call whose assembly language interface has the specified number with the specified arguments. Employing `syscall()` is useful, for example, when invoking a system call that has no wrapper function in the C library.

Symbolic constants for system call numbers can be found in `/usr/include/zos/syscalls.h` (and `SYS1.SIEAHDR.H(BPXYSYSC)`).

Returned value

The return value is defined by the system call that is invoked.

Example

```
#define _XPLATFORM_SOURCE
#include <stdio.h>
#include <stdlib.h>
#include <unistd.h>
#include <errno.h>

int main (void) {
    int i;
    int dirlen = 10;
    char dirname[10]= "/u/userexample";
    int buflen = 1023;
    char *bufferc;
    char bufferout[1024];
    int retval = 0;
    int retcod = 0;
    int reascod = 0;

    int fd;
    int alet = 0;

    bufferc = (char *)malloc(1024);
    memset(bufferc,0x00,1024);

    /* opendir */
    i = syscall(37,&dirlen,dirname,&retval,&retcod,&reascod);
    if (retval > 0) {
        fd = retval;
        retval = 0;
        /* readdir */
        i = syscall(41,&fd,&bufferc,&alet,&buflen,&retval,&retcod,&reascod);
    }

    printf("fd = %d\n", fd);
    printf("errno = %d, errno2 = %x\n", errno, __errno2());
    memcpy(bufferout,bufferc,1024);
    printf("***bufferc start***\n");
    for (i=0; i<1024; i++) {
        printf("%c", bufferout[i]);
    }
    printf("\n***bufferc end***\n");

    return 0;
}
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)

sysconf() — Determine system configuration options

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

long sysconf(int name);
```

General description

Determines the value of a configurable system option.

int *name*

Specifies the system configuration option to be obtained. The value of *name* can be any one of the following set of symbols defined in the `unistd.h` header file, each corresponding to a system configuration option:

The following are available when `_POSIX_SOURCE` is defined.

_SC_ARG_MAX

Represents **ARG_MAX**, as defined by the values returned by `sysconf()`, the maximum number of bytes of arguments and environment data that can be passed in an `exec` function.

_SC_CHILD_MAX

Represents `CHILD_MAX`, as defined by the values returned by `sysconf()`, the maximum number of processes that a real user ID (UID) may have running simultaneously.

_SC_CLK_TCK

Represents the `CLK_TCK` macro defined in the `time.h` header file: the number of clock ticks in a second.

_SC_JOB_CONTROL

Represents the `_POSIX_JOB_CONTROL` macro that can be defined in the `unistd.h` header file. This indicates that certain job control operations are implemented by this version of the operating system. If `_POSIX_JOB_CONTROL` is defined, various functions (for example, `setpgid()`) have more functionality than when the macro is not defined.

_SC_NGROUPS_MAX

Represents **NGROUPS_MAX**, as defined by the values returned by `sysconf()`, the maximum number of supplementary group IDs (GIDs) that can be associated with a process.

_SC_OPEN_MAX

Represents **OPEN_MAX**, as defined by the values returned by `sysconf()`, the maximum number of files that a single process can have open at one time.

_SC_SAVED_IDS

Represents the `_POSIX_SAVED_IDS` macro, which may be defined in `unistd.h` header file, indicating that this POSIX implementation has a saved set UID and a saved set GID. This symbol affects the behavior of such functions as `setuid()` and `setgid()`.

_SC_STREAM_MAX

Represents the `_STREAM_MAX` macro, which may be defined in the `unistd.h` header file, indicating the maximum number of streams that a process can have open at one time.

_SC_THREADS_MAX_NP

Represents the `THREAD_MAX` macro, as defined by the values returned by `sysconf()`, the maximum number of concurrent threads processed by `pthread_create()`, including running, queued, and exited undetached threads in the caller's process.

_SC_THREAD_TASKS_MAX_NP

Represents the `THREAD_TASKS_MAX` macro, as defined by the values returned by `sysconf()`, the maximum number of MVS tasks simultaneously in use for threads processed by `pthread_create()` in the caller's process.

_SC_TTY_GROUP

Retrieves the group number associated with the `TTYGROUP()` initialization parameter.

_SC_TZNAME_MAX

Represents the `_TZNAME_MAX` macro, which may be defined in the `unistd.h` header file, indicating the maximum length of the name of a time zone.

_SC_VERSION

Represents the `_POSIX_VERSION` macro, which will be defined in the `unistd.h` header file, indicating the version of the POSIX.1 standard that the system conforms to.

In addition to the symbols exposed by `_POSIX_SOURCE`, the following are visible when `_XOPEN_SOURCE` is defined:

_SC_XOPEN_CRYPT

Represents `_XOPEN_CRYPT`, the implementation supports the X/Open Encryption Option Group.

_SC_XOPEN_VERSION

Represents `_XOPEN_VERSION`, integer value indicating version of the X/Open Portability Guide to which the implementation conforms.

_SC_PASS_MAX

Represents `PASS_MAX`, as defined by the values returned by `sysconf()`, the maximum number of bytes allowed in a password, `PassTicket`, or password phrase.

Note:

It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

In addition to the symbols exposed by `_XOPEN_SOURCE`, the following are visible when `_XOPEN_SOURCE_EXTENDED` is defined to be 1:

_SC_PAGE_SIZE

Returns the current page size in bytes.

_SC_PAGESIZE

Returns the current page size in bytes.

In addition to the symbols exposed by `_POSIX_SOURCE`, the following are visible when `_POSIX_C_SOURCE` is defined to be 2:

_SC_2_C_BIND

Represents `_POSIX2_C_BIND`, the implementation supports the C-Language Binding option.

_SC_2_C_DEV

Represents `_POSIX2_C_DEV`, the implementation supports the C-Language Development Utilities option.

_SC_2_LOCALEDEF

Represents _POSIX2_LOCALEDEF, the implementation supports the creation of locales by the localedef utility.

_SC_2_UPE

Represents _POSIX2_UPE, the implementation supports the User Portability Utilities option. .

_SC_2_VERSION

Represents _POSIX2_VERSION, integer value indicating version of the Shell and Utilities to which the implementation conforms.

In addition to the symbols exposed by _POSIX_C_SOURCE defined to be 2, the following are visible when _POSIX_C_SOURCE is defined to be 200112L:

_SC_HOST_NAME_MAX

Represents HOST_NAME_MAX, Maximum length of a host name (not including the terminating null) as returned from the gethostname() function.

_SC_IPV6

Represents _POSIX_IPV6, the implementation supports the IPv6 option.

_SC_LOGIN_NAME_MAX

Represents LOGIN_NAME_MAX, Maximum length of a login name.

_SC_READER_WRITER_LOCKS

Represents _POSIX_READER_WRITER_LOCKS, the implementation supports the Read-Write Locks option. This is always set to a value greater than zero if the Threads option is supported.

_SC_REGEX

Represents _POSIX_REGEX, the implementation supports the Regular Expression Handling option.

_SC_SHELL

Represents _POSIX_SHELL, the implementation supports the POSIX shell.

_SC_SYMLOOP_MAX

Represents SYMLOOP_MAX, maximum number of symbolic links that can be reliably traversed in the resolution of a path name in the absence of a loop.

_SC_THREAD_ATTR_STACKSIZE

Represents _POSIX_THREAD_ATTR_STACKSIZE, the implementation supports the Thread Stack Size Attribute option.

_SC_THREAD_KEYS_MAX

Represents PTHREAD_KEYS_MAX, maximum number of data keys that can be created by a process.

_SC_THREAD_PROCESS_SHARED

Represents _POSIX_THREAD_PROCESS_SHARED, the implementation supports the Thread Process-Shared Synchronization option.

_SC_THREAD_SAFE_FUNCTIONS

Represents _POSIX_THREAD_SAFE_FUNCTIONS, the implementation supports the Thread-Safe Functions option.

_SC_THREAD_STACK_MIN

Represents PTHREAD_STACK_MIN, minimum size in bytes of thread stack storage.

_SC_THREAD_THREADS_MAX

Represents PTHREAD_THREADS_MAX, maximum number of threads that can be created per process.

_SC_THREADS

Represents _POSIX_THREADS, the implementation supports the Threads option.

_SC_TTY_NAME_MAX

Represents TTY_NAME_MAX, maximum length of terminal device name.

_SC_V6_ILP32_OFF32

Represents `_POSIX_V6_ILP32_OFF32`, the implementation provides a C-language compilation environment with 32-bit int, long, pointer, and `off_t` types.

_SC_V6_ILP32_OFFBIG

Represents `_POSIX_V6_ILP32_OFFBIG`, the implementation provides a C-language compilation environment with 32-bit int, long, and pointer types and an `off_t` type using at least 64 bits.

_SC_V6_LP64_OFF64

Represents `_POSIX_V6_LP64_OFF64`, the implementation provides a C-language compilation environment with 32-bit int and 64-bit long, pointer, and `off_t` types.

_SC_V6_LPBIG_OFFBIG

Represents `_POSIX_V6_LPBIG_OFFBIG`, the implementation provides a C-language compilation environment with an int type using at least 32 bits and long, pointer, and `off_t` types using at least 64 bits.

_SC_XOPEN_LEGACY

Represents `_XOPEN_LEGACY`, the implementation supports the Legacy Option Group.

The following symbols are available under `_XOPEN_SOURCE 500`:

_SC_GETPW_R_SIZE_MAX

Maximum size of `getpwuid_r()` and `getpwnam_r()` data buffers

_SC_GETGR_R_SIZE_MAX

Maximum size of `getgrgid_r()` and `getgrnam_r()` data buffers

Returned value

If successful, `sysconf()` returns the value associated with the specified option.

If the variable corresponding to *name* exists but is not supported by the system, `sysconf()` returns -1 but does not change the value of `errno`. If `sysconf()` fails in some other way, it returns -1.

If unsuccessful, `sysconf()` sets `errno` to one of the following values:

Error Code**Description****EINVAL**

The value specified for the *name* argument is incorrect.

Example**CELEBS61**

```
/* CELEBS61

   This example determines the value of ARG_MAX.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <unistd.h>
#include <errno.h>

main() {
    long result;

    errno = 0;
    puts("examining ARG_MAX limit");
    if ((result = sysconf(_SC_ARG_MAX)) == -1)
        if (errno == 0)
            puts("ARG_MAX is not supported.");
        else perror("sysconf() error");
    else
        printf("ARG_MAX is %ld\n", result);
}
```

Output

```
examining ARG_MAX limit
ARG_MAX is 1048576
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“clock\(\) — Determine processor time” on page 286](#)
- [“exec functions” on page 442](#)

syslog() — Send a message to the control log

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <syslog.h>

void syslog(int priority, const char *message, ... /* argument */);
```

General description

The `syslog()` function sends a message to an implementation-specific logging facility, which loads it in an appropriate system log, writes it to the system console, forwards it to a list of users, or forwards it to the logging facility on another host over the network. The logged message includes a message header and a message body. The message header consists of a facility indicator, a severity indicator, a timestamp, a tag string, and optionally the process ID. The process ID is surrounded by square brackets. The code point values for the square brackets are taken from code page IBM-1047. The value for the left square bracket is 0xAD. The value for the right square bracket is 0xBD.

The message body is generated from the *message* and following arguments in the same manner as if these were arguments to the `printf()` function, except that occurrences of `%m` in the format string pointed to by the *message* argument are replaced by the error message string associated with the current value of `errno`. A trailing newline character is added if needed.

Note: If the total length of the format string and the parameters is greater than 4096 bytes, then the results are undefined.

Values of the *priority* argument are formed by ORing together a severity level values and an option facility value. If no facility value is specified, the current default facility value is used. Possible values of severity level include:

LOG_ALERT

A condition that should be corrected immediately, such as a corrupted system database.

LOG_CRIT

Critical conditions, such as hard device errors.

LOG_DEBUG

Messages that contain information normally of use only when debugging a program.

LOG_EMERG

A Panic condition. This is normally broadcast to all processes.

LOG_ERR

Errors.

LOG_INFO

Informational messages.

LOG_NOTICE

Conditions that are not error conditions, but that may require special handling.

LOG_WARNING

Warning messages.

The facility indicates the application or system component generating the message. Possible facility values include:

LOG_USER

Message generated by random processes. This is the default facility identifier if none is specified.

LOG_LOCAL0

Reserved for local use.

LOG_LOCAL1

Reserved for local use.

LOG_LOCAL2

Reserved for local use.

LOG_LOCAL3

Reserved for local use.

LOG_LOCAL4

Reserved for local use.

LOG_LOCAL5

Reserved for local use.

LOG_LOCAL6

Reserved for local use.

LOG_LOCAL7

Reserved for local use.

Returned value

syslog() returns no values.

Related information

- [“syslog.h — System error logging” on page 67](#)
- [“closelog\(\) — Close the control log” on page 297](#)
- [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data” on page 593](#)
- [“openlog\(\) — Open the system control log” on page 1172](#)
- [“setlogmask\(\) — Set the mask for the control log” on page 1555](#)

system() — Execute a command

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 IEEE Std 1003.1, 2004 Edition | both | |

Format

```
#include <stdlib.h>

int system(const char *string);
```

General description

The `system()` function has two different behaviors. These behaviors are designated as ISO C/C++ `system()` and POSIX `system()`. The ISO C/C++ `system()` behavior is based on the ISO C standard definition of the function, whereas the POSIX `system()` behavior is based on the POSIX standard definition. The ISO C/C++ `system()` behavior is used when a) running POSIX(OFF) or b) when running POSIX(ON) and environment variable `__POSIX_SYSTEM` is set to NO. Otherwise the POSIX `system()` behavior is used.

Restriction:

- The `system()` function is not supported under CICS. If the *string* argument is NULL, `system()` returns 0 since there is no command processor under CICS, otherwise it returns -1.

ISO C/C++ `system()` function:

Note: In this topic, MVS specifically refers to MVS batch (excluding batch TSO/E), whereas TSO/E includes both batch TSO/E (IKJEFT01 as the program specified on the JCL EXEC statement) and interactive TSO/E (which is TSO/E at a terminal).

Using the ISO C/C++ `system()` function, you can call commands, EXECs, CLISTs, or executable modules under the MVS environment and TSO/E. You cannot use the ISO C/C++ `system()` function to invoke z/OS UNIX services shell programs.

The *string* argument can take one of the two formats:

command-line

A string with TSO/E command line syntax:

```
command_name parm1 parm2 ...
```

Example:

```
system("user_pgm1 1234 abcd xyz");
```

If the *string* argument is in the command-line format, the `system()` function passes the given string to the command processor, if available, for execution.

named-program

A string, of the following form, with no embedded blanks except in the PARM area.

```
"PGM=program_name[,PARM='...']"
```

Example:

```
system("PGM=user_pgm1, PARM='1234 abcd xyz'");
```

If the *string* argument is a named-program format, the `system()` function calls `program_name` with the parameters following “`PARM=`”, if any.

The two formats are supported under both MVS and TSO/E, but not all targets can be called from all environments. For example, TSO/E commands cannot be called in an MVS environment. As a result, the two formats are equivalent under the MVS environment, but are different under TSO/E. The details of each are provided below. For maximum portability when invoking executable modules under the different environments, use the named-program format.

If the specified executable module is a z/OS XL C or z/OS XL C++ module, full initialization and termination will be performed: including, but not limited to, automatic closing of files and releasing of fetched modules. In addition, if the ISO C/C++ `system()` call uses the named-program format under either MVS or TSO/E, or the command-line format under the MVS environment, information can be passed across the program boundary using memory files. Memory files are not removed until either the highest level (root) program in the call chain terminates or the `clrmemf()` function is used. Standard streams are also shared in this environment.

ISO C/C++ MVS considerations: Under the MVS environment, the ISO C/C++ `system()` function accepts either command-line or named-program format strings. However, the command-line string is restricted to specifying only executable modules (that is, TSO/E commands, EXECs, and CLISTs cannot be specified). Because of this restriction, both formats provide the same functionality.

In the case of either a command-line or named-program string, the ISO C/C++ `system()` function will search the usual MVS sources (STEPLIB/JOBLIB concatenation, Link Pack Area (LPA), Extended Link Pack Area (ELPA), and the link libraries) for the specified program name. The LINK SVC is used to give control to the program.

Under the MVS environment, using ATTACH instead of ISO C/C++ `system()` will prevent you from sharing memory files or standard streams between the programs.

ISO C/C++ TSO/E considerations: Under TSO/E, the ISO C/C++ `system()` function accepts either command-line or named-program format strings.

Command-line format strings are presented to the TSO/E command processor and can be used to execute user modules, TSO/E commands, EXECs or CLISTs. If there is any ambiguity as to what is to be run when a command-line format string is supplied, the hierarchy is:

1. TSO/E command or user module
2. CLIST or EXEC

Therefore, if a command-line format string is used and a CLIST or EXEC exists with the same name as a TSO/E command or user module, the TSO/E EXEC command must be used to specifically invoke the CLIST or EXEC.

If the command-line format string is used to call a user module, it effectively uses ATTACH to execute the program. As with MVS, when using ATTACH, memory files and standard streams are not shared between the programs. This is the reason that named-program format strings should be used for maximum portability. The named-program format provides the same memory file and standard stream sharing in both the MVS and TSO/E environments.

Notes:

1. If an executable module is placed in the STEPLIB or ISPLLIB (under ISPF), TSO/E will allow the module to be activated as a command. Recall from the discussion above, that, if a CLIST or EXEC has the same name, the module would be activated first, due to the hierarchy rules. Activating a module as a command involves a different input interface. If required, you can use the CALL command to activate a module that is not prepared to take the TSO/E command input format. z/OS XL C and z/OS XL C++ modules can be called as TSO/E commands.
2. A module that exists in the Link Pack Area (LPA) or Extended Link Pack Area (ELPA) and not in the STEPLIB concatenation (ISPLLIB on ISPF) will not be activated as a TSO/E command, and is treated as an executable module.

Named-program format strings are not presented to the TSO/E command processor and can only be used to execute user modules.

POSIX system() function: Using the POSIX system() function, you can call z/OS UNIX services shell programs. You cannot use the POSIX system() function to call commands, EXECs, CLISTs, or executable modules under the MVS environment and TSO/E.

The POSIX system() function passes *string* to the **sh** shell command for execution. The environment is established by the runtime library through a spawn() of the shell.

The POSIX system() function ignores the SIGINT and SIGQUIT signals, and blocks the SIGCHLD signal while it waits for the command specified by *string* argument to end.

Special considerations for POSIX C: The system() function has these additional considerations:

- A program running with POSIX(ON) can call another program that will also use POSIX(ON) only if the calling program uses the POSIX system() function to invoke the called program out of the shell. Using the ISO C/C++ system() function to call a program that will also use POSIX(ON) will result in message CEE3648S being issued, followed by ABENDU4093-AC.
- A program running with POSIX(ON) can receive signals other than SIGINT, SIGQUIT, or SIGCHLD while the POSIX system() function is waiting for the shell command to complete. If there is a signal catcher registered for the signal, it will be invoked immediately. If the signal catcher calls siglongjmp() or setcontext() to pass control back to the application, the SIGINT and SIGQUIT signals will remain ignored, and the SIGCHLD signal will remain blocked.
- If the calling program is the child of a forked process, it cannot use the ISO C/C++ system() function to run TSO/E commands since the TSO/E address space is not available.
- If the calling program was invoked using one of the exec or spawn functions, it cannot use the ISO C/C++ system() function to run TSO/E commands since the TSO/E address space is not available.
- The system() function is not thread-safe. It cannot be called simultaneously from more than one thread. A multithreaded application must ensure that no more than one system() call is ever outstanding from the various threads. Results are undefined if this restriction is violated..
- When using a signal handler and setting the default handler for SIGCHLD to be SIG_IGN, an errno value of ECHILD will be returned. This is due to the speed at which the process executes and finishes before system() can call waitpid() to wait for the child process to end. In this case, the ECHILD can be ignored because the process has already completed successfully and returned.

Note: If an application invokes a z/OS UNIX service shell command or utility that performs terminal I/O, the command may fail due to the z/OS UNIX services shell file descriptors not being initialized. z/OS UNIX files for terminal I/O must be defined. An example of how these can be defined in a C application are as follows:

```
stdin = fopen("/tmp/sys.stdin","r");
stdout = fopen("/tmp/sys.stdout","w");
stderr = fopen("/tmp/sys.stderr","w");
```

See z/OS XL C/C++ applications with z/OS UNIX System Services C functions in topic 1.9 for more information about using POSIX support.

Mixed environments across an ISO C/C++ system() call: The mixing of z/OS Language Environment, C/370 Library Version 1 or Version 2, and System Programming C (SPC) environments across a system() call is not supported. Whichever of these environments is active when the first system() call is made is the only one that is tolerated in the system() call chain. Results are undefined if this restriction is violated.

Returned value

If the *string* argument is a NULL pointer, the system() function returns nonzero if a command processor exists, or 0 if one does not exist.

ISO C/C++ MVS considerations: The returned value from ISO C/C++ system() will be that from the user module, if successfully called. If system() cannot call the specified module, the returned value is -1 and errno is set appropriately.

ISO C/C++ TSO/E considerations: The returned value from ISO C/C++ `system()` will be nonzero if the command processor cannot execute the command or user module. The macros `__abendcode` and `__rsncode` will contain the abend code and reason code from a failing TSO/E command, EXEC, or CLIST.

POSIX considerations: If the *string* argument is a NULL pointer, the POSIX `system()` function returns nonzero. If the *string* argument is not NULL, the POSIX `system()` function returns the termination status of the command language interpreter in the format specified by `waitpid()`. If a child process cannot be created, or if the termination status for the command language interpreter cannot be obtained, `system()` returns -1.

Note: When using a signal handler and setting the default handler for SIGCHLD to be SIG_IGN, an `errno` value of ECHILD will be returned. This is due to the speed at which the process executes and finishes before `system()` can call `waitpid()` to wait for the child process to end. In this case, the ECHILD can be ignored because the process has already completed successfully and returned.

If `system()` returns -1, `errno` may be set to one of the following:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EAGAIN

There are insufficient resources to create another process, or the maximum number of processes you can run has been reached.

ECHILD

The new process finished before `system()` could call `waitpid()` to wait for the child process to end. This error can be ignored because the child process has already completed successfully and returned.

ENOMEM

The process requires more space than is available.

ENOSYS

The ISO C/C++ `system()` function was requested from an AMODE 64 application.

Example

```
/* This example illustrates how to use system() to execute a command which
   returns the time. The example works only under TSO.
   */
#include <stdlib.h>

int main(void)
{
    int rc;
    rc = system("time");
    exit(0);
}
```

```
/* This example may only be used in a POSIX program. */
#include <stdlib.h>

int main(void)
{
    int result;

    result = system("date | tee result.log");
}
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“clrmemf\(\) — Clear memory files” on page 298](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)

t_accept() – Accept a connect request

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_accept(int fd, int resfd, struct t_call *call);
```

General description

t_accept() is issued by a transport user to accept a connect request. The parameter *fd* identifies the local transport endpoint where the connect indication arrived. *resfd* specifies the local transport endpoint where the connection is to be established, and *call* contains information required by the transport provider to complete the connection. The parameter *call* points to a *t_call* structure which contains the following members:

```
struct netbuf  addr;
struct netbuf  opt;
struct netbuf  udata;
int            sequence;
```

In *call*, *addr* is the protocol address of the calling transport user. *opt* indicates any options associated with the connection. *udata* points to any user data to be returned to the caller, and *sequence* is the value returned by t_listen() that uniquely associates the response with a previously received connect indication. The address of the caller, *addr* may be NULL (length zero). Where *addr* is not NULL, then it may optionally be checked by XTI.

A transport user may accept a connection on either the same, or on a different, local transport endpoint than the one on which the connect indication arrived. Before the connection can be accepted on the same endpoint (*resfd*==*fd*), the user must have responded to any previous connect indications received on that transport endpoint (using t_accept() or t_snddis()). Otherwise, t_accept() fails and sets *t_errno* to TINDOUT.

If a different transport endpoint is specified (*resfd*!=*fd*), then the user may or may not choose to bind the endpoint before the t_accept() is issued. If the endpoint is not bound before the t_accept() , then the transport provider will automatically bind it to the same protocol address *fd* is bound to. If the transport user chooses to bind the endpoint it must be bound to a protocol address with a *qlen* of zero and must be in the T_IDLE state before the t_accept() is issued.

The call to t_accept() will fail with *t_errno* set to TLOOK if there are indications (for example, connect or disconnect) waiting to be received on the endpoint *fd*.

Return of user data over a connection accept is not supported under TCP, so the *udata* field is always meaningless.

When the user does not indicate any option (*call->opt.len* == 0) it is assumed that the connection is to be accepted unconditionally. The transport provider may choose options other than the defaults to ensure that the connection is accepted successfully.

Due to implementation restrictions, behavior is undefined if a different process accepts a connection pending on an endpoint than obtained it (with t_listen).

Valid states: *fd*: T_INCON *resfd* (*fd*!=*resfd*): T_IDLE

Returned value

If successful, `t_accept()` returns 0.

If unsuccessful, `t_accept()` returns -1 and sets `t_errno` to one of the following values:

Error Code

Description

TACCES

The user does not have permission to accept a connection on the responding transport endpoint or to use the specified options.

TBADADDR

The specified protocol address was in an incorrect format or contained illegal information.

TBADDATA

The amount of user data specified was not within the bounds allowed by the transport provider.

TBADF

The file descriptor *fd* or *resfd* does not refer to a transport endpoint.

TBADOPT

The specified options were in an incorrect format or contained illegal information.

TBADSEQ

An invalid sequence number was specified.

TINDOUT

The function was called with *fd*==*resfd* but there are outstanding connection indications on the endpoint. Those other connection indications must be handled either by rejecting them using `t_snddis` (3) or accepting them on a different endpoint using `t_accept` (3).

TLOOK

An asynchronous event has occurred on the transport endpoint referenced by *fd* and requires immediate attention.

TNOTSUPPORT

This function is not supported by the underlying transport provider.

TOUTSTATE

The function was called in the wrong sequence on the transport endpoint referenced by *fd*, or the transport endpoint referred to by *resfd* is not in the appropriate state.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TPROVMISMATCH

The file descriptors *fd* and *resfd* do not refer to the same transport provider.

TRESADDR

This transport provider requires both *fd* and *resfd* to be bound to the same address. This error results if they are not.

TRESQLEN

The endpoint referenced by *resfd* (where *resfd* != *fd*) was bound to a protocol address with a *qlen* that is greater than 0.

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_connect\(\) — Establish a connection with another transport user” on page 1830](#)
- [“t_getstate\(\) — Get the current state” on page 1864](#)
- [“t_listen\(\) — Listen for a connect indication” on page 1870](#)

- [“t_open\(\) — Establish a transport endpoint”](#) on page 1884
- [“t_optmgmt\(\) — Manage options for a transport endpoint”](#) on page 1886
- [“t_rcvconnect\(\) — Receive the confirmation from a connect request”](#) on page 1894

takesocket() — Acquire a socket from another program

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS SOCK_EXT
#include <sys/types.h>
#include <socket.h>

int takesocket(struct clientid *clientid, int sdesc);
```

General description

The takesocket() function acquires a socket from another program. Typically, the other program passes its client ID and socket descriptor, and/or process id (PID), to your program through your program's startup parameter list.

Parameter

Description

clientid

A pointer to the *clientid* of the application from which you are taking a socket.

sdesc

The descriptor of the socket to be taken.

If your program is using the PID to ensure integrity between givesocket() and takesocket(), before issuing the takesocket() call, your program should set the *c_pid.pid* field of the clientid structure to the PID of the giving program (that is, program that issued the givesocket() call). This identifies the process from which the socket is to be taken. If the *c_reserved.type* field of the clientid structure was set to SO_CLOSE on the givesocket() call, *c_close.SockToken* of clientid structure should be used as input to takesocket() instead of the normal socket descriptor. See [“givesocket\(\) — Make the specified socket available”](#) on page 805 for a description of the clientid structure.

Returned value

If successful, takesocket() returns the new socket descriptor.

If unsuccessful, takesocket() returns -1 and sets errno to one of the following values:

Error Code

Description

EACCES

The other application did not give the socket to your application.

EBADF

The *sdesc* parameter does not specify a valid socket descriptor owned by the other application, or the socket has already been taken.

EFAULT

Using the *clientid* parameter as specified would result in an attempt to access storage outside the caller's address space.

EINVAL

The *clientid* parameter does not specify a valid client identifier. Either the client process cannot be found, or the client exists, but has no outstanding givesockets.

EMFILE

The socket descriptor table is already full.

Related information

- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“getclientid\(\) — Get the identifier for the calling application” on page 692](#)
- [“__getclientid\(\) — Get the PID identifier for the calling application” on page 693](#)
- [“givesocket\(\) — Make the specified socket available” on page 805](#)

t_alloc() — Allocate a library structure

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

char *t_alloc(int fd, int struct_type, int fields);
```

General description

Dynamically allocates memory for the various transport function argument structures as specified below. `t_alloc()` allocates memory for the specified structure, and memory for buffers referenced by the structure.

The structure to allocate is specified by *struct_type* and must be one of the following:

| | |
|------------|-------------------|
| T_BIND | struct t_bind |
| T_CALL | struct t_call |
| T_OPTMGMT | struct t_optmgmt |
| T_DIS | struct t_discon |
| T_UNITDATA | struct t_unitdata |
| T_UDERROR | struct t_uderr |
| T_INFO | struct t_info |

where each of these structures may subsequently be used as an argument to one or more transport functions.

Each of the above structures, except `T_INFO`, contains at least one field of type `struct netbuf`. For each field of this type, the user may specify that the buffer for that field should be allocated as well. The length of the buffer allocated will be equal to or greater than the appropriate size as returned in the *info* argument of `t_open()` or `t_getinfo()`. The relevant fields of the *info* argument are described in the following list. The *fields* argument specifies which buffers to allocate, where the argument is the bitwise OR of any of the following:

T_ADDR

The *addr* field of the `t_bind`, `t_call`, `t_unitdata` or `t_uderr` structures.

T_OPT

The *opt* field of the `t_optmgmt`, `t_call`, `t_unitdata` or `t_uderr` structures.

T_UDATA

The *udata* field of the *t_call*, *t_discon* or *t_unitdata* structures.

T_ALL

All relevant fields of the given structure. Fields which are not supported by the transport provider specified by *fd* will not be allocated.

For each relevant field specified in *fields*, *t_alloc()* allocates memory for the buffer associated with the field, and initializes the *len* field to zero and the *buf* pointer and *maxlen* field accordingly. Irrelevant or unknown values passed in fields are ignored. Since the length of the buffer allocated will be based on the same size information that is returned to the user on a call to *t_open()* and *t_getinfo()*, *fd* must refer to the transport endpoint through which the newly allocated structure will be passed. In this way the appropriate size information can be accessed. If the size value associated with any specified field is -1 or -2 (see *t_open()* or *t_getinfo()*), *t_alloc()* will be unable to determine the size of the buffer to allocate and will fail, setting *t_errno* to *TSYSERR* and *errno* to *EINVAL*. For any field not specified in *fields*, *buf* will be set to the NULL pointer and *len* and *maxlen* will be set to zero.

Use of *t_alloc()* to allocate structures helps ensure the compatibility of user programs with future releases of the transport interface functions.

Valid states: All - except for *T_UNINIT*

Returned value

If successful, *t_alloc()* returns a pointer to the newly allocated structure.

If unsuccessful, *t_alloc()* returns a NULL pointer and sets *errno* to one of the following values:

Error Code**Description****TBADF**

The specified file descriptor does not refer to a transport endpoint.

TNOSTRUCTYPE

Unsupported *struct_type* requested. This can include a request for a structure type which is inconsistent with the transport provider type specified, that is, connection-oriented or connectionless.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_free\(\) — Free a library structure” on page 1859](#)
- [“t_getinfo\(\) — Get protocol-specific service information” on page 1862](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)

tan(), tanf(), tanl() – Calculate tangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double tan(double x);
float tan(float x);           /* C++ only */
long double tan(long double x); /* C++ only */
float tanf(float x);
long double tanl(long double x);
```

General description

Calculates the tangent of x , where x is expressed in radians. If x is large, a partial loss of significance in the result can occur.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

Returns the calculated tangent of x .

If the correct value would cause an underflow, 0 is returned. If the result overflows, $\pm\text{HUGE_VAL}$ is returned. For both an underflow and an overflow, the value `ERANGE` is stored in `errno`.

Special behavior for XPG4.2: The following error is added:

Error Code

Description

EDOM

The argument exceeded an internal limit for the function (approximately 2^{50}).

Example

CELEBT01

```
/* CELEBT01
   This example computes x as the tangent of PI/4.
*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double pi, x;

    pi = 3.1415926;
    x = tan(pi/4.0);
```

```
printf("tan( %lf ) is %lf\n", pi/4, x);
}
```

Output

```
tan( 0.785398 ) is 1.000000
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“atanh\(\), atanhf\(\), atanhhl\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)
- [“sinh\(\), sinh\(\), sinhl\(\) — Calculate hyperbolic sine” on page 1664](#)
- [“tanh\(\), tanhf\(\), tanhl\(\) — Calculate hyperbolic tangent” on page 1812](#)

tand32(), tand64(), tand128() - Calculate tangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 tand32(_Decimal32 x);
_Decimal64 tand64(_Decimal64 x);
_Decimal128 tand128(_Decimal128 x);
_Decimal32 tan(_Decimal32 x); /* C++ only */
_Decimal64 tan(_Decimal64 x); /* C++ only */
_Decimal128 tan(_Decimal128 x); /* C++ only */
```

General description

Calculates the tangent of *x*, where *x* is expressed in radians. If *x* is large, a partial loss of significance in the result can occur.

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

Returns the calculated tangent of *x*.

If the correct value would cause underflow, zero is returned. If the result overflows, $\pm\text{HUGE_VAL_D32}$, $\pm\text{HUGE_VAL_D64}$, or $\pm\text{HUGE_VAL_D128}$ is returned. For both underflow and overflow, the value `ERANGE` is stored in `errno`.

Example

CELEBT22

```
/* CELEBT22

   This example illustrates the tand64() function.

   This example computes x as the tangent of PI/4.

*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 pi, x;

    pi = 3.1415926DD;
    x = tand64(pi/4.0DD);

    printf("tand64( %Df ) is %Df\n", pi/4.0DD, x);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“atanh\(\), atanhf\(\), atanh128\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“acosd32\(\), acosd64\(\), acosd128\(\) - Calculate arccosine” on page 139](#)
- [“acoshd32\(\), acoshd64\(\), acoshd128\(\) - Calculate hyperbolic arccosine” on page 142](#)
- [“asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine” on page 184](#)
- [“asinh32\(\), asinh64\(\), asinh128\(\) - Calculate hyperbolic arcsine” on page 187](#)
- [“atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent” on page 192](#)
- [“atanhd32\(\), atanh64\(\), atanh128\(\) - Calculate hyperbolic arctangent” on page 195](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“coshd32\(\), coshd64\(\), coshd128\(\) - Calculate hyperbolic cosine” on page 334](#)
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine” on page 1663](#)
- [“sinhd32\(\), sinhd64\(\), sinhd128\(\) - Calculate hyperbolic sine” on page 1666](#)
- [“tanh32\(\), tanhd64\(\), tanhd128\(\) - Calculate hyperbolic tangent” on page 1813](#)

tanh(), tanhf(), tanhl() – Calculate hyperbolic tangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 ISO/ANSI C++ C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | |

Format

```
#include <math.h>

double tanh(double x);
float tanh(float x);           /* C++ only */
long double tanh(long double x); /* C++ only */
float tanhf(float x);
long double tanhl(long double x);
```

General description

Calculates the hyperbolic tangent of x , where x is expressed in radians. The result of the function cannot have a range error.

Note: These functions work in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point” on page 97](#) for more information about IEEE Binary Floating-Point.

Returned value

Returns the calculated value of the hyperbolic tangent of x .

If the result underflows, the function returns 0 and sets the `errno` to `ERANGE`.

Example

CELEBT02

```
/* CELEBT02

   This example computes x as the hyperbolic tangent of PI/4.

*/
#define _POSIX_SOURCE
#include <math.h>
#include <stdio.h>

int main(void)
{
    double pi, x;

    pi = 3.1415926;
    x = tanh(pi/4);

    printf("tanh( %lf ) = %lf\n", pi/4, x);
}
```

Output

```
tanh( 0.785398 ) = 0.655794
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“acos\(\), acosf\(\), acosl\(\) — Calculate arccosine” on page 137](#)
- [“acosh\(\), acoshf\(\), acoshl\(\) — Calculate hyperbolic arccosine” on page 140](#)
- [“asin\(\), asinf\(\), asinl\(\) — Calculate arcsine” on page 183](#)
- [“asinh\(\), asinhf\(\), asinhl\(\) — Calculate hyperbolic arcsine” on page 186](#)
- [“atan\(\), atanf\(\), atanl\(\), atan2\(\), atan2f\(\), atan2l\(\) — Calculate arctangent” on page 191](#)
- [“atanh\(\), atanhf\(\), atanh1\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“cos\(\), cosf\(\), cosl\(\) — Calculate cosine” on page 330](#)
- [“cosh\(\), coshf\(\), coshl\(\) — Calculate hyperbolic cosine” on page 333](#)
- [“sin\(\), sinf\(\), sinl\(\) — Calculate sine” on page 1662](#)
- [“sinh\(\), sinhf\(\), sinhl\(\) — Calculate hyperbolic sine” on page 1664](#)
- [“tan\(\), tanf\(\), tanl\(\) — Calculate tangent” on page 1809](#)

tanh32(), tanh64(), tanh128() - Calculate hyperbolic tangent

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 tanh32(_Decimal32 x);
_Decimal64 tanh64(_Decimal64 x);
_Decimal128 tanh128(_Decimal128 x);
_Decimal32 tanh(_Decimal32 x); /* C++ only */
_Decimal64 tanh(_Decimal64 x); /* C++ only */
_Decimal128 tanh(_Decimal128 x); /* C++ only */
```

General description

Calculates the hyperbolic tangent of x , where x is expressed in radians.

Returned value

Returns the calculated value of the hyperbolic tangent of x .

If the result underflows, the function returns 0 and sets the `errno` to `ERANGE`.

Example

CELEBT23

```
/* CELEBT23
   This example illustrates the tanh64() function.
   This example computes x as the hyperbolic tangent of PI/4.
*/
#define __STDC_WANT_DEC_FP__
```

t_bind

```
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal64 pi, x;

    pi = 3.1415926DD;
    x = tanhd64(pi/4.0DD);

    printf("tanh64( %Df ) = %Df\n", pi/4.0DD, x);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“atanh\(\), atanhf\(\), atanhf\(\) — Calculate hyperbolic arctangent” on page 194](#)
- [“acosd32\(\), acosd64\(\), acosd128\(\) - Calculate arccosine” on page 139](#)
- [“acoshd32\(\), acoshd64\(\), acoshd128\(\) - Calculate hyperbolic arccosine” on page 142](#)
- [“asind32\(\), asind64\(\), asind128\(\) - Calculate arcsine” on page 184](#)
- [“asinh32\(\), asinh64\(\), asinh128\(\) - Calculate hyperbolic arcsine” on page 187](#)
- [“atand32\(\), atand64\(\), atand128\(\), atan2d32\(\), atan2d64\(\), atan2d128\(\) - Calculate arctangent” on page 192](#)
- [“atanhd32\(\), atanh64\(\), atanh128\(\) - Calculate hyperbolic arctangent” on page 195](#)
- [“cosd32\(\), cosd64\(\), cosd128\(\) — Calculate cosine” on page 332](#)
- [“coshd32\(\), coshd64\(\), coshd128\(\) - Calculate hyperbolic cosine” on page 334](#)
- [“sind32\(\), sind64\(\), sind128\(\) — Calculate sine” on page 1663](#)
- [“sinhd32\(\), sinhd64\(\), sinhd128\(\) - Calculate hyperbolic sine” on page 1666](#)
- [“tand32\(\), tand64\(\), tand128\(\) - Calculate tangent” on page 1810](#)

t_bind() — Bind an address to a transport endpoint

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_bind(int fd, struct t_bind *req, struct t_bind *ret);
```

General description

Associates a protocol address with the transport endpoint specified by *fd* and activates that transport endpoint. In connection mode, the transport provider may begin enqueueing incoming connect indications, or servicing a connection request on the transport endpoint. In connectionless mode, the transport user may send or receive data units through the transport endpoint.

The *req* and *ret* arguments point to a `t_bind` structure containing the following members:

```
struct netbuf    addr;
unsigned         qlen;
```


The *addr* field of the `t_bind` structure specifies a protocol address, and the *qlen* field is used to indicate the maximum number of outstanding connect indications.

The parameter *req* is used to request that an address, represented by the `netbuf` structure, be bound to the given transport endpoint. The parameter *len* specifies the number of bytes in the address, and *buf* points to the address buffer. The parameter *maxlen* has no meaning for the *req* argument. On return, *ret* contains the address that the transport provider actually bound to the transport endpoint. This is the same as the address specified by the user in *req*. In *ret*, the user specifies *maxlen*, which is the maximum size of the address buffer, and *buf* which points to the buffer where the address is to be placed. On return, *len* specifies the number of bytes in the bound address, and *buf* points to the bound address. If *maxlen* is not large enough to hold the returned address, an error results.

If the requested address is not available, `t_bind()` returns -1 with *t_errno* set as appropriate. If no address is specified in *req* (the *len* field of *addr* in *req* is zero or *req* is NULL), the transport provider will assign an appropriate address to be bound, and will return that address in the *addr* field of *ret*. If the transport provider could not allocate an address, `t_bind()` fails with *t_errno* set to `TNOADDR`.

The parameter *req* may be a NULL pointer if the user does not wish to specify an address to be bound. Here, the value of *qlen* is assumed to be zero, and the transport provider assigns an address to the transport endpoint. Similarly, *ret* may be a NULL pointer if the user does not care what address was bound by the provider and is not interested in the negotiated value of *qlen*. It is valid to set *req* and *ret* to the NULL pointer for the same call, in which case the provider chooses the address to bind to the transport endpoint and does not return that information to the user.

The *qlen* field specifies the number of outstanding connect indications that the transport provider should support for the given transport endpoint. An outstanding connect indication is one that has been passed to the transport user by the transport provider, but which has not been accepted or rejected. A value of *qlen* greater than 0 is only meaningful when issued by a passive transport user that expects other users to call it. The value of *qlen* will be negotiated by the transport provider and will always be negotiated to 1 (one) from any nonzero value. On return, the *qlen* field in *ret* will contain the negotiated value.

If *fd* refers to a connection-oriented service, then multiple endpoints may be bound to the same protocol address by way of connections accepted on an endpoint using `t_accept`. The TCP transport provider will not permit the user to explicitly bind multiple endpoints to the same address. It is also not possible to bind an endpoint to more than one protocol address. If a user attempts to explicitly bind multiple endpoints to a protocol address, the second and subsequent binds will fail with *t_errno* set to `TADDRBUSY`. When a user accepts a connection on the transport endpoint that is being used as the listening endpoint, the bound protocol address will be found to be busy for the duration of the connection, until a `t_unbind()` or `t_close()` call has been issued. No other transport endpoints may be bound for listening on that same protocol address while that initial listening endpoint is active (in the data transfer phase or in the `T_IDLE` state). This prevents more than one transport endpoint bound to the same protocol address from accepting connect indications.

Valid states: `T_UNBND`

Returned value

If successful, `t_bind()` returns 0.

If unsuccessful, `t_bind()` returns -1 and sets *errno* to one of the following values:

Error Code

Description

TACCES

The user does not have permission to use the specified address.

TADDRBUSY

The requested address is in use.

TBADADDR

The specified protocol address was in an incorrect format or contained illegal information.

TBADF

The specified file descriptor does not refer to a transport endpoint.

TBUFOVFLW

The number of bytes allowed for an incoming argument (*maxlen*) is greater than 0 but not sufficient to store the value of that argument. The provider's state will change to T_IDLE and the information to be returned in *ret* will be discarded.

TNOADDR

The transport provider could not allocate an address.

TOUTSTATE

The function was issued in the wrong sequence.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_alloc\(\) — Allocate a library structure” on page 1807](#)
- [“t_close\(\) — Close a transport endpoint” on page 1829](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_optmgmt\(\) — Manage options for a transport endpoint” on page 1886](#)
- [“t_unbind\(\) — Disable a transport endpoint” on page 1916](#)

tcdrain() — Wait until output has been transmitted

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

int tcdrain(int fildes);
```

General description

The tcdrain() function waits until all output sent to *fildes* has actually been sent to the terminal device. If tcdrain() is called from a background process group against the caller's controlling terminal, a SIGTTOU signal may be generated depending how the process is handling SIGTTOUs:

| Processing for SIGTTOU System Behavior | |
|--|---|
| Default or signal handler | The SIGTTOU signal is generated, and the function is not performed. tcdrain() returns -1 and sets errno to EINTR. |

Processing for SIGTTOU System Behavior

| | |
|--------------------|--|
| Ignored or blocked | The SIGTTOU signal is not sent, and the function continues normally. |
|--------------------|--|

Returned value

If successful, `tcdrain()` returns 0.

If unsuccessful, `tcdrain()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EBADF**

fildev is not a valid open file descriptor.

EINTR

A signal interrupted `tcdrain()`.

EIO

The process group of the process issuing the function is an orphaned, background process group, and the process issuing the function is not ignoring or blocking SIGTTOU.

ENOTTY

fildev is not associated with a terminal.

Example**CELEBT03**

```
/* CELEBT03 */

#define _POSIX_SOURCE
#include <termios.h>
#include <stdio.h>
#include <time.h>
#include <fcntl.h>
#include <unistd.h>
#include <sys/stat.h>
#include <string.h>

main() {
    char Manager[]="manager.tty";
    char Subsidiary[]="subsidiary.tty";
    char text[]="text to be written to tty";
    char data[80];
    int manager, subsidiary;
    time_t T;

    if (mknod(Manager, S_IFCHR|S_IRUSR|S_IWUSR, 0x00010000 + 10) !=0)
        perror("mknod() error for manager tty");
    else {
        if (mknod(Subsidiary, S_IFCHR|S_IRUSR|S_IWUSR, 0x00020000 + 10) !=0)
            perror("mknod() error for subsidiary tty");
        else {
            if ((manager = open(Manager, O_RDWR|O_NONBLOCK)) < 0)
                perror("open() error for manager tty");
            else {
                if ((subsidiary = open(Subsidiary, O_RDWR|O_NONBLOCK)) < 0)
                    perror("open() error for subsidiary tty");
                else {
                    if (fork() == 0) {
                        if (write(subsidiary, text, strlen(text)+1) == -1)
                            perror("write() error");
                        time(&T);
                        printf("child has written to tty, tcdrain() started at %s",
                               ctime(&T));
                        if (tcdrain(subsidiary) != 0)
                            perror("tcdrain() error");
                        time(&T);
                        printf("tcdrain() returned at %s", ctime(&T));
                        exit(0);
                    }
                    time(&T);
                }
            }
        }
    }
}
```

```
        printf("parent is starting nap at %s", ctime(&T));
        sleep(5);
        time(&T);
        printf("parent is done with nap at %s", ctime(&T));
        if (read(manager, data, sizeof(data)) == -1)
            perror("read() error");
        else printf("read '%s' from the tty\n", data);
        sleep(5);
        close(subsidiary);
    }
    close(manager);
}
unlink(Subsidiary);
}
unlink(Manager);
}
}
```

Output

```
parent is starting nap at Fri Jun 16 12:46:28 2006
child has written to tty, tcdrain() started at Fri Jun 16 12:46:28 2006
parent is done with nap at Fri Jun 16 12:46:34 2006
read 'text to be written to tty' from the tty
tcdrain() returned at Fri Jun 16 12:46:34 2006
```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“tcflow\(\) — Suspend or resume data flow on a terminal” on page 1818](#)
- [“tcflush\(\) — Flush input or output on a terminal” on page 1821](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcgetpgrp\(\) — Get the foreground process group ID” on page 1827](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)
- [“tcsendbreak\(\) — Send a break condition to a terminal” on page 1833](#)
- [“tcsetpgrp\(\) — Set the foreground process group ID” on page 1847](#)

tcflow() — Suspend or resume data flow on a terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

int tcflow(int fildes, int action);
```

General description

Suspends or resumes transmission or reception of data on a terminal device.

int fildes

A file descriptor associated with a terminal device.

int action

Indicates the action you want to perform, represented by one of the following symbols defined in the `termios.h` include file:

Symbol**Meaning****TCOOFF**

Suspends output.

TCOON

Resumes suspended output.

TCIOFF

Sends a STOP character to the terminal, to stop the terminal from sending any further input.

TCION

Sends a START character to the terminal, to tell the terminal that it can resume sending input.

If `tcflow()` is called from a background process group against the caller's controlling terminal, a SIGTTOU signal may be generated depending how the process is handling SIGTTOUs:

| Processing for SIGTTOU System Behavior | |
|--|--|
| Default or signal handler | The SIGTTOU signal is generated, and the function is not performed. <code>tcflow()</code> returns -1 and sets <code>errno</code> to <code>EINTR</code> . |
| Ignored or blocked | The SIGTTOU signal is not sent, and the function continues normally. |

Returned value

If successful, `tcflow()` returns 0.

If unsuccessful, `tcflow()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EBADF**

fildev is not a valid open file descriptor.

EINTR

A signal interrupted `tcflow()`.

EINVAL

action had an incorrect value.

EIO

For either of the following reasons:

- TCIOFF or TCION was requested, but the other side of the pseudoterminal connection is closed.
- The process group of the process issuing the function is an orphaned, background process group, and the process issuing the function is not ignoring or blocking SIGTTOU.

ENOTTY

fildev is not associated with a terminal.

Example**CELEBT04**

```
/* CELEBT04
   This example suspends and then resumes transmission.
*/
#define _POSIX_SOURCE
#include <termios.h>
#include <stdio.h>
```

```

#include <fcntl.h>
#include <unistd.h>
#include <sys/stat.h>
#include <string.h>

main() {
    char Manager[]="/dev/ptyp0010";
    char Subsidiary[]="/dev/ttyp0010";
    char text[]="text to be written to tty";
    char data[80];
    int manager, subsidiary;

    if ((manager = open(Manager, O_RDWR|O_NONBLOCK)) < 0) {
        perror("open() error for manager tty");
        exit(1);
    }
    if ((subsidiary = open(Subsidiary, O_RDWR|O_NONBLOCK)) < 0) {
        perror("open() error for subsidiary tty");
        exit(1);
    }

    if (write(subsidiary, text, strlen(text)+1) == -1) {
        perror("write() error");
        exit(1);
    }
    puts("output is suspended to tty");
    if (read(manager, data, sizeof(data)) == -1)
        perror("read() error");
    else printf("read '%s' from the tty\n", data);
    if (tcflow(subsidiary, TCOON) != 0)
        perror("tcflow() error");
    exit(1);
}
puts("output is resumed to tty");
if (read(manager, data, sizeof(data)) == -1) {
    perror("read() error");
    exit(1);
}
printf("read '%s' from the tty\n", data);
close(subsidiary);
close(manager);
}

```

Output

```

output is suspended to tty
read() error: Resource temporarily unavailable
output is resumed to tty
read 'text to be written to tty' from the tty

```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“tcdrain\(\) — Wait until output has been transmitted” on page 1816](#)
- [“tcflush\(\) — Flush input or output on a terminal” on page 1821](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcgetpgrp\(\) — Get the foreground process group ID” on page 1827](#)
- [“tcsendbreak\(\) — Send a break condition to a terminal” on page 1833](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)
- [“tcsetpgrp\(\) — Set the foreground process group ID” on page 1847](#)

tcflush() – Flush input or output on a terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

int tcflush(int fildes, int where);
```

General description

Flushes input or output on a terminal.

int *fil*des;

Indicates a file descriptor associated with a terminal device.

int *where*;

Indicates whether the system is to flush input or output, represented by one of the following symbols defined in the `termios.h` header file.

Symbol

Meaning

TCIFLUSH

Flushes input data that has been received by the system but not read by an application.

TCOFLUSH

Flushes output data that has been written by an application but not sent to the terminal.

TCIOFLUSH

Flushes both input and output data.

If `tcflush()` is called from a background process group against the caller's controlling terminal, a SIGTTOU signal may be generated depending how the process is handling SIGTTOUs:

| Processing for SIGTTOU System Behavior | |
|--|---|
| Default or signal handler | The SIGTTOU signal is generated, and the function is not performed. <code>tcflush()</code> returns -1 and sets <code>errno</code> to <code>EINTR</code> . |
| Ignored or blocked | The SIGTTOU signal is not sent, and the function continues normally. |

Returned value

If successful, `tcflush()` returns 0.

If unsuccessful, `tcflush()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

*fil*des is not a valid open file descriptor.

EINTR

A signal interrupted `tcflush()`.

EINVAL

where has an incorrect value.

EIO

The process group of the process issuing the function is an orphaned, background process group, and the process issuing the function is not ignoring or blocking SIGTTOU.

ENOTTY

fildev is not associated with a terminal.

Example**CELEBT05**

```

/* CELEBT05

   This example flushes a string.

*/
#define _POSIX_SOURCE
#include <termios.h>
#include <stdio.h>
#include <fcntl.h>
#include <unistd.h>
#include <sys/stat.h>
#include <string.h>

main() {
    char Manager[]="manager.tty";
    char Subsidiary[]="subsidiary.tty";
    char text1[]="string that will be flushed from buffer";
    char text2[]="string that will not be flushed from buffer";
    char data[80];
    int manager, subsidiary;

    if (mknod(Manager, S_IFCHR|S_IRUSR|S_IWUSR, 0x00010000 + 10) != 0)
        perror("mknod() error for manager tty");
    else {
        if (mknod(Subsidiary, S_IFCHR|S_IRUSR|S_IWUSR, 0x00020000 + 10) != 0)
            perror("mknod() error for subsidiary tty");
        else {
            if ((manager = open(Manager, O_RDWR|O_NONBLOCK)) < 0)
                perror("open() error for manager tty");
            else {
                if ((subsidiary = open(Subsidiary, O_RDWR|O_NONBLOCK)) < 0)
                    perror("open() error for subsidiary tty");
                else {
                    if (write(subsidiary, text1, strlen(text1)+1) == -1)
                        perror("write() error");
                    else if (tcflush(subsidiary, TCOFLUSH) != 0)
                        perror("tcflush() error");
                    else {
                        puts("first string is written and tty flushed");
                        puts("now writing string that will not be flushed");
                        if (write(subsidiary, text2, strlen(text2)+1) == -1)
                            perror("write() error");
                        else if (read(manager, data, sizeof(data)) == -1)
                            perror("read() error");
                        else printf("read '%s' from the tty\n", data);
                    }
                }
                close(subsidiary);
            }
            close(manager);
        }
        unlink(Subsidiary);
    }
    unlink(Manager);
}

```

Output

```

first string is written and tty flushed
now writing string that will not be flushed
read 'string that will not be flushed from buffer' from the tty

```


Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“tcdrain\(\) — Wait until output has been transmitted” on page 1816](#)
- [“tcflow\(\) — Suspend or resume data flow on a terminal” on page 1818](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcgetpgrp\(\) — Get the foreground process group ID” on page 1827](#)
- [“tcsendbreak\(\) — Send a break condition to a terminal” on page 1833](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)
- [“tcsetpgrp\(\) — Set the foreground process group ID” on page 1847](#)

tcgetattr() — Get the attributes for a terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

int tcgetattr(int fildev, struct termios *termpptr);
```

General description

Gets a `termios` structure, which contains control information for a terminal associated with *fildev*. It stores that information in a memory location that *termpptr* points to. The contents of a `termios` structure are described in [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#).

`tcgetattr()` can run in either a foreground or background process; however, if the process is in the background, a foreground process may subsequently change the attributes.

`tcgetattr()` only works in an environment where either a controlling terminal exists, or `stdin` and `stderr` refer to tty devices. Specifically, it does not work in a TSO environment.

Note: The `tcgetattr()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, `tcgetattr()` returns 0.

If unsuccessful, `tcgetattr()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

fildev is not a valid open file descriptor.

ENOTTY

The file associated with *fildev* is not a terminal.

Example

CELEBT06

```

/* CELEBT06

   This example provides information about the attributes.

   */
#define _POSIX_SOURCE
#include <termios.h>
#include <stdio.h>
#include <unistd.h>

main() {
    struct termios term;

    if (tcgetattr(STDIN_FILENO, &term) != 0)
        perror("tcgetattr() error");
    else {
        if (term.c_iflag & BRKINT)
            puts("BRKINT is set");
        else
            puts("BRKINT is not set");
        if (term.c_cflag & PARODD)
            puts("Odd parity is used");
        else
            puts("Even parity is used");
        if (term.c_lflag & ECHO)
            puts("ECHO is set");
        else
            puts("ECHO is not set");
        printf("The end-of-file character is x'%02x'\n",
            term.c_cc[VEOF]);
    }
}

```

Output

```

ECHO is set
The End Of File character is x'37'

```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“cfgetispeed\(\) — Determine the input baud rate” on page 254](#)
- [“cfgetospeed\(\) — Determine the output baud rate” on page 256](#)
- [“cfsetispeed\(\) — Set the input baud rate in the termios” on page 258](#)
- [“cfsetospeed\(\) — Set the output baud rate in the termios” on page 260](#)
- [“tcdrain\(\) — Wait until output has been transmitted” on page 1816](#)
- [“tcflow\(\) — Suspend or resume data flow on a terminal” on page 1818](#)
- [“tcflush\(\) — Flush input or output on a terminal” on page 1821](#)
- [“tcgetpgrp\(\) — Get the foreground process group ID” on page 1827](#)
- [“tcsendbreak\(\) — Send a break condition to a terminal” on page 1833](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)
- [“tcsetpgrp\(\) — Set the foreground process group ID” on page 1847](#)

__tcgetcp() — Get terminal code page names

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_PTY_EXTENSIONS
#include <termios.h>

int __tcgetcp(int fildev, size_t termcplen, struct __termcp *termcp_ptr);
```

General description

The `__tcgetcp()` function gets the terminal session code page information contained in the `termcp` structure and the Code Page Change Notification (CPCN) capability for the terminal file.

The following arguments are used:

`fildev`

The file descriptor of the terminal for which you want to get the code page names and CPCN capability.

`termcplen`

The length of the passed `termcp` structure.

`termcp_ptr`

A pointer to a `__termcp` structure.

`__tcgetcp()` stores the `termcp` information in a memory location pointed to by *termcp_ptr*. The return value contains the CPCN capability. The following CPCN capabilities are defined:

Symbol

Meaning

`_CPCN_NAMES`

Forward code page names only

Use the `__tcsetcp()` function to change the terminal session data conversion. The z/OS UNIX pseudotty device driver supports this CPCN capability.

`_CPCN_TABLES`

Forward code page names and tables

Use `__tcsettables()` to change the terminal session data conversion. The OCS remote-tty device driver supports this CPCN capability.

In the returned `termcp` structure, if the `_TCCP_FASTP` bit is set then the data conversion that is specified by the source and target code page names can be performed locally by the data conversion application. This is valid any time that a table-driven conversion can be performed. For example, the data conversion point (application) could use the z/OS UNIX `iconv()` service to build local data conversion tables and perform all data conversion using the local tables instead of using `iconv()` all in subsequent conversions. This provides for better-performing data conversion.

In the returned `termcp` structure, if the `_TCCP_BINARY` bit is set then no data conversion is being performed and the code page names contained in the `termcp` structure should be ignored.

`__tcgetcp()` can run in either a foreground or background process; however, if the process is in the background, a foreground process may subsequently change the terminal code pages.

Note: The `__tcgetcp()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `__tcgetcp()` returns the `termcp` structure in a memory location pointed to by *termcp_ptr*. The return value contains the CPCN capability.

If unsuccessful, `__tcgetcp()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

fildev is not a valid open file descriptor.

EINVAL

The value of *termcplen* was invalid.

ENODEV

One of the following error conditions exist:

- The terminal device driver does not support CPCN functions.
- CPCN functions have not been enabled.

For a z/OS UNIX pseudotty terminal device file, issue the `__tcsetcp()` function against the manager pty first to enable CPCN support.

ENOTTY

The file associated with *fildev* is not a terminal device.

Example

The following example retrieves the current code pages used in the data conversion and CPCN capability. Here, the `__tcgetcp()` function is issued against a session using a pty terminal device; ISO8859-1 and IBM-1047 code pages are being used.

```
#define _OPEN_SYS_PTY_EXTENSIONS
#include <unistd.h>
#include <stdio.h>
#include <fcntl.h>
#include <termios.h>

void main(void)
{
    struct __termcp mytermcp;
    int rv;
    int cterm_fd;

    if ((cterm_fd = open("/dev/tty", O_RDWR)) == -1)
        printf("No controlling terminal established.\n");
    else {
        if ((rv = __tcgetcp(cterm_fd, sizeof(mytermcp), &mytermcp)) == -1)
            perror("__tcgetcp() error");
        else {
            if (_CPCN_NAMES == rv)
                printf("Forward Code Page Names Only.\n");
            else
                printf("Forward Code Page Names and Tables.\n");
            if (_TCCP_BINARY == (mytermcp.__tccp_flags & _TCCP_BINARY))
                printf("Binary mode is in effect.\n");
            else {
                printf("ASCII code page name is %s.\n",
                    mytermcp.__tccp_fromname);
                printf("EBCDIC code page name is %s.\n",
                    mytermcp.__tccp_toname);
            }
        }
        close(cterm_fd);
    }
} /* main */
```

Output

```
Forward code page names only.
ASCII code page name is ISO8859-1.
EBCDIC code page name is IBM-1047.
```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“__tcsetcp\(\) — Set terminal code page names” on page 1844](#)
- [“__tcsettables\(\) — Set terminal code page names and conversion tables” on page 1849](#)

tcgetpgrp() — Get the foreground process group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

pid_t tcgetpgrp(int fildev);
```

General description

Gets the process group ID (PGID) of the foreground process group associated with the terminal referred to by *fildev*. `tcgetpgrp()` can run from a background process, but the information may subsequently be changed by a process in the foreground process group.

Returned value

If successful, `tcgetpgrp()` returns of the foreground process group's PGID.

If unsuccessful, `tcgetpgrp()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

fildev is not a valid open file descriptor.

ENOTTY

The calling process does not have a controlling terminal, or the file is not the controlling terminal.

Example

CELEBT07

```
/* CELEBT07
   This example gets the foreground PGID.
*/
#define _POSIX_SOURCE
#include <termios.h>
```

```
#include <unistd.h>
#include <sys/wait.h>      /*FIX: was #include <sys/wait.h> */
#include <stdio.h>

main() {
    pid_t pid;

    if ((pid = tcgetpgrp(STDOUT_FILENO)) < 0)
        perror("tcgetpgrp() error");
    else
        printf("the foreground process group id of stdout is %d\n",
               (int) pid);
}
```

Output

```
the foreground process group id of stdout is 4063240
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“setpgid\(\) — Set process group ID for job control” on page 1560](#)
- [“setsid\(\) — Create session, set process group ID” on page 1571](#)
- [“tcdrain\(\) — Wait until output has been transmitted” on page 1816](#)
- [“tcflow\(\) — Suspend or resume data flow on a terminal” on page 1818](#)
- [“tcflush\(\) — Flush input or output on a terminal” on page 1821](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcsendbreak\(\) — Send a break condition to a terminal” on page 1833](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)
- [“tcsetpgrp\(\) — Set the foreground process group ID” on page 1847](#)

tcgetsid() — Get process group ID for session leader for controlling terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <termios.h>

pid_t tcgetsid(int fildev);
```

General description

The `tcgetsid()` obtains the process group ID of the session for which the terminal specified by *fildev* is the controlling terminal.

Returned value

If successful, `tcgetsid()` returns the process group ID associated with the terminal.

If unsuccessful, `tcgetsid()` returns `(pid_t)-1` and sets `errno` to one of the following values:

Error Code Description

EACCES

The *fildev* argument is not associated with a controlling terminal. If the environment variable `_EDC_SUSV3` is set to 1, `ENOTTY` will be returned instead of `EACCES`.

EBADF

The *fildev* argument is not a valid file descriptor.

ENOTTY

The calling process does not have a controlling terminal, or the file is not the controlling terminal.

Note: Starting with z/OS V1.9, environment variable `_EDC_SUSV3` can be used to control the behavior of `tcgetsid()` with respect to setting `errno` to `ENOTTY` instead of `EACCES`. By default, `tcgetsid()` will set `EACCES` when *fildev* is not associated with a controlling terminal. When `_EDC_SUSV3` is set to 1, `setenv()` will set `errno` to `ENOTTY` in place of `EACCES`.

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)

t_close() — Close a transport endpoint

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_close(int fd);
```

General description

Notifies the transport provider that the user is finished with the transport endpoint specified by *fd*, and frees any local library resources associated with the endpoint. `t_close()` also closes the file associated with the transport endpoint.

`t_close()` should be called from the `T_UNBND` state. However, `t_close()` does not check state information, so it may be called from any state to close a transport endpoint. If this occurs, the local library resources associated with the endpoint are freed automatically. In addition, `close()` is issued for that file descriptor. The `close()` will be abortive if there are no other descriptors in this, or in another process which references the transport endpoint, and in this case will break any transport connection that may be associated with that endpoint.

A `t_close()` issued on a connection endpoint may cause data previously sent, or data not yet received, to be lost. It is the responsibility of the transport user to ensure that data is received by the remote peer.

Valid states: All - except for `T_UNINIT`

Returned value

If successful, `t_close()` returns 0.

If unsuccessful, `t_close()` returns -1 and sets `errno` to one of the following values:

Error Code
Description

TBADF

The specified file descriptor does not refer to a transport endpoint.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (t_errno).

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_getstate\(\) — Get the current state” on page 1864](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_unbind\(\) — Disable a transport endpoint” on page 1916](#)

t_connect() — Establish a connection with another transport user

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_connect(int fd, struct t_call *call, struct t_call *rcvcall);
```

General description

Enables a transport user to request a connection to the specified destination transport user. This function can only be issued in the T_IDLE state. The parameter *fd* identifies the local transport endpoint where communication will be established, while *sndcall* and *rcvcall* point to a *t_call* structure which contains the following members:

```
struct netbuf  addr;
struct netbuf  opt;
struct netbuf  udata;
int            sequence;
```

The parameter *sndcall* specifies information needed by the transport provider to establish a connection, and *rcvcall* specifies information that is associated with the newly established connection.

In *sndcall*, *addr* specifies the protocol address of the destination transport user. *opt* presents any protocol-specific information that might be needed by the transport provider. *udata* points to optional user data that may be passed to the destination transport user during connection establishment. *sequence* has no meaning for this function.

On return, in *rcvcall*, *addr* contains the protocol address associated with the responding transport endpoint. *opt* represents any protocol-specific information associated with the connection. *udata* points to optional user data that may be returned by the destination transport user during connection establishment. *sequence* has no meaning for this function.

The *opt* argument permits users to define the options that may be passed to the transport provider. See the discussion of supported options in *t_optmgmt()*. The user may choose not to negotiate protocol options by setting the *len* field of *opt* to zero. In this case, the provider may use default options.

If used, *sndcall->opt.buf* must point to a buffer with the corresponding options. The *maxlen* and *buf* fields of the netbuf structure pointed by *rcvcall->addr* and *rcvcall->opt* must be set before the call.

Since passing of userdata over a connection request is not supported under TCP, the *udata* argument is always meaningless.

On return, the *addr*, *opt* and *udata* fields of *rcvcall* will be updated to reflect values associated with the connection. Thus, the *maxlen* field of each argument must be set before issuing this function to indicate the maximum size of the buffer for each. However, *rcvcall* may be a NULL pointer, in which case no information is given to the user on return from *t_connect()*.

By default, *t_connect()* executes in synchronous mode, and will wait for the destination user's response before returning control to the local user. A successful return (that is, return value of zero) indicates that the requested connection has been established. However, if *O_NONBLOCK* is set (using *t_open()* or *fcntl()*), *t_connect()* executes in asynchronous mode. In this case, the call will not wait for the remote user's response, but will return control immediately to the local user and return -1 with *t_errno* set to *TNODATA* to indicate that the connection has not yet been established. In this way, the function simply initiates the connection establishment procedure by sending a connect request to the destination transport user. The *t_rcvconnect()* function is used in conjunction with *t_connect()* to determine the status of the requested connection.

When a synchronous *t_connect()* call is interrupted by the arrival of a signal, the state of the corresponding transport endpoint is *T_OUTCON*, allowing a further call to either *t_rcvconnect()*, *t_rcvdis()* or *t_snddis()*.

Valid states: *T_IDLE*

Returned value

If successful, *t_connect()* returns 0.

If unsuccessful, *t_connect()* returns -1 and sets *errno* to one of the following values:

Error Code

Description

TACCES

The user does not have permission to use the specified address or options.

TADDRBUSY

This transport provider does not support multiple connections with the same local and remote addresses. This error indicates that a connection already exists.

TBADADDR

The specified protocol address was in an incorrect format or contained illegal information.

TBADDATA

The amount of user data specified was not within the bounds allowed by the transport provider.

TBADF

The specified file descriptor does not refer to a transport endpoint.

TBADOPT

The specified protocol options were in an incorrect format or contained illegal information.

TBUFOVFLW

The number of bytes allocated for an incoming argument (*maxlen*) is greater than 0 but not sufficient to store the value of that argument. If executed in synchronous mode, the provider's state, as seen by the user, changes to *T_DATAXFER*, and the information to be returned in *rcvcall* is discarded.

TLOOK

An asynchronous event has occurred on this transport endpoint and requires immediate attention.

TNODATA

O_NONBLOCK was set, so the function successfully initiated the connection establishment procedure, but did not wait for a response from the remote user.

TNOTSUPPORT

This function is not supported by the underlying transport provider.

TOUTSTATE

The function was issued in the wrong sequence.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_accept\(\) — Accept a connect request” on page 1804](#)
- [“t_alloc\(\) — Allocate a library structure” on page 1807](#)
- [“t_getinfo\(\) — Get protocol-specific service information” on page 1862](#)
- [“t_listen\(\) — Listen for a connect indication” on page 1870](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_optmgmt\(\) — Manage options for a transport endpoint” on page 1886](#)
- [“t_rcvconnect\(\) — Receive the confirmation from a connect request” on page 1894](#)

tcperror() — Print the error messages of a socket function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_SOCK_EXT
#include <sys/socket.h>
#include <stdio.h>
#include <errno.h>

void tcperror(const char *s);
```

General description

When a socket call produces an error, the call returns a negative value and the variable *errno* is set to an error value found in *ERRNO.H*. The *tcperror()* call prints a short error message describing the last error that occurred. If *s* is non-NULL, *tcperror()* prints the string *s* followed by a colon, followed by a space, followed by the error message, and terminated with a newline character. If *s* is NULL or points to a NULL string, only the error message and the newline character are output.

The *tcperror()* function is equivalent to the *perror()* function in UNIX.

Parameter

Description

s

A NULL or NULL-terminated character string.

Returned value

tcperror() returns no values.

Example

The following are examples of the tcperror() call.

Example 1:

```
if ((s=socket(AF_INET, SOCK_DGRAM, 0)) < 0) {
    tcperror("socket()");
    exit(2);
}
```

If the socket() call produces the error ENOMEM, socket() returns a negative value and sets errno to ENOMEM. When tcperror() is called, it prints the string:

```
socket(): not enough storage (ENOMEM)
```

Example 2:

```
if ((s=socket(AF_INET, SOCK_DGRAM, 0)) < 0)
    tcperror(NULL);
```

If the socket() call produces the error ENOMEM, socket() returns a negative value and sets errno to ENOMEM. When tcperror() is called, it prints the string:

```
Not enough storage (ENOMEM)
```

Related information

- [“errno.h — Symbolic constants for errno” on page 19](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/socket.h — Sockets definitions” on page 70](#)
- [“perror\(\) — Print error message” on page 1184](#)

tcsendbreak() — Send a break condition to a terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

int tcsendbreak(int fildes, int duration);
```

General description

Sends a break condition to a terminal (indicated by *fildev*) that is using asynchronous serial data transmission. `tcsendbreak()` sends a continuous stream of zero bits for the specified *duration*. `tcsendbreak()` is the usual method of sending a BREAK on a line.

If `tcsendbreak()` is issued against a pseudoterminal, this function has no effect.

If `tcsendbreak()` is called from a background process group against the caller's controlling terminal, a SIGTTOU signal may be generated depending how the process is handling SIGTTOUs:

| Processing for SIGTTOU System Behavior | |
|--|---|
| Default or signal handler | The SIGTTOU signal is generated, and the function is not performed. <code>tcsendbreak()</code> returns -1 and sets <code>errno</code> to <code>EINTR</code> . |
| Ignored or blocked | The SIGTTOU signal is not sent, and the function continues normally. |

Returned value

If successful, `tcsendbreak()` returns 0.

If unsuccessful, `tcsendbreak()` returns -1 and sets `errno` to one of the following values:

Error Code Description

EBADF
fildev is not a valid open file descriptor.

EINTR
A signal interrupted `tcsendbreak()`.

EIO
The process group of the process issuing the function is an orphaned, background process group, and the process issuing the function is not ignoring or blocking SIGTTOU.

ENOTTY
fildev is not associated with a terminal.

Example

CELEBT08

```
/* CELEBT08

   This example breaks terminal transmission.

*/
#define _POSIX_SOURCE
#include <stdio.h>
#include <termios.h>
#include <unistd.h>

main() {
    if (tcsendbreak(STDIN_FILENO, 100) != 0)
        perror("tcsendbreak() error");
    else
        puts("break sent");
}
```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“tcdrain\(\) — Wait until output has been transmitted” on page 1816](#)
- [“tcflow\(\) — Suspend or resume data flow on a terminal” on page 1818](#)
- [“tcflush\(\) — Flush input or output on a terminal” on page 1821](#)

- “[tcgetattr\(\)](#) — Get the attributes for a terminal” on page 1823
- “[tcgetpgrp\(\)](#) — Get the foreground process group ID” on page 1827
- “[tcsetattr\(\)](#) — Set the attributes for a terminal” on page 1835
- “[tcsetpgrp\(\)](#) — Set the foreground process group ID” on page 1847

tcsetattr() — Set the attributes for a terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <termios.h>

int tcsetattr(int fd, int when, const struct termios *term_ptr);
```

General description

`tcsetattr()` only works in an environment where either a controlling terminal exists, or `stdin` and `stderr` refer to tty devices. Specifically, it does not work in a TSO environment.

Changes the attributes associated with a terminal. New attributes are specified with a `termios` control structure. Programs should always issue a `tcgetattr()` first, modify the desired fields, and then issue a `tcsetattr()`. `tcsetattr()` should never be issued using a `termios` structure that was not obtained using `tcgetattr()`. `tcsetattr()` should use only a `termios` structure that was obtained by `tcgetattr()`.

fd

Indicates an open file descriptor associated with a terminal.

when

Indicates a symbol, defined in the `termios.h` header file, specifying when to change the terminal attributes:

Symbol

Meaning

TCSANOW

The change should take place immediately.

TCSADRAIN

The change should take place after all output written to *fd* has been read by the manager pseudoterminal. Use this value when changing terminal attributes that affect output.

TCSAFLUSH

The change should take place after all output written to *fd* has been sent; in addition, all input that has been received but not read should be discarded (flushed) before the change is made.

**term_ptr*

A pointer to a `termios` control structure containing the desired terminal attributes.

A `termios` structure contains the following members:

tcflag_t c_iflag

Input modes. `tcflag_t` is defined in the `termios.h` header file. Each bit in `c_iflag` indicates an input attribute and is associated with a symbol defined in the `termios.h` include file. All symbols are bitwise distinct. Thus `c_iflag` is the bitwise inclusive-OR of several of these symbols. Possible symbols are:

Symbol**Meaning****BRKINT**

Indicates that an interrupt should be generated if the user types a BREAK.

ICRNL

Automatically converts input carriage returns to newline (line-feed) characters before they are passed to the application that reads the input.

IGNBRK

Ignores BREAK conditions. If this bit is set to 1, applications are not informed of any BREAK condition on the terminal; the setting of BRKINT has no effect.

If IGNBRK is 0 but BRKINT is 1, BREAK flushes all input and output queues. In addition, if the terminal is the controlling terminal of a foreground process group, the BREAK condition generates a single SIGINT signal for that foreground process group.

If both IGNBRK and BRKINT are 0, a BREAK condition is taken as the single input character NULL, if PARMRK is 0, and as the three input characters \377-NULL-NULL, if PARMRK is 1.

IGNCR

Ignores input carriage returns. If this bit is set to 1, the setting of ICRNL has no effect.

If IGNCR is 0 and ICRNL is 1, input carriage returns are converted to newline characters. For z/OS UNIX "NL" or '\n' is the EBCDIC character NL.

IGNPAR

Ignores input characters (other than BREAK) that have parity errors.

INLCR

Automatically converts input newline (line-feed) characters to carriage returns before they are passed to the application that reads the input.

INPCK

Enables input parity checking. If this bit is set to 0, it allows output parity generation without input parity errors. The enabling of input parity checking is independent of the enabling of parity checking in the control modes field. (See the description of "`tcflag_t c_cflag`," which follows.) While the control modes may dictate that the hardware recognizes the parity bit, but the terminal special file does not check whether this bit is set correctly.

ISTRIP

Strips valid input bytes to 7 bits. If this bit is set to 0, the complete byte is processed.

Note: Do not set this bit for pseudoterminals, since it will make the terminal unusable. If you strip the first bit off of EBCDIC characters, you destroy all printable EBCDIC characters.

IUCLC

Map uppercase to lowercase on the received character. In locales other than the POSIX locale, the mapping is unspecified. Thus, this function only applies to the characters in the POSIX-portable character set that have lowercase equivalents, namely the characters A-Z.

Note:

This symbol is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3.

If it is necessary to continue using this symbol in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

IXANY

Enable any character to restart output. If IXOFF and IXANY are set and a previous STOP character has been received, then receipt of any input character will cause the STOP condition to be removed. For pseudoterminals, data in the output queue is passed to the application during manager read() processing, and subsidiary pseudoterminal writes are allowed to proceed. The character which caused the output to restart is also processed normally as well (unless it is a STOP character).

IXOFF

Enables start/stop input control. If this bit is set to 1, the system attempts to prevent the number of bytes in the input queue from exceeding the MAX_INPUT value. It sends one or more STOP characters to the terminal device when the input queue is in danger of filling up. The character used as the STOP character is dictated by the c_cc member of the termios structure. It is intended to tell the terminal to stop sending input for a while. The system transmits one or more START characters when it appears that there is space in the input queues for more input. Again, the character used as the START character is dictated by the c_cc member. It is intended to tell the terminal that it can resume transmission of input.

Note: Do not use IXOFF while in DBCS mode. If you intersperse STOP and START characters inside DBCS data while using IXOFF, you could corrupt output data,

IXON

Enables start/stop output control. If the system receives a STOP character as input, it will suspend output on the associated terminal until a START character is received. An application reading input from the terminal does not see STOP or START characters; they are intercepted by the system, which does all the necessary processing.

If IXON is 0, any STOP or START characters read are passed on as input to an application reading from the terminal.

PARMRK

Marks characters with parity errors. If this bit is set to 1 and IGNPAR is 0, a byte with a framing or parity error is sent to the application as the characters \377 and NULL, followed by the data part of the byte that had the parity error. If ISTRIP is 0, a valid input character of \377 is sent as a pair of characters \377, \377 to avoid ambiguity.

If both PARMRK and IGNPAR are 0, a character with a framing or parity error is sent to the application as NULL.

tcflag_t c_oflag

Output modes. Each bit in c_oflag indicates an output attribute, and is associated with a symbol defined in the termios.h header file. Thus c_oflag is the bitwise inclusive-OR of a number of these symbols. Possible symbols are:

Symbol**Meaning****OPOST**

Modifies lines of text in an implementation-defined way to appear appropriately on the terminal device. If this bit is set to 0, characters that an application puts out are sent without change.

OLCUC

If OPOST and OLCUC are set, then map lowercase to uppercase on the output. In locales other than the POSIX locale, the mapping is unspecified. Thus, this function only applies to the characters in the POSIX-portable character set that have uppercase equivalents, namely the characters a-z.

Note:

This symbol is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3.

If it is necessary to continue using this symbol in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including

any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

ONLCR

If OPOST and ONLCR are set, the NL character is transmitted as the CR-NL character pair.

OCRNL

If OPOST and OCRNL are set, the CR character is transmitted as the NL character.

ONOCR

If OPOST and ONOCR are set, no CR character is transmitted if the current column is zero.

ONLRET

If OPOST and ONLRET are set, the NL character does the carriage return function; the column pointer is set to 0. If OPOST is set and ONLRET is not set, then the NL does the line-feed function; the column pointer is unchanged.

OFILL

Fill characters are used for delay instead of using a timed delay.

OFDEL

The fill character is DEL. If OFILL is not set, then the fill character is NUL.

NLDLY

Delay associated with newline character.

NLO

No delay.

NL1

0.10 seconds delay. If ONLRET is set, then carriage-return delays are used instead of newline delays. If OFILL is set, then two fill characters are transmitted.

CRDLY

Delay associated with carriage-return character.

CR0

No delay.

CR1

Delay dependent on column position, or if OFILL is set then two fill characters are transmitted.

CR2

0.10 seconds delay, or if OFILL is set then four fill characters are transmitted.

CR3

0.15 seconds delay.

TABDLY

Delay associated with tab character.

TAB0

No horizontal tab processing.

TAB1

Delay dependent on column position, or if OFILL is set then two fill characters are transmitted.

TAB2

0.10 seconds delay, or if OFILL is set then two fill characters are transmitted.

TAB3

Tabs are expanded into spaces.

BSDLY

Delay associated with backspace character.

BS0

No delay.

BS1

0.05 seconds delay, or if OFILL is set then one fill character is transmitted.

VTDLY

Delay associated with vertical-tab processing.

VTO

No delay.

VT1

2 seconds delay.

FFDLY

Delay associated with form-feed processing.

FFO

No delay.

FF1

2 seconds delay.

tcflag_t c_cflag

Control modes. Each bit in `c_cflag` indicates a control attribute and is associated with a symbol defined in the `termios.h` header file. Thus `c_cflag` is the bitwise inclusive-OR of several of these symbols. Possible symbols are:

Symbol**Meaning****CLOCAL**

Ignores modem status lines. A call to `open()` returns immediately without waiting for a modem connection to complete. If this bit is set to 0, modem status lines are monitored and `open()` waits for the modem connection.

CREAD

Enables reception. If this bit is set to 0, no input characters are received from the terminal.

Using z/OS UNIX pseudoterminal support, this bit is always enabled and set to 1.

CSIZE

Is a collection of bits indicating the number of bits per byte (not counting the parity bit, if any). These bits specify byte size for both transmission and reception. Possible settings of `CSIZE` are given with the following symbols:

```
CS5 - 5 bits per byte
CS6 - 6 bits per byte
CS7 - 7 bits per byte
CS8 - 8 bits per byte
```

Using z/OS UNIX pseudoterminal support, all values are accepted, but `CSIZE` is changed to `CS8`.

Using z/OS UNIX Outboard Communications Server (OCS) support, the specified value is used.

CSTOPB

Sends two stop bits when necessary. If `CSTOPB` is 0, only one stop bit is used.

Using z/OS UNIX pseudoterminal support, this bit is always 0. Using z/OS UNIX OCS support, the specified value is used.

HUPCL

Lowers the modem control lines for a port when the last process that has the port open closes the port (or the process ends). In other words, this tells the system to hang up when all relevant processes have finished using the port.

For pseudoterminals `HUPCL` controls what happens when the subsidiary pseudoterminals is closed. If `HUPCL` is set when the last file descriptor for the subsidiary pseudoterminal is closed, then the subsidiary pseudoterminal cannot be re-opened. The manager terminal has to be closed and re-opened before the pair can be used again.

PARENB

Enables parity generation and detection. A parity bit is added to each character on output, and expected from each character on input.

Under z/OS UNIX, if this bit is set to 1 in a request, it is ignored. It is always set to 0. Using z/OS UNIX OCS support, the specified value is used.

PARODD

Indicates odd parity (when parity is enabled). If PARODD is 0, even parity is used (when parity is enabled).

Under z/OS UNIX, if this bit is set to 1 in a request, it is ignored. It is always set to 0. Using z/OS UNIX OCS support, the specified value is used.

If the object for which the control modes are set is not an asynchronous serial connection, some bits may be ignored. For example, on a network connection, it may not be possible to set the baud rate.

tcflag_t c_lflag

Local modes. Each bit in `c_lflag` indicates a local attribute, and is associated with a symbol defined in the `termios.h` include file. Thus `c_lflag` is the bitwise inclusive-OR of a number of these symbols. Possible symbols are:

Symbol

Meaning

ECHO

Echoes input characters back to the terminal. If this bit is 0, input characters are not echoed.

ECHOE

Echoes the ERASE character as an error-correcting backspace. When the user inputs an ERASE character, the terminal erases the last character in the current line from the display (if possible). The character used as the ERASE character is dictated by the `c_cc` member of the `termios` structure. ECHOE has an effect only if the ICANON bit is 1.

ECHOK

Either causes the terminal to erase the line from the display, or echoes the KILL character followed by an `\n` character. ECHOK has an effect only if the ICANON bit is set to 1.

ECHONL

Echoes the newline (line-feed) character `'\n'` even if the ECHO bit is off. ECHONL has an effect only if the ICANON bit is set to 1.

ICANON

Enables canonical input processing, also called *line mode*. Input is not delivered to the application until an entire line has been input. The end of a line is indicated by a newline, End Of File (EOF), or EOL character (where the character used as the EOL character is directed by the `c_cc` member of the `termios` structure [described shortly]). Canonical input processing uses the ERASE character to erase a single input character, and the KILL character to erase an entire line. The `MAX_CANON` value specifies the maximum number of bytes in an input line in canonical mode.

If ICANON is 0, read requests take input directly from the input queue; the system does not wait for the user to enter a complete line. This is called *noncanonical mode*. ERASE and KILL characters are not handled by the system but passed directly to the application. See also the descriptions of MIN and TIME in the `c_cc` member.

IEXTEN

Enables extended implementation-defined functions. These are not defined, and IEXTEN is always set to 0.

If the ERASE, KILL or EOF character is preceded by a backslash character, the special character is placed in the input queue without doing the "special character" processing and the backslash is discarded.

ISIG

If ISIG is set to 1, signals are generated if special control characters are entered. SIGINT is generated if INTR is entered; SIGQUIT is generated if QUIT is entered; and SIGTSTP is generated if SUSP is entered and job control is supported. The special control characters are controlled by the `c_cc` member.

If ISIG is 0, the system does not generate signals when these special control characters are entered.

NOFLSH

If this bit is set to 1, the system does not flush the input and output queues if a signal is generated by one of the special characters described in ISIG above. If NOFLSH is set to 0, the queues are flushed if one of the special characters is found.

TOSTOP

If this bit is set to 1, a SIGTTOU signal is sent to the process group of a process that tries to write to a terminal when it is not in the terminal's foreground process group. However, if the process that tries to write to the terminal is blocking or ignoring SIGTTOU signals, the system does not raise the SIGTTOU signal.

If TOSTOP is 0, output from background processes is output to the current output stream, and no signal is raised.

XCASE

Do canonical lower and canonical upper presentation. In locales other than the POSIX locale, the effect is unspecified. XCASE set by itself makes all uppercase letters on input and output be preceded by a "\" character.

Some terminals can generate lowercase characters, but can display only uppercase characters. For these terminals, XCASE would be used by itself. Other terminals cannot generate lowercase characters either. For these terminals, XCASE would be used with IUCLC to generate lowercase characters when characters are typed without the backslash, and uppercase characters when the typed character is preceded by a backslash.

If a terminal can generate only uppercase characters, but can display either upper or lowercase, then XCASE would be used with OLCUC.

Note:

This symbol is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3.

If it is necessary to continue using this symbol in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

cc_t c_cc[NCCS]

Control characters. This is an array of characters that may have special meaning for terminal handling. You can access characters in this array using subscripts that are symbols defined in the `termios.h` header file. For example, the STOP character is given by `c_cc[VSTOP]`. Possible subscript symbols are:

Symbol

Meaning

VEOF

Gives the End Of File character EOF. It is recognized only in canonical (line) mode. When this is found in input, all bytes waiting to be read are immediately passed to the application without waiting for the end of the line. The EOF character itself is discarded. If EOF occurs at the beginning of a line, the `read` function that tries to read that line receives an End Of File (EOF) indication. Note that EOF results in End Of File only if it is at the beginning of a line; if it is preceded by one or more characters, it indicates only End Of Line (EOL).

VEOL

Gives the End Of Line character EOL. It is recognized only in canonical (line) mode. This is an alternate character for marking the end of a line (in addition to the newline `\n`).

VERASE

Gives the ERASE character. It is recognized only in canonical (line) mode. It deletes the last character in the current line. It cannot delete beyond the beginning of the line.

VINTR

Gives the interrupt character INTR. It is recognized only if ISIG is set to 1 in `c_lflag`. If the character is received, the system sends a SIGINT signal to all the processes in the foreground process group that has this device as its controlling terminal.

VKILL

Gives the KILL character. It is recognized only in canonical (line) mode. It deletes the entire contents of the current line.

VMIN

Gives the MIN value for noncanonical mode processing.

This is the minimum number of bytes that a call to `read` should return in noncanonical mode; it is not used in canonical mode.

If both MIN and TIME are greater than 0, `read` returns when MIN characters are available or when the timer associated with TIME runs out (whichever comes first). The timer starts running as soon as a single character has been entered; if there is already a character in the queue when `read` is called, the timer starts running immediately.

If MIN is greater than zero and TIME is zero, `read` waits for MIN characters to be entered, no matter how long that takes.

If MIN is zero and TIME is greater than zero, `read` returns when the timer runs out or when a single character is received (whichever comes first). `read` returns either one character (if one is received) or zero (if the timer runs out). The timer starts running as soon as `read` is called. (Contrast this with the case where MIN and TIME are both greater than zero, and the timer starts only when a character is received.)

If both MIN and TIME are zero, `read` returns immediately from every call. It returns the number of bytes that are immediately available, up to the maximum specified in the call to `read`.

VQUIT

Gives the quit character QUIT. It is recognized only if ISIG is set to 1 in `c_lflag`. If the character is received, the system sends a SIGQUIT signal to all the processes in the foreground process group that has this device as its controlling terminal.

VSUSP

Gives the suspend character SUSP. It is recognized only if ISIG is set to 1 in `c_lflag`. If the character is received, the system sends a SIGTSTP signal to all the processes in the foreground process group that has this device as its controlling terminal.

VTIME

Gives the TIME value, used in noncanonical mode in connection with MIN. It expresses a time in terms of tenths of a second.

VSTOP

Gives the STOP character. You can use this to suspend output temporarily when IXON is set to 1 in `c_iflag`. Users can enter the STOP character to prevent output from running off the top of a display screen.

VSTART

Gives the START character. You can use this to resume suspended output when IXON is set to 1 in `c_iflag`.

When `tcsetattr()` is called from a background session against a controlling terminal, SIGTTOU processing is as follows:

| Processing for SIGTTOU Expected Behavior | |
|--|---|
| Default or signal handler | The SIGTTOU signal is generated, and the function is not performed. <code>tcsetattr()</code> returns -1 and sets <code>errno</code> to <code>EINTR</code> . |
| Ignored or blocked | The SIGTTOU signal is not sent, and the function continues normally. |

Note: The `tcsetattr()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `tcsetattr()` returns 0.

If unsuccessful, `tcsetattr()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

fildev is not a valid open file descriptor.

EINTR

A signal interrupted `tcsetattr()`.

EINVAL

when is not a recognized value, or some entry in the supplied `termios` structure had an incorrect value.

EIO

The process group of the process issuing the function is an orphaned, background process group, and the process issuing the function is not ignoring or blocking SIGTTOU.

ENOTTY

fildev is not associated with a terminal.

Example

CELEBT09

```
/* CELEBT09
   The following attributes changes the terminal attributes.
*/
#define _POSIX_SOURCE
#include <termios.h>
#include <unistd.h>
#include <stdio.h>

main() {
    struct termios term1, term2;

    if (tcgetattr(STDIN_FILENO, &term1) != 0)
        perror("tcgetattr() error");
    else {
        printf("the original end-of-file character is x'%02x'\n",
               term1.c_cc[VEOF]);
        term1.c_cc[VEOF] = 'z';
        if (tcsetattr(STDIN_FILENO, TCSANOW, &term1) != 0)
            perror("tcsetattr() error");
        if (tcgetattr(STDIN_FILENO, &term1) != 0)
            perror("tcgetattr() error");
        else
            printf("the new end-of-file character is x'%02x'\n",
                   term1.c_cc[VEOF]);
    }
}
```

Output

```
the original End Of File character is x'37'
the new End Of File character is x'a9'
```

Related information

- [“termios.h — POSIX terminal I/O functions”](#) on page 74

- [“cfgetispeed\(\) — Determine the input baud rate” on page 254](#)
- [“cfgetospeed\(\) — Determine the output baud rate” on page 256](#)
- [“cfsetispeed\(\) — Set the input baud rate in the termios” on page 258](#)
- [“cfsetospeed\(\) — Set the output baud rate in the termios” on page 260](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“tcdrain\(\) — Wait until output has been transmitted” on page 1816](#)
- [“tcflow\(\) — Suspend or resume data flow on a terminal” on page 1818](#)
- [“tcflush\(\) — Flush input or output on a terminal” on page 1821](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcgetpgrp\(\) — Get the foreground process group ID” on page 1827](#)
- [“tcsendbreak\(\) — Send a break condition to a terminal” on page 1833](#)
- [“tcsetpgrp\(\) — Set the foreground process group ID” on page 1847](#)

__tcsetcp() — Set terminal code page names

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------------|-----------------|---------------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_PTY_EXTENSIONS
#include <termios.h>

int __tcsetcp(int fildev, size_t termcplen, const struct __termcp *termcpptr);
```

General description

The `__tcsetcp()` function sets (or changes) the terminal session code page information contained in the `termcp` structure.

The following arguments are used:

`fildev`

The file descriptor of the terminal for which you want to get the code page names and CPCN capability.

`termcplen`

The length of the passed `termcp` structure.

`termcpptr`

A pointer to a `__termcp` structure.

Use the `__tcsetcp()` function to send new code page information to the data conversion point in order to change the data conversion environment for the terminal session. This function is used with terminal devices that support the “forward code page names only” Code Page Change Notification (CPCN) capability. The z/OS UNIX pseudotty (pty) device driver supports this capability.

For terminal sessions that use the z/OS UNIX pty device driver, the data conversion point is the application that uses the manager pty device. An example data conversion point is the z/OS UNIX **rlogin** server. Here, **rlogin** uses CPCN functions to determine the ASCII source and/or EBCDIC target code pages to use for the conversion of the terminal data. During its processing of the `__tcsetcp()` function, the pty device driver applies the `__termcp` structure once the pty outbound data queue is drained. When

this occurs, the pty input data queue is also flushed and a TIOCPKT_CHCP packet exception event is generated if extended packet mode is enabled (PKTXTND is set in the termios structure) to notify the application using the manager pty that the code page information has been changed. The manager pty application can then use the `__tcgetcp()` function to retrieve the new code page information and establish a new data conversion environment.

The `__tcsetcp()` function is supported by both the manager and subsidiary pty device drivers, however, CPCN functions first must be enabled by the application that uses the manager pty; enabling CPCN functions is performed by the system during the initial `__tcsetcp()` invocation against the manager pty device. Once the `__tcsetcp()` function is performed against the manager pty then it may be subsequently issued against the subsidiary pty.

Note: The data conversion for a z/OS UNIX terminal session is performed on a session (terminal file) basis. If you change the data conversion characteristics for one file descriptor, the new data conversion will apply to all open file descriptors associated with this terminal file.



Attention: Use this service carefully. By changing the code pages for the data conversion you may cause unpredictable behavior in the terminal session if the actual data used for the session is not encoded to the specified source (ASCII) and target (EBCDIC) code pages.

A `__termcp` structure contains the following members:

__tccp_flags

Flags. The following symbols are defined as bitwise distinct values. Thus, `__tccp_flags` is the bitwise inclusive-OR of these symbols:

Symbol

Meaning

_TCCP_BINARY

Use `_TCCP_BINARY` to notify the data conversion point to stop data conversion. If this flag is set, the source and target code page names (`__tccp_fromname` and `__tccp_toname` respectively) are not changed from their current values.



Attention: Use this option carefully. Once the data conversion is disabled the z/OS UNIX Shell cannot be used until the data conversion is re-enabled, using valid code pages for the terminal session.

_TCCP_FASTP

Use `_TCCP_FASTP` to indicate to the data conversion point (for example, **rlogin**) that the data conversion specified by the source and target code page names can be performed locally to the application. This is valid any time that a table-driven conversion can be performed. For example, the data conversion point (application) could use the z/OS UNIX `iconv()` service to build the local data conversion tables and perform all data conversion using the local tables instead of using `iconv()` in subsequent conversions. This provides for better-performing data conversion.

__tccp_fromname

The source code page name; typically this is the ASCII code page name. `__tccp_fromname` is a NULL-terminated string with a maximum length of `_TCCP_CPNAME_MAX`, including the NULL (`\00`) character.

`__tccp_fromname` is case-sensitive.

__tccp_toname

The target code page name; typically this is the EBCDIC code page name. `__tccp_toname` is a NULL-terminated string with a maximum length of `_TCCP_CPNAME_MAX`, including the NULL (`\00`) character.

`__tccp_toname` is case-sensitive.

When `__tcsetcp()` is issued against the subsidiary pty from a process in a background process group, SIGTTOU processing is as follows:

| Processing for SIGTTOU Expected Behavior | |
|--|--|
| Default or signal handler | The SIGTTOU signal is generated. The function is not performed. __tcsetcp() returns -1 and sets errno to EINTR. |
| Ignored or blocked | The SIGTTOU signal is not sent. The function continues normally. |

Note: The __tcsetcp() function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support ” on page 2123](#) for details.

Returned value

If successful, __tcsetcp() returns 0.
If unsuccessful, __tcsetcp() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|---------------|---|
| EBADF | <i>fildev</i> is not a valid open file descriptor. |
| EINTR | A signal interrupted the call. |
| EINVAL | The value of <i>termcplen</i> was invalid. |
| EIO | The process group of the process issuing the function is an orphaned, background process group, and the process issuing the function is not ignoring or blocking SIGTTOU. |
| ENODEV | One of the following error conditions exist: <ul style="list-style-type: none">• CPCN functions have not been enabled. The __tcsetcp() function must be issued against the manager pty before any CPCN function can be issued against the subsidiary pty.• The terminal device driver does not support the “forward code page names only” CPCN capability. |
| ENOTTY | The file associated with <i>fildev</i> is not a terminal device. |

Example

The following example retrieves the CPCN capability and code pages and then changes the ASCII code page to IBM-850.

```
#define _OPEN_SYS_PTY_EXTENSIONS
#include <unistd.h>
#include <stdio.h>
#include <fcntl.h>
#include <termios.h>

void main(void)
{
    struct __termcp mytermcp;
    int rv;
    int cterm_fd;

    if ((cterm_fd = open("/dev/tty",O_RDWR)) == -1)
        printf("No controlling terminal established.\n");
    else {
        if ((rv = __tcgetcp(STDIN_FILENO,sizeof(mytermcp),&mytermcp))== -1)
            perror("__tcgetcp() error");
        else {
            if (rv==_CPCN_NAMES) {
                if (_TCCP_BINARY == (mytermcp.__tccp_flags & _TCCP_BINARY))
```



```

        printf("Binary mode is in effect. No change made.\n");
    else {
        strcpy(mytermcp.__tccp_fromname,"IBM-850");
        if (__tcsetcp(STDOUT_FILENO,sizeof(mytermcp),&mytermcp)!=0)
            perror("__tcsetcp() error");
        else
            printf("ASCII code page changed to IBM-850.\n");
    } /*not binary mode */
} /* _CPCN_NAMES */
} /* __tcgetcp success */
close(cterm_fd);
} /* controlling terminal established */
} /* main */

```

Output

```
ASCII code page changed to IBM-850.
```

Related information

- [“termios.h – POSIX terminal I/O functions” on page 74](#)
- [“__tcgetcp\(\) – Get terminal code page names” on page 1824](#)
- [“__tcsettables\(\) – Set terminal code page names and conversion tables” on page 1849](#)

tcsetpgrp() – Set the foreground process group ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _POSIX_SOURCE
#include <unistd.h>

int tcsetpgrp(int fildes, pid_t newid);

```

General description

Sets the process group ID (PGID) of the foreground process group associated with the terminal referred to by *fildes*. This terminal must be the controlling terminal of the process calling `tcsetpgrp()` and must be currently associated with the session of the calling process. *newid* must match a PGID of a process in the same session as the calling process.

After the PGID associated with the terminal is set, reads by the process group formerly associated with the terminal fail or cause the process group to stop from a SIGTTIN signal. Writes may also cause the process to stop (from a SIGTTOU signal), or they may succeed, depending on how `tcsetattr()` sets TOSTOP and the signal options for SIGTTOU.

fildes can be any of the descriptors representing the controlling terminal (such as standard input, standard output, and standard error), and the function affects future access from any file descriptor in use for the terminal. Consider using redirection when specifying the file descriptor.

If `tcsetpgrp()` is called from a background process group against the caller's controlling terminal, a SIGTTOU signal may be generated depending how the process is handling SIGTTOUs:

Processing for SIGTTOU System Behavior

| | |
|---------------------------|---|
| Default or signal handler | The SIGTTOU signal is generated, and the function is not performed. tcsetpgrp() returns -1 and sets errno to EINTR. |
| Ignored or blocked | The SIGTTOU signal is not sent, and the function continues normally. |

Returned value

If successful, tcsetpgrp() returns 0.

If unsuccessful, tcsetpgrp() returns -1 and sets errno to one of the following values:

Error Code**Description****EBADF**

fildev is not a valid open file descriptor.

EINTR

A signal interrupted the tcsetpgrp() function.

EINVAL

The *newid* value is not supported by this implementation.

ENOTTY

The process calling tcsetpgrp() does not have a controlling terminal, or *fildev* is not associated with the controlling terminal, or the controlling terminal is no longer associated with the session of the calling process.

EPERM

The *newid* value is supported by the implementation but does not match the process group ID of any process in the same session as the process calling tcsetpgrp().

Example**CELEBT10**

```

/* CELEBT10

   This example changes the PGID.

   */
#define _POSIX_SOURCE
#include <termios.h>
#include <unistd.h>
#include <sys/wait.h>
#include <stdio.h>
#include <signal.h>

main() {
    pid_t pid;
    int status;

    if (fork() == 0)
        if ((pid = tcgetpgrp(STDOUT_FILENO)) < 0)
            perror("tcgetpgrp() error");
        else {
            printf("original foreground process group id of stdout was %d\n",
                (int) pid);
            if (setpgid(getpid(), 0) != 0)
                perror("setpgid() error");
            else {
                printf("now setting to %d\n", (int) getpid());
                if (tcsetpgrp(STDOUT_FILENO, getpid()) != 0)
                    perror("tcsetpgrp() error");
                else if ((pid = tcgetpgrp(STDOUT_FILENO)) < 0)
                    perror("tcgetpgrp() error");
                else
                    printf("new foreground process group id of stdout was %d\n",
                        (int) pid);
            }
        }
}

```

```
    else wait(&status);
}
```

Output

```
original foreground process group id of stdout was 2228230
now setting to 2949128
new foreground process group id of stdout was 2949128
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“tcdrain\(\) — Wait until output has been transmitted” on page 1816](#)
- [“tcflow\(\) — Suspend or resume data flow on a terminal” on page 1818](#)
- [“tcflush\(\) — Flush input or output on a terminal” on page 1821](#)
- [“tcgetattr\(\) — Get the attributes for a terminal” on page 1823](#)
- [“tcgetpgrp\(\) — Get the foreground process group ID” on page 1827](#)
- [“tcsendbreak\(\) — Send a break condition to a terminal” on page 1833](#)
- [“tcsetattr\(\) — Set the attributes for a terminal” on page 1835](#)

__tcsettables() — Set terminal code page names and conversion tables

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS_PTY_EXTENSIONS
#include <termios.h>

int __tcsettables(int fildev, size_t termcplen,
                  const struct __termcp *termcp_ptr,
                  const char atoe[256],
                  const char etoe[256]);
```

General description

The `__tcsettables()` function changes the data conversion environment for terminal sessions that support the “forward code page names and tables” Code Page Change Notification (CPCN) capability. The OCS remote-tty (rty) device driver supports this capability.

The following arguments are used:

fildev

The file descriptor of the terminal for which you want to set the code page names and data conversion tables.

termcplen

The length of the passed `termcp` structure.

termcp_ptr

A pointer to a `__termcp` structure. A `__termcp` structure contains the following members:

__tccp_flags

Flags. The following symbols are defined as bitwise distinct values. Thus, `__tccp_flags` is the bitwise inclusive-OR of these symbols:

Symbol

Meaning

_TCCP_BINARY

Use `_TCCP_BINARY` to notify the data conversion point to stop data conversion. If this flag is set the source and target code page names (`__tccp_fromname` and `__tccp_toname` respectively) are not changed, and the data conversion tables *atoe* and *etoa* are not used.



Attention: Use this option carefully. Once the data conversion is disabled the z/OS shell cannot be used until the data conversion is re-enabled, using valid code pages for the terminal session.

_TCCP_FASTP

Use `_TCCP_FASTP` to indicate to the data conversion point that the data conversion specified by the source and target code page names can be performed locally by the application that performs the data conversion. This is valid any time that a table-driven conversion can be performed.

This value is not used by the OCS rty device driver and thus has no effect.

__tccp_fromname

The source code page name; typically this is the ASCII code page name. `__tccp_fromname` is a NULL-terminated string with a maximum length of `_TCCP_CPNAME_MAX`, including the NULL (`\0`) character.

`__tccp_fromname` is case-sensitive.

__tccp_toname

The target code page name; typically this is the EBCDIC code page name. `__tccp_toname` is a NULL-terminated string with a maximum length of `_TCCP_CPNAME_MAX`, including the NULL (`\0`) character.

`__tccp_toname` is case-sensitive.

const char *atoe*[256]

A 256-byte data conversion table for the source-to-target (ASCII-to-EBCDIC) data conversion. The byte offset into this table corresponds to the character code from the source (ASCII) code page. The data value at each offset is the “converted” target (EBCDIC) character code.

const char *etoe*[256]

A 256-byte data conversion table for the target-to-source (EBCDIC-to-ASCII) data conversion. The byte offset into this table corresponds to the character code from the target (EBCDIC) code page. The data value at each offset is the “converted” source (ASCII) character code.

Note: The data conversion for a z/OS UNIX terminal session is performed on a session (terminal file) basis. If you change the data conversion characteristics for one file descriptor, the new data conversion will apply to all open file descriptors associated with this terminal file.

For terminal sessions that use the OCS rty device driver, the ASCII/EBCDIC data conversion is performed outboard by OCS on the AIX server system. Use the `__tcsettables()` function to specify new code pages and conversion tables to be used in the data conversion.

During its processing of the `__tcsettables()` function, the OCS rty device driver applies the new code page names once the outbound data queue is drained. When this occurs, the rty input data queue is also flushed and the new conversion environment takes effect.

OCS processing of the *atoe* and *etoe* arguments is as follows:

- If the code page names specified in the `__termcp` structure are for supported double-byte data conversion then the *atoe* and *etoe* arguments are not used. The following double-byte translation is supported for OCS sessions:

- If `__fromname` specifies **ISO8859-1** and `__toname` specifies **IBM-1047** then OCS uses its own data conversion tables and `atoe` and `etoa` arguments are not used.
- Otherwise the conversion tables in `atoe` and `etoa` are used.



Attention: Use this service carefully. By changing the code pages for the data conversion you may cause unpredictable behavior in the terminal session if the actual data used for the session is not encoded to the specified source (ASCII) and target (EBCDIC) code pages.

When `__tcsettables()` is issued from a process in a background process group, SIGTTOU is processing in this way:

| Processing for SIGTTOU Expected Behavior | |
|--|--|
| Default or signal handler | The SIGTTOU signal is generated. The function is not performed. <code>__tcsettables()</code> returns -1 and sets <code>errno</code> to <code>EINTR</code> . |
| Ignored or blocked | The SIGTTOU signal is not sent. The function continues normally. |

Returned value

If successful, `__tcsettables()` returns 0.

If unsuccessful, `__tcsettables()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

fildev is not a valid open file descriptor.

EINTR

A signal interrupted the call.

EINVAL

One of the following error conditions exists:

- The value of *termcplen* was invalid.
- An invalid combination of multibyte code page names was specified in the `__termcp` structure.

One of the following applies:

- The source code page specified in `__tccp_fromname` specified a supported ASCII multibyte code page and the `__tccp_toname` did not specify a supported EBCDIC multibyte code page.
- The target code page specified in `__tccp_toname` specified a supported EBCDIC multibyte code page and the `__tccp_fromname` did not specify a supported ASCII multibyte code page.

EIO

The process group of the process issuing the function is an orphaned, background process group, and the process issuing the function is not ignoring or blocking SIGTTOU.

ENODEV

The terminal device driver does not support the “forward code page names and tables” CPCN capability.

ENOTTY

The file associated with *fildev* is not a terminal device.

Example

The following example retrieves the current code pages used in the data conversion and CPCN capability. The conversion tables using ASCII code page IBM-850 and the current EBCDIC code page are generated and exported to the data conversion point using `__tcsettables()`.

```
#define _OPEN_SYS_PTY_EXTENSIONS
#include <fcntl.h>
```

```

#include <unistd.h>
#include <stdio.h>
#include <termios.h>
#include <iconv.h>

main()
{
    struct __termcp mytermcp;          /* local __termcp          */
    unsigned char *intabptr;           /* pointer to input table  */
    unsigned char *outtabptr;          /* pointer to output table */
    unsigned char intab[256],
        atoe[256],
        etoa[256];                    /* conversion tables       */
    iconv_t cd;                        /* conversion descriptor   */
    size_t inleft;                     /* number of bytes left in input */
    size_t outleft;                    /* number of bytes left in output */
    int i;                             /* loop variable           */
    int rv;                             /* return value            */
    int cterm_fd;                      /* file descriptor for controlling
                                     terminal                  */

    if ((cterm_fd = open("/dev/tty", O_RDWR)) == -1)
    {
        printf("No controlling terminal established. ");
        printf("Code pages were not changed.\n");
        exit(0);
    }
    if ((rv = __tcgetcp(cterm_fd, sizeof(mytermcp), &mytermcp)) == -1)
    {
        perror("__tcgetcp() error");
        exit(1);
    }

    if (_TCCP_BINARY == (mytermcp.__tccp_flags & _TCCP_BINARY))
    {
        printf("Binary mode is in effect. No change made.\n");
        exit(0);
    }

    if (rv == _CPCN_TABLES) {
        /* build ASCII -> EBCDIC conversion table */

        strcpy(mytermcp.__tccp_fromname, "IBM-850");
        if ((cd = iconv_open(mytermcp.__tccp_toname,
            mytermcp.__tccp_fromname)) ==
            (iconv_t) (-1)) {
            fprintf(stderr, "Cannot open converter from %s to %s\n",
                mytermcp.__tccp_fromname, mytermcp.__tccp_toname);
            exit(1);
        }

        /* build input table with character values of 00 - FF */

        for (i=0; i<256; i++) {
            intab[i] = (unsigned char) i;
        } /* endfor */

        inleft = 256;
        outleft = 256;
        intabptr = intab;
        outtabptr = atoe;

        /* build ASCII -> EBCDIC conversion table. */

        rv = iconv(cd, &intabptr, &inleft, &outtabptr, &outleft);
        if (rv == -1) {
            fprintf(stderr, "Error in building ASCII to EBCDIC table\n");
            exit(1);
        }
        iconv_close(cd);

        /* build EBCDIC -> ASCII conversion table */

        if ((cd = iconv_open(mytermcp.__tccp_fromname,
            mytermcp.__tccp_toname)) ==
            (iconv_t) (-1)) {
            fprintf(stderr, "Cannot open converter from %s to %s\n",
                mytermcp.__tccp_toname, mytermcp.__tccp_fromname);
            exit(1);
        }
        inleft = 256;
    }
}

```

```

outleft = 256;
intabptr = intab;
outtabptr = etoa;
rv = iconv(cd,&intabptr, &inleft, &outtabptr, &outleft);
if (rv == -1) {
    fprintf(stderr,"Error in building EBCDIC to ASCII table\n");
    exit(1);
}
iconv_close(cd);

/*
 * Change the data conversion to use IBM-850 as the ASCII source
 */

if (__tcsettables(cterm_fd, sizeof(mytermcp), &mytermcp,
    atoe,etoa) == -1) {
    perror("__tcsettables() error");
    exit(1);
} else {
    printf("Data conversion now using ASCII IBM-850\n");
} /* endif */
} /* endif */
close(cterm_fd);
} /* main */

```

Output

```
Data conversion now using ASCII IBM-850.
```

Related information

- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“__tcgetcp\(\) — Get terminal code page names” on page 1824](#)
- [“__tcsetcp\(\) — Set terminal code page names” on page 1844](#)

tdelete() — Binary tree delete

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _XOPEN_SOURCE
#include <search.h>

void *tdelete(const void *__restrict key, void **__restrict rootp,
    int (*compar)(const void *, const void *));

```

General description

The `tdelete()` function deletes a node from a binary search tree. The arguments are the same as for the `tsearch()` function. The variable pointed to by `rootp` will be changed if the deleted node was the root of the tree. `tdelete()` returns a pointer to the parent of the deleted node, or a NULL pointer if the node is not found. If the deleted node was the root of the tree, the function returns a pointer to the deleted node, since it had no parent. It frees the storage for this node before returning, so the contents of storage at the returned address are unreliable in this case.

Comparisons are made with a user-supplied routine, the address of which is passed as the `compar` argument. This routine is called with two arguments, the pointers to the elements being compared. The

user-supplied routine must return an integer less than, equal to or greater than 0, according to whether the first argument is to be considered less than, equal to or greater than the second argument. The comparison functions need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

Threading Behavior: see “tsearch() — Binary tree search” on page 1903.

Special behavior for C++: Because C and C++ linkage conventions are incompatible, tdelete() cannot receive a C++ function pointer as the comparator argument. If you attempt to pass a C++ function pointer to tdelete(), the compiler will flag it as an error. You can pass a C or C++ function to tdelete() by declaring it as extern "C".

Returned value

If successful, tdelete() returns a pointer to the parent of the deleted node.

If the node is not found, tdelete() returns a NULL pointer.

If rootp is a NULL pointer on entry, tdelete() returns a NULL pointer.

No errors are defined.

Related information

- “search.h — Searching tables” on page 58
- “bsearch() — Search arrays” on page 221
- “hsearch() — Search hash tables” on page 818
- “lsearch() — Linear search and update” on page 1022
- “tfind() — Binary tree find node” on page 1858
- “tsearch() — Binary tree search” on page 1903
- “twalk() — Binary tree walk” on page 1917

telldir() — Current location of directory stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <dirent.h>

long telldir(DIR *dirp);
```

General description

The telldir() function obtains the current location associated with the directory stream specified by dirp.

If the most recent operation on the directory stream was a seekdir(), then the directory position returned from telldir() is the same as that supplied as a loc argument to seekdir().

Returned value

If successful, `telldir()` returns the current location of the specified directory stream.

If the *dirp* argument supplied is NULL or invalid, `telldir()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBADF

The *dirp* argument was invalid.

Related information

- [“dirent.h — POSIX directory access” on page 18](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“closedir\(\) — Close a directory” on page 296](#)
- [“opendir\(\) — Open a directory” on page 1168](#)
- [“readdir\(\) — Read an entry from a directory” on page 1385](#)
- [“rewinddir\(\) — Reposition a directory stream to the beginning” on page 1450](#)
- [“seekdir\(\) — Set position of directory stream” on page 1471](#)
- [“fdopendir\(\) — Opens directory associated with file descriptor” on page 502](#)
- [“fdclosedir\(\) — Closes directory associated with file descriptor” on page 494](#)

tempnam() — Generate a temporary file name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE
#include <stdio.h>

char *tempnam(const char *dir, const char *pfx);
```

General description

The `tempnam()` function generates a path name that may be used for a temporary file. If the environment variable `TMPDIR` is set, then the directory it specifies will be used as the directory part of the generated path name if it is accessible. Otherwise, if the *dir* argument is non-NULL and accessible, it will be used in the generated path name. Otherwise, the value of `{P_tmpdir}` defined in the `<stdio.h>` header is used as the directory component of the name. If that is inaccessible, then `/tmp` is used.

The *pfx* argument can be used to specify an initial component of the file name part of the path name. It may be a NULL pointer or point to a string of up to five bytes to be used as the beginning of a file name.

The names generated are unique across processes and threads, and over time, so multiple threads should be able to each repeatedly call `tempnam()` and consistently obtain unique names.

This function is supported only in a POSIX program.

Returned value

If successful, `tempnam()` allocates space for the generated name, copies the name into it, and returns a pointer to the name.

If unsuccessful, `tempnam()` returns a NULL pointer and sets `errno` to one of the following values:

Error Code

Description

ENAMETOOLONG

The generated name exceeded the maximum allowable path name length.

ENOMEM

Insufficient storage is available.

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)
- [“free\(\) — Free a block of storage” on page 620](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“tmpfile\(\) — Create temporary file” on page 1874](#)
- [“tmpnam\(\) — Produce temporary file name” on page 1876](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

terminate() — Terminate after failures in C++ error handling

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ANSI/ISO C++ | C++ only | |

Format

```
#include <exception>

void terminate(void);
```

General description

The `terminate()` function is called when the C++ error handling mechanism fails. If `terminate()` is called directly by the program, the `terminate_handler` is the one most recently set by a call to `set_terminate()`. If `terminate()` is called for any of several other reasons during evaluation of a throw expression, the `terminate_handler` is the one in effect immediately after evaluating the throw expression. If `set_terminate()` has not yet been called, then `terminate()` calls `abort()`.

In a multithreaded environment, if a thread issues a throw, the stack is unwound until a matching catcher is found, up to and including the thread start routine. (The thread start routine is the function passed to `pthread_create()`.) If the exception is not caught, then the `terminate()` function is called, which in turn defaults to calling `abort()`, which in turn causes a `SIGABRT` signal to be generated to the thread issuing the throw. If the `SIGABRT` signal is not caught, the process is terminated. You can replace the default `terminate()` behavior for all threads in the process by using the `set_terminate()` function. One possible use of `set_terminate()` is to call a function which issues a `pthread_exit()`. If this is done, a throw of a condition by a thread that is uncaught results in thread termination but not process termination.

Returned value

terminate() returns no values.

Refer to [z/OS XL C/C++ Language Reference](#) for more information about C++ exception handling including the terminate() function.

Related information

- [“exception — Exception handling” on page 87](#)
- [“abort\(\) — Stop a program” on page 103](#)
- [“set_terminate\(\) — Register a function for terminate\(\)” on page 1584](#)
- [“unexpected\(\) — Handle exception not listed in exception specification” on page 1940](#)

t_error() — Produce error message

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_error(char *errmsg);
```

General description

Produces a language-dependent message on the standard error output which describes the last error encountered during a call to a transport function. The argument string *errmsg* is a user-supplied error message that gives context to the error.

The error message is written as follows: first (if *errmsg* is not a NULL pointer and the character pointed to by *errmsg* is not the NULL character) the string pointed to by *errmsg* followed by a colon and a space; then a standard error message string for the current error defined in *t_errno*. If *t_errno* has a value different from TSYSErr, the standard error message string is followed by a newline character. If, however, *t_errno* is equal to TSYSErr, the *t_errno* string is followed by the standard error message string for the current error defined in *errno* followed by a newline.

If the calling program is running in any one of the SAA, S370, C or POSIX locales, the error message string describing the value in *t_errno* is identical to the comments following the *t_errno* codes defined in *xti.h*. It is noteworthy that message numbers are not produced in this situation. The contents of the error message strings describing the value in *errno* are the same as those returned by the *strerror(3C)* function with an argument of *errno*.

The error number, *t_errno*, is only set when an error occurs and it is not cleared on successful calls.

Valid states: All - except for T_UNINIT

Returned value

No errors are defined for *t_error()*.

Example

If a `t_connect()` function fails on transport endpoint *fd2* because a bad address was given, the following call might follow the failure:

```
t_error("t_connect failed on fd2");
```

The diagnostic message to be printed would look like:

```
t_connect failed on fd2: incorrect addr format
```

where *incorrect addr format* identifies the specific error that occurred, and *t_connect failed on fd2* tells the user which function failed on which transport endpoint.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)

tfind() — Binary tree find node

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <search.h>

void *tfind(const void *key, void *const *rootp,
            int (*compar)(const void *, const void *));
```

General description

The `tfind()` function, like `tsearch()`, will search for a node in the tree, returning a pointer to it if found. However, if it is not found, the `tfind()` function will return a NULL pointer. The arguments for the `tfind()` function are the same as for the `tsearch()` function.

Comparisons are made with a user-supplied routine, the address of which is passed as the *compar* argument. This routine is called with two arguments, the pointers to the elements being compared. The user-supplied routine must return an integer less than, equal to or greater than 0, according to whether the first argument is to be considered less than, equal to or greater than the second argument. The comparison functions need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

Threading Behavior: see [“tsearch\(\) — Binary tree search” on page 1903](#).

Special behavior for C++: Because C and C++ linkage conventions are incompatible, `tfind()` cannot receive a C++ function pointer as the comparator argument. If you attempt to pass a C++ function pointer to `tfind()`, the compiler will flag it as an error. You can pass a C or C++ function to `tfind()` by declaring it as `extern "C"`.

Returned value

If the node is found, `tfind()` returns a pointer to it.

If unsuccessful, `tfind()` returns a NULL pointer.

If *rootp* is a NULL pointer on entry, *tfind()* returns a NULL pointer.

No errors are defined.

Related information

- [“search.h — Searching tables” on page 58](#)
- [“bsearch\(\) — Search arrays” on page 221](#)
- [“hsearch\(\) — Search hash tables” on page 818](#)
- [“lsearch\(\) — Linear search and update” on page 1022](#)
- [“tdelete\(\) — Binary tree delete” on page 1853](#)
- [“tsearch\(\) — Binary tree search” on page 1903](#)
- [“twalk\(\) — Binary tree walk” on page 1917](#)

t_free() — Free a library structure

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_free(char *ptr, int struct_type);
```

General description

Frees memory previously allocated by *t_alloc()*. This function frees memory for the specified structure, and also frees memory for buffers referenced by the structure.

The argument *ptr* points to one of the seven structure types described for *t_alloc()* , and *struct_type* identifies the type of that structure which must be one of the following:

| | | |
|------------|--------|------------|
| T_BIND | struct | t_bind |
| T_CALL | struct | t_call |
| T_OPTMGMT | struct | t_optmgmt |
| T_DIS | struct | t_discon |
| T_UNITDATA | struct | t_unitdata |
| T_UDERROR | struct | t_uderr |
| T_INFO | struct | t_info |

where each of these structures is used as an argument to one or more transport functions.

t_free() checks the *addr*, *opt* and *udata* fields of the given structure (as appropriate) and frees the buffers pointed to by the *buf* field of the netbuf structure. If *buf* is a NULL pointer, *t_free()* does not attempt to free memory. After all buffers are freed, *t_free()* frees the memory associated with the structure pointed to by *ptr*.

Undefined results occur if *ptr* or any of the *buf* pointers points to a block of memory that was not previously allocated by *t_alloc()*.

Valid states: All - except for T_UNINIT

Returned value

If successful, *t_free()* returns 0.

If unsuccessful, `t_free()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****TNOSTRUCTYPE**

Unsupported *struct_type* requested.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (`t_errno`).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro”](#) on page 81
- [“t_alloc\(\) — Allocate a library structure”](#) on page 1807

tgamma(), tgammaf(), tgamma1() — Calculate gamma function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R5 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double tgamma(double x);
float tgammaf(float x);
long double tgamma1(long double x);
```

C++ TR1 C99

```
#define _TR1_C99
#include <math.h>

float tgamma(float x);
long double tgamma1(long double x);
```

General description

The `tgamma` functions compute the gamma function of x . A domain error occurs if x is a negative integer or when x is zero and the result cannot be represented. A range error occurs if the magnitude of x is too large or too small.

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------------------|-----|------|
| <code>tgamma</code> | X | X |
| <code>tgammaf</code> | X | X |
| <code>tgamma1</code> | X | X |

Special behavior for IEEE: A pole error occurs if the input of tgammaf is 0 and sets errno to ERANGE. A domain error occurs if the input of tgammaf is a negative integer and sets errno to EDOM.

Returned value

The tgamma functions return $G(x)$.

tgammad32(), tgammad64(), tgammad128() - Calculate gamma function

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.10 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 tgammad32(_Decimal32 x);
_Decimal64 tgammad64(_Decimal64 x);
_Decimal128 tgammad128(_Decimal128 x);
_Decimal32 tgamma(_Decimal32 x);      /* C++ only */
_Decimal64 tgamma(_Decimal64 x);      /* C++ only */
_Decimal128 tgamma(_Decimal128 x);    /* C++ only */
```

General description

The tgamma() functions compute the gamma function of x .

These functions work in IEEE decimal floating-point format. See [“IEEE decimal floating-point” on page 97](#) for more information.

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

The tgamma functions return $G(x)$.

A domain error occurs if x is a negative integer or when x is zero and the result cannot be represented. A range error occurs if the magnitude of x is too large or too small.

Example

CELEBT24

```
/* CELEBT24
   This example illustrates the tgammad128() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x, y;
```

```

x = 5.6DL;
y = tgammad128(x);

printf("tgammad128(%DDf) = %DDf\n", x, y);
}

```

Related information

- [“math.h — Floating-point math functions” on page 40](#)

t_getinfo() — Get protocol-specific service information

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```

#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_getinfo(int fd, struct t_info *info);

```

General description

Returns the current characteristics of the underlying transport protocol and/or transport connection associated with file descriptor *fd*. The *info* pointer is used to return the same information returned by `t_open()`, although not necessarily precisely the same values. This function enables a transport user to access this information during any phase of communication. This argument points to a `t_info` structure which contains the following members:

```

long addr;      /* max size of the transport protocol address */
long options;   /* max number of bytes of protocol-specific options */
long tsdu;      /* max size of a transport service data unit (TSDU) */
long etsdu;     /* max size of an expedited transport service
                /* data unit (ETSDU)
long connect;   /* max amount of data allowed on connection
                /* establishment functions
long discon;    /* max amount of data allowed on t_snddis()
                /* and t_rcvdis() functions
long servtype;  /* sdis() functions
long servtype;  /* service type supported by the transport provider
long flags;     /* other info about the transport provider

```

The fields take on the following values:

addr

The size of a struct `sockaddr_in` is returned.

options

The value 304, which is the maximum number of bytes of options which can possibly be specified or requested, is returned.

tsdu

Zero is returned, indicating that the TCP transport provider does not support the concept of TSDUs.

etsdu

A value of -1 is returned, indicating that there is no limit on the size of an ETSDU.

connect

A value of -2 is returned, indicating that the TCP transport provider does not allow data to be sent with connection establishment functions.

discon

A value of -2 is returned, indicating that the transport provider does not allow data to be sent with the abortive release functions.

servtype

T_COTS is always returned, since this is the only service type supported.

flags

The T_SENDZERO bit is always set in this field, indicating that the TCP transport provider supports the sending of zero-length TSDUs.

If a transport user is concerned with protocol independence, the above sizes may be accessed to determine how large the buffers must be to hold each piece of information. Alternatively, the `t_alloc()` function may be used to allocate these buffers. An error results if a transport user exceeds the allowed data size on any function. The value of each field may change as a result of protocol option negotiation during connection establishment (the `t_optmgmt()` call has no effect on the values returned by `t_getinfo()`). These values will only change from the values presented to `t_open()` after the endpoint enters the T_DATAXFER state.

Valid states: All - except for T_UNINIT

Returned value

If successful, `t_getinfo()` returns 0.

If unsuccessful, `t_getinfo()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****TBADF**

The specified file descriptor does not refer to a transport endpoint.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (`t_errno`).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_alloc\(\) — Allocate a library structure” on page 1807](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)

t_getprotaddr() — Get the protocol addresses

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_getprotaddr(int fd, struct t_bind *boundaddr,
                  struct t_bind *peeraddr);
```

General description

Returns local and remote protocol addresses currently associated with the transport endpoint specified by *fd*. In *boundaddr* and *peeraddr* the user specifies *maxlen*, which is the maximum size of the address buffer, and *buf* which points to the buffer where the address is to be placed. On return, the *buf* field of *boundaddr* points to the address, if any, currently bound to *fd*, and the *len* field specifies the length of the address. If the transport endpoint is in the T_UNBND state, zero is returned in the *len* field of *boundaddr*. The *buf* field of *peeraddr* points to the address, if any, currently connected to *fd*, and the *len* field specifies the length of the address. If the transport endpoint is not in the T_DATAXFER state, zero is returned in the *len* field of *peeraddr*.

Valid states: All - except for T_UNINIT

Returned value

If successful, t_getprotaddr() returns 0.
If unsuccessful, t_getprotaddr() returns -1 and sets errno to one of the following values:

Error Code
Description

- TBADF**
The specified file descriptor does not refer to a transport endpoint.
- TBUFOVFLW**
The number of bytes allocated for an incoming argument (maxlen) is greater than 0 but not sufficient to store the value of that argument.
- TPROTO**
This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (t_errno).
- TSYSERR**
A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_bind\(\) — Bind an address to a transport endpoint” on page 1814](#)

t_getstate() — Get the current state

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_getstate(int fd);
```

General description

Returns the current state of the provider associated with the transport endpoint specified by *fd*.
Valid states: All - except for T_UNINIT

Returned value

If successful, `t_getstate()` returns the state. The current state is one of the following:

T_DATAXFER

Data transfer.

T_IDLE

Idle.

T_INCON

Incoming connection pending.

T_OUTCON

Outgoing connection pending.

T_UNBND

Unbound.

If the provider is undergoing a state transition when `t_getstate()` is called, the function will fail.

If unsuccessful, `t_getstate()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

TBADF

The specified file descriptor does not refer to a transport endpoint.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (`t_errno`).

TSTATECHNG

The transport provider is undergoing a transient state change.

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)

time(),time64() — Determine current UTC time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <time.h>

time_t time(time_t *timeptr);
```

```
#define _LARGE_TIME_API
#include <time.h>
```

```
time64_t time64(time64_t *timer);
```

General description

Determines the current UTC time.

Returned value

The `time()` function returns the value of time in seconds since the Epoch.

Returns the current UTC time. The returned value is also stored in the location given by *timeptr*. If *timeptr* is NULL, the returned value is not stored. If the calendar time is not available, the value `(time_t)-1` is returned.

`time()` returns the current value of the time-of-day (TOD) clock value obtained with the STCK instruction, rounded off to the nearest second, and normalized to the POSIX Epoch, January 1, 1970. The TOD clock value does not account for leap seconds. If you need more accuracy, use the STCK instruction or the TIME macro which does account for leap seconds using whatever value the system operator has entered for number of leap seconds in the CVT field. For more information about the STCK instruction, refer to *z/Architecture Principles of Operation*.

A returned value of 0 indicates the epoch, which was at the Coordinated Universal Time (UTC) of 00:00:00 on January 1, 1970.

The function `time64()` will behave exactly like `time()` except it will support calendar times beyond 03:14:07 UTC on January 19, 2038.

Example

CELEBT11

```
/* CELEBT11

   This example gets the time and assigns it to ltime, then uses
   the &time. function to convert the number of seconds to the
   current date and time.
   Finally, it prints a message giving the current time.

*/
#include <time.h>
#include <stdio.h>

int main(void)
{
    time_t ltime;

    time(&ltime);
    printf("The time is %s\n", ctime(&ltime));
}
```

Output

```
The time is Fri Jun 16 11:01:41 2006
```

Related information

- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“clock\(\) — Determine processor time” on page 286](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)

- “[gmtime\(\), gmtime64\(\)](#) — Convert time to broken-down UTC time” on page 811
- “[gmtime_r\(\), gmtime64_r\(\)](#) — Convert a time value to broken-down UTC time” on page 813
- “[localdtconv\(\)](#) — Date and time formatting convention inquiry” on page 986
- “[localtime\(\), localtime64\(\)](#) — Convert time and correct for local time” on page 989
- “[localtime_r\(\), localtime64_r\(\)](#) — Convert time value to broken-down local time” on page 991
- “[mktime\(\), mktime64\(\)](#) — Convert local time” on page 1084
- “[strftime\(\)](#) — Convert to formatted time” on page 1735
- “[tzset\(\)](#) — Set the time zone” on page 1918

times() — Get process and child process times

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/times.h>

clock_t times(struct tms *buffer);
```

General description

Gets processor times of interest to a process.

struct tms *buffer

Points to a memory location where `times()` can store a structure of information describing processor time used by the current process and other related processes.

`times()` returns information in a `tms` structure, which has the following elements:

clock_t tms_utime

Amount of processor time used by instructions in the calling process.

Under z/OS UNIX, this does not include processor time spent running in the kernel. It does include any processor time accumulated for the address space before it became a z/OS UNIX process.

clock_t tms_stime

Amount of processor time used by the system.

Under z/OS UNIX, this value represents kernel busy time running on behalf of the calling process. It does not include processor time performing other MVS system functions on behalf of the process.

clock_t tms_cutime

The sum of `tms_utime` and `tms_cutime` values for all waited-for child processes which have terminated.

clock_t tms_cstime

The sum of `tms_stime` and `tms_cstime` values for all terminated child processes of the calling process.

`clock_t` is an integral type determined in the `time.h` header file. It measures times in terms of *clock ticks*. The number of clock ticks in a second (for your installation) can be found in `sysconf(_SC_CLK_TCK)`.

Times for a terminated child can be determined once `wait()` or `waitpid()` have reported the child's termination.

Pthreads can not be separately clocked by the `times()` function because they do not run in a separate process like forked children do.

Returned value

If successful, `times()` returns a value giving the elapsed time since the process was last invoked (for example, at system startup). If this time value cannot be determined, `times()` returns `(clock_t)-1`.

If unsuccessful, `times()` sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|---------------|--|
| ERANGE | An overflow having occurred computing time values. |
|---------------|--|

Example

CELEBT12

```

/* CELEBT12

   This example provides the amount of processor time
   used by instructions and the system for the parent and child
   processes.

*/
#define _POSIX_SOURCE
#include <sys/times.h>
#include <time.h>
#include <sys/types.h>
#include <sys/wait.h>
#include <stdio.h>
#include <unistd.h>

main() {
    int status;
    long i, j;
    struct tms t;
    clock_t dub;

    int tics_per_second;

    tics_per_second = sysconf(_SC_CLK_TCK);

    if (fork() == 0) {
        for (i=0, j=0; i<1000000; i++)
            j += i;
        exit(0);
    }

    if (wait(&status) == -1)
        perror("wait() error");
    else if (!WIFEXITED(status))
        puts("Child did not exit successfully");
    else if ((dub = times(&t)) == -1)
        perror("times() error");
    else {
        printf("process was dubbed %f seconds ago.\n\n",
            ((double) dub)/tics_per_second);
        printf("      utime      stime\n");
        printf("parent:      %f      %f\n",
            ((double) t.tms_utime)/tics_per_second,
            ((double) t.tms_stime)/tics_per_second);
        printf("child:      %f      %f\n",
            ((double) t.tms_cutime)/tics_per_second,
            ((double) t.tms_cstime)/tics_per_second);
    }
}

```

Output

```
process was dubbed 1.600000 seconds ago.

      utime      stime
parent: 0.000000  0.020000
child:  0.320000  0.000000
```

Related information

- [“sys/times.h — Processor times” on page 71](#)
- [“time.h — Time and date” on page 75](#)
- [“exec functions” on page 442](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“time\(\),time64\(\) — Determine current UTC time” on page 1865](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)
- [“waitpid\(\) — Wait for a specific child process to end” on page 1981](#)

tinit() — Attach and initialize MTF subtasks

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | C only | |

Format

```
#include <mtf.h>

int tinit(const char *parallel_loadmod_name, int num_subtasks);
```

General description

Restriction: This function is not supported in AMODE 64.

Initializes the multitasking facility (MTF) environment under the [MVS environment](#).

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

tinit() is invoked from a main task to dynamically attach and initialize the number of subtasks specified by *num_subtasks*, where *num_subtasks* ranges from 1 to MAXTASK (which is defined in the header file mtf.h). After the subtasks have been attached and initialized by tinit(), each of the subtasks will be given a *task_id* and can then compute independent pieces of the program, in parallel with the main task, under the control of the tsched() and tsyncro() library functions.

The parallel load module (*parallel_loadmod_name*) must contain all parallel functions and reside in a partitioned data set named in the STEPLIB DD statement of the JCL that runs the program.

The tinit() function may be called by a main task only once before invoking tterm(). Invocations of tinit() after the first are one are terminated with a returned value indicating that MTF is already active.

After tterm() has been called to terminate and remove the MTF environment, or after an abend, tinit() can be called again to create a new MTF environment. The new initialization is independent of the old one and may provide a different number of tasks and/or a different parallel load module.

If `tinit()` is called from a parallel function, `tinit()` will be terminated with a returned value indicating that MTF calls cannot be issued from a parallel function.

If `tinit()` is called by a program running under IMS, CICS, or DB2, the request will not be processed and the returned value will indicate that MTF calls are not supported under these systems.

Returned value

If the subtasks have been attached successfully and the MTF environment created, `tinit()` returns `MTF_OK`.

If unsuccessful, `tinit()` sets `errno` to one of the following values:

Error Code

Description

EACTIVE

MTF has already been initialized and is active.

EAUTOALC

Automatic allocation of standard stream DD has failed.

EMODFIND

Parallel load module was not found.

EMODFMT

Parallel load module has an invalid format.

EMODREAD

Parallel load module was not successfully read.

ENAME2LNG

Parallel load module name is longer than 8 characters.

ENOMEM

There was insufficient storage for MTF-internal areas.

ESUBCALL

The MTF call was issued from a subtask.

ETASKABND

One or more subtasks have terminated abnormally.

ETASKFAIL

The attempt to attach task(s) failed.

ETASKNUM

Number of tasks specified is invalid (<1 or >MAXTASK).

EWRONGOS

MTF is not supported under IMS, CICS or DB2*.

Note: These values are macros and can be found in the `mtf.h` header file.

Related information

- [“mtf.h — Multitasking facility functions” on page 45](#)
- [“tsched\(\) — Schedule MTF subtask” on page 1902](#)
- [“tsyncro\(\) — Wait for MTF subtask termination” on page 1911](#)
- [“tterm\(\) — Terminate MTF subtasks” on page 1912](#)

t_listen() — Listen for a connect indication

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_listen(int fd, struct t_call *call);
```

General description

Listens for a connect request from a calling transport user. The argument *fd* identifies the local transport endpoint where connect indications arrive, and on return, *call* contains information describing the connect indication. The parameter *call* points to a *t_call* structure which contains the following members:

```
struct netbuf  addr;
struct netbuf  opt;
struct netbuf  udata;
int            sequence;
```

In *call*, *addr* returns the protocol address of the calling transport user. This address is in a format usable in future calls to *t_connect()*. However, *t_connect()* may fail for other reasons; For example *TADDRBUSY*. *opt* returns options associated with the connect request. *udata* is meaningless because transmission of user data is not supported across a connect request. *sequence* is a number that uniquely identifies the returned connect indication. The value of sequence enables the user to listen for multiple connect indications before responding to any of them.

Since this function returns values for the *addr*, *opt* and *udata* fields of *call*, the *maxlen* field of each must be set before issuing the *t_listen()* to indicate the maximum size of the buffer for each.

By default, *t_listen()* executes in synchronous mode and waits for a connect indication to arrive before returning to the user. However, if *O_NONBLOCK* is set using *t_open()* or *fcntl()*, *t_listen()* executes asynchronously, reducing to a poll for existing connect indications. If none are available, it returns -1 and sets *t_errno* to *TNODATA*.

Valid states: *T_IDLE*, *T_INCON*

Returned value

If successful, *t_listen()* returns 0. The TCP transport provider does not differentiate between a connect indication and the connection itself. A successful return of *t_listen()* indicates an existing connection.

If unsuccessful, *t_listen()* returns -1 and sets *errno* to one of the following values:

Error Code

Description

TBADF

The specified file descriptor does not refer to a transport endpoint.

TBADQLEN

The argument *qlen* of the endpoint referenced by *fd* is zero.

TBUFOVFLW

The number of bytes allocated for an incoming argument (*maxlen*) is greater than 0 but not sufficient to store the value of that argument. The provider's state, as seen by the user, changes to *T_INCON*, and the connect indication information to be returned in *call* is discarded. The value of sequence returned can be used to do a *t_snddis()*.

TLOOK

An asynchronous event has occurred on this transport endpoint and requires immediate attention.

TNODATA

O_NONBLOCK was set, but no connect indications had been queued.

TNOTSUPPORT

This function is not supported by the underlying transport provider.

TOUTSTATE

The function was issued in the wrong sequence on the transport endpoint referenced by *fd*.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TQFULL

The maximum number of outstanding indications has been reached for the endpoint referenced by *fd*.

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“t_accept\(\) — Accept a connect request” on page 1804](#)
- [“t_alloc\(\) — Allocate a library structure” on page 1807](#)
- [“t_bind\(\) — Bind an address to a transport endpoint” on page 1814](#)
- [“t_connect\(\) — Establish a connection with another transport user” on page 1830](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_optmgmt\(\) — Manage options for a transport endpoint” on page 1886](#)
- [“t_rcvconnect\(\) — Receive the confirmation from a connect request” on page 1894](#)

t_look() — Look at the current event on a transport endpoint

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_look(int fd);
```

General description

Returns the current event on the transport endpoint specified by *fd*. This function enables a transport provider to notify a transport user of an asynchronous event when the user is calling functions in synchronous mode. Certain events require immediate notification of the user and are indicated by a specific error, TLOOK, on the current or next function to be executed. This function also enables a transport user to poll a transport endpoint periodically for asynchronous events.

Additional functionality for handling events is provided through select and poll.

Valid states: All - except for T_UNINIT

The following list describes the asynchronous events which cause an XTI call to return with a TLOOK error:

t_accept()

T_DISCONNECT, T_LISTEN

t_connect()

T_DISCONNECT, T_LISTEN

This occurs only when a t_connect is done on an endpoint which has been bound with a *qlen* > 0 and for which a connect indication is pending.

t_listen()

T_DISCONNECT

This event indicates a disconnect on an outstanding connect indication.

t_rcv()

T_DISCONNECT

This occurs only when all pending data has been read.

t_rcvconnect()

T_DISCONNECT

t_rcvudata()

T_UDERR

t_snd()

T_DISCONNECT

t_sndudata()

T_UDERR

t_unbind()

T_LISTEN, T_DATA

T_DATA may only occur for the connectionless mode.

t_snddis()

T_DISCONNECT

Once a TLOOK error has been received on a transport endpoint using an XTI function, subsequent calls to that and other XTI functions, to which the same TLOOK error applies, will continue to return TLOOK until the event is consumed. An event causing the TLOOK error can be determined by calling t_look() and then can be consumed by calling the corresponding consuming XTI function as defined in [Table 70 on page 1873](#).

Table 70. Events and t_look()

| Event | Cleared on t_look()? | Consuming XTI functions |
|--------------|----------------------|--|
| T_LISTEN | No | t_listen() |
| T_CONNECT | No | t_{rcv}connect() In the case of the t_connect() function the T_CONNECT event is both generated and consumed by the execution of the function and is therefore not visible to the application. |
| T_DATA | No | t_rcv() |
| T_EXDATA | No | t_rcv() |
| T_DISCONNECT | No | t_rcvdis() |
| T_GODATA | Yes | t_snd() |
| T_GOEXDATA | Yes | t_snd() |

Returned value

If successful, `t_look()` returns a value that indicates which of the allowable events has occurred, or returns 0 if no event exists. One of the following events is returned:

T_CONNECT

Connect confirmation received.

T_DATA

Normal data received.

T_DISCONNECT

Disconnect received.

T_EXDATA

Expedited data received.

T_GODATA

Flow control restrictions on normal data flow that led to a TFLOW error have been lifted. Normal data may be sent again.

T_GOEXDATA

Flow control restrictions on expedited data flow that led to a TFLOW error have been lifted. Expedited data may be sent again.

T_LISTEN

Connection indication received.

If unsuccessful, `t_look()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

TBADF

The specified file descriptor does not refer to a transport endpoint.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (`t_errno`).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_snd\(\) — Send data or expedited data over a connection” on page 1904](#)
- [“t_sndudata\(\) — Send a data unit” on page 1908](#)

tmpfile() — Create temporary file

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdio.h>

FILE *tmpfile(void);
```

General description

Creates a temporary binary file. It opens the temporary file in wb+ mode. The file is automatically removed when it is closed or when the program is terminated.

Note: When the tmpfile() function is issued from multiple tasks within one address space, the temporary file names may not be unique. The execution of the tmpfile() function concurrently within one address space will result in errors. For example, an open will fail because the file is already open.

Returned value

If successful, tmpfile() returns a pointer to the stream associated with the file created.

If tmpfile() cannot open the file, it returns a NULL pointer. On normal termination (exit()), these temporary files are removed. On abnormal termination, an effort is made to remove these files.

Returned value for POSIX C

When the calling application is a z/OS UNIX program, the temporary file is created in the hierarchical file system. The file is created in the directory referred to by the TMPDIR environment variable, or '/tmp' if TMPDIR is not defined.

Special behavior for XPG4: The following are the possible values of errno:

Error Code

Description

EINTR

A signal was caught during tmpfile().

EMFILE

OPEN_MAX file descriptors are currently open in the calling process.

{FOPEN_MAX} streams are currently open in the calling process.

ENFILE

The maximum allowable number of files is currently open in the system.

ENOMEM

Insufficient storage space is available.

ENOSPC

The directory or file system which would contain the new file cannot be expanded.

Example

CELEBT13

```
/* CELEBT13

   This example creates a temporary file and if successful,
   writes tmpstring to it.
   At program termination, the file is removed.

*/
#include <stdio.h>

int main(void) {
    FILE *stream;
    char tmpstring[ ] = "This string will be written";

    {
        if((stream = tmpfile( )) == NULL)
```

```

        printf("Cannot make a temporary file\n");
    else
        fprintf(stream, "%s", tmpstring);
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)

tmpnam() — Produce temporary file name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <stdio.h>

char *tmpnam(char *string);

```

General description

Produces a valid file name that is not the same as the name of any existing file. It stores this name in *string*. If *string* is a NULL pointer, tmpnam() leaves the result in an internal static buffer. Any subsequent calls may modify this object. If *string* is not a NULL pointer, it must point to an array of at least L_tmpnam bytes. The value of L_tmpnam is defined in the stdio.h header file.

Returned value

If *string* is a NULL pointer, tmpnam() returns the pointer to the internal static object in which the generated unique name is placed. Otherwise, if *string* is not a NULL pointer, it returns the value of *string*. The tmpnam() function produces a different name each time it is called within a module up to at least TMP_MAX names. Files created using names returned by tmpnam() are not automatically discarded at the end of the program.

Returned value for POSIX C

The tmpnam() function behaves differently when a program is running with POSIX(ON).

When the __POSIX_TMPNAM environment variable is unset or is not set to NO, the file name returned is a unique file name in the UNIX file system. The directory component of the file name will be the value of the TMPDIR environment variable, or '/tmp' if TMPDIR is not defined.

When the __POSIX_TMPNAM environment variable is set to NO, the file name returned is as if the calling application were running POSIX(OFF).

Example

CELEBT14

```
/* CELEBT14

   This example calls &tmpnam. to produce a valid file name.

*/
#include <stdio.h>

int main(void)
{
    char *name1;
    if ((name1 = tmpnam(NULL)) != NULL)
        printf("%s can be used as a file name.\n", name1);
    else printf("Cannot create a unique file name\n");
}
```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fopen\(\) — Open a file” on page 571](#)

toascii() — Translate integer to a 7-bit ASCII character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

_XOPEN_SOURCE

```
#define _XOPEN_SOURCE
#include <ctype.h>

int toascii(int c);
```

_ALL_SOURCE

```
#define _ALL_SOURCE
#include <ctype.h>

int toascii(int c);
```

General description

Special behavior for `_XOPEN_SOURCE`: The `toascii()` function converts its argument to a 7-bit US-ASCII character code.

The `toascii()` function is not intended to be used to convert EBCDIC characters to ASCII, attempts to use it in this manner will not function as expected.

Special behavior for `_ALL_SOURCE`: The `toascii()` function assumes `c` modulo 256 is a single-byte EBCDIC encoding for a Latin 1 character, `<input-character>`, in the current locale. Then, `toascii()` determines to what character, `<output-character>`, `toascii()` would map `<input-character>` in an ASCII locale (for example, on an `*IX` system) and returns the EBCDIC encoding for `<output-character>` in the current locale.

For example, if the program invoking `toascii()` was compiled with `_ALL_SOURCE` defined and if the value `c` input to `toascii()` modulo 256 is the EBCDIC encoding for `<international-currency-symbol>` in the current locale, `toascii()` returns the EBCDIC encoding for `<dollar>` in the current locale because `toascii()` maps `<international-currency-symbol>` to `<dollar>` on ASCII platforms.

Returned value

EBCDIC and ASCII encodings and `<input-character>` to `<output-character>` mapping performed by `toascii()` in an IBM-1047 locale are as follows:

```

/*****
/*
/* IBM-1047 toascii table (sorted by ebcdic)
/*
/* For ISO-8859 character encoding toascii(ch) returns ch for
/* values of ch less than 128 and ch-128 for values between
/* 128 and 255, inclusive. Table below shows corresponding
/* toascii(ch) equivalence for IBM-1047 character encoding
/* of the Latin character set.
/*
/*
/* Character          IBM 1047          ISO 8859-1
/* (Symbolic Name)   (Hexadecimal)   (Hexadecimal)
/*
/* ch      toascii(ch)  ch  toascii(ch)  ch  toascii(ch)
/*
/* <NUL>    <NUL>      00      00      00      00
/* <SOH>    <SOH>      01      01      01      01
/* <STX>    <STX>      02      02      02      02
/* <ETX>    <ETX>      03      03      03      03
/* <SEL>    <IFS/IS4>  04      1C      9C      1C
/* <HT>     <HT>       05      05      09      09
/* <RNL>    <ACK>      06      2E      86      06
/* <DEL>    <DEL>      07      07      7F      7F
/* <GE>     <ETB>      08      26      97      17
/* <SPS>    <CR>       09      0D      8D      0D
/* <RPT>    <SO>       0A      0E      8E      0E
/* <VT>     <VT>       0B      0B      0B      0B
/* <FF>     <FF>       0C      0C      0C      0C
/* <CR>     <CR>       0D      0D      0D      0D
/* <SO>     <SO>       0E      0E      0E      0E
/* <SI>     <SI>       0F      0F      0F      0F
/* <DLE>    <DLE>      10      10      10      10
/* <DC1>    <DC1>      11      11      11      11
/* <DC2>    <DC2>      12      12      12      12
/* <DC3>    <DC3>      13      13      13      13
/* <RES/ENP> <IGS/IS3>  14      1D      9D      1D
/* <NL>     <NL>       15      15      0A      0A
/* <BS>     <BS>       16      16      08      08
/* <POC>    <BEL>      17      2F      87      07
/* <CAN>    <CAN>      18      18      18      18
/* <EM>     <EM>       19      19      19      19
/* <UBS>    <DC2>      1A      12      92      12
/* <CU1>    <SI>       1B      0F      8F      0F
/* <IFS/IS4> <IFS/IS4>  1C      1C      1C      1C
/* <IGS/IS3> <IGS/IS3>  1D      1D      1D      1D
/* <IRS/IS2> <IRS/IS2>  1E      1E      1E      1E
/* <IUS/IS1> <IUS/IS1>  1F      1F      1F      1F
/* <DS>     <NUL>      20      00      80      00
/* <SOS>    <SOH>      21      01      81      01
/* <FS>     <STX>      22      02      82      02
/* <WUS>    <ETX>      23      03      83      03
/* <BYP/INP> <EOT>      24      37      84      04
/* <LF>     <ENQ>      25      2D      85      05
/* <ETB>    <ETB>      26      26      17      17
/* <ESC>    <ESC>      27      27      1B      1B
/* <SA>     <BS>       28      16      88      08
/* <SFE>    <HT>       29      05      89      09
/* <SM/SW>  <NL>       2A      15      8A      0A
/* <CSP>    <VT>       2B      0B      8B      0B
/* <MFA>    <FF>       2C      0C      8C      0C
/* <ENQ>    <ENQ>      2D      2D      05      05
/* <ACK>    <ACK>      2E      2E      06      06
/* <BEL>    <BEL>      2F      2F      07      07
/* (reserved) <DLE>    30      10      90      10
/* (reserved) <DC1>    31      11      91      11

```


| | | | | | | | |
|----|-------------|-------------|----|----|----|----|----|
| /* | <SYN> | <SYN> | 32 | 32 | 16 | 16 | */ |
| /* | <IR> | <DC3> | 33 | 13 | 93 | 13 | */ |
| /* | <PP> | <DC4> | 34 | 3C | 94 | 14 | */ |
| /* | <TRN> | <NAK> | 35 | 3D | 95 | 15 | */ |
| /* | <NBS> | <SYN> | 36 | 32 | 96 | 16 | */ |
| /* | <EOT> | <EOT> | 37 | 37 | 04 | 04 | */ |
| /* | <SBS> | <CAN> | 38 | 18 | 98 | 18 | */ |
| /* | <IT> | | 39 | 19 | 99 | 19 | */ |
| /* | <RFF> | <SUB> | 3A | 3F | 9A | 1A | */ |
| /* | <CU3> | <ESC> | 3B | 27 | 9B | 1B | */ |
| /* | <DC4> | <DC4> | 3C | 3C | 14 | 14 | */ |
| /* | <NAK> | <NAK> | 3D | 3D | 15 | 15 | */ |
| /* | (reserved) | <IRS/IS2> | 3E | 1E | 9E | 1E | */ |
| /* | <SUB> | <SUB> | 3F | 3F | 1A | 1A | */ |
| /* | | | | | | | */ |
| /* | <space> | <space> | 40 | 40 | 20 | 20 | */ |
| /* | <nobrk-sp> | <space> | 41 | 40 | A0 | 20 | */ |
| /* | <a-circum> | | 42 | 82 | E2 | 62 | */ |
| /* | <a-diaere> | <d> | 43 | 84 | E4 | 64 | */ |
| /* | <a-grave> | <grave> | 44 | 79 | E0 | 60 | */ |
| /* | <a-acute> | <a> | 45 | 81 | E1 | 61 | */ |
| /* | <a-tilde> | <c> | 46 | 83 | E3 | 63 | */ |
| /* | <a-ring> | <e> | 47 | 85 | E5 | 65 | */ |
| /* | <c-cedilla> | <g> | 48 | 87 | E7 | 67 | */ |
| /* | <n-tilde> | <q> | 49 | 98 | F1 | 71 | */ |
| /* | <cent-sign> | <quote> | 4A | 7F | A2 | 22 | */ |
| /* | <period> | <period> | 4B | 4B | 2E | 2E | */ |
| /* | <lt> | <lt> | 4C | 4C | 3C | 3C | */ |
| /* | <l-paren> | <l-paren> | 4D | 4D | 28 | 28 | */ |
| /* | <plus> | <plus> | 4E | 4E | 2B | 2B | */ |
| /* | <ver-line> | <ver-line> | 4F | 4F | 7C | 7C | */ |
| /* | <ampersand> | <ampersand> | 50 | 50 | 26 | 26 | */ |
| /* | <e-acute> | <i> | 51 | 89 | E9 | 69 | */ |
| /* | <e-circum> | <j> | 52 | 91 | EA | 6A | */ |
| /* | <e-diaere> | <k> | 53 | 92 | EB | 6B | */ |
| /* | <e-grave> | <h> | 54 | 88 | E8 | 68 | */ |
| /* | <i-acute> | <m> | 55 | 94 | ED | 6D | */ |
| /* | <i-circum> | <n> | 56 | 95 | EE | 6E | */ |
| /* | <i-diaere> | <o> | 57 | 96 | EF | 6F | */ |
| /* | <i-grave> | <l> | 58 | 93 | EC | 6C | */ |
| /* | <s-sharp> | <underscr> | 59 | 6D | DF | 5F | */ |
| /* | <exclama> | <exclama> | 5A | 5A | 21 | 21 | */ |
| /* | <dollar> | <dollar> | 5B | 5B | 24 | 24 | */ |
| /* | <asterisk> | <asterisk> | 5C | 5C | 2A | 2A | */ |
| /* | <r-paren> | <r-paren> | 5D | 5D | 29 | 29 | */ |
| /* | <semicolon> | <semicolon> | 5E | 5E | 3B | 3B | */ |
| /* | <circum> | <circum> | 5F | 5F | 5E | 5E | */ |
| /* | <hyphen> | <hyphen> | 60 | 60 | 2D | 2D | */ |
| /* | <slash> | <slash> | 61 | 61 | 2F | 2F | */ |
| /* | <A-circum> | | 62 | C2 | C2 | 42 | */ |
| /* | <A-diaere> | <D> | 63 | C4 | C4 | 44 | */ |
| /* | <A-grave> | <at> | 64 | 7C | C0 | 40 | */ |
| /* | <A-acute> | <A> | 65 | C1 | C1 | 41 | */ |
| /* | <A-tilde> | <C> | 66 | C3 | C3 | 43 | */ |
| /* | <A-ring> | <E> | 67 | C5 | C5 | 45 | */ |
| /* | <C-cedilla> | <G> | 68 | C7 | C7 | 47 | */ |
| /* | <N-tilde> | <Q> | 69 | D8 | D1 | 51 | */ |
| /* | <brok-bar> | <ampersand> | 6A | 50 | A6 | 26 | */ |
| /* | <comma> | <comma> | 6B | 6B | 2C | 2C | */ |
| /* | <percent> | <percent> | 6C | 6C | 25 | 25 | */ |
| /* | <underscr> | <underscr> | 6D | 6D | 5F | 5F | */ |
| /* | <gt> | <gt> | 6E | 6E | 3E | 3E | */ |
| /* | <question> | <question> | 6F | 6F | 3F | 3F | */ |
| /* | <o-stroke> | <x> | 70 | A7 | F8 | 78 | */ |
| /* | <E-acute> | <I> | 71 | C9 | C9 | 49 | */ |
| /* | <E-circum> | <J> | 72 | D1 | CA | 4A | */ |
| /* | <E-diaere> | <K> | 73 | D2 | CB | 4B | */ |
| /* | <E-grave> | <H> | 74 | C8 | C8 | 48 | */ |
| /* | <I-acute> | <M> | 75 | D4 | CD | 4D | */ |
| /* | <I-circum> | <N> | 76 | D5 | CE | 4E | */ |
| /* | <I-diaere> | <O> | 77 | D6 | CF | 4F | */ |
| /* | <I-grave> | <L> | 78 | D3 | CC | 4C | */ |
| /* | <grave> | <grave> | 79 | 79 | 60 | 60 | */ |
| /* | <colon> | <colon> | 7A | 7A | 3A | 3A | */ |
| /* | <num-sign> | <num-sign> | 7B | 7B | 23 | 23 | */ |
| /* | <at> | <at> | 7C | 7C | 40 | 40 | */ |
| /* | <apostro> | <apostro> | 7D | 7D | 27 | 27 | */ |
| /* | <eq> | <eq> | 7E | 7E | 3D | 3D | */ |
| /* | <quote> | <quote> | 7F | 7F | 22 | 22 | */ |
| /* | <O-stroke> | <X> | 80 | E7 | D8 | 58 | */ |
| /* | <a> | <a> | 81 | 81 | 61 | 61 | */ |
| /* | | | 82 | 82 | 62 | 62 | */ |

| | | | | | | | |
|----|-------------|-------------|----|----|----|----|----|
| /* | <c> | <c> | 83 | 83 | 63 | 63 | */ |
| /* | <d> | <d> | 84 | 84 | 64 | 64 | */ |
| /* | <e> | <e> | 85 | 85 | 65 | 65 | */ |
| /* | <f> | <f> | 86 | 86 | 66 | 66 | */ |
| /* | <g> | <g> | 87 | 87 | 67 | 67 | */ |
| /* | <h> | <h> | 88 | 88 | 68 | 68 | */ |
| /* | <i> | <i> | 89 | 89 | 69 | 69 | */ |
| /* | <l-guille> | <plus> | 8A | 4E | AB | 2B | */ |
| /* | <r-guille> | <semicolon> | 8B | 5E | BB | 3B | */ |
| /* | <eth> | <p> | 8C | 97 | F0 | 70 | */ |
| /* | <y-acute> | <r-brace> | 8D | D0 | FD | 7D | */ |
| /* | <thorn> | <tilde> | 8E | A1 | FE | 7E | */ |
| /* | <plusminus> | <one> | 8F | F1 | B1 | 31 | */ |
| /* | <degree> | <zero> | 90 | F0 | B0 | 30 | */ |
| /* | <j> | <j> | 91 | 91 | 6A | 6A | */ |
| /* | <k> | <k> | 92 | 92 | 6B | 6B | */ |
| /* | <l> | <l> | 93 | 93 | 6C | 6C | */ |
| /* | <m> | <m> | 94 | 94 | 6D | 6D | */ |
| /* | <n> | <n> | 95 | 95 | 6E | 6E | */ |
| /* | <o> | <o> | 96 | 96 | 6F | 6F | */ |
| /* | <p> | <p> | 97 | 97 | 70 | 70 | */ |
| /* | <q> | <q> | 98 | 98 | 71 | 71 | */ |
| /* | <r> | <r> | 99 | 99 | 72 | 72 | */ |
| /* | <fem-ind> | <asterisk> | 9A | 5C | AA | 2A | */ |
| /* | <mas-ind> | <colon> | 9B | 7A | BA | 3A | */ |
| /* | <ae> | <f> | 9C | 86 | E6 | 66 | */ |
| /* | <cedilla> | <eight> | 9D | F8 | B8 | 38 | */ |
| /* | <AE> | <F> | 9E | C6 | C6 | 46 | */ |
| /* | <cur-sign> | <dollar> | 9F | 5B | A4 | 24 | */ |
| /* | <mu> | <five> | A0 | F5 | B5 | 35 | */ |
| /* | <tilde> | <tilde> | A1 | A1 | 7E | 7E | */ |
| /* | <s> | <s> | A2 | A2 | 73 | 73 | */ |
| /* | <t> | <t> | A3 | A3 | 74 | 74 | */ |
| /* | <u> | <u> | A4 | A4 | 75 | 75 | */ |
| /* | <v> | <v> | A5 | A5 | 76 | 76 | */ |
| /* | <w> | <w> | A6 | A6 | 77 | 77 | */ |
| /* | <x> | <x> | A7 | A7 | 78 | 78 | */ |
| /* | <y> | <y> | A8 | A8 | 79 | 79 | */ |
| /* | <z> | <z> | A9 | A9 | 7A | 7A | */ |
| /* | <inv-excl> | <exclama> | AA | 5A | A1 | 21 | */ |
| /* | <inv-ques> | <question> | AB | 6F | BF | 3F | */ |
| /* | <Eth> | <P> | AC | D7 | D0 | 50 | */ |
| /* | <l-brk> | <l-brk> | AD | AD | 5B | 5B | */ |
| /* | <Thorn> | <circum> | AE | 5F | DE | 5E | */ |
| /* | <register> | <period> | AF | 4B | AE | 2E | */ |
| /* | <not-sign> | <comma> | B0 | 6B | AC | 2C | */ |
| /* | <pound> | <num-sign> | B1 | 7B | A3 | 23 | */ |
| /* | <yen> | <percent> | B2 | 6C | A5 | 25 | */ |
| /* | <mid-dot> | <seven> | B3 | F7 | B7 | 37 | */ |
| /* | <copyright> | <r-paren> | B4 | 5D | A9 | 29 | */ |
| /* | <section> | <apostro> | B5 | 7D | A7 | 27 | */ |
| /* | <paragraph> | <six> | B6 | F6 | B6 | 36 | */ |
| /* | <1/4> | <lt> | B7 | 4C | BC | 3C | */ |
| /* | <1/2> | <eq> | B8 | 7E | BD | 3D | */ |
| /* | <3/4> | <gt> | B9 | 6E | BE | 3E | */ |
| /* | <Y acute> | <r-brk> | BA | BD | DD | 5D | */ |
| /* | <diaeresis> | <l-paren> | BB | 4D | A8 | 28 | */ |
| /* | <macron> | <slash> | BC | 61 | AF | 2F | */ |
| /* | <r-brk> | <r-brk> | BD | BD | 5D | 5D | */ |
| /* | <acute> | <four> | BE | F4 | B4 | 34 | */ |
| /* | <multiply> | <W> | BF | E6 | D7 | 57 | */ |
| /* | <l-brace> | <l-brace> | C0 | C0 | 7B | 7B | */ |
| /* | <A> | <A> | C1 | C1 | 41 | 41 | */ |
| /* | | | C2 | C2 | 42 | 42 | */ |
| /* | <C> | <C> | C3 | C3 | 43 | 43 | */ |
| /* | <D> | <D> | C4 | C4 | 44 | 44 | */ |
| /* | <E> | <E> | C5 | C5 | 45 | 45 | */ |
| /* | <F> | <F> | C6 | C6 | 46 | 46 | */ |
| /* | <G> | <G> | C7 | C7 | 47 | 47 | */ |
| /* | <H> | <H> | C8 | C8 | 48 | 48 | */ |
| /* | <I> | <I> | C9 | C9 | 49 | 49 | */ |
| /* | <soft-hyp> | <hyphen> | CA | 60 | AD | 2D | */ |
| /* | <o-circum> | <t> | CB | A3 | F4 | 74 | */ |
| /* | <o-diaere> | <v> | CC | A5 | F6 | 76 | */ |
| /* | <o-grave> | <r> | CD | 99 | F2 | 72 | */ |
| /* | <o-acute> | <s> | CE | A2 | F3 | 73 | */ |
| /* | <o-tilde> | <u> | CF | A4 | F5 | 75 | */ |
| /* | <r-brace> | <r-brace> | D0 | D0 | 7D | 7D | */ |
| /* | <J> | <J> | D1 | D1 | 4A | 4A | */ |
| /* | <K> | <K> | D2 | D2 | 4B | 4B | */ |
| /* | <L> | <L> | D3 | D3 | 4C | 4C | */ |
| /* | <M> | <M> | D4 | D4 | 4D | 4D | */ |

```

/* <N>      <N>      D5      D5      4E      4E      */
/* <O>      <O>      D6      D6      4F      4F      */
/* <P>      <P>      D7      D7      50      50      */
/* <Q>      <Q>      D8      D8      51      51      */
/* <R>      <R>      D9      D9      52      52      */
/* <super-1> <nine>   DA      F9      B9      39      */
/* <u-circum> <l-brace> DB      C0      FB      7B      */
/* <u-diaere> <ver_line> DC      4F      FC      7C      */
/* <u-grave>  <y>      DD      A8      F9      79      */
/* <u-acute>  <z>      DE      A9      FA      7A      */
/* <y-diaere> <DEL>   DF      07      FF      7F      */
/* <backslash><backslash> E0      E0      5C      5C      */
/* <division> <w>     E1      A6      F7      77      */
/* <S>        <S>     E2      E2      53      53      */
/* <T>        <T>     E3      E3      54      54      */
/* <U>        <U>     E4      E4      55      55      */
/* <V>        <V>     E5      E5      56      56      */
/* <W>        <W>     E6      E6      57      57      */
/* <X>        <X>     E7      E7      58      58      */
/* <Y>        <Y>     E8      E8      59      59      */
/* <Z>        <Z>     E9      E9      5A      5A      */
/* <super-2>  <two>   EA      F2      B2      32      */
/* <0-circum> <T>     EB      E3      D4      54      */
/* <0-diaere> <V>     EC      E5      D6      56      */
/* <0-grave>  <R>     ED      D9      D2      52      */
/* <0-acute>  <S>     EE      E2      D3      53      */
/* <0-tilde>  <U>     EF      E4      D5      55      */
/* <zero>     <zero>  F0      F0      30      30      */
/* <one>      <one>   F1      F1      31      31      */
/* <two>      <two>   F2      F2      32      32      */
/* <three>    <three> F3      F3      33      33      */
/* <four>     <four>  F4      F4      34      34      */
/* <five>     <five>  F5      F5      35      35      */
/* <six>      <six>   F6      F6      36      36      */
/* <seven>    <seven> F7      F7      37      37      */
/* <eight>    <eight> F8      F8      38      38      */
/* <nine>     <nine>  F9      F9      39      39      */
/* <super-3>  <three> FA      F3      B3      33      */
/* <U-circum> <l-brk> FB      AD      DB      5B      */
/* <U-diaere> <backslash> FC      E0      DC      5C      */
/* <U-grave>  <Y>     FD      E8      D9      59      */
/* <U-acute>  <Z>     FE      E9      DA      5A      */
/* <E0>      <IUS/IS1> FF      1F      9F      1F      */
/*
/*****

```

Special behavior for `_XOPEN_SOURCE`: The `toascii()` function returns the value `(c & 0x7f)`.

Special behavior for `_ALL_SOURCE`: If the current locale is not a single-byte locale (that is, `mb_cur_max > 1`), `toascii()` sets `errno` to **ENOSYS** and returns `-1`. Otherwise, `toascii()` assumes `c` modulo 256 is the encoding of a Latin 1 character, `<input_character>`, in the current locale and returns the EBCDIC encoding of the same or another Latin 1 character, `<output-character>`, in the current locale; where `<output-character>` corresponds to the character to which `toascii()` would map `<input-character>` on an ASCII platform.

Related information

- “[ctype.h – Character classification](#)” on page 17
- “[isascii\(\)](#) – Test for 7-bit US-ASCII character” on page 898

__toCcsid() – Convert codeset name to coded character set ID

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R2 |

Format

```
#include <_Ccsid.h>

__ccsid_t __toCcsid(char *codesetName);
```

General description

The __toCcsid() function returns the coded character set ID corresponding to the provided *codesetName* argument.

Returned value

If successful, __toCcsid() returns the corresponding CCSID for *codesetName*, if one exists. The returned __ccsid_t type is defined in <_Ccsid.h> as an unsigned short.

If unsuccessful, __toCcsid() returns 0 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|--------|--|
| EINVAL | The length of the <i>codesetName</i> argument is greater than _CSNAME_LEN_MAX as defined in header <_Ccsid.h>. |
|--------|--|

Related information

- [“_Ccsid.h – CCSID to codeset name conversion” on page 17](#)
- [“__CcsidType\(\) – Return coded character set ID type” on page 247](#)
- [“__CSNameType\(\) – Return codeset name type” on page 351](#)
- [“__toCSName\(\) – Convert coded character set ID to codeset name ” on page 1882](#)

__toCSName() – Convert coded character set ID to codeset name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R2 |

Format

```
#include <_Ccsid.h>

int __toCSName(__ccsid_t Ccsid, char *codesetName);
```

General description

The __toCSName() function returns the codeset name, corresponding to coded character codeset ID, *Ccsid*, in *codesetName*.

Returned value

If successful, __toCSName() returns 0 and stores the codeset name in *codesetName*, when a corresponding codeset name exists for *Ccsid*.

If unsuccessful, __toCSName() returns -1.

If `__toCSName()` returns -1 for a reason other than no corresponding codeset name exists, it sets `errno` to one of the following values:

Error Code
Description

EINVAL

The corresponding *codesetName* length is greater than `_CSNAME_LEN_MAX` as defined in header `<_Ccsid.h>`.

Related information

- “[_Ccsid.h — CCSID to codeset name conversion](#)” on page 17
- “[__CcsidType\(\)](#) — Return coded character set ID type” on page 247
- “[__CSNameType\(\)](#) — Return codeset name type” on page 351
- “[__toCcsid\(\)](#) — Convert codeset name to coded character set ID” on page 1881

tolower(), toupper() — Convert character case

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <ctype.h>

int tolower(int c); /* Convert c to lowercase if appropriate */
int toupper(int c); /* Convert c to uppercase if appropriate */
```

General description

Converts *c* to a lowercase letter, if possible. Conversely, the `toupper()` function converts *c* to an uppercase letter, if possible.

The DBCS is not supported. The use of characters from the DBCS results in unspecified behavior.

Returned value

If successful, `tolower()` and `toupper()` return the corresponding character, as defined in the `LC_CTYPE` category of the current locale, if such a character exists.

If unsuccessful, `tolower()` and `toupper()` return the unchanged value *c*.

Example

CELEBT15

```
/* CELEBT15

   This example demonstrates the result of using
   &toupper. and &tolower. on a lower-case a.

*/
#include <stdio.h>
```

```
#include <ctype.h>

int main(void)
{
    int ch;

    ch = 0x81;
    printf("toupper=%#04x\n", toupper(ch));
    printf("tolower=%#04x\n", tolower(ch));
}
```

Related information

- [“ctype.h — Character classification” on page 17](#)
- [“isalnum\(\) to isxdigit\(\) — Test integer value” on page 895](#)
- [“tolower\(\), toupper\(\) — Convert wide character case” on page 1892](#)

_tolower() — Translate uppercase characters to lowercase

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <ctype.h>

int _tolower(int c);
```

General description

The `_tolower()` macro is equivalent to `tolower(c)` except that the argument `c` must be an uppercase letter.

Returned value

`_tolower()` returns the lowercase letter corresponding to the argument passed.

Related information

- [“ctype.h — Character classification” on page 17](#)
- [“tolower\(\), toupper\(\) — Convert character case” on page 1883](#)

t_open() — Establish a transport endpoint

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_open(char *name, int oflag, struct t_info *info);
```

General description

t_open() must be called as the first step in the initialization of a transport endpoint. This function establishes a transport endpoint by supplying a transport provider identifier that indicates a particular transport provider (that is, transport protocol) and returning a file descriptor that identifies that endpoint.

Note: There must be at least one available file descriptor less than 65536.

The argument *name* points to a transport provider identifier. The only supported transport provider is "/dev/tcp", indicating a TCP transport provider. No device by that name actually exists in the file system. It is purely used to follow historical convention. The argument *oflag* identifies any open flags (as in open()). It is constructed from O_RDWR optionally bitwise inclusive-OR'ed with O_NONBLOCK. These flags are defined by the header <fcntl.h>. The file descriptor returned by t_open() will be used by all subsequent functions to identify the particular local transport endpoint.

This function also returns various default characteristics of the underlying transport protocol by setting fields in the *info* structure. This argument points to a t_info structure which contains the following members:

```
long addr;          /* max size of the transport protocol address */
long options;       /* max number of bytes of options */
long tsdu;          /* max size of a transport service data unit (TSDU) */
long etsdu;         /* max size of an expedited transport service data unit (ETSDU) */
long connect;       /* max amount of data allowed on connection establishment functions */
long discon;        /* max amount of data allowed on t_snddis() and t_rcvdis() functions */
long servtype;      /* service type supported by the transport provider */
long flags;         /* other info about the transport provider */
```

The fields take on the following values:

addr

The size of a struct sockaddr_in is returned.

options

The value 304, which is the maximum number of bytes of options which can possibly be specified or requested, is returned.

tsdu

Zero is returned, indicating that the TCP transport provider does not support the concept of TSUs.

etsdu

A value of -1 is returned, indicating that there is no limit on the size of an ETSDU.

connect

A value of -2 is returned, indicating that the TCP transport provider does not allow data to be sent with connection establishment functions.

discon

A value of -2 is returned, indicating that the transport provider does not allow data to be sent with the abortive release functions.

servtype

T_COTS is always returned, since this is the only service type supported.

flags

The T_SENDZERO bit is always set in this field, indicating that the TCP transport provider supports the sending of zero-length TSDUs.

If info is set to a NULL pointer by the transport user, no protocol information is returned by t_open().

Valid states: T_UNINIT

Returned value

If successful, t_open() returns a valid file descriptor.

If unsuccessful, t_open() returns -1 and sets errno to one of the following values:

Error Code**Description****TBADFLAG**

An invalid flag is specified.

TBADNAME

Invalid transport provider name.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“open\(\) — Open a file” on page 1157](#)

t_optmgmt() — Manage options for a transport endpoint

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_optmgmt(int fd, struct t_optmgmt *req, struct t_optmgmt *ret);
```

General description

Enables a transport user to retrieve, verify or negotiate protocol options with the transport provider. The argument *fd* identifies a transport endpoint. The *req* and *ret* arguments point to a t_optmgmt structure containing the following members:

```
struct netbuf    opt;
long            flags;
```

The *opt* field identifies protocol options and the *flags* field is used to specify the action to take with those options.

The options are represented by a *netbuf* structure in a manner similar to the address in *t_bind()*. The *netbuf* structure contains the following members:

| | | |
|--------------|--------|-----------------------------|
| unsigned int | maxlen | maximum buffer value length |
| unsigned int | len | actual buffer value length |
| char * | buf | pointer to buffer |

The argument *req* is used to request a specific action of the provider and to send options to the provider. The argument *len* specifies the number of bytes in the options, *buf* points to the options buffer, and *maxlen* has no meaning for the *req* argument. The transport provider may return options and flag values to the user through *ret*. For *ret*, *maxlen* specifies the maximum size of the options buffer, and *buf* points to the buffer where the options are to be placed. On return, *len* specifies the number of bytes of options returned. The value in *maxlen* has no meaning for the *req* argument, but must be set in the *ret* argument to specify the maximum number of bytes the options buffer can hold.

Each option in the options buffer is of the form struct *t_opthdr* possibly followed by an option value. The *t_opthdr* structure contains the following members:

AMODE(31):

| | | |
|---------------|--------|-----------------------------|
| unsigned long | len | sizeof(t_opthdr)+optval len |
| unsigned long | level | protocol affected |
| unsigned long | name | option value |
| unsigned long | status | status value |

AMODE(64):

| | | |
|--------------|--------|-----------------------------|
| unsigned int | len | sizeof(t_opthdr)+optval len |
| unsigned int | level | protocol affected |
| unsigned int | name | option value |
| unsigned int | status | status value |

The *level* field of struct *t_opthdr* identifies the XTI level or a protocol of the transport provider. The *name* field identifies the option within the level, and *len* contains its total length. The total length is the length of the option header *t_opthdr* plus the length of the option value. If *t_optmgmt()* is called with the action *T_NEGOTIATE* set, the *status* field of the returned options contains information about the success or failure of a negotiation.

Each option in the input or output option buffer must start at a long-word boundary. The macro *OPT_NEXTHDR(pbuf, buflen, poption)* can be used for that purpose. The parameter *pbuf* denotes a pointer to an option buffer *opt.buf*, and *buflen* is its length. The parameter *poption* points to the current option in the option buffer. *OPT_NEXTHDR* returns a pointer to the position of the next option, or returns a NULL pointer if the option buffer is exhausted. The macro is helpful for writing and reading. See “[xti.h — _XOPEN_SOURCE_EXTENDED feature test macro](#)” on page 81 for the exact definition.

If the transport user specifies several options on input, all options must address the same level.

If any option in the options buffer does not indicate the same level as the first option, or the level specified is unsupported, then the *t_optmgmt()* request will fail with *TBADOPT*. If the error is detected, some options have possibly been successfully negotiated. The transport user can check the current status by calling *t_optmgmt()* with the *T_CURRENT* flag set.

Before using this function, you should read Chapter 6 , “Use of Options in XTI”, in *X/Open CAE Specification, Networking Services, Issue 4*

The *flags* field of *req* must specify one of the following actions:

T_NEGOTIATE

This action enables the transport user to negotiate option values.

The user specifies the options of interest and their values in the buffer specified by *req->opt.buf* and *req->opt.len*. The negotiated option values are returned in the buffer pointed to by *ret->opt.buf*. The *status* field of each returned option is set to indicate the result of the negotiation. The value is *T_SUCCESS* if the proposed value was negotiated, *T_PARTSUCCESS* if a degraded value was negotiated, *T_FAILURE* if the negotiation failed (according to the negotiation rules), *T_NOTSUPPORT* if the transport provider does not support this option or illegally requests negotiation of a privileged

option, and T_READONLY if modification of a read-only option was requested. If the status is T_SUCCESS, T_FAILURE, T_NOTSUPPORT or T_READONLY, the returned option value is the same as the one requested on input.

The overall result of the negotiation is returned in *ret->flags*.

This field contains the worst single result, whereby the rating is done according to the order T_NOTSUPPORT, T_READONLY, T_FAILURE, T_PARTSUCCESS, T_SUCCESS. The value T_NOTSUPPORT is the worst result and T_SUCCESS is the best.

For each level, the option T_ALLOPT (see below) can be requested on input. No value is given with this option; only the *t_opthdr* part is specified. This input requests to negotiate all supported options of this level to their default values. The result is returned option by option in *ret->opt.buf*. (Note that depending on the state of the transport endpoint, not all requests to negotiate the default value may be successful.)

T_CHECK

This action enables the user to verify whether the options specified in *req* are supported by the transport provider.

If an option is specified with no option value (it consists only of a *t_opthdr* structure), the option is returned with its status field set to T_SUCCESS if it is supported, T_NOTSUPPORT if it is not or needs additional user privileges, and T_READONLY if it is read-only (in the current XTI state). No option value is returned.

If an option is specified with an option value, the *status* field of the returned option has the same value, as if the user had tried to negotiate this value with T_NEGOTIATE. If the status is T_SUCCESS, T_FAILURE, T_NOTSUPPORT or T_READONLY, the returned option value is the same as the one requested on input.

The overall result of the option checks is returned in *ret->flags*. This field contains the worst single result of the option checks, whereby the rating is the same as for T_NEGOTIATE.

Note that no negotiation takes place. All currently effective option values remain unchanged.

T_DEFAULT

This action enables the transport user to retrieve the default option values. The user specifies the options of interest in *req->opt.buf*. The option values are irrelevant and will be ignored. It is sufficient to specify the *t_opthdr* part of an option only. The default values are then returned in *ret->opt.buf*.

The status field returned is T_NOTSUPPORT if the protocol level does not support this option or the transport user illegally requested a privileged option, T_READONLY if the option is read-only, and set to T_SUCCESS in all other cases. The overall result of the request is returned in *ret->flags*. This field contains the worst single result, whereby the rating is the same as for T_NEGOTIATE.

For each level, the option T_ALLOPT (see below) can be requested on input. All supported options of this level with their default values are then returned. In this case, *ret->opt.maxlen* must be given at least the value *info->options* (see *t_getinfo()*, *t_open()*) before the call.

T_CURRENT

This action enables the transport user to retrieve the currently effective option values. The user specifies the options of interest in *req->opt.buf*. The option values are irrelevant and will be ignored. It is sufficient to specify the *t_opthdr* part of an option only. The currently effective values are then returned in *ret->opt.buf*.

The status field returned is T_NOTSUPPORT if the protocol level does not support this option, or the transport user illegally requested a privileged option, T_READONLY if the option is read-only, and set to T_SUCCESS in all other cases. The overall result of the request is returned in *ret->flags*. This field contains the worst single result, whereby the rating is the same as for T_NEGOTIATE.

For each level, the option T_ALLOPT (see below) can be requested on input. All supported options of this level with their currently effective values are then returned.

The option T_ALLOPT can only be used with *t_optmgmt()* and the actions T_NEGOTIATE, T_DEFAULT and T_CURRENT. It can be used with any supported level and addresses all supported options of this level.

The option has no value; it consists of a *t_opthdr* only. Since in a *t_optmgmt()* call only options of one level may be addressed, this option should not be requested together with other options. The function returns as soon as this option has been processed.

Options are independently processed in the order they appear in the input option buffer. If an option is multiply input, it depends on the implementation whether it is multiply output or whether it is returned only once.

The function *t_optmgmt()* may block under various circumstances and depending on the implementation. The function will block, for instance, if the protocol addressed by the call resides on a separate controller. It may also block due to flow control constraints. For example, if data sent previously across this transport endpoint has not yet been fully processed. If the function is interrupted by a signal, the option negotiations that have been done so far may remain valid. The behavior of the function is not changed if *O_NONBLOCK* is set.

Valid states: All - except for *T_UNINIT*

XTI-level options: XTI-level options are not specific for a particular transport provider. An XTI implementation supports none, all or any subset of the options defined below. An implementation may restrict the use of any of these options by offering them only in the privileged or read-only mode, or if *fd* relates to specific transport providers.

The subsequent options are not association-related. They may be negotiated in all XTI states except *T_UNINIT*. See Chapter 6, “Use of Options in XTI”, in *X/Open CAE Specification, Networking Services, Issue 4* for more information.

The protocol level is *XTI_GENERIC*. For this level, the following options are defined:

XTI_DEBUG

This option enables debugging. The valid values of this option are:

- None (option header only) - indicating that debug is to be turned off.
- -1 - indicating that debug output is to go to *stderr*.
- A file descriptor - indicating the destination file for debug output.

The debug output contains varying information depending on the XTI services invoked. It is meant to be used by customer support personnel.

XTI_LINGER

This option is used to linger the execution of a *t_close()* or *close()* if send data is still queued in the send buffer. The option value specifies the linger period. If a *close()* or *t_close()* is issued and the send buffer is not empty, the system attempts to send the pending data within the linger period before closing the endpoint. Data still pending after the linger period has elapsed is discarded.

Depending on the implementation, *t_close()* or *close()* either block for at maximum the linger period, or immediately return, whereupon the system holds the connection in existence for at most the linger period.

The *option* value consists of a structure *t_linger* declared as:

```
struct t_linger {
    long l_onoff; /* switch option on/off */
    long l_linger; /* linger period in seconds */
}
```

Legal values for the field *l_onoff* are:

T_NO

switch option off

T_YES

activate option

The value *l_onoff* is an absolute requirement.

The field *l_linger* determines the linger period in seconds. The transport user can request the default value by setting the field to *T_UNSPEC*. The default timeout value depends on the underlying transport

provider (it is often T_INFINITE). Legal values for this field are T_UNSPEC, T_INFINITE and all nonnegative numbers.

The *l_linger* value is not an absolute requirement. The implementation may place upper and lower limits to this value. Requests that fall short of the lower limit are negotiated to the lower limit.

Note that this option does not linger the execution of `t_snddis()`.

XTI_RCVBUF

This option is used to adjust the internal buffer size allocated for the receive buffer. The buffer size may be increased for high-volume connections, or decreased to limit the possible backlog of incoming data.

This request is not an absolute requirement. The implementation may place upper and lower limits on the option value. Requests that fall short of the lower limit are negotiated to the lower limit.

Legal values are all positive numbers.

XTI_SNDBUF

This option is used to adjust the internal buffer size allocated for the send buffer.

This request is not an absolute requirement. The implementation may place upper and lower limits on the option value. Requests that fall short of the lower limit are negotiated to the lower limit.

Legal values are all positive numbers.

TCP-level options: The protocol level is INET_TCP. The following TCP-level options are supported. They are not association-related.

TCP_KEEPALIVE

If this option is set, a keep-alive timer is activated to monitor idle connections that might no longer exist. If a connection has been idle since the last keep-alive timeout, a keep-alive packet is sent to check if the connection is still alive or broken.

The option value consists of a structure *t_kpalive* declared as:

```
struct t_kpalive {
    long    kp_onoff;        /* switch option on/off */
    long    kp_timeout;      /* keep-alive timeout in minutes */
}
```

Legal values for the field *kp_onoff* are:

T_NO

switch keep-alive timer off

T_YES

activate keep-alive timer

The field *kp_timeout* determines the frequency of keep-alive packets being sent, in minutes. The transport user can request the default value by setting the field to T_UNSPEC. The default is 120 minutes. Legal values for this field are T_UNSPEC and all positive numbers.

The timeout value is not an absolute requirement. However, no limits are currently specified by the TCP transport provider.

IP-level options: The protocol level is INET_IP. The following IP-level options are supported. They are not association-related.

IP_REUSEADDR

Generally, users are not allowed to bind more than one transport endpoint to addresses with identical port numbers. If IP_REUSEADDR is set to T_YES this restriction is relaxed in the sense that it is now permissible to bind a transport endpoint to an address with a port number and an under-specified internet address and further endpoints to addresses with the same port number and (mutually exclusive) fully specified internet addresses.

Returned value

If successful, `t_optmgmt()` returns 0.

If unsuccessful, `t_optmgmt()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

TACCES

The user does not have permission to negotiate the specified options.

TBADF

The specified file descriptor does not refer to a transport endpoint.

TBADFLAG

An invalid flag was specified.

TBADOPT

The specified options were in an incorrect format or contained illegal information.

TBUFOVFLW

The number of bytes allowed for an incoming argument (*maxlen*) is greater than 0 but not sufficient to store the value of that argument. The information to be returned in *ret* will be discarded.

TNOTSUPPORT

This action is not supported by the transport provider.

TOUTSTATE

The function was issued in the wrong sequence.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_accept\(\) — Accept a connect request” on page 1804](#)
- [“t_alloc\(\) — Allocate a library structure” on page 1807](#)
- [“t_connect\(\) — Establish a connection with another transport user” on page 1830](#)
- [“t_getinfo\(\) — Get protocol-specific service information” on page 1862](#)
- [“t_listen\(\) — Listen for a connect indication” on page 1870](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_rcvconnect\(\) — Receive the confirmation from a connect request” on page 1894](#)
- *X/Open CAE Specification, Networking Services, Issue 4*, Chapter 6 “Use of Options in XTI”.

_toupper() — Translate lowercase characters to uppercase

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <ctype.h>

int _toupper(int c);
```

General description

The `_toupper()` macro is equivalent to `toupper(c)` except that the argument `c` must be a lowercase letter.

Returned value

`_toupper()` returns the uppercase letter corresponding to the argument passed.

Related information

- [“ctype.h — Character classification” on page 17](#)
- [“isalnum\(\) to isxdigit\(\) — Test integer value” on page 895](#)
- [“tolower\(\), toupper\(\) — Convert character case” on page 1883](#)

tolower(), toupper() — Convert wide character case

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wctype.h>

wint_t tolower(wint_t wc);
wint_t toupper(wint_t wc);
```

General description

Converts `wc` to the corresponding lowercase letter. The `toupper()` function converts `wc` to the corresponding uppercase letter.

Returned value

If `wc` is a wide character for which `iswupper()` (or `iswlower()`) is true and there is a corresponding wide character for which `iswlower()` (or `iswupper()`) is true, `tolower()` (or `toupper()`) returns the corresponding wide character; otherwise, `wc` is returned unchanged.

Related information

- [“wctype.h — Wide character properties” on page 81](#)
- [“iswalnum\(\) to iswxdigit\(\) — Test wide integer value” on page 920](#)
- [“tolower\(\), toupper\(\) — Convert character case” on page 1883](#)

towctrans() – Transliterate wide character transliteration

The information for this function is included in “wctrans(), towctrans() – Transliterate wide character ” on page 2041.

t_rcv() – Receive data or expedited data sent over a connection

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_rcv(int fd, char *buf, unsigned int nbytes, int *flags);
```

General description

Receives either normal or expedited data. The argument *fd* identifies the local transport endpoint through which data will arrive. *buf* points to a receive buffer where user data is placed. *nbytes* specifies the size of the receive buffer. The argument *flags* may be set on return from *t_rcv()* and specifies optional flags as described below.

By default, *t_rcv()* operates in synchronous mode and will wait for data to arrive if none is currently available. However, if *O_NONBLOCK* is set (using *t_open()* or *fcntl()*), *t_rcv()* will execute in asynchronous mode and will fail if no data is available. (See *TNODATA* below.)

On return from the call, if *T_MORE* is set in *flags*, this indicates that there is more data, and the current expedited transport service data unit (ETSDU) must be received in multiple *t_rcv()* calls. In the asynchronous mode, the *T_MORE* flag may be set on return from the *t_rcv()* call even when the number of bytes received is less than the size of the receive buffer specified. Each *t_rcv()* with the *T_MORE* flag set indicates that another *t_rcv()* must follow to get more data for the current ETSDU. The end of the ETSDU is identified by the return of a *t_rcv()* call with the *T_MORE* flag not set. The *T_MORE* flag is not meaningful for normal data when using the TCP transport provider and should be ignored. If *nbytes* is greater than zero on the call to *t_rcv()* , *t_rcv()* will return 0 only if the end of a TSDU is being returned to the user.

On return, the data returned is expedited data if *T_EXPEDITED* is set in *flags*. If the number of bytes of expedited data exceeds *nbytes*, *t_rcv()* will set *T_EXPEDITED* and *T_MORE* on return from the initial call. Subsequent calls to retrieve the remaining ETSDU will have *T_EXPEDITED* set on return. The end of the ETSDU is identified by the return of a *t_rcv()* call with the *T_MORE* flag not set.

In synchronous mode, the only way for the user to be notified of the arrival of normal or expedited data is to issue this function or check for the *T_DATA* or *T_EXDATA* events using the *t_look()* function. Additionally, the process can arrange to be notified by the select/poll interface.

Valid states: *T_DATAXFER*

Returned value

If successful, *t_rcv()* returns the number of bytes received.

If unsuccessful, *t_rcv()* returns -1 and sets *errno* to one of the following values:

Error Code

Description

TBADF

The specified file descriptor does not refer to a transport endpoint.

TLOOK

An asynchronous event has occurred on this transport endpoint and requires immediate attention.

TNODATA

O_NONBLOCK was set, but no data is currently available from the transport provider.

TNOTSUPPORT

This function is not supported by the underlying transport provider.

TOUTSTATE

The function was issued in the wrong sequence on the transport endpoint referenced by *fd*.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“t_getinfo\(\) — Get protocol-specific service information” on page 1862](#)
- [“t_look\(\) — Look at the current event on a transport endpoint” on page 1872](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_snd\(\) — Send data or expedited data over a connection” on page 1904](#)

t_rcvconnect() — Receive the confirmation from a connect request

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_rcvconnect(int fd, struct t_call *call);
```

General description

Enables a calling transport user to determine the status of a previously sent connect request. *t_rcvconnect()* is used in conjunction with *t_connect()* to establish a connection in asynchronous mode. The connection will be established on successful completion of this function.

The argument *fd* identifies the local transport endpoint where communication will be established, and *call* contains information associated with the newly established connection. The argument *call* points to a *t_call* structure which contains the following members:

```
struct netbuf  addr;
struct netbuf  opt;
struct netbuf  udata;
int            sequence;
```


In *call*, *addr* returns the protocol address associated with the responding transport endpoint. *opt* presents any options associated with the connection. *udata* is meaningless since the TCP transport provider does not support transmission of user data during connection establishment. *sequence* has no meaning for this function.

The *maxlen* field of each argument must be set before issuing this function to indicate the maximum size of the buffer for each. However, *call* may be a NULL pointer, in which case no information is given to the user on return from `t_rcvconnect()`. By default, `t_rcvconnect()` executes in synchronous mode and waits for the connection to be established before returning. On return, the *addr* field contains the address of the remote endpoint, and *opt* reflects the result of negotiation of the options the user specified on input.

If `O_NONBLOCK` is set (using `t_open()` or `fcntl()`), `t_rcvconnect()` executes in asynchronous mode, and reduces to a poll for existing connect confirmations. If none are available, `t_rcvconnect()` fails and returns immediately without waiting for the connection to be established. (See `TNODATA` below.) In this case, `t_rcvconnect()` must be called again to complete the connection establishment phase and retrieve the information returned in *call*.

Valid states: `T_OUTCON`

Returned value

If successful, `t_rcvconnect()` returns 0.

If unsuccessful, `t_rcvconnect()` returns -1 and sets `errno` to one of the following values:

Error Code Description

TBADF

The specified file descriptor does not refer to a transport endpoint.

TBUFOVFLW

The number of bytes allocated for an incoming argument (*maxlen*) is greater than 0 but not sufficient to store the value of that argument, and the connect information to be returned in *call* will be discarded. The provider's state, as seen by the user, will be changed to `T_DATAXFER`.

TLOOK

An asynchronous event has occurred on this transport connection and requires immediate attention.

TNODATA

`O_NONBLOCK` was set, but a connect confirmation has not yet arrived.

TNOTSUPPORT

This function is not supported by the underlying transport provider.

TOUTSTATE

The function was issued in the wrong sequence on the transport endpoint referenced by *fd*.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_accept\(\) — Accept a connect request” on page 1804](#)
- [“t_alloc\(\) — Allocate a library structure” on page 1807](#)
- [“t_bind\(\) — Bind an address to a transport endpoint” on page 1814](#)
- [“t_connect\(\) — Establish a connection with another transport user” on page 1830](#)
- [“t_listen\(\) — Listen for a connect indication” on page 1870](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)

- [“t_optmgmt\(\) — Manage options for a transport endpoint” on page 1886](#)

t_rcvdis() — Retrieve information from disconnect

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_rcvdis(int fd, struct t_discon *discon);
```

General description

Used to identify the cause of a disconnect. The argument *fd* identifies the local transport endpoint where the connection existed, and *discon* points to a *t_discon* structure containing the following members:

```
struct netbuf    udata;
int              reason;
int              sequence;
```

The field *reason* specifies the reason for the disconnect through a protocol-dependent reason code, *udata* is always empty since the TCP transport provider does not support sending of user data with a disconnect, and *sequence* may identify an outstanding connect indication with which the disconnect is associated. The field *sequence* is only meaningful when *t_rcvdis()* is issued by a passive transport user who has executed one or more *t_listen()* functions and is processing the resulting connect indications. If a disconnect indication occurs, *sequence* can be used to identify which of the outstanding connect indications is associated with the disconnect.

If a user does not care if there is incoming data and does not need to know the value of *reason* or *sequence*, *discon* may be a NULL pointer. However, if a user has retrieved more than one outstanding connect indication (using *t_listen()*) and *discon* is a NULL pointer, the user will be unable to identify with which connect indication the disconnect is associated.

Valid states: T_DATAXFER,T_OUTCON,T_INCON(ocnt > 0)

Returned value

If successful, *t_rcvdis()* returns 0.

If unsuccessful, *t_rcvdis()* returns -1 and sets *errno* to one of the following values:

Error Code

Description

TBADF

The specified file descriptor does not refer to a transport endpoint.

TBUFOVFLW

The number of bytes allocated for incoming data (*maxlen*) is greater than 0 but not sufficient to store the data. If *fd* is a passive endpoint with *ocnt* > 1, it remains in state T_INCON; otherwise, the endpoint state is set to T_IDLE.

TNODIS

No disconnect indication currently exists on the specified transport endpoint.

TNOTSUPPORT

This function is not supported by the underlying transport provider.

TOUTSTATE

The function was issued in the wrong sequence on the transport endpoint referenced by *fd*.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_alloc\(\) — Allocate a library structure” on page 1807](#)
- [“t_connect\(\) — Establish a connection with another transport user” on page 1830](#)
- [“t_listen\(\) — Listen for a connect indication” on page 1870](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_snddis\(\) — Send user-initiated disconnect request” on page 1906](#)

t_rcvrel() — Acknowledge receipt of an orderly release indication

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_rcvrel(int fd);
```

General description

Since orderly release is not supported, this function always fails.

Returned value

t_rcvrel() always returns -1 and sets *t_errno* to TNOTSUPPORT.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_getinfo\(\) — Get protocol-specific service information” on page 1862](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_sndrel\(\) — Initiate an orderly release” on page 1907](#)

t_rcvudata() – Receive a data unit

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_rcvudata(int fd, struct t_unitdata *unitdata, int *flags);
```

General description

T_CLTS service is not supported in this implementation, so this function always fails.

Returned value

t_rcvudata() always returns -1 and sets t_errno to TNOTSUPPORT.

Related information

- [“xti.h – _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_open\(\) – Establish a transport endpoint” on page 1884](#)
- [“t_sndudata\(\) – Send a data unit” on page 1908](#)
- [“t_rcvuderr\(\) – Receive a unit data error indication” on page 1898](#)

t_rcvuderr() – Receive a unit data error indication

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_rcvuderr(int fd, struct t_uderr *uderr);
```

General description

T_CLTS service is not supported in this implementation, so this function always fails.

Returned value

t_rcvuderr() always returns -1 and sets t_errno to TNOTSUPPORT.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro”](#) on page 81
- [“t_open\(\) — Establish a transport endpoint”](#) on page 1884
- [“t_rcvudata\(\) — Receive a data unit”](#) on page 1898
- [“t_sndudata\(\) — Send a data unit”](#) on page 1908

trunc(), truncf(), trunc() — Truncate an integer value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R5 |

Format

```
#define _ISOC99_SOURCE
#include <math.h>

double trunc(double x);
float truncf(float x);
long double Trunc1(long double x);
```

C++ TR1 C99

```
#define _TR1_C99
#include <math.h>

float trunc(float x);
long double trunc(long double x);
```

General description

The trunc functions round x to the integer value, in floating-point format, nearest to but no larger in magnitude than x .

Note: The following table shows the viable formats for these functions. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

| Function | Hex | IEEE |
|----------|-----|------|
| trunc | X | X |
| truncf | X | X |
| trunc1 | X | X |

Returned value

The trunc functions return the truncated integer value of x .

Related information

- [“math.h — Floating-point math functions”](#) on page 40

truncd32(), truncd64(), truncd128() – Truncate an integer value

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <math.h>

_Decimal32 truncd32(_Decimal32 x);
_Decimal64 truncd64(_Decimal64 x);
_Decimal128 truncd128(_Decimal128 x);
_Decimal32 trunc(_Decimal32 x); /* C++ only */
_Decimal64 trunc(_Decimal64 x); /* C++ only */
_Decimal128 trunc(_Decimal128 x); /* C++ only */
```

General description

The trunc functions round *x* to the integer value, in decimal floating-point format, nearest to but no larger in magnitude than *x*.

Notes:

1. To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.
2. These functions work in IEEE decimal floating-point format. See "IEEE Decimal Floating-Point" for more information.

Returned value

The trunc functions return the truncated integer value of *x*.

Example

```
/* CELEBT21
   This example illustrates the truncd128() function.
*/

#define __STDC_WANT_DEC_FP__
#include <math.h>
#include <stdio.h>

int main(void)
{
    _Decimal128 x = 123456789.40DL, y;

    y = truncd128(x);

    printf("The result of truncd128(%DDf) is %DDf\n", x, y);
}
```

Related information

- [“math.h — Floating-point math functions” on page 40](#)
- [“trunc\(\), truncf\(\), trunci\(\) — Truncate an integer value” on page 1899](#)

truncate() — Truncate a file to a specified length

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int truncate(const char *path, off_t length);
```

General description

Truncates the file indicated by the *path* to the indicated *length*. The calling process must have write permission for the file. If the file size exceeds *length*, any extra data is discarded. If the file size is smaller than *length*, bytes between the old and new lengths are read as zeros. A change to the size of the file has no impact on the file offset.

If truncate() would cause the file size to exceed the soft file size limit for the process, truncate() will fail and a SIGXFSZ signal will be generated for the process.

If successful, truncate() marks the st_ctime and st_mtime fields of the file.

If unsuccessful, the file is unchanged.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, truncate() returns 0.

If unsuccessful, truncate() returns -1 and sets errno to one of the following values:

Error Code

Description

EFBIG

The length argument was greater than the maximum file size.

EINTR

A signal was caught during execution

EINVAL

path does not refer to a regular file, or the length specified is incorrect.

EIO

An I/O error occurred while reading from or writing to a file system.

EISDIR

The file specified is a directory. The system cannot perform the requested function on a directory.

EROFS

The file resides on a read-only file system.

Related information

- [“ftruncate\(\) — Truncate a file” on page 663](#)
- [“open\(\) — Open a file” on page 1157](#)

tsched() — Schedule MTF subtask

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | C only | |

Format

```
#include <mtf.h>

int tsched(int task_id, const char *func_name, ...);
```

General description

Restriction: This function is not supported in AMODE 64.

The `tsched()` built-in library function is used to schedule parallel functions under the [MVS environment](#).

The `tsched()` library function schedules a parallel function (*func_name*) to be executed in a subtask that has been attached and initialized by `tinit()`. The first argument *task_id* can be used to specify the task where the parallel function is to be executed. The *task_id* can be set to `MTF_ANY` to indicate that the parallel function can be run in any task or, *task_id* can be set to a specific task number between 1 and the number of subtasks specified on `tinit()`.

The `tsched()` function allocates approximately 2K of space as a work area. This work area is not freed. However, a call to the `tsyncro()` function will make work areas previously allocated by `tsched()` available for reuse by `tsched()`. Because `tsched()` does not free the work area storage, it is possible the `tsched()` will cause an application Short on Storage condition to occur if enough calls are made to the `tsched()` function.

You can call `tsched()` from your main C task as often as necessary to schedule parallel functions for execution. If all of the subtasks are busy running previously scheduled functions, each call in excess of the number of subtasks will cause *func_name* to be run after previously scheduled functions in the first qualifying subtask that becomes available.

All scheduled functions must be computationally independent. A function cannot use variables that are modified by another scheduled function or the scheduling function. To determine if all other scheduled functions have completed, use the `tsyncro()` library function (see [“tsyncro\(\) — Wait for MTF subtask termination” on page 1911](#)).

The name of the parallel function, *func_name*, must not be longer than 8 characters. If it is, the name will be truncated to the first 8 characters with no warning.

Usually `tsched()` returns to the calling main task program before the scheduled parallel function has completed execution. Therefore, you must call `tsyncro()` to ensure that your parallel functions have completed execution.

If `tinit()` has not been successfully called before `tsched()`, `tsched()` indicates that MTF is inactive.

If `tinit()` is called by a program running under IMS, CICS, or DB2, the request will not be processed and the returned value will indicate that MTF calls are not supported under these systems.

Note: This function is *not* supported under the z/OS UNIX with the POSIX(ON) runtime option.

Returned value

If successful, scheduling the parallel function for execution in a subtask, `tsched()` returns `MTF_OK`.

If unsuccessful, `tsched()` returns one of the following values:

Error Code

Description

EBADLNKG

`tsched()` has been invoked using an invalid linkage. The header file `mtf.h` may have been missing from the source at compile.

EENTRY

The parallel function was not found in the parallel module.

EINACTIVE

MTF is inactive.

ENOMEM

There was insufficient storage for MTF-internal areas.

ETASKABND

One or more subtasks have terminated abnormally.

ETASKID

The `task_id` specified is not valid.

Note: These values are macros. They can be found in the `mtf.h` header file.

Related information

- [“mtf.h — Multitasking facility functions” on page 45](#)
- [“tinit\(\) — Attach and initialize MTF subtasks” on page 1869](#)
- [“tsyncro\(\) — Wait for MTF subtask termination” on page 1911](#)
- [“tterm\(\) — Terminate MTF subtasks” on page 1912](#)

tsearch() — Binary tree search

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <search.h>

void *tsearch(const void *key, void **rootp,
              int (*compar)(const void *, const void *));
```

General description

The `tsearch()` function is used to build and access a binary search tree. The `key` argument is a pointer to an element to be accessed or stored. If there is a node in the tree whose element is equal to the value pointed to by `key`, a pointer to this found node is returned. Otherwise, the value pointed to by `key` is inserted (that is, a new node is created and the value of `key` is copied to this node), and a pointer to this node returned. Only pointers are copied, so the calling routine must store the data. The `rootp` argument points to a variable that points to the root node of the tree. A NULL pointer value for the variable pointed

to by *rootp* denotes an empty tree; in this case, the variable will be set to point to the node which will be at the root of the new tree.

Comparisons are made with a user-supplied routine, the address of which is passed as the *compar* argument. This routine is called with two arguments, the pointers to the elements being compared. The user-supplied routine must return an integer less than, equal to or greater than 0, according to whether the first argument is to be considered less than, equal to or greater than the second argument. The comparison functions need not compare every byte, so arbitrary data may be contained in the elements in addition to the values being compared.

Threading Behavior: Since the tree is anchored by the user's *rootp* pointer, the tree storage is visible to the user and could be shared among threads. The user would be responsible for serializing access to a shared tree. There are no variables related to these functions which are internal to the library and/or give rise to multithreading considerations.

Special behavior for C++: Because C and C++ linkage conventions are incompatible, `tsearch()` cannot receive a C++ function pointer as the comparator argument. If you attempt to pass a C++ function pointer to `tsearch()`, the compiler will flag it as an error. You can pass a C or C++ function to `tsearch()` by declaring it as `extern "C"`.

Returned value

If the node is found, `tsearch()` returns a pointer to it, otherwise it returns a pointer to the inserted item.

If there is not enough space available to create a new node, or if *rootp* is a NULL pointer on entry, `tsearch()` returns a NULL pointer.

No errors are defined.

Related information

- [“search.h — Searching tables” on page 58](#)
- [“bsearch\(\) — Search arrays” on page 221](#)
- [“hsearch\(\) — Search hash tables” on page 818](#)
- [“lsearch\(\) — Linear search and update” on page 1022](#)
- [“tdelete\(\) — Binary tree delete” on page 1853](#)
- [“tfind\(\) — Binary tree find node” on page 1858](#)
- [“twalk\(\) — Binary tree walk” on page 1917](#)

t_snd() — Send data or expedited data over a connection

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_snd(int fd, char *buf, unsigned int nbytes, int flags);
```

General description

Sends either normal or expedited data. The argument *fd* identifies the local transport endpoint over which data should be sent, *buf* points to the user data, *nbytes* specifies the number of bytes of user data to be sent, and *flags* specifies any optional flags described below:

T_EXPEDITED

If set in *flags*, the data will be sent as expedited data and will be subject to the interpretations of the transport provider.

T_MORE

Since the TCP transport provider does not support the concept of a TSDU, the T_MORE flag is not meaningful and will be ignored if set.

By default, `t_snd()` operates in synchronous mode and may wait if flow control restrictions prevent the data from being accepted by the local transport provider at the time the call is made. However, if `O_NONBLOCK` is set (using `t_open()` or `fcntl()`), `t_snd()` will execute in asynchronous mode, and will fail immediately if there are flow control restrictions. The process can arrange to be informed when the flow control restrictions are cleared using either `t_look()` or `select/poll`.

If successful, `t_snd()` returns the number of bytes accepted by the transport provider. Normally this will equal the number of bytes specified in *nbytes*. However, if `O_NONBLOCK` is set, it is possible that only part of the data will actually be accepted by the transport provider. In this case, `t_snd()` will return a value that is less than the value of *nbytes*.

The size of each TSDU or ETSDU must not exceed the limits of the transport provider as specified by the current values in the TSDU or ETSDU fields in the *info* argument returned by `t_getinfo()`. The error `TL00K` may be returned to inform the process that an event (for example, a disconnect) has occurred.

Valid states: T_DATAXFER

Returned value

If successful, `t_snd()` returns the number of bytes accepted by the transport provider.

Note that in asynchronous mode, if the number of bytes accepted by the transport provider is less than the number of bytes requested, this may indicate that the transport provider is blocked due to flow control.

If unsuccessful, `t_snd()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

TBADDATA

Illegal amount of data:

- A single send was attempted specifying a TSDU (ETSDU) or fragment TSDU (ETSDU) greater than that specified by the current values of the TSDU or ETSDU fields in the *info* argument.
- Multiple sends were attempted resulting in a TSDU (ETSDU) larger than that specified by the current value of the TSDU or ETSDU fields in the *info* argument

TBADF

The specified file descriptor does not refer to a transport endpoint.

TBADFLAG

An invalid flag was specified.

TFLOW

`O_NONBLOCK` was set, but the flow control mechanism prevented the transport provider from accepting any data at this time.

TLOOK

An asynchronous event has occurred on this transport endpoint.

TNOTSUPPORT

This function is not supported by the underlying transport provider.

TOUTSTATE

The function was issued in the wrong sequence on the transport endpoint referenced by *fd*.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (*t_errno*).

TSYSERR

A system error has occurred during execution of this function.

It is important to remember that the transport provider treats all users of a transport endpoint as a single user. Therefore if several processes issue concurrent *t_snd()* calls then the different data may be intermixed. Multiple sends which exceed the maximum TSDU or ETSDU size may not be discovered by XTI. In this case an implementation-dependent error will result (generated by the transport provider) perhaps on a subsequent XTI call. This error may take the form of a connection abort, a *TSYSERR*, a *TBADDATA* or a *TPROTO* error. If multiple sends which exceed the maximum TSDU or ETSDU size are detected by XTI, *t_snd()* fails with *TBADDATA*.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_getinfo\(\) — Get protocol-specific service information” on page 1862](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_rcv\(\) — Receive data or expedited data sent over a connection” on page 1893](#)

t_snddis() — Send user-initiated disconnect request

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_snddis(int fd, struct t_call *call);
```

General description

Initiates an abortive release on an already established connection, or rejects a connect request. The argument *fd* identifies the local transport endpoint of the connection, and *call* specifies information associated with the abortive release. The argument *call* points to a *t_call* structure which contains the following members:

```
struct netbuf  addr;
struct netbuf  opt;
struct netbuf  udata;
int            sequence;
```

The values in *call* have different semantics, depending on the context of the call to *t_snddis()*. When rejecting a connect request, *call* must be non-NULL and contain a valid value of *sequence* to uniquely identify the rejected connect indication to the transport provider. The *sequence* field is only meaningful if the transport connection is in the *T_INCON* state. The *addr* and *opt* fields of *call* are ignored. In all other cases, *call* should be a NULL pointer, since its only use would be to specify user data to be passed on the disconnect request, which is not supported by the TCP transport provider.

t_snddis() is an abortive disconnect. Therefore a t_snddis() issued on a connection endpoint may cause data previously sent using t_snd(), or data not yet received, to be lost (even if an error is returned).

Because of implementation restrictions, a t_snddis() called on one descriptor referring to an endpoint will not affect descriptors in other processes referring to the same endpoint. If descriptors in multiple processes refer to the same endpoint, the endpoint will not actually be disconnected by a t_snddis in one process. Multiple processes cooperating on an endpoint are responsible for providing their own explicit synchronization to support coordinated disconnects.

Valid states: T_DATAXFER, T_OUTCON, T_INCON(ocnt > 0)

Returned value

If successful, t_snddis() returns 0.

If unsuccessful, t_snddis() returns -1 and sets errno to one of the following values:

Error Code

Description

TBADDATA

The amount of user data specified was not within the bounds allowed by the transport provider.

TBADF

The specified file descriptor does not refer to a transport endpoint.

TBADSEQ

An invalid sequence number was specified, or a NULL *call* pointer was specified, when rejecting a connect request.

TLOOK

An asynchronous event, which requires attention, has occurred.

TNOTSUPPORT

This function is not supported by the underlying transport provider.

TOUTSTATE

The function was issued in the wrong sequence on the transport endpoint referenced by *fd*.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (t_errno).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_connect\(\) — Establish a connection with another transport user” on page 1830](#)
- [“t_getinfo\(\) — Get protocol-specific service information” on page 1862](#)
- [“t_listen\(\) — Listen for a connect indication” on page 1870](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)

t_sndrel() — Initiate an orderly release

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_sndrel(int fd);
```

General description

Since orderly release is not supported, `t_sndrel()` always fails.

Returned value

`t_sndrel()` always returns -1 and sets `t_errno` to TNOTSUPPORT.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_getinfo\(\) — Get protocol-specific service information” on page 1862](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_rcvrel\(\) — Acknowledge receipt of an orderly release indication” on page 1897](#)

t_sndudata() — Send a data unit

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_sndudata(int fd, struct t_unitdata *unitdata);
```

General description

T_CLTS service is not supported in this implementation, so this function always fails.

Returned value

`t_sndudata()` always returns -1 and sets `t_errno` to TNOTSUPPORT.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_open\(\) — Establish a transport endpoint” on page 1884](#)
- [“t_rcvudata\(\) — Receive a data unit” on page 1898](#)
- [“t_rcvuderr\(\) — Receive a unit data error indication” on page 1898](#)

t_strerror() — Produce an error message string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

char *t_strerror(int errnum);
```

General description

Maps the error number in *errnum* that corresponds to an XTI error to a language-dependent error message string and returns a pointer to the string. The string pointed to should not be modified by the program, but may be overwritten by a subsequent call to the `t_strerror` function. The string is not terminated by a newline character. If the calling program is operating in any one of the C, POSIX, SAA or S370 locales, then the error message string describing the value in *t_errno* is identical to the comments following the *t_errno* codes defined in `<xti.h>`. Note that no message number is prefixed to the message text in this situation. If an error code is unknown, and the language is English, `t_strerror()` returns the string:

```
"<error>: error unknown"
```

where `<error>` is the error number supplied as input. In other languages, an equivalent text is provided.

Valid states: All - except for T_UNINIT

Returned value

`t_strerror()` returns a pointer to the generated message string.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro”](#) on page 81
- [“t_error\(\) — Produce error message”](#) on page 1857

t_sync() — Synchronize transport library

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_sync(int fd);
```

General description

Synchronizes the data structures managed by the transport library with information from the underlying transport provider, for the transport endpoint specified by *fd*. In doing so, it can convert an uninitialized file descriptor (obtained using `open()`, `dup()`, or as a result of a `fork()` and `exec()`) to an initialized transport endpoint, assuming that the file descriptor referenced a transport endpoint, by updating and allocating the necessary library data structures. This function also allows two cooperating processes to synchronize their interaction with a transport provider.

For example, if a process forks a new process and issues an `exec()` , the new process must issue a `t_sync()` to build the private library data structure associated with a transport endpoint and to synchronize the data structure with the relevant provider information.

It is important to remember that the transport provider treats all users of a transport endpoint as a single user. If multiple processes are using the same endpoint, they should coordinate their activities so as not to violate the state of the transport endpoint. The function `t_sync()` returns the current state of the transport endpoint to the user, thereby enabling the user to verify the state before taking further action. This coordination is only valid among cooperating processes. It is possible that a process or an incoming event could change the endpoint's state after a `t_sync()` is issued.

If the transport endpoint is undergoing a state transition when `t_sync()` is called, the function will fail.

Valid states: All - except for `T_UNINIT`

Returned value

If successful, `t_sync()` returns the state of the transport endpoint. The state returned is one of the following:

T_DATAXFER

Data transfer.

T_IDLE

Idle.

T_INCON

Incoming connection pending.

T_OUTCON

Outgoing connection pending.

T_UNBND

Unbound.

If unsuccessful, `t_sync()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

TBADF

The specified file descriptor does not refer to a transport endpoint. This error may be returned when the `fd` has been previously closed or an erroneous number may have been passed to the call.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (`t_errno`).

TSTATECHNG

The transport endpoint is undergoing a state change.

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)

- “exec functions” on page 442
- “fork() — Create a new process” on page 577
- “open() — Open a file” on page 1157

tsyncro() — Wait for MTF subtask termination

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | C only | |

Format

```
#include <mtf.h>

int tsyncro(int MTF_ANY|MTF_ALL|nn);
```

General description

Waits for termination of parallel functions under the [MVS environment](#).

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

The tsyncro() library function causes the main task to wait for the first subtask, a particular subtask, or all subtasks to finish executing all of the parallel functions that have been scheduled for them. You can monitor the completion of any, all, or a specific subtask by specifying:

MTF_ANY

To wait for the completion of any subtask.

MTF_ALL

To wait for the completion of all subtasks.

nn

To wait for the completion of the subtask having a *task_id* of *nn*. See “[tinit\(\) — Attach and initialize MTF subtasks](#)” on page 1869 for a description of *task_id*.

You can invoke tsyncro() from your main task program as often as necessary.

If tinit() is called by a program running under IMS, CICS, or DB2, the request will not be processed and the returned value will indicate that MTF calls are not supported under these systems.

Note: This function is *not* supported under the z/OS UNIX with the POSIX(ON) runtime option.

Returned value

If successful, tsyncro() will always return a value suitable for use as a target task on a subsequent tsched(). In particular, the return codes on success depend on the nature of the tsyncro() call, and the state of the subtasks at the time of the tsyncro() call as follows:

| Task_id passed to tsyncro() | Return code (if successful) |
|---|--|
| MTF_ANY (and at least one subtask not previously returned from a tsyncro()) | <i>nn</i> = <i>task_id</i> of first subtask to become free |
| MTF_ANY (and all subtasks have previously been returned from a tsyncro()) | MTF_ANY |

| Task_id passed to tsyncro() | Return code (if successful) |
|-----------------------------|-----------------------------|
| MTF_ALL | MTF_ANY |
| <i>nn = task_id</i> | <i>nn</i> |

If tinit() has not been successfully called before the tsyncro() call, tsyncro() indicates that MTF is inactive and returns one of the following values:

Error Code

Description

EINACTIVE

MTF is inactive.

ETASKABND

One or more subtasks have terminated abnormally.

ETASKID

The *task_id* argument specified is out of range.

Note: These values are macros. They can be found in the mtf.h header file.

Related information

- [“mtf.h — Multitasking facility functions” on page 45](#)
- [“tinit\(\) — Attach and initialize MTF subtasks” on page 1869](#)
- [“tsched\(\) — Schedule MTF subtask” on page 1902](#)
- [“tterm\(\) — Terminate MTF subtasks” on page 1912](#)

tterm() — Terminate MTF subtasks

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | C only | |

Format

```
#include <mtf.h>

int tterm(void);
```

General description

Restriction: This function is not supported in AMODE 64.

Terminates the MTF environment under the MVS environment. The function is invoked by a main task to await the completion of all parallel functions that were scheduled by tsched() and to detach all subtasks and remove the MTF environment created by tinit(), see [“tinit\(\) — Attach and initialize MTF subtasks” on page 1869](#).

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

If tinit() has not been successfully called before a tterm() call, tterm() indicates that MTF is already inactive.

If a `tterm()` call is not issued before main program termination, a system abend with completion code A03 will occur. The program's termination will terminate the main task while subtasks are still active even if all scheduled parallel functions have completed execution.

If `tinit()` is called by a program running under IMS, CICS, or DB2, the request will not be processed and the returned value will indicate that MTF calls are not supported under these systems.

Note: This function is *not* supported under the z/OS UNIX with the POSIX(ON) runtime option.

Returned value

If successful, detaching the subtasks and removing the MTF environment, `tterm()` returns `MTF_OK`.

If unsuccessful, `tsched()` returns one of the following values:

Error Code

Description

EINACTIVE

MTF is inactive.

ETASKABND

One or more subtasks have terminated abnormally.

Note: These values are macros. They can be found in the `mtf.h` header file ([“mtf.h — Multitasking facility functions”](#) on page 45).

Related information

- [“mtf.h — Multitasking facility functions”](#) on page 45
- [“tinit\(\) — Attach and initialize MTF subtasks”](#) on page 1869
- [“tsched\(\) — Schedule MTF subtask”](#) on page 1902
- [“tsyncro\(\) — Wait for MTF subtask termination”](#) on page 1911

ttyname() — Get the name of a terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

char *ttyname(int fildes);
```

General description

Returns a string containing the path name of the terminal associated with the given file descriptor, *fil*des. Subsequent calls to `ttyname()` may overwrite this string, because the pointer returned may point to static data.

Returned value

If successful, `ttyname()` returns a string containing a path name.

If unsuccessful because *fildev* is not a terminal, or the path name cannot be determined, `ttyname()` returns a NULL pointer.

Special behavior for XPG4: The `ttyname()` function sets `errno` to one of the following values:

Error Code
Description

EBADF
The *fildev* argument is not a valid open file descriptor.

ENOTTY
The *fildev* argument is not associated with a terminal.

Example

CELEBT16

```
/* CELEBT16

   This example provides the pathname of the terminal
   associated with stdin.

*/
#define _POSIX_SOURCE
#include <unistd.h>
#include <stdio.h>

main() {
    char *ret, tty[40];

    if ((ret = ttyname(STDIN_FILENO)) == NULL)
        perror("ttyname() error");
    else {
        strcpy(tty, ret);
        printf("The ttyname associated with my stdin is %s\n", tty);
    }
}
```

Output

The ttyname associated with my stdin is /dev/tty0000

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“ctermid\(\) — Generate path name for controlling terminal” on page 358](#)
- [“isatty\(\) — Test if descriptor represents a terminal” on page 903](#)
- [“ttynamer_r\(\) — Find path name of a terminal” on page 1914](#)

ttynamer_r() — Find path name of a terminal

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| Single UNIX Specification, Version 2 Single UNIX Specification, Version 3 | both | OS/390 V2R8 |

Format

```
#define _XOPEN_SOURCE 500
#include <unistd.h>

int ttypslot(int fdes, char *name, size_t namesize);
```

General description

The `ttypslot()` function stores the NULL-terminated path name of the terminal associated with the file descriptor, *fdes*, in the character array referenced by *name*. The array is *namesize* characters long and should have space for the name and the terminating NULL character. The maximum length of the terminal name is **TTY_NAME_MAX**.

Returned value

If successful, `ttypslot()` returns 0.

If unsuccessful, `ttypslot()` sets `errno` to one of the following values:

EBADF

The *fdes* argument is not a valid file descriptor.

ENOTTY

The *fdes* argument does not refer to a tty.

ERANGE

The value of *namesize* is smaller than the length of the string to be returned including the terminating NULL character.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“isatty\(\) — Test if descriptor represents a terminal” on page 903](#)
- [“ctermid\(\) — Generate path name for controlling terminal” on page 358](#)
- [“ttypslot\(\) — Get the name of a terminal” on page 1913](#)

ttypslot() — Find the slot in the utmpx file of the current user

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

int ttypslot(void);
```

General description

The `ttypslot()` function returns the index of the current user's entry in the `utmpx` database. The current user's entry is an entry for which the `ut_line` member matches the name of a terminal device associated with any of the process's file descriptors 0, 1 or 2. The `ttypslot()` function is used to obtain the terminal device. The `"/dev/"` part returned by `ttypslot()` is not used when searching the `utmpx` database member `ut_line`.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `ttyslot()` returns the index of the current user's entry in the `utmpx` database.

If unsuccessful, `ttyslot()` returns -1 if an error was encountered while searching the database or if none of the file descriptors 0, 1, or 2 is associated with a terminal device.

No errors are defined.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“endutxent\(\) — Close the utmpx database” on page 425](#)
- [“ttyname\(\) — Get the name of a terminal” on page 1913](#)

t_unbind() — Disable a transport endpoint

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <xti.h>

int t_unbind(int fd);
```

General description

Disables the transport endpoint specified by *fd* which was previously bound by `t_bind()`. On completion of this call, no further data or events destined for this transport endpoint will be accepted by the transport provider. An endpoint which is disabled by using `t_unbind()` can be enabled by a subsequent call to `t_bind()`.

Due to implementation-imposed restrictions, `t_unbind` does not affect descriptors in processes other than the caller which were derived from *fd* by normal descriptor inheritance. Processes cooperating on an endpoint in this way must explicitly provide their own synchronization for endpoint takedown.

Valid states: `T_IDLE`

Returned value

If successful, `t_unbind()` returns 0.

If unsuccessful, `t_unbind()` returns -1 and sets `errno` to one of the following values:

Error Code**Description**

TBADF

The specified file descriptor does not refer to a transport endpoint.

TLOOK

An asynchronous event has occurred on this transport endpoint.

TOUTSTATE

The function was issued in the wrong sequence.

TPROTO

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI (`t_errno`).

TSYSERR

A system error has occurred during execution of this function.

Related information

- [“xti.h — _XOPEN_SOURCE_EXTENDED feature test macro” on page 81](#)
- [“t_bind\(\) — Bind an address to a transport endpoint” on page 1814](#)

twalk() — Binary tree walk

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <search.h>

void *twalk(const void *root, void (*action)(const void *, VISIT, int));
```

General description

The `twalk()` function traverses a binary search tree. The *root* argument is a pointer to the root node of the tree to be traversed. (Any node in a tree may be used as the root for a walk below that node.) The argument *action* is the name of a routine to be invoked at each node. This routine is, in turn, called with three arguments. The first argument is the address of the node being visited. The structure pointed to by this argument is unspecified and must not be modified by the application, but is guaranteed that a pointer-to-node can be converted to pointer-to-pointer-to-element to access the element stored in the node. The second argument is a value from an enumeration data type:

```
typedef enum {preorder, postorder, endorder, leaf } VISIT;
```

(defined in the `<search.h>` header), depending on whether this is the first, second or third time that the node is visited (during a depth-first, left-to-right traversal of the tree), or whether the node is a leaf. The third argument is the level of the node in the tree, with the root being level zero.

Threading Behavior: see [“tsearch\(\) — Binary tree search” on page 1903](#).

Special behavior for C++: Because C and C++ linkage conventions are incompatible, `twalk()` cannot receive a C++ function pointer as the argument. If you attempt to pass a C++ function pointer to `twalk()`, the compiler will flag it as an error. You can pass a C or C++ function to `twalk()` by declaring it as extern "C".

Returned value

twalk() returns no values.

No errors are defined.

Related information

- [“search.h — Searching tables” on page 58](#)
- [“bsearch\(\) — Search arrays” on page 221](#)
- [“hsearch\(\) — Search hash tables” on page 818](#)
- [“lsearch\(\) — Linear search and update” on page 1022](#)
- [“tdelete\(\) — Binary tree delete” on page 1853](#)
- [“tfind\(\) — Binary tree find node” on page 1858](#)
- [“tsearch\(\) — Binary tree search” on page 1903](#)

tzset() — Set the time zone

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1 XPG4 XPG4.2 z/OS UNIX Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <time.h>

void tzset(void);
```

General description

The tzset() function uses the value of the environment variable TZ to set time conversion information used by ctime(), localtime(), mktime(), and strftime(). If TZ is absent from the environment, or it is incorrect, time-conversion information is obtained from the LC_TOD locale category.

tzset() also sets the external variable *tzname*:

```
extern char *tzname[2] = {"std", "dst"};
```

Here, *std* and *dst* are Standard and Daylight Savings time zone names, specified by TZ or the LC_TOD local category, respectively.

tzset() is called by ctime(), localtime(), mktime(), setlocale(), and strftime(). It can also be called explicitly by an application program.

The format of TZ values recognized by tzset() is as follows:

```
stdoffset[dst[offset][,rule]]
```


std and dst

Indicate no fewer than three, but not more than TZNAME_MAX, bytes that are the designation for the standard (*std*) and daylight savings (*dst*) time zones. If more than TZNAME_MAX bytes are specified for *std* or *dst*, tzset() truncates to TZNAME_MAX bytes. Only *std* is required; if *dst* is missing, daylight savings time does not apply in this locale. Uppercase and lowercase letters are explicitly allowed. Any character except a leading colon (:) or digits, the comma (,), the minus (-), the plus (+), and the NULL character are permitted to appear in these fields. The meaning of these letters and characters is unspecified.

offset

Indicates the value that must be added to the local time to arrive at Coordinated Universal Time (UTC). *offset* has the form: hh[:mm[:ss]] The minutes (mm) and seconds (ss) are optional. The hour (hh) is required and may be a single digit. *offset* following *std* is required. If no *offset* follows *dst*, daylight savings time is assumed to be 1 hour ahead of standard time. One or more digits may be used; the value is always interpreted as a decimal number. The hour must be between 0 and 24; minutes and seconds, if present, between 0 and 59. The difference between standard time *offset* and daylight savings time *offset* must be greater than or equal to 0, but the difference may not be greater than 24 hours. Use of values outside of these ranges causes tzset() to use the LC_TOD category rather than the TZ environment variable for time conversion information. An *offset* preceded by a minus (-) indicates a time zone east of the Prime Meridian. A plus (+) preceding *offset* is optional and indicates the time zone west of the Prime Meridian.

rule

Indicates when to change to and back from daylight savings time. The rule has the form: date[/time],date[/time]

The first date describes when the change from standard to daylight savings time occurs and the second date describes when the change back happens. Each time field describes when, in current local time, the change to the other time is made.

The format of date must be one of the following:

Jn

The Julian day *n* ($1 \leq n \leq 365$). Leap days are not counted. That is, in all years—including leap years—February 28 is day 59 and March 1 is day 60. It is impossible to explicitly refer to the occasional February 29.

n

The zero-based Julian day ($0 \leq n \leq 365$). Leap days are counted, and it is possible to refer to February 29.

Mm.n.d

The *d*th day ($0 \leq d \leq 6$) of week *n* of month *m* of the year ($1 \leq n \leq 5$, and $1 \leq m \leq 12$, where week 5 means “the last *d* day in month *m*,” which may occur in either the fourth or the fifth week). Week 1 is the first week in which the *d*th day occurs. Day zero is Sunday.

The time has the same format as offset except that no leading sign, minus (-) or plus (+), is allowed. The default, if time is not given, is 02:00:00.

If *dst* is specified and *rule* is not specified by TZ or in LC_TOD category, the default for the daylight savings time start date is M4.1.0 and for the daylight savings time end date is M10.5.0.

Special behavior for XPG4: The tzset() function sets the external variable `timezone` to the difference, in seconds, between Coordinated Universal Time (UTC) and local standard time. tzset() sets the external variable `daylight` to 0 if summer time conversions should never be applied for the time zone in use; otherwise to nonzero.

Since the external variables `timezone` and `daylight` are global to the process, they cannot be reliably used in a multithreaded application or an application running from a DLL. The runtime library provides two special functions, `__tzzone()` and `__dlght()`, which return the address of thread-specific versions of these external variables.

Special behavior for POSIX C: The tzset() function only parses the TZ environment variable if it is called from the initial processing thread (IPT) by a threaded application.

Note: This function is sensitive to time zone information which is provided by:

- The TZ environmental variable when POSIX(ON) and TZ is correctly defined, or by the _TZ environmental variable when POSIX(OFF) and _TZ is correctly defined.
- The LC_TOD category of the current locale if POSIX(OFF) or TZ is not defined.
- When neither TZ nor _TZ is defined, the current locale is interrogated for time zone information. If neither TZ nor _TZ is defined and LC_TOD time zone information is not present in the current locale, a default value is applied to local time. POSIX programs simply default to Coordinated Universal Time (UTC), while non-POSIX programs establish an offset from UTC based on the setting of the system clock. For more information about customizing a time zone to work with local time, see “Customizing a time zone” in *z/OS XL C/C++ Programming Guide*.

The time zone external variables tzname, timezone, and daylight declarations remain feature test protected in time.h.

Returned value

tzset() returns no values.

There are no documented errno values.

Example

CELEBT17

```
/* CELEBT17

   This example set time conversion information for
   Eastern Standard and Eastern Daylight Savings Time in the
   United States.

*/
#define _POSIX_SOURCE
#include <env.h>
#include <time.h>

int main(void)
{
    setenv("TZ", "EST5EDT", 1);
    tzset();
}
```

Related information

- For more information about external variables and associated restrictions, see [“External variables” on page 98](#).
- [“time.h — Time and date” on page 75](#)
- [“asctime\(\), asctime64\(\) — Convert time to character string” on page 180](#)
- [“asctime_r\(\), asctime64_r\(\) — Convert date and time to a character string” on page 182](#)
- [“ctime\(\), ctime64\(\) — Convert time to character string” on page 360](#)
- [“ctime_r\(\), ctime64_r\(\) — Convert time value to date and time character string” on page 362](#)
- [“gmtime\(\), gmtime64\(\) — Convert time to broken-down UTC time” on page 811](#)
- [“gmtime_r\(\), gmtime64_r\(\) — Convert a time value to broken-down UTC time” on page 813](#)
- [“localdtconv\(\) — Date and time formatting convention inquiry” on page 986](#)
- [“localtime\(\), localtime64\(\) — Convert time and correct for local time” on page 989](#)
- [“localtime_r\(\), localtime64_r\(\) — Convert time value to broken-down local time” on page 991](#)
- [“mktime\(\), mktime64\(\) — Convert local time” on page 1084](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)

- [“time\(\),time64\(\) — Determine current UTC time”](#) on page 1865

ualarm() — Set the interval timer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4.2 Single Unix Standard, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

useconds_t ualarm(useconds_t uscs, useconds_t intrval)
```

General description

The `ualarm()` function causes the SIGALRM signal to be generated for the calling process after the number of real-time microseconds specified by the *uscs* argument has elapsed. When the *intrval* argument is nonzero, repeated timeout notification occurs with a period in microseconds specified by the *intrval* argument. If the notification signal, SIGALRM, is not caught or ignored, the calling process is terminated.

The `ualarm()` function is a simplified interface to `setitimer()` and uses the ITIMER_REAL interval timer.

Note: The `ualarm()` and `usleep()` functions have been moved to obsolescence in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `setitimer()`, `timer_create()`, `timer_delete()`, `timer_getoverrun()`, `timer_gettime()`, or `timer_settime()` functions are preferred for portability.

Returned value

`ualarm()` returns the number of microseconds remaining from the previous `ualarm()`, `alarm()`, or `setitimer(ITIMER_REAL)` call.

If no timeouts are pending, `ualarm()` returns 0.

No `errno`s are defined for the `ualarm()` function.

Related information

- [“unistd.h — Implementation-specific functions”](#) on page 77
- [“alarm\(\) — Set an alarm”](#) on page 156
- [“setitimer\(\) — Set value of an interval timer”](#) on page 1540
- [“sigaction\(\) — Examine or change a signal action”](#) on page 1605
- [“sleep\(\) — Suspend execution of a thread”](#) on page 1668
- [“usleep\(\) — Suspend execution for an interval”](#) on page 1951

__ucreate() — Create a heap using user-provided storage

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <uheap.h>

__uheapid_t __ucreate(void *block,
                      size_t size,
                      __uheap_cellpool_attrib_table_t *cellpool_attrib_table,
                      void *rsvd1,
                      void *rsvd2,
                      void *rsvd3,
                      void *rsvd4);
```

General description

The `__ucreate()` function creates a heap out of storage that is provided by the caller. The heap is divided up into cell pools based on the information provided in the `cellpool_attrib_table`. Up to 12 cell pools can be created within the heap. Note that this is a fixed-size heap; when storage within a given cell pool is exhausted, no additional storage will be allocated. `__ucreate()` returns a `uheapid` that is used to identify the heap on subsequent user-created heap function calls, such as `__umalloc()`, `__ufree()`, and `__uheapreport()` calls.

Parameter Description

block

A pointer to the storage which is to be used for the heap.

size

The size of the block of storage. Note that Language Environment reserves approximately 328 bytes of this storage for use in allocating heap management control blocks. Additional storage is reserved if storage report usage statistics are being collected for the heap. The amount of this storage is related to the largest cell size and the granularity of the statistics, and is calculated as: storage amount = $((\text{largestcellsize} + \text{granularity} - 1) / \text{granularity}) * 4$.

cellpool_attrib_table

A pointer to a structure describing the attributes of the cell pools to be created by `__ucreate()`.

The first field of the structure, `number_of_pools`, indicates the number of cell pools to be created. Up to 12 cell pools can be created in the heap.

The second field of the structure, `granularity`, indicates the granularity to which storage usage statistics is to be collected. This value must be zero, or a power of 2 greater than or equal to 8. If the value is zero, then statistics are not collected.

Following these words are pairs of words describing the attributes of each cell pool in the heap:

The first field in the pair, `size`, is the size of the cell in the cell pool. The cell size must be a multiple of 8 and greater than or equal to 8, up to a maximum of 64K (65536). Note that Language Environment adds an additional 8 bytes to the size of the cell for use in managing the cells. The second field in the pair, `count`, is the number of cells of this size to be allocated. Note the minimum is four.

rsvd1-rsvd4

Reserved for future use.

Returned value

If successful, `__ucreate()` returns a `uheapid`.

If unsuccessful, `__ucreate()` returns -1 and sets `errno` to `EINVAL`.

Related information

- [“uheap.h — Heap storage” on page 77](#)
- [“__ufree\(\) — Return storage to a user-created heap” on page 1923](#)
- [“__uheapreport\(\) — Produce a storage report for a user-created heap” on page 1924](#)
- [“__umalloc\(\) — Allocate storage from a user-created heap” on page 1928](#)

[__ufree\(\) — Return storage to a user-created heap](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <uheap.h>

void __ufree(__uheapid_t heapid, void *ptr);
```

General description

The `__ufree()` function returns storage to the heap identified by the `heapid`. If the returned storage does not belong to the given heap, the result is unpredictable.

Parameter

Description

heapid

The identifier of the user-created heap to which the storage is to be returned.

ptr

A pointer to the storage to be returned to the heap.

Returned value

`__ufree()` returns no values.

Related information

- [“uheap.h — Heap storage” on page 77](#)
- [“__ucreate\(\) — Create a heap using user-provided storage” on page 1922](#)
- [“__uheapreport\(\) — Produce a storage report for a user-created heap” on page 1924](#)
- [“__umalloc\(\) — Allocate storage from a user-created heap” on page 1928](#)

__uheapreport() – Produce a storage report for a user-created heap

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <uheap.h>

void __uheapreport(__uheapid_t heapid);
```

General description

The `__uheapreport()` function generates a report of the storage used within the user-created heap identified by *heapid*. The report is directed to the ddname specified in the MSGFILE runtime option except for AMODE 64 applications, in which case the report is directed to the stderr stream. The report format is similar to the heap pools portion of the storage report generated for the RPTSTG runtime option.

Statistics for the user-created heap will only be collected if the granularity field of the `cellpool_attrb_table` passed to `__ucreate()` is nonzero and a valid value.

Parameter

Description

heapid

The identifier of the user-created heap for which a report is to be produced.

Returned value

`__uheapreport()` returns no values.

Related information

- [“uheap.h – Heap storage” on page 77](#)
- [“__ucreate\(\) – Create a heap using user-provided storage” on page 1922](#)
- [“__ufree\(\) – Return storage to a user-created heap” on page 1923](#)
- [“__umalloc\(\) – Allocate storage from a user-created heap” on page 1928](#)

ulimit() – Get or set process file size limits

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <ulimit.h>
```

```
long int ulimit(int cmd, ...);
```

General description

The `ulimit()` function provides control over the process file size limits. The *cmd* argument controls whether the file size limits are obtained or set. The *cmd* argument can be one of the following, defined in `<ulimit.h>`:

UL_GETFSIZE

Return the soft (current) file size limit of the process. The limit returned is in units of 512-byte blocks. The return value is the integer portion of the soft file size limit divided by 512. Refer to the `setrlimit()` function, `RLIMIT_FSIZE` resource description for more detail.

UL_SETFSIZE

Set the hard (maximum) and soft (current) file size limits for output operations of the process. The value of the second argument is used, and is treated as a long int. Refer to the `setrlimit()` function, `RLIMIT_FSIZE` resource description for more detail and restrictions on lowering and raising file size limits. The hard and soft file size limits are set to the specified value multiplied by 512. The new file size limit (in 512 byte increments) is returned.

Returned value

If successful, `ulimit()` returns the value of the requested limit.

If unsuccessful, `ulimit()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The *cmd* argument is not valid.

EPERM

To increase the file size limit, superuser authority is required.

Related information

- [“ulimit.h — ulimit commands” on page 77](#)
- [“getrlimit\(\) — Get current or maximum resource consumption” on page 767](#)
- [“setrlimit\(\) — Control maximum resource consumption” on page 1568](#)

ulltoa() — Convert unsigned long long into a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

```
#define _OPEN_SYS_ITOA_EXT
#include <stdlib.h>

char * ulltoa(uint64_t ll, char * buffer, int radix);
```

Compile Requirement

Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

The `ulltoa()` function converts the `uint64_t ll` into a character string. The string is placed in the buffer passed, which must be large enough to hold the output. The radix values can be OCTAL, DECIMAL, or HEX. When the radix is DECIMAL, `ulltoa()` produces the same result as the following statement:

```
(void) sprintf(buffer, "%llu", ll);
```

with `buffer` the returned character string. When the radix is OCTAL, `ulltoa()` formats `uint64_t ll` into an octal constant. When the radix is HEX, `ulltoa()` formats `uint64_t ll` into a hexadecimal constant. The hexadecimal value will include lower case `abcdef`, as necessary.

Returned value

String pointer (same as `buffer`) will be returned. When passed an invalid radix argument, function will return NULL and set `errno` to `EINVAL`.

Portability considerations

This is a non-standard function. Even though the prototype given is commonly used by compilers on other platforms, there is no guarantee that this function will behave the same on all platforms, in all cases. You can use this function to help port applications from other platforms, but you should avoid using it when writing new applications, in order to ensure maximum portability.

Example

CELEBU12

```
/* CELEBU12

   This example reads uint64_t and formats it to a decimal,
   octal, hexadecimal constants converted to a character string.

*/

#define _OPEN_SYS_ITOA_EXT
#include <stdio.h>
#include <stdlib.h>

int main ()
{
    uint64_t i;
    char buffer [sizeof(uint64_t)*8+1];
    printf ("Enter a number: ");
    if (scanf ("%llu",&i) == 1) {
        ulltoa (i,buffer,DECIMAL);
        printf ("decimal: %s\n",buffer);
        ulltoa (i,buffer,HEX);
        printf ("hexadecimal: %s\n",buffer);
        ulltoa (i,buffer,OCTAL);
        printf ("octal: %s\n",buffer);
    }
    return 0;
}
```

Output

If the input is 1234, then the output should be:

```
decimal: 1234
hexadecimal: 4d2
octal: 2322
```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“itoa\(\) — Convert int into a string” on page 925](#)

- [“ltoa\(\) — Convert long into a string” on page 985](#)
- [“ltoa\(\) — Convert long into a string” on page 1030](#)
- [“ultoa\(\) — Convert unsigned long into a string” on page 1927](#)
- [“utoa\(\) — Convert unsigned int into a string” on page 1958](#)

ultoa() — Convert unsigned long into a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

```
#define _OPEN_SYS_ITOA_EXT
#include <stdlib.h>

char * ultoa(unsigned long l, char * buffer, int radix);
```

General description

The `ultoa()` function converts the unsigned long `l` into a character string. The string is placed in the buffer passed, which must be large enough to hold the output. The radix values can be OCTAL, DECIMAL, or HEX. When the radix is DECIMAL, `ultoa()` produces the same result as the following statement:

```
(void) sprintf(buffer, "%lu", l);
```

with `buffer` the returned character string. When the radix is OCTAL, `ultoa()` formats unsigned long `l` into an octal constant. When the radix is HEX, `ultoa()` formats unsigned long `l` into a hexadecimal constant. The hexadecimal value will include lower case `abcdef`, as necessary.

Returned value

String pointer (same as `buffer`) will be returned. When passed an invalid radix argument, function will return NULL and set `errno` to `EINVAL`.

Portability considerations

This is a non-standard function. Even though the prototype given is commonly used by compilers on other platforms, there is no guarantee that this function will behave the same on all platforms, in all cases. You can use this function to help port applications from other platforms, but you should avoid using it when writing new applications, in order to ensure maximum portability.

Example

CELEBU11

```
/* CELEBU11

   This example reads an unsigned long and formats it to a decimal,
   octal, hexadecimal constants converted to a character string.

*/

#define _OPEN_SYS_ITOA_EXT
#include <stdio.h>
#include <stdlib.h>

int main ()
{
```

```
unsigned long i;
char buffer [sizeof(unsigned long)*8+1];
printf ("Enter a number: ");
if (scanf ("%lu",&i) == 1) {
    ultoa (i,buffer,DECIMAL);
    printf ("decimal: %s\n",buffer);
    ultoa (i,buffer,HEX);
    printf ("hexadecimal: %s\n",buffer);
    ultoa (i,buffer,OCTAL);
    printf ("octal: %s\n",buffer);
}
return 0;
}
```

Output

If the input is 1234, then the output should be:

```
decimal: 1234
hexadecimal: 4d2
octal: 2322
```

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“itoa\(\) – Convert int into a string” on page 925](#)
- [“lltoa\(\) – Convert long long into a string” on page 985](#)
- [“ltoa\(\) – Convert long into a string” on page 1030](#)
- [“ulltoa\(\) – Convert unsigned long long into a string” on page 1925](#)
- [“utoa\(\) – Convert unsigned int into a string” on page 1958](#)

__umalloc() – Allocate storage from a user-created heap

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <uheap.h>

void *__umalloc(__uheapid_t heapid, size_t size);
```

General description

The __umalloc() function allocates storage from the heap identified by the heapid. __umalloc() will search for an available cell within the cell pool that contains cells at least as large and closest in size to the requested size.

Parameter

Description

heapid

The identifier of the user-created heap from which the storage is to be allocated.

size

The amount of storage to be allocated.

Returned value

If successful, `__umalloc()` returns a pointer to the reserved cell.

If a cell of the required size is not available, if size was larger than the largest available cell size, or if size was specified as 0, `__umalloc()` returns `NULL`.

If there is not enough storage or if the requested size was too large, `__umalloc()` returns `NULL` and sets `errno` to one of the following values:

Error Code

Description

E2BIG

Requested amount of storage is larger than the largest available cell size

ENOMEM

Insufficient memory is available

Related information

- [“uheap.h — Heap storage” on page 77](#)
- [“__ucreate\(\) — Create a heap using user-provided storage” on page 1922](#)
- [“__ufree\(\) — Return storage to a user-created heap” on page 1923](#)
- [“__uheapreport\(\) — Produce a storage report for a user-created heap” on page 1924](#)

umask() — Set and retrieve file creation mask

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/stat.h>

mode_t umask(mode_t newmask);
```

General description

Changes the file creation mask of the process. *newmask* specifies new file-permission bits for the file creation mask of the process.

This mask restricts the setting of (or turns off) file-permission bits specified in the *mode* argument that is used with all `open()`, `creat()`, `mkdir()`, and `mkfifo()` functions issued by the current process. File-permission bits set to 1 in the file creation mask are set to 0 in the file-permission bits of files that are created by the process.

For example, if a call to `open()` specifies a *mode* argument with file-permission bits, the file creation mask of the process affects the *mode* argument; bits that are 1 in the mask are set to 0 in the *mode* argument, and therefore in the mode of the created file.

Only the file-permission bits of the new mask are used. The meaning of other bits is implementation-defined. For more information on these symbols, refer to [“chmod\(\) — Change the mode of a file or directory”](#) on page 274.

The `_EDC_UMASK_DFLT` environment variable controls how the C runtime library sets the default umask.

- When `_EDC_UMASK_DFLT` is not set:
 - If the system parameter `UMASK` is set to a valid value, the default umask value is the same as that value.
 - If the system parameter `UMASK` is not set, the C runtime library sets the default umask value to 022.
- When `_EDC_UMASK_DFLT` is set to one of the following values:

NO (case insensitive)

The C runtime library does not change the umask. The default umask value depends on the value of the system parameter `UMASK`.

A valid octal value

The library uses this octal value as the default umask value no matter how the system parameter `UMASK` is set.

Any other value

When the system parameter `UMASK` is set to a valid value, the C runtime library does not change default umask. When the system parameter `UMASK` is not set, the C runtime library set the default umask value to 022.

Returned value

`umask()` is always successful and returns the previous value of the file creation mask.

There are no documented `errno` values.

Example

CELEBU01

```
/* CELEBU01

   This example will work only from C/MVS, not C++/MVS.

*/
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    int fd;
    mode_t oldmask;

    printf("Your old umask is %i\n",oldmask=umask(S_IRWXG));
    if ((fd = creat("umask.file", S_IRWXU|S_IRWXG)) < 0)
        perror("creat() error");
    else {
        system("ls -l umask.file");
        close(fd);
        unlink("umask.file");
    }
    umask(oldmask);
}
```

Output

```
-IWX----- 1 WELLIE  SYS1          0 Apr 19 14:50 umask.file
```

Related information

- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)
- [“chmod\(\) — Change the mode of a file or directory” on page 274](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“mkdir\(\) — Make a directory” on page 1071](#)
- [“mkfifo\(\) — Make a FIFO special file” on page 1075](#)
- [“open\(\) — Open a file” on page 1157](#)

umount() — Remove a virtual file system

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

Format 1:

```
#include <sys/stat.h>

int umount(const char *filesystem, mtm_t mtm);
```

Format 2:

```
#define _OPEN_SYS
#define _XPLATFORM_SOURCE
#include <sys/mount.h>

int umount(const char *target);
```

General description

`umount()` supports different input parameters and functions when it is defined under different feature test macros.

When only `_OPEN_SYS` is defined:

Removes a file system from the file hierarchy, or changes the mount mode of a mounted file system between read-only and read/write. The *filesystem* argument is a NULL-terminated string that contains the file system name. This is the same name that is specified when the file system is mounted.

To unmount a file system, the caller must be an authorized program, or must be running for a user with appropriate privileges.

The *mtm* argument can be one of the following:

MTM_UMOUNT

A normal unmount request. If the files in the named file system are not in use, the unmount is done. Otherwise, the request is rejected.

MTM_DRAIN

An unmount drain request. The requester is willing to wait for all uses of this file system to be ended normally before the file system is unmounted.

MTM_IMMED

An immediate unmount request. The file system is unmounted immediately, forcing any users of files in the specified file system to fail. All data changes that were made up to the time of the request are saved. If there is a problem saving the data, the unmount request fails.

MTM_FORCE

A forced unmount request. The file system is unmounted immediately, forcing any users of any files in the specified file system to fail. All data changes that were made up to the time of the request are saved. If there is a problem saving the data, the request continues, and the data may be lost. To prevent lost data, issue an immediate `umount()` request before issuing a forced `umount()` request.

MTM_RESET

A reset unmount request. This allows a previous unmount drain request to be stopped.

MTM_REMOUNT

A remount request. This changes the mount mode of a file system from read-only to read/write or from read/write to read-only. If neither `MTM_RDONLY` nor `MTM_RDWR` is specified, the mode is set to the opposite of its current state. If a mode is specified, it must be the opposite of the current state.

MTM_SAMEMODE

A remount request to unmount and mount back without changing the mount mode. If either `MTM_RDONLY` or `MTM_RDWR` is also specified, it must be the current state. This can be used to attempt to regain use of a file system that has had I/O errors.

When both `_OPEN_SYS` and `_XPLATFORM_SOURCE` are defined:

`umount()` removes the attachment of the topmost file system that is mounted on *target*.

To unmount a file system, the caller must be an authorized program, or must be running for a user with appropriate privileges.

Returned value

If successful, `umount()` returns 0.

If unsuccessful, `umount()` returns -1 and sets `errno` to one of the following values:

When only `_OPEN_SYS` is defined:

Error Code

Description

EBUSY

The file system is busy, for one of these reasons:

- A `umount()` (`MTM_UMOUNT`) is requested, and the file system has open files or other file systems that are mounted under it.
- A file system is mounted on the requested file system.
- A `RESET` is requested, and the previous `umount()` request is either immediate or forced, instead of a drain request.
- There is a `umount()` request in progress for the specified file system.
- A `umount()` drain request is being reset.

EINTR

`umount()` is interrupted by a signal.

EINVAL

A parameter is incorrectly specified. Verify the spelling of the file system name and the setting of *mtm*.

EIO

An I/O error occurs.

EPERM

Superuser authority is required to issue an unmount.

When both `_OPEN_SYS` and `_XPLATFORM_SOURCE` are defined:

Error Code

Description

EBUSY

target is busy for one of the following reasons:

- A `umount()` (`MTM_UMOUNT`) is requested, and the file system has open files or other file systems that are mounted under it.
- A file system is mounted on the requested file system.
- There is an unmount request in progress for the specified file system.

EINTR

`umount()` is interrupted by a signal.

EINVAL

target is not a mount point.

EIO

An I/O error occurs.

ENAMETOOLONG

A path name is longer than `PATH_MAX`, or some component of path name is longer than `NAME_MAX` characters.

ENOENT

A target is empty or has a nonexistent component.

ENOTDIR

A component of the path prefix is not a directory.

EPERM

Superuser authority is required to issue an unmount.

Example**CELEBU02**

```
/* CELEBU02

   This example removes a file, using umount().

*/
#define _OPEN_SYS 1
#include <sys/stat.h>
#include <stdio.h>
#include <unistd.h>

main() {
    char HFS[]="POSIX.NEW.HFS";
    char filesystem[9]="HFS ";
    setvbuf(stdout, NULL, _IOLBF, 0);
    puts("before umount()");
    system("df -Pk");
    if (umount(HFS, MTM_UMOUNT) != 0)
        perror("umount() error");
    else {
        puts("After umount()");
        system("df -Pk");
    }
}
```

Output

```
before umount()
Filesystem 1024-blocks      Used Available Capacity Mounted on
POSIX.NEW.HFS      200          20         180      10%    /new_fs
POSIX.ROOT.FS     9600        8180        1420      85%    /

After umount()
Filesystem 1024-blocks      Used Available Capacity Mounted on
POSIX.ROOT.FS     9600        8180        1420      85%    /
```

Related information

- [“sys/mount.h — File system mount and unmount” on page 69](#)
- [“sys/stat.h — z/OS UNIX files and access” on page 70](#)

- “[mount\(\)](#) — Make a file system available” on page 1098
- “[umount2\(\)](#) — Unmount file system” on page 1934

umount2() — Unmount file system

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sys/mount.h>

int umount2(const char *target, int flags);
```

General description

`umount2()` removes the attachment of the topmost file system that is mounted on *target*.

To unmount a file system, the caller must be an authorized program, or must run for a user with appropriate privileges.

The *flags* specifies the flag that controls the behavior of the operation. The valid value of *flags* is:

MNT_DETACH

Perform a lazy unmount:

1. Make the mount unavailable for new accesses.
2. Disconnect the file system and all file systems that are mounted under it from each other and from the mount table.
3. Unmount when the mount ceases to be busy.

An unmount drain request. The requester waits for all uses of this file system to be ended normally before the file system is unmounted.

Returned value

If successful, `umount2()` returns 0.

If unsuccessful, `umount2()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EBUSY

target cannot be unmounted because it is busy for one of the following reasons:

- A `umount2()` is requested, and the attached file system has open files or other file systems that are mounted under it.
- A file system is mounted on the requested file system.
- There is an unmount request in progress for the specified file system.

EINTR

`umount2()` is interrupted by a signal.

EINVAL

target is not a mount point.

`umount2()` is called with an invalid flag value in *flags*.

EIO

An I/O error occurs.

ENAMETOOLONG

A target is longer than PATH_MAX, or some component of path name is longer than NAME_MAX characters.

ENOTDIR

A component of the path prefix is not a directory.

ENOENT

A target is empty or has a nonexistent component.

EPERM

Superuser authority is required to issue an unmount.

Related information

- [“sys/mount.h — File system mount and unmount” on page 69](#)
- [“mount\(\) — Make a file system available” on page 1098](#)
- [“umount2\(\) — Unmount file system” on page 1934](#)

uname() — Display current operating system name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/utsname.h>

int uname(struct utsname *name);
```

General description

The `uname()` function retrieves information identifying the operating system you are running on. The argument *name* points to a memory area where a structure describing the operating system the process is running on can be stored.

The information about the operating system is returned in a `utsname` structure, which has the following elements:

char *sysname;

The name of the implementation of the operating system.

char *nodename;

The node name of this particular machine. The node name is set by the `SYSNAME` sysparm (specified at IPL), and usually differentiates machines running at a single location.

char *release;

The current release level of the implementation.

char *version;

The current version level of the release.

char *machine;

The name of the hardware type the system is running on.

Each of the utsname structure elements is a normal C string, terminated with a NULL character.

As of OS/390 Release 2, the `uname()` function will return "OS/390" as the *sysname* value, even if the true name of the operating system is different. This is for compatibility purposes. The version value will increase at every new version of the operating system. The release value will increase at every new release of the operating system.

Table 71 on page 1936 lists the operating system names and corresponding values returned by the `uname()` function. To retrieve the true operating system name, version, and release, use the `__osname()` function.

Table 71. Operating system information returned by the `uname()` function

| Operating system | Sysname | Release | Version |
|------------------|---------|---------|---------|
| z/OS 3.2 | OS/390 | 30.00 | 05 |
| z/OS 3.1 | OS/390 | 29.00 | 04 |
| z/OS 2.5 | OS/390 | 28.00 | 04 |

Returned value

If successful, the `uname()` function returns a non-negative value.

If unsuccessful, the `uname()` function returns -1. An `errno` might be set to indicate the reason for the failure, but no `errno` values are specified by the POSIX.1 standard.

Example

CELEBU03

```
/* CELEBU03

   This example gets information about the system you are running on.

*/
#define _POSIX_SOURCE
#include <sys/utsname.h>
#include <stdio.h>

main() {
    struct utsname uts;

    if (uname(&uts) < 0)
        perror("uname() error");
    else {
        printf("Sysname: %s\n", uts.sysname);
        printf("Nodename: %s\n", uts.nodename);
        printf("Release: %s\n", uts.release);
        printf("Version: %s\n", uts.version);
        printf("Machine: %s\n", uts.machine);
    }
}
```

Output

```
Sysname:  OS/390
Nodename: SY1
Release:  30.00
Version:  05
Machine:  8561
```

Related information

- [“sys/utsname.h — Operating system name” on page 73](#)

- “`__osname()` — Get true operating system name” on page 1176

uncaught_exception() — Determine if an exception is being processed

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ANSI/ISO C++ | C++ only | z/OS V1R2 |

Format

```
#include <exception>

bool uncaught_exception(void);
```

General description

The `uncaught_exception()` function returns true only if a thrown exception is currently being processed. When `uncaught_exception()` is true, throwing an exception can result in a call of `terminate()`.

Returned value

`uncaught_exception()` returns true after completing evaluation of a throw expression and before completing initialization of the exception declaration in the matching handler or calling `unexpected()` as a result of the throw expression.

Otherwise, `uncaught_exception()` returns false.

Example

```
#include <exception>
#include <iostream>

using namespace std;

class X
{
public:
    ~X ();
};

X::~X()
{
    if (uncaught_exception ())
        printf (" X::~X called during stack unwind\n");
    else
        printf (" X::~X called normally\n");
}

int main()
{
    X x1;
    try
    {
        X x2;
        throw 1;
    }
    catch (...) { /*...*/ }
    return 0;
}

// under a Standard-conforming implementation, this program yields
```

```
// X::~X called during stack unwind
// X::~X called normally
```

Related information

- [“exception — Exception handling” on page 87](#)
- [“set_terminate\(\) — Register a function for terminate\(\)” on page 1584](#)
- [“set_unexpected\(\) — Register a function for unexpected\(\)” on page 1587](#)
- [“terminate\(\) — Terminate after failures in C++ error handling” on page 1856](#)
- [“unexpected\(\) — Handle exception not listed in exception specification” on page 1940](#)

UnDoExportWorkUnit() — WLM undo export service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R9 |

Format

```
#include <sys/__wlm.h>

int UnDoExportWorkUnit(wlmxtok_t *exporttoken, unsigned long *conntoken);
```

AMODE 64:

```
#include <sys/__wlm.h>

int UnDoExportWorkUnit(wlmxtok_t *exporttoken, unsigned int *conntoken);
```

General description

Undoes an earlier request to export an enclave using the ExportWorkUnit() function. The caller is expected to invoke UnDoExportWorkUnit() after all importing systems have invoked the UnDoImportWorkUnit() function.

The UnDoExportWorkUnit() function uses the following parameters:

***exporttoken**

Points to a work unit export token that was returned from a call to ExportWorkUnit().

***conntoken**

Specifies the connect token that represents the connection to WLM.

Returned value

If successful, UnDoExportWorkUnit() returns 0.

If unsuccessful, UnDoExportWorkUnit() returns -1 and sets errno to one of the following values:

Error Code

Description

EFAULT

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained a value that is not correct.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

A WLM service failed. Use `__errno2()` to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSEVER Facility class. The caller's address space must be permitted to the BPX.WLMSEVER Facility class, if the BPX.WLMSEVER class is defined. If BPX.WLMSEVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- “[sys/__wlm.h — WorkLoad Manager functions](#)” on page 73
- “[ExportWorkUnit\(\) — WLM export service](#)” on page 458
- “[ImportWorkUnit\(\) — WLM import service](#)” on page 838
- For more information, see [z/OS MVS Programming: Workload Management Services](#).

UnDoImportWorkUnit() — WLM undo import service

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R9 |

Format

```
#include <sys/__wlm.h>

int UnDoImportWorkUnit(wlmxtok_t *exporttoken, unsigned long *conntoken);
```

AMODE 64:

```
#include <sys/__wlm.h>

int UnDoImportWorkUnit(wlmxtok_t *exporttoken, unsigned int *conntoken);
```

General description

Undoes an earlier request to import an enclave using the `ImportWorkUnit()` function.

The `UnDoImportWorkUnit()` function uses the following parameters:

***exporttoken**

Points to a work unit export token that was returned from a call to `ExportWorkUnit()`.

***conntoken**

Specifies the connect token that represents the connection to WLM.

Returned value

If successful, `UnDoImportWorkUnit()` returns 0.

If unsuccessful, `UnDoImportWorkUnit()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EFAULT**

An argument of this function contained an address that was not accessible to the caller.

EINVAL

An argument of this function contained a value that is not correct.

EMVSSAF2ERR

An error occurred in the security product.

EMVSWLMERROR

A WLM service failed. Use `__errno2()` to obtain the WLM service reason code for the failure.

EPERM

The calling thread's address space is not permitted to the BPX.WLMSERVER Facility class. The caller's address space must be permitted to the BPX.WLMSERVER Facility class, if the BPX.WLMSERVER class is defined. If BPX.WLMSERVER is not defined, the calling process is not defined as a superuser (UID=0).

Related information

- [“sys/_wlm.h — WorkLoad Manager functions” on page 73](#)
- [“ExportWorkUnit\(\) — WLM export service” on page 458](#)
- [“ImportWorkUnit\(\) — WLM import service” on page 838](#)
- For more information, see *z/OS MVS Programming: Workload Management Services*.

unexpected() — Handle exception not listed in exception specification

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| ANSI/ISO C++ | C++ only | |

Format

```
#include <exception>

void unexpected(void);
```

General description

The `unexpected()` function is part of the z/OS XL C++ error handling mechanism. If `unexpected()` is called directly by the program, the `unexpected_handler` is the one most recently set by a call to `set_unexpected()`. If `unexpected()` is called when control leaves a function by a thrown exception of a type not permitted by an exception specification for the function, as in:

```
void f() throw()      // function may throw no exceptions
{throw "bad"; }      // throw calls unexpected()
```

the `unexpected_handler` is the one in effect immediately after evaluating the throw expression.

An `unexpected_handler` may not return to its caller. It may terminate execution by:

- Throwing an object of a type listed in the exception specification (or an object of any type if the `unexpected_handler` is called directly by the program).
- Throwing an object of type `bad_exception`.
- Calling `terminate()`, `abort()`, or `exit(int)`.

If `set_unexpected()` has not yet been called, then `unexpected()` calls `terminate()`.

In a multithreaded environment, if a thread throws an exception that is not listed in its exception specification, then `unexpected()` is called. The default for `unexpected()` is to call `terminate()`, which defaults to calling `abort()`, which then causes a SIGABRT signal to be generated to the thread issuing the throw. If the SIGABRT signal is not caught, the process is terminated. You can replace the default `unexpected()` behavior for all threads in the process by using the `set_unexpected()` function. One possible use of `set_unexpected()` is to call a function which issues a `pthread_exit()`. If this is done, a throw of a condition by a thread that is not in the exception specification results in thread termination, but not process termination.

Returned value

`unexpected()` returns no values.

Refer to *z/OS XL C/C++ Language Reference* for more information about z/OS XL C++ exception handling, including the `unexpected()` function.

Related information

- [“exception — Exception handling” on page 87](#)
- [“set_unexpected\(\) — Register a function for unexpected\(\)” on page 1587](#)
- [“terminate\(\) — Terminate after failures in C++ error handling” on page 1856](#)

ungetc() — Push character onto input stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C POSIX.1 XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdio.h>

int ungetc(int c, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int ungetc_unlocked(int c, FILE *stream);
```

General description

Pushes the character specified by the value of `c` converted to the unsigned char back onto the given input *stream*. The pushed-back characters are returned by any subsequent read on the same stream in the reverse order of their pushing. That is, the last character pushed will be returned first.

Up to 4 characters can be pushed back to a given input stream. You can call `ungetc()` up to 4 times consecutively; this will result in 4 characters being pushed back in total.

The *stream* must be open for reading. A subsequent read operation on the *stream* starts with `c`. You cannot push EOF back on the stream using `ungetc()`. A successful call to the `ungetc()` function clears the EOF indicator for the stream.

Characters pushed back by `ungetc()`, and subsequently not read in, will be erased if a `fseek()`, `fsetpos()`, `rewind()`, or `fflush()` function is called before the character is read from the *stream*. After all the pushed-back characters are read in, the file position indicator is the same as it was before the characters were pushed back.

Each character of pushback backs up the file position by one byte. This affects the value returned by `ftell()` or `fgetpos()`, the result of an `fseek()` using `SEEK_CUR`, or the result of an `fflush()`. For example, consider a file that contains: a b c d e f g h

After you have just read 'a', the current file position is at the start of 'b'. The following operations will all result in the file position being at the start of 'a', ready to read 'a' again.

```
/* 1 */      ungetc('a', fp);
              fflush(fp); /* flushes ungetc char and keeps position */

/* 2 */      ungetc('a', fp);
              pos = ftell(fp); /* points to first character */
              fseek(fp, pos, SEEK_SET);

/* 3 */      ungetc('a', fp);
              fseek(fp, 0, SEEK_CUR) /* starts at new file pos'n */

/* 4 */      ungetc('a', fp);
              fgetpos(fp, &fpos); /* gets position of first char */
              fsetpos(fp, &fpos);
```

You can use the environment variable `_EDC_COMPAT` to cause a z/OS XL C/C++ application to ignore `ungetc()` characters for `fflush()`, `fgetpos()`, and `fseek()` using `SEEK_CUR`. For more details, see [z/OS XL C/C++ Programming Guide](#).

The `ungetc()` function is not supported for files opened with `type=record` or `type=blocked`.

`ungetc()` has the same restriction as any read operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`ungetc_unlocked()` is functionally equivalent to `ungetc()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `ungetc()` returns the integer argument `c` converted to an unsigned `char`.

If `c` cannot be pushed back, `ungetc()` returns EOF.

`ungetc()` is treated as a read operation. A flush or reposition is required after a call to `ungetc()` and before the next write operation.

Example

CELEBU04

```
/* CELEBU04

In this example, the while statement reads decimal digits
from an input data stream by using arithmetic statements to
compose the numeric values of the numbers as it reads them.
When a nondigit character appears before the EOF, &ungetc.
replaces it in the input stream so that later input functions
can process it.

*/
#include <stdio.h>
#include <ctype.h>

int main(void)
{
```



```

FILE *stream;
int ch;
unsigned int result = 0;

stream = fopen("myfile.dat","r+");
while ((ch = getc(stream)) != EOF && isdigit(ch))
{
    result = result * 10 + ch - '0';
}
printf("result is %i\n",result);
if (ch != EOF)
{
    ungetc(ch,stream);          /* Put the nondigit character back */
    ch=getc(stream);
    printf("value put back was %c\n",ch);
}
}

```

Related information

- [“stdio.h — Standard input and output” on page 63](#)
- [“fflush\(\) — Write buffer to file” on page 530](#)
- [“fseek\(\) — Change file position” on page 638](#)
- [“getc\(\), getchar\(\) — Read a character” on page 689](#)
- [“putc\(\), putchar\(\) — Write a character” on page 1352](#)

ungetwc() — Push a wide character onto a stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```

#include <wchar.h>

wint_t ungetwc(wint_t wc, FILE *stream);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

wint_t ungetwc_unlocked(wint_t wc, FILE *stream);

```

General description

Pushes the wide character specified by *wc* back onto the input stream pointed to by *stream*. The pushed-back wide characters will be returned by subsequent reads on that stream in the reverse order of their pushing. A successful intervening call (with the stream pointed to by *stream*) to a file positioning function (*fseek()*, *fsetpos()*, or *rewind()*) discards any pushed-back wide characters for the stream. The external storage corresponding to the stream is unchanged. There is always at least one wide character of push-back.

If the value of *wc* equals that of the macro *WEOF*, the operation fails and the input stream is unchanged.

A successful call to the *ungetwc()* function clears the EOF indicator for the stream. The value of the file position indicator for the stream after reading or discarding all pushed-back wide characters is the same as it was before the wide characters were pushed back.

For a text stream, the file position indicator is backed up by one wide character. This affects `ftell()`, `fflush()`, `fseek()` using `SEEK_CUR`, and `fgetpos()`. The environment variable, `_EDC_COMPAT` can be used to cause a pushed-back wide char to be ignored by `fflush()`, `fseek()` with `SEEK_CUR`, and `fgetpos()`. For details, see [z/OS XL C/C++ Programming Guide](#).

For a binary stream, the position indicator is unspecified until all characters are read or discarded, unless the last character is pushed back, in which case the file position indicator is backed up by one wide character. This affects `ftell()` and `fseek()` with `SEEK_CUR`, `fgetpos()`, and `fflush()`. The environment variable `_EDC_COMPAT` can be used to cause the pushed-back wide character to be ignored by `fflush()`, `fgetpos()`, and `fseek()`.

`ungetwc()` is not supported for files opened with `type=record` or `type=blocked`.

`ungetwc()` has the same restriction as any read operation for a read immediately following a write, or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`ungetwc_unlocked()` is functionally equivalent to `ungetwc()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `ungetwc()` returns the wide character pushed back after conversion.

If unsuccessful, `ungetwc()` returns `WEOF`.

Notes:

1. For z/OS XL C/C++ applications, only 1 wide character can be pushed back.
2. The position on the stream after a successful `ungetwc()` is one wide character before the current position. See [z/OS XL C/C++ Programming Guide](#) for details on backing up a wide char.

Example

```
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    FILE    *stream;
    wint_t   wc;
    unsigned int result = 0;
    :
    while ((wc = fgetwc(stream)) != WEOF && iswdigit(wc))
        result = result * 10 + wc - L'0';

    if (wc != WEOF)
        ungetwc(wc, stream);
    /* Put the nondigit wide character back */
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fflush\(\) — Write buffer to file” on page 530](#)
- [“fgetwc\(\) — Get next wide character” on page 538](#)
- [“fputwc\(\) — Output a wide-character” on page 609](#)
- [“fseek\(\) — Change file position” on page 638](#)
- [“fsetpos\(\) — Set file position” on page 647](#)

unlink() — Remove a directory entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

int unlink(const char *pathname);
```

General description

Removes a directory entry. This unlink() deletes the link named by *pathname* and decrements the link count for the file itself.

pathname can refer to a pathname, a link, or a symbolic link. If the *pathname* refers to a symbolic link, unlink() removes the symbolic link but not any file or directory named by the contents of the symbolic link.

If the link count becomes 0 and no process currently has the file open, the file itself is deleted. The space occupied by the file is freed for new use, and the current contents of the file are lost. If one or more processes have the file open when the last link is removed, unlink() removes the link, but the file itself is not removed until the last process closes the file.

unlink() cannot be used to remove a directory; use rmdir() instead.

If unlink() succeeds, the change and modification times for the parent directory are updated. If the file's link count is not 0, the change time for the file is also updated. If unlink() fails, the link is not removed.

Returned value

If successful, unlink() returns 0.

If unsuccessful, unlink() returns -1 and sets errno to one of the following values:

Error Code

Description

EACCES

The process did not have search permission for some component of *pathname*, or did not have write permission for the directory containing the link to be removed.

EBUSY

pathname cannot be unlinked because it is currently being used by the system or some other process.

ELOOP

A loop exists in symbolic links. This error is issued if more than POSIX_SYMLINK_MAX symbolic links are detected in the resolution of *pathname*.

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters, or some component of *pathname* is longer than **NAME_MAX** characters while _POSIX_NO_TRUNC is in effect. For symbolic links, the length of the pathname string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using pathconf().

ENOENT

pathname does not exist, or it is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EPERM

pathname is a directory, and `unlink()` cannot be used on directories.

EROFS

The link to be removed is on a read-only file system.

Example

CELEBU06

```
/* CELEBU06

   This example removes a directory entry, using unlink().

*/
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdio.h>

main() {
    int fd;
    char fn[]="unlink.file";

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        close(fd);
        if (unlink(fn) != 0)
            perror("unlink() error");
    }
}
```

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“close\(\) — Close a file” on page 293](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“remove\(\) — Delete file” on page 1429](#)
- [“rmdir\(\) — Remove a directory” on page 1457](#)

unlinkat() — Remove a directory or directory entry

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>          /* Definition of AT_* constants */
#include <unistd.h>

int unlinkat(int dirfd, const char *pathname, int flags);
```

General description

`unlinkat()` operates in the same way as either `unlink()` or `rmdir()`, depending on whether or not *flags* includes the `AT_REMOVEDIR` flag except for the following differences.

- If *pathname* is relative, it is interpreted relative to the directory that is referred to by the file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by `unlink()` and `rmdir()` for a relative path name).
- If *pathname* is relative and *dirfd* is the special value `AT_FDCWD`, *pathname* is interpreted relative to the current working directory of the calling process (like `unlink()` and `rmdir()`).
- If *pathname* is absolute, *dirfd* is ignored.

flags is a bit mask that can either be specified as 0, or by ORing together flag values that control the operation of `unlinkat()`. The valid flag value is:

AT_REMOVEDIR

By default, `unlinkat()` performs the equivalent of `unlink()` on *pathname*. If the `AT_REMOVEDIR` flag is specified, performs the equivalent of `rmdir()` on *pathname*.

Returned value

If successful, `unlinkat()` returns 0.

If unsuccessful, `unlinkat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have search permission for some component of *pathname*, or does not have write permission for the directory that contains the link to be removed.

EBADF

The file descriptor that is specified for *dirfd* is incorrect.

EBUSY

pathname cannot be unlinked because it is used by the system or some other process.

EINVAL

One of the input parameters is not valid.

EISDIR

pathname refers to a directory.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLINK_MAX` symbolic links are detected in the resolution of *pathname*.

ENAMETOOLONG

pathname is longer than 1023 characters, or a component of *pathname* is longer than 255 characters.

ENOENT

A component of *pathname* does not name an existing file or *pathname* is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EROFS

The file resides on a read-only file system.

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“close\(\) — Close a file” on page 293](#)
- [“link\(\) — Create a link to a file” on page 973](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“remove\(\) — Delete file” on page 1429](#)
- [“rmdir\(\) — Remove a directory” on page 1457](#)
- [“unlink\(\) — Remove a directory entry” on page 1945](#)

unlockpt() — Unlock a pseudoterminal manager and subsidiary pair

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

int unlockpt(int fildev);
```

General description

The `unlockpt()` function unlocks the subsidiary pseudoterminal device associated with the manager to which *fildev* refers.

Portable applications must call `unlockpt()` before opening the subsidiary side of a pseudoterminal device.

Returned value

If successful, `unlockpt()` returns 0.

If unsuccessful, `unlockpt()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCESS**

Either a `grantpt()` has not yet been issued, or an `unlockpt()` has already been issued. An `unlockpt()` must be issued after a `grantpt()`, and can only be issued once.

EBADF

The *fildev* argument is not a file descriptor open for writing.

EINVAL

The *fildev* argument is not associated with a manager pseudoterminal device.

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“grantpt\(\) — Grant access to the subsidiary pseudoterminal device” on page 814](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“ptsname\(\) — Get name of the subsidiary pseudoterminal device” on page 1351](#)

unsetenv() — Delete an environment variable

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--------------------------------------|----------|--------------|
| Single UNIX Specification, version 3 | both | z/OS V1R7 |

Format

```
#define _UNIX03_SOURCE
#include <stdlib.h>

int unsetenv(const char *name);
```

General description

unsetenv() deletes an environment variable from the environment of the calling process. The *name* argument points to a string, which is the name of the variable to be removed. If the string pointed to by *name* contains an '=' character, unsetenv() will fail. If the named variable does not exist in the current environment, the environment will not be changed and unsetenv() will succeed.

Returned value

If successful, unsetenv() returns 0. If unsuccessful, unsetenv() returns -1 and sets errno to indicate the error.

- EINVAL – The name argument is a null pointer, points to an empty string, or points to a string containing an '=' character.

Related information

- "Using Environment Variables" in the [z/OS XL C/C++ Programming Guide](#).
- [“stdlib.h — Standard library functions” on page 65](#)
- [“clearenv\(\) — Clear environment variables” on page 283](#)
- [“getenv\(\) — Get value of environment variables” on page 705](#)
- [“__getenv\(\) — Get an environment variable” on page 706](#)
- [“putenv\(\) — Change or add an environment variable” on page 1354](#)
- [“setenv\(\) — Add, delete, and change environment variables” on page 1523](#)

unshare() — Isolate a process from one or more of its namespaces

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XPLATFORM_SOURCE
#include <sched.h>

int unshare(int flags);
```

General description

unshare() disassociates the current process from a mount, network, IPC, and/or UTS namespace into a newly created namespace or disassociate subsequent children from the PID namespace.

The flags argument is a bit mask that specifies which namespaces are to be disassociated by the process and a new namespace created. This argument is specified by zero or more of the following supported constants:

| Table 72. Supported constants for the flag argument | |
|---|--|
| Flag | Description |
| CLONE_NEWIPC | Unshare the process from the IPC namespace and move into a new IPC namespace. |
| CLONE_NEWNS | Unshare the process from the mount namespace and move into a new mount namespace. |
| CLONE_NEWPID | Unshare the PID namespace so the children of the process have a new PID namespace. |
| CLONE_NEWUTS | Unshare the process from the UTS namespace and move into a new UTS namespace. |

If flags is specified as zero, unshare() is a no-op; no changes are made to the calling process's execution context and unshare() indicates success on return.

Restriction: The CLONE_NEWNET or CLONE_NEWUTS flags cannot be specified in a multi-process address space. This results in an errno EINVAL.

Returned value

If successful, unshare() returns 0.

If unsuccessful, unshare() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

An invalid bit was specified in flags. Flags that are supported by unshare() are CLONE_NEWNS, CLONE_NEWPID, CLONE_NEWIPC, CLONE_NEWNET, and CLONE_NEWUTS. Any other flag results in the operation failing with an EINVAL error.

ENOMEM

The process requires more space than is available.

ENOSPC

A system limit is reached.

EPERM

The calling process does not have the required privileges for this operation.

Related information

- [“sched.h — Manipulate and examine process execution scheduling” on page 57](#)
- [“clone\(\) — Create a child process” on page 289](#)

- [“setns\(\) — Allow for a thread to join a descendant namespace” on page 1558](#)

usleep() — Suspend execution for an interval

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

int usleep(useconds_t useconds);
```

General description

The `usleep()` function suspends thread execution for the number of microseconds specified by the *useconds* argument. Because of other activity, or because of the time spent processing the call, the actual suspension time may be longer than the amount of time specified.

The *useconds* argument must be less than 1,000,000. If the value of *useconds* is 0, then the call has no effect.

The `usleep()` function will not interfere with a previous setting of the real-time interval timer. If the thread has set this timer before calling `usleep()`, and if the time specified by *useconds* equals or exceeds the interval timer's prior setting, then the thread will be awakened when the previously set timer interval expires.

Note: The `ualarm()` and `usleep()` functions have been moved to obsolescence in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `setitimer()`, `timer_create()`, `timer_delete()`, `timer_getoverrun()`, `timer_gettime()`, or `timer_settime()` functions are preferred for portability.

Returned value

If successful, `usleep()` returns 0.

If unsuccessful, `usleep()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The *useconds* argument was greater than or equal to 1,000,000.

Related information

- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“setitimer\(\) — Set value of an interval timer” on page 1540](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“sleep\(\) — Suspend execution of a thread” on page 1668](#)
- [“ualarm\(\) — Set the interval timer” on page 1921](#)

utime(), utime64() – Set file access and modification times

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

utime:

```
#define _POSIX_SOURCE
#include <utime.h>

int utime(const char *pathname, const struct utimbuf *newtimes);
```

utime64:

```
#define _POSIX_SOURCE
#define _LARGE_TIME_API
#include <utime.h>

int utime64(const char *pathname, const struct utimbuf64 *newtimes);
```

Compile requirement: Use of the utime64() function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

Function utime() sets the access and modification times of *pathname* to the values in the utimbuf structure. If *newtimes* is a NULL pointer, the access and modification times are set to the current time. Normally, the effective user ID (UID) of the calling process must match the owner UID of the file, or the calling process must have appropriate privileges. However, if *newtimes* is a NULL pointer, the effective UID of the calling process must match the owner UID of the file, or the calling process must have write permission to the file or appropriate privileges.

The contents of a utimbuf structure are:

time_t actime

The new access time (The time_t type gives the number of seconds since the epoch.)

time_t modtime

The new modification time

The utime64() function behaves exactly like utime() except utime64() uses struct utimbuf64 instead of struct utimbuf to support times beyond 03:14:07 UTC on January 19, 2038.

The contents of a utimbuf64 structure are as follows:

time64_t actime

The new access time (The time64_t type gives the number of seconds since the epoch.)

time64_t modtime

The new modification time

Returned value

If successful, utime() returns 0 and updates the access and modification times of the file to those specified.

If unsuccessful, `utime()` returns -1, does not update file times, and sets `errno` to one of the following values:

Error Code Description

EACCES

The process does not have search permission on some component of the *pathname* prefix; or all of the following are true:

- *newtimes* is NULL.
- The effective user ID of the process does not match the file's owner.
- The process does not have write permission on the file.
- The process does not have appropriate privileges.

ELOOP

A loop exists in symbolic links. This error is issued if more than POSIX_SYMLOOP symbolic links (defined in the `limits.h` header file) are detected in the resolution of *pathname*.

ENAMETOOLONG

pathname is longer than **PATH_MAX** characters, or some component of *pathname* is longer than **NAME_MAX** characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the *pathname* string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using `pathconf()`.

ENOENT

There is no file named *pathname*, or the *pathname* argument is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EPERM

newtimes is not NULL, the effective user ID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.

EROFS

pathname is on a read-only file system.

Example

CELEBU07

```
/* CELEBU07 */
#define _POSIX_SOURCE
#include <fcntl.h>
#include <stdio.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <time.h>
#include <unistd.h>
#include <utime.h>

main() {
    int fd;
    char fn[]="utime.file";
    struct utimbuf ubuf;

    if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        close(fd);
        puts("before utime()");
        system("ls -l utime.file");
        ubuf.modtime = 0;
        time(&ubuf.actime);
        if (utime(fn, &ubuf) != 0)
            perror("utime() error");
        else {
            puts("after utime()");
            system("ls -l utime.file");
        }
    }
}
```

```
        unlink(fn);
    }
}
```

Output

```
before utime()
--w----- 1 WELLIE  SYS1      0 Apr 19 15:23 utime.file
after utime()
--w----- 1 WELLIE  SYS1      0 Dec 31  1969 utime.file
```

Related information

- [“limits.h — Standard values for limits on resources” on page 34](#)
- [“utime.h — File access and time modification” on page 78](#)
- [“utimes\(\), utimes64\(\) — Set file access and modification times” on page 1956](#)

utimensat() — Change file timestamps with nanosecond precision

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <fcntl.h>
#include <sys/stat.h>

/* Definition of AT_* constants */

int utimensat(int dirfd, const char *pathname, const struct timespec times[2], int flags);
```

General description

utimensat() updates the timestamps of a file with nanosecond precision while utime() and utimes() permit only second and microsecond precision, respectively, when setting file timestamps. The new file timestamps are specified in the array *times*: *times*[0] specifies the new “last access time” (atime); *times*[1] specifies the new “last modification time” (mtime). Each of the elements of *times* specifies a time as the number of seconds and nanoseconds since the Epoch, 1970-01-01 00:00:00 + 0000 (UTC). This information is conveyed in a structure of the following form:

```
struct timespec {
    time_t tv_sec;      /* seconds */
    long tv_nsec;      /* nanoseconds */
};
```

- If the *tv_nsec* field of one of the *timespec* structures has the special value *UTIME_NOW*, the corresponding file timestamp is set to the current time.
- If the *tv_nsec* field of one of the *timespec* structures has the special value *UTIME_OMIT*, the corresponding file timestamp is left unchanged.
- In both of these cases, the value of the corresponding *tv_sec* field is ignored.

If *times* is NULL, both timestamps are set to the current time.

If *pathname* is relative, by default it is interpreted relative to the directory referred to by the open file descriptor *dirfd* (rather than relative to the current working directory of the calling process, as is done by *utimes()* for a relative *pathname*).

If *pathname* is absolute, *dirfd* is ignored.

The *flags* field is a bit mask that may be 0, or include the following constant, which is defined in `<fcntl.h>`:

AT_SYMLINK_NOFOLLOW

If *pathname* specifies a symbolic link, update the timestamps of the link, rather than the file to which it refers.

Returned value

If successful, `utimensat()` returns 0.

If unsuccessful, `utimensat()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

The process does not have appropriate permissions. Possible reasons include:

- The process attempts to set access time or modification time to current time (*times* is NULL), but the effective UID of the process does not match the file's owner.
- The process does not have write permission on the file.
- The process does not have appropriate privileges.

EBADF

pathname is relative but *dirfd* is not `AT_FDCWD` or a valid file descriptor, or *dirfd* is not a valid file descriptor.

EBUSY

The file is open by a remote NFS client with a share reservation that conflicts with the requested operation.

EINVAL

- Invalid value in *flags*.
- *pathname* is NULL, *dirfd* is not `AT_FDCWD`, and *flags* contains `AT_SYMLINK_NOFOLLOW`.
- Invalid value in one of the *tv_nsec* fields (value outside range 0 to 999,999,999, and not `UTIME_NOW` or `UTIME_OMIT`); or an invalid value in one of the *tv_sec* fields.

ELOOP

A loop exists in symbolic links. This error is issued if more than `POSIX_SYMLINK_MAX` symbolic links are detected in the resolution of *pathname*.

EMVSERR

An MVS environmental error is detected.

ENAMETOOLONG

pathname is longer than `PATH_MAX` characters, or some component of *pathname* is longer than `NAME_MAX` characters while `_POSIX_NO_TRUNC` is in effect. For symbolic links, the length of the *pathname* string that is substituted for a symbolic link exceeds `PATH_MAX`.

ENOENT

There is no file that is named *pathname*, or the *pathname* argument is an empty string.

ENOTDIR

Some component of the *pathname* prefix is not a directory.

EPERM

times is not NULL. The effective user ID of the calling process does not match the owner of the file. The calling process does not have appropriate privileges.

EROFS

pathname is on a read-only file system.

Related information

- [“futimes\(\) — Change file access and modification times” on page 670](#)
- [“futimesat\(\) — Change timestamps of a file relative to a directory file descriptor” on page 672](#)
- [“openat\(\) — Open a file relative to a directory file descriptor” on page 1162](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“utimes\(\), utimes64\(\) — Set file access and modification times” on page 1956](#)

utimes(), utimes64() — Set file access and modification times

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

utimes:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/time.h>

int utimes(const char *path, const struct timeval times[2]);
```

utimes64:

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _LARGE_TIME_API
#include <sys/time.h>

int utimes64(const char *path, const struct timeval64 times64[2]);
```

Compile requirement: Use of the utimes64() function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

The utimes() function sets the access and modification times of the file pointed to by the path argument to the value of the times argument.

The times argument is an array of two timeval structures. The first array member represents the date and time of the last access, and the second member represents the date and time of the last modification. The times in the timeval structure are measured in seconds and microseconds since the Epoch, but the actual time stored with the file are rounded to the nearest second. The timeval members are:

tv_sec

Seconds since January 1, 1970 (UTC)

tv_usec

Microseconds

If the times argument is a NULL pointer, the access and modification times of the file are set to the current time. The same process privilege requirements of the utime() function are required by utimes(). The last file status change, field st_ctime in a stat(), is updated with the current time.

Note: The utimes() function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The utime() function is preferred for portability.

The `utimes64()` function behaves exactly like `utimes()` except `utimes64()` supports calendar times beyond 03:14:07 UTC on January 19, 2038. The `times64` argument is an array of two `timeval64` structures:

tv_sec64

Seconds since January 1, 1970 (UTC)

tv_usec64

microseconds

Returned value

If successful, `utimes()` returns 0.

If unsuccessful, `utimes()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****EACCES**

The process does not have search permission on some component of the *path* prefix; or all of the following are true:

- *times* is NULL
- The effective user ID of the process does not match the file's owner
- The process does not have write permission on the file
- The process does not have appropriate privileges

ELOOP

A loop exists in symbolic links. This error is issued if more than **POSIX_SYMLLOOP** symbolic links (defined in the `limits.h` header file) are detected in the resolution of *path*.

ENAMETOOLONG

path is longer than **PATH_MAX** characters or some component of *path* is longer than **NAME_MAX** characters while **_POSIX_NO_TRUNC** is in effect. For symbolic links, the length of the *pathname* string substituted for a symbolic link exceeds **PATH_MAX**. The **PATH_MAX** and **NAME_MAX** values can be determined using *pathconf()*.

ENOTDIR

Some component of the *path* prefix is not a directory.

ENOTENT

There is no file named *path*, or the *path* argument is an empty string.

EPERM

times is not NULL, the effective user ID of the calling process does not match the owner of the file, and the calling process does not have appropriate privileges.

EROFS

path is on a read-only file system.

Related information

- [“sys/time.h — Time types” on page 71](#)
- [“utime\(\), utime64\(\) — Set file access and modification times” on page 1952](#)

__utmpxname() — Change the utmpx database name

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <utmpx.h>

int __utmpxname(char *file);
```

General description

The `__utmpxname()` function changes the name of the utmpx database file for the current thread from default `/etc/utmpx` to the name specified by *file*. The `__utmpxname()` function does not open the file. It closes the old utmpx database file, if it is currently opened for the current thread, and saves the new utmpx database file name. If the file does not exist no indication is given.

Because the `__utmpxname()` function processes thread-specific data the `__utmpxname()` function can be used safely from a multithreaded application. If multiple threads in the same process open the database, then each thread opens the database with a different file descriptor. The thread's database file descriptor is closed when the calling thread terminates or the `endutxent()` function is called by the calling thread.

Programs must not reference the data passed back by `getutxline()/getutxline64()`, `getutxent()/getutxent64()`, `getutxid()/getutxid64()`, or `pututxline()/pututxline64()` after `__utmpxname()` has been called (the storage has been freed.) The `endutxent()` function resets the name of the utmpx database back to the default value. If you must do additional utmpx operations on a nonstandard utmpx database after calling `endutxent()`, then call `__utmpxname()` again, to reestablish the nonstandard name.

Returned value

If successful, `__utmpxname()` returns 0.

If unsuccessful, `__utmpxname()` returns -1.

Related information

- [“utmpx.h — User accounting database” on page 78](#)
- [“endutxent\(\) — Close the utmpx database” on page 425](#)
- [“getutxent\(\), getutxent64\(\) — Read next entry in utmpx database” on page 794](#)
- [“getutxid\(\), getutxid64\(\) — Search by ID utmpx database” on page 795](#)
- [“getutxline\(\), getutxline64\(\) — Search by line utmpx database” on page 797](#)
- [“pututxline\(\), pututxline64\(\) — Write entry to utmpx database” on page 1359](#)
- [“setutxent\(\) — Reset to start of utmpx database” on page 1588](#)

utoa() — Convert unsigned int into a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

```
#define _OPEN_SYS_ITOA_EXT
#include <stdlib.h>

char * utoa(unsigned int n, char * buffer, int radix);
```

General description

The `utoa()` function converts the unsigned integer `n` into a character string. The string is placed in the buffer passed, which must be large enough to hold the output. The radix values can be OCTAL, DECIMAL, or HEX. When the radix is DECIMAL, `utoa()` produces the same result as the following statement:

```
(void) sprintf(buffer, "%u", n);
```

with `buffer` the returned character string. When the radix is OCTAL, `utoa()` formats unsigned integer `n` into an octal constant. When the radix is HEX, `utoa()` formats unsigned integer `n` into a hexadecimal constant. The hexadecimal value will include lower case `abcdef`, as necessary.

Returned value

String pointer (same as `buffer`) will be returned. When passed an invalid radix argument, function will return NULL and set `errno` to `EINVAL`.

Portability considerations

This is a non-standard function. Even though the prototype given is commonly used by compilers on other platforms, there is no guarantee that this function will behave the same on all platforms, in all cases. You can use this function to help port applications from other platforms, but you should avoid using it when writing new applications, in order to ensure maximum portability.

Example

CELEBU10

```
/* CELEBU10

   This example reads an unsigned int and formats it to decimal,
   octal, hexadecimal constants converted to a character string.
*/

#define _OPEN_SYS_ITOA_EXT
#include <stdio.h>
#include <stdlib.h>

int main ()
{
    unsigned int i;
    char buffer [sizeof(unsigned int)*8+1];
    printf ("Enter a number: ");
    if (scanf ("%u",&i) == 1) {
        utoa (i,buffer,DECIMAL);
        printf ("decimal: %s\n",buffer);
        utoa (i,buffer,HEX);
        printf ("hexadecimal: %s\n",buffer);
        utoa (i,buffer,OCTAL);
        printf ("octal: %s\n",buffer);
    }
    return 0;
}
```

Output

If the input is 1234, then the output should be:

```
decimal: 1234
hexadecimal: 4d2
octal: 2322
```

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“itoa\(\) – Convert int into a string” on page 925](#)
- [“lltoa\(\) – Convert long long into a string” on page 985](#)
- [“ltoa\(\) – Convert long into a string” on page 1030](#)
- [“ulltoa\(\) – Convert unsigned long long into a string” on page 1925](#)
- [“ultoa\(\) – Convert unsigned long into a string” on page 1927](#)

va_arg(), va_copy(), va_end(), va_start() – Access function arguments

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdarg.h>

var_type va_arg(va_list arg_ptr, var_type);
void va_end(va_list arg_ptr);
void va_start(va_list arg_ptr, variable_name);
```

C99:

```
#define _ISOC99_SOURCE
#include <stdarg.h>

var_type va_arg(va_list arg_ptr, var_type);
void va_end(va_list arg_ptr);
void va_start(va_list arg_ptr, variable_name);
void va_copy(va_list dest, va_list src);
```

General description

The va_arg(), va_end(), and va_start() macros access the arguments to a function when it takes a fixed number of required arguments and a variable number of optional arguments. You declare required arguments as ordinary parameters to the function and access the arguments through the parameter names.

The va_start() macro initializes the arg_ptr pointer for subsequent calls to va_arg() and va_end().

The argument variable_name is the identifier of the rightmost named parameter in the parameter list (preceding , ...). Use the va_start() macro before the va_arg() macro. Corresponding va_start() and va_end() macro calls must be in the same function. If variable_name is declared as a register, with a function or an array type, or with a type that is not compatible with the type that results after application of the default argument promotions, then the behavior is undefined.

The `va_arg()` macro retrieves a value of the given *var_type* from the location given by *arg_ptr* and increases *arg_ptr* to point to the next argument in the list. The `va_arg()` macro can retrieve arguments from the list any number of times within the function.

The macros also provide fixed-point decimal support under z/OS XL C. The `sizeof(xx)` operator is used to determine the size and type casting that is used to generate the values. Therefore, a call, such as, `x = va_arg(ap, _Decimal(5,2));` is valid. The size of a fixed-point decimal number, however, cannot be made a variable. Therefore, a call, such as, `z = va_arg(ap, _Decimal(x,y))` where `x = 5` and `y = 2` is invalid.

The `va_end()` macro is needed by some systems to indicate the end of parameter scanning.

`va_start()` and `va_arg()` do not work with parameter lists of functions whose linkages were changed with the `#pragma linkage` directive.

`stdarg.h` and `varargs.h` are mutually exclusive. Whichever `#include` comes first, determines the form of macro that is visible.

The type definition for the `va_list` type is normally `"char *va_list[2]"`. Some applications (especially ported applications) require that the `va_list` type be defined as `"char *va_list"`. This alternate `va_list` type is available if the user defines the feature test macro `_VARARG_EXT_` before the inclusion of any system header file. If the `_VARARG_EXT_` feature test macro is defined, `va_list` will be typed as `char *va_list`, and the functions `vprintf()`, `vfprintf()`, `vsprintf()`, and `vswprintf()` will use this alternate `va_list` type.

The `va_copy()` function creates a copy (*dest*) of a variable of type `va_list` (*src*). The copy appear as if it has gone through a `va_start()` and the exact set of sequences of `va_arg()` as that of *src*.

After `va_copy()` initializes *dest*, the `va_copy()` macro shall not be invoked to reinitialize *dest* without an intervening invocation of the `va_end()` macro for the same *dest*.

Returned value

The `va_arg()` macro returns the current argument.

The `va_end()`, `va_copy()`, and `va_start()` macros return no values.

Example

CELEBV01

```
/* CELEBV01

   This example passes a variable number of arguments to a function,
   stores each argument in an array, and prints each argument.

*/
#include <stdio.h>
#include <stdarg.h>

void vout(int max, ...);

int main(void)
{
    vout(3, "Sat", "Sun", "Mon");
    printf("\n");
    vout(5, "Mon", "Tues", "Wed", "Thurs", "Fri");
}

void vout(int max, ...)
{
    va_list arg_ptr;
    int args = 0;
    char *days[7];

    va_start(arg_ptr, max);
    while(args < max)
    {
        days[args] = va_arg(arg_ptr, char *);
        printf("Day: %s \n", days[args++]);
    }
    va_end(arg_ptr);
}
```

```
}

```

Output

```
Day:  Sat
Day:  Sun
Day:  Mon

Day:  Mon
Day:  Tues
Day:  Wed
Day:  Thurs
Day:  Fri

```

```
/* This example uses a variable number of arguments for
   fixed-point decimal data types.
   The example works in z/OS XL C only.
*/
#include <stdio.h>
#include <stdarg.h>
#include <decimal.h>

void vprint(int, ...);

int main(void) {
    int i = 168;
    decimal(10,2) pd01 = 12345678.12d;
    decimal(20,5) pd02 = -987.65d;
    decimal(31,20) pd03 = 12345678901.12345678900987654321d;
    int j = 135;

    vprint(0, i, pd01, pd02, pd03, j);

    return(0);
}

void vprint(int whichcase, ...) {
    va_list arg_ptr;
    int m, n;
    decimal(10,2) va01;
    decimal(20,5) va02;
    decimal(31,20) va03;

    va_start(arg_ptr, whichcase);

    switch (whichcase) {
        case 0:
            m = va_arg(arg_ptr, int);
            va01 = va_arg(arg_ptr, decimal(10,2));
            va02 = va_arg(arg_ptr, decimal(20,5));
            va03 = va_arg(arg_ptr, decimal(31,20));
            n = va_arg(arg_ptr, int);
            printf("m      = %d\n", m);
            printf("va01 = %D(10,2)\n", va01);
            printf("va02 = %D(20,5)\n", va02);
            printf("va03 = %D(31,20)\n", va03);
            printf("n      = %d\n", n);
            break;
        default:
            printf("Illegal case number : %d\n", whichcase);
    }

    va_end(arg_ptr);
}

```

Output:

```
m      = 168
va01 = 12345678.12
va02 = -987.65000
va03 = 12345678901.12345678900987654321
n      = 135

```

CELEBV02

```

/* CELEBV02

   These examples use the _XOPEN_SOURCE feature test macro,
   This example passes a variable number of arguments to a function,
   stores each argument in an array, and prints each argument.

*/
#define _XOPEN_SOURCE
#include <stdio.h>
#include <varargs.h>

void vout(va_alist)
va_dcl
{
    va_list arg_ptr;
    int args = 0;
    int max;
    char *days[7];

    va_start(arg_ptr);
    max = va_arg(arg_ptr, int);
    while(args < max) {
        days[args] = va_arg(arg_ptr, char *);
        printf("Days:      %s\n", days[args++]);
    }
    va_end(arg_ptr);
}

int main(void)
{
    vout(3, "Sat", "Sun", "Mon");
    printf("\n");
    vout(5, "Mon", "Tues", "Wed", "Thurs", "Fri");
}

```

```

/* This example uses a variable number of arguments for
   fixed-point decimal data types.
   The example works in z/OS XL C only.

*/
#define _XOPEN_SOURCE
#include <stdio.h>
#include <varargs.h>
#include <decimal.h>

void vprint(va_alist)
va_dcl
{
    va_list arg_ptr;
    int m, n, whichcase;
    decimal(10,2) va01;
    decimal(20,5) va02;
    decimal(31,20) va03;

    va_start(arg_ptr);
    whichcase = va_arg(arg_ptr, int);

    switch (whichcase) {
        case 0:
            m = va_arg(arg_ptr, int);
            va01 = va_arg(arg_ptr, decimal(10,2));
            va02 = va_arg(arg_ptr, decimal(20,5));
            va03 = va_arg(arg_ptr, decimal(31,20));
            n = va_arg(arg_ptr, int);
            printf("m      = %d\n", m);
            printf("va01 = %D(10,2)\n", va01);
            printf("va02 = %D(20,5)\n", va02);
            printf("va03 = %D(31,20)\n", va03);
            printf("n      = %d\n", n);
            break;
        default:
            printf("Illegal case number : %d\n", whichcase);
    }

    va_end(arg_ptr);
}

```

```
int main(void) {
    int i = 168;
    decimal(10,2) pd01 = 12345678.12d;
    decimal(20,5) pd02 = -987.65d;
    decimal(31,20) pd03 = 12345678901.12345678900987654321d;
    int j = 135;

    vprint(0, i, pd01, pd02, pd03, j);

    return(0);
}
}
```

```
#define _ISOC99_SOURCE
#include <stdio.h>
#include <stdarg.h>
void prnt(int max, ...);

int main(void)
{
    prnt(8, "0", "1", "1", "2", "3", "5", "8", "13");
}

void prnt(int max, ...)
{
    va_list src;
    va_list dest;
    int args = 0;
    char *fib[8];
    va_start(src, max);
    va_copy(dest, src);
    while(args < max) {
        fib[args] = va_arg(dest, char *);
        printf("fib[%d]: %s \n", args, fib[args++]);
    }
    va_end(dest);
}
```

Output

```
fib[0]: 0
fib[1]: 1
fib[2]: 1
fib[3]: 2
fib[4]: 3
fib[5]: 5
fib[6]: 8
fib[7]: 13
```

Related information

- [“stdarg.h — Access arguments in functions with variable-length argument lists” on page 60](#)
- [“varargs.h — Handle variable argument lists” on page 78](#)
- [“vfprintf\(\) — Format and print data to stream” on page 1968](#)
- [“vprintf\(\) — Format and print data to stdout” on page 1974](#)
- [“vsprintf\(\) — Format and print data to buffer” on page 1976](#)

valloc() — Page-aligned memory allocator

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <stdlib.h>

void *valloc(size_t size);
```

General description

Restriction: This function is not supported in AMODE 64.

The `valloc()` function has the same effect as `malloc()`, except that the allocated memory will be aligned to a multiple of the value returned by `sysconf(_SC_PAGESIZE)`.

Note: When `free()` is used to release storage obtained by `valloc()`, the storage is not made available for reuse. The storage will not be freed until the enclave goes away.

Special behavior for C++: The C++ keywords `new` and `delete` are not interoperable with `valloc()`, `aligned_alloc()`, `calloc()`, `free()`, `malloc()`, or `realloc()`.

Note:

This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. The `malloc()` or `mmap()` functions are preferred for portability.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `valloc()` returns a pointer to the reserved storage. The storage space to which the returned value points is guaranteed to be aligned on a page boundary.

If unsuccessful, `valloc()` returns `NULL` if there is not enough storage available, or if `size` is 0. If `valloc()` returns `NULL` because there is not enough storage, it sets `errno` to one of the following values:

Error Code

Description

ENOMEM

Insufficient memory is available

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“malloc\(\) — Reserve storage block” on page 1035](#)
- [“sysconf\(\) — Determine system configuration options” on page 1794](#)

vfork() — Create a new process

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/types.h>
#include <unistd.h>

pid_t vfork(void);
```

Note: Although POSIX.1 does not require that the `<sys/types.h>` include file be included, XPG4 has it as an optional header. Therefore it is recommended that you include it for portability.

General description

The `vfork()` function creates a new process. The `vfork()` function has the same effect as `fork()`, except that the behavior is undefined, if the process created by `vfork()` attempts to call any other C/370 function before calling either `exec()` or `_exit()`. The new process (the *child process*) is an exact duplicate of the process that calls `vfork()` (the *parent process*), except for the following:

- The child process has a unique process ID (PID), which does not match any active process group ID.
- The child has a different parent process ID, that is, the process ID of the process that called `vfork()`.
- The child has its own copy of the parent's file descriptors. Each file descriptor in the child refers to the same open file description as the corresponding file descriptor in the parent.
- The child has its own copy of the parent's open directory streams. Each child's open directory stream may share directory stream positioning with the corresponding parent's directory stream.
- The following elements in the `tms` structure are set to 0 in the child:

```
tms_utime
tms_stime
tms_cutime
tms_cstime
```

For more information about these elements, see [“times\(\) — Get process and child process times” on page 1867](#).

- The child does not inherit any file locks previously set by the parent.
- The child process has no alarms set (similar to the results of a call to `alarm()` with an argument value of 0).
- The child has no pending signals.
- The child process may have its own copy of the parent's message catalog descriptors.
- All `semadj` values are cleared.
- Interval timers are reset in the child process.

In all other respects, the child is identical to the parent. Because the child is a duplicate, it contains the same call to `vfork()` that was in the parent. Execution begins with this `vfork()` call, which returns a value of 0; the child then proceeds with normal execution.

The `vfork()` function is not supported from a multithread environment.

For more information on `vfork()` from a z/OS perspective, refer to [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#).

You can use z/OS memory files from a z/OS UNIX program. However, use of the `vfork()` function from the program removes access from a hiperspace memory file for the child process. Use of an `exec` function from the program clears a memory file when the process address space is cleared.

Special behavior for C: For POSIX resources, `vfork()` behaves as just described. But in general, MVS resources that existed in the parent do *not* exist in the child. This is true for open streams in MVS data sets and assembler-accessed z/OS facilities, such as STIMERS. In addition, z/OS allocations (through JCL, SVC99, or ALLOCATE) are not passed to the child process.

Note: The `vfork()` function has been moved to obsolescence in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `fork()` function is preferred for portability.

Returned value

If successful, `vfork()` returns 0 to the child process and the process ID of the newly created child to the parent process.

If unsuccessful, `vfork()` fails to create a child process and returns -1 to the parent. `vfork()` sets `errno` to one of the following values:

Error Code Description

EAGAIN

There are insufficient resources to create another process, or else the process has already reached the maximum number of processes you can run.

ELEMSGERR

Language Environment message file not available.

ELEMULTITHREAD

`vfork()` was invoked from a multi-threaded environment.

ELENOFORK

Application contains a language that does not support `fork()`.

ENOMEM

The process requires more space than is available.

Related information

- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“alarm\(\) — Set an alarm” on page 156](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getrlimit\(\) — Get current or maximum resource consumption” on page 767](#)
- [“nice\(\) — Change priority of a process” on page 1150](#)
- [“putenv\(\) — Change or add an environment variable” on page 1354](#)
- [“rexec\(\) — Execute commands one at a time on a remote host” on page 1451](#)
- [“semop\(\) — Semaphore operations” on page 1488](#)
- [“setlocale\(\) — Set locale” on page 1547](#)
- [“shmat\(\) — Shared memory attach operation” on page 1593](#)
- [“sigaction\(\) — Examine or change a signal action” on page 1605](#)
- [“signal\(\) — Handle interrupts” on page 1635](#)
- [“sigpending\(\) — Examine pending signals” on page 1641](#)
- [“sigprocmask\(\) — Examine or change a thread” on page 1643](#)
- [“stat\(\), stat64\(\) — Get file information” on page 1706](#)
- [“system\(\) — Execute a command” on page 1800](#)
- [“times\(\) — Get process and child process times” on page 1867](#)
- [“ulimit\(\) — Get or set process file size limits” on page 1924](#)

vfprintf() — Format and print data to stream

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdarg.h>
#include <stdio.h>

int vfprintf(FILE * __restrict__ stream,
             const char * __restrict__ format, va_list arg_ptr);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int vfprintf_unlocked(FILE * __restrict__ stream,
                    const char * __restrict__ format, va_list arg_ptr);
```

General description

The `vfprintf()` function is similar to `fprintf()`, except that *arg_ptr* points to a list of arguments whose number can vary from call to call in the program. These arguments should be initialized by `va_start()` for each call. In contrast, `fprintf()` can have a list of arguments, but the number of arguments in that list is fixed when you compile the program. For a specification of the *format* string, see [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data”](#) on page 593.

`vfprintf()` is not supported for files opened with `type=record` or `type=blocked`.

`vfprintf()` has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

`vfprintf_unlocked()` is functionally equivalent to `vfprintf()` with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the `flockfile()` or `ftrylockfile()` function.

Returned value

If successful, `vfprintf()` returns the number of characters written to *stream*.

If unsuccessful, `vfprintf()` returns a negative value.

Note: In contrast to some UNIX-based implementations of the C language, the z/OS XL C/C++ implementation of the `vfprintf()` family increments the pointer to the variable arguments list. To control whether the pointer to the argument is incremented, call the `va_end` macro after each call to `vsprintf()`.

Example

CELEBV03

```
/* CELEBV03

   This example prints out a variable number of strings to the
   file myfile.dat, using &vfprt..

*/
#include <stdarg.h>
#include <stdio.h>

void vout(FILE *stream, char *fmt, ...);
char fmt1 [] = "%s %s %s\n";

int main(void)
{
    FILE *stream;
    stream = fopen("myfile.dat", "w");

    vout(stream, fmt1, "Sat", "Sun", "Mon");
}

void vout(FILE *stream, char *fmt, ...)
{
    va_list arg_ptr;

    va_start(arg_ptr, fmt);
    vfprintf(stream, fmt, arg_ptr);
    va_end(arg_ptr);
}
```

Output:

Sat Sun Mon

Related information

- [“stdarg.h — Access arguments in functions with variable-length argument lists” on page 60](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“va_arg\(\), va_copy\(\), va_end\(\), va_start\(\) — Access function arguments” on page 1960](#)
- [“vprintf\(\) — Format and print data to stdout” on page 1974](#)
- [“vsprintf\(\) — Format and print data to buffer” on page 1976](#)

vfscanf(), vscanf(), vsscanf() — Format input of a STDARG argument list

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 Language Environment C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <stdarg.h>
#include <stdio.h>
```

```
int vfscanf(FILE *__restrict__ stream,
            const char *__restrict__ format, va_list arg);

int vscanf(const char *__restrict__ format, va_list arg);

int vsscanf(const char *__restrict__ s,
            const char *__restrict__ format, va_list arg);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int vfscanf_unlocked(FILE *__restrict__ stream,
                    const char *__restrict__ format, va_list arg);

int vscanf_unlocked(const char *__restrict__ format, va_list arg);
```

General description

The vfscanf(), vscanf(), and vsscanf() functions are equivalent to the fscanf(), scanf(), and sscanf() functions, respectively, except that instead of being called with a variable number of arguments, they are called with an argument list as defined in stdarg.h.

The argument list should be initialized using the va_start macro before each call. These functions do not invoke the va_end macro, but instead invoke the va_arg macro causing the value of arg after the return to be unspecified.

vfscanf() and vscanf() are not supported for files opened with a record type. They also have the same restrictions as a write immediately following a read or a read immediately following a write. This is because, between a write and a subsequent read, there must be an intervening flush or reposition and between a read and a subsequent write, there must also be an intervening flush or reposition unless EOF has been reached.

Note: In contrast to some UNIX-based implementations of the C language, the z/OS XL C/C++ implementation of the vscanf() family increments the pointer to the variable arguments list. To control whether the pointer is incremented, call the va_end macro after each function call.

vfscanf_unlocked() and vscanf_unlocked() are functionally equivalent to vfscanf() and vscanf() with the exception that they are not thread-safe. These functions may safely be used in a multithreaded application if and only they are called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

Returned value

Refer to fscanf().

Related information

- stdarg.h
- stdio.h
- fscanf()

vwfprintf(), vswprintf(), vwprintf() – Format and write wide characters of a STDARG argument list

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

Non-XP4:

```
#include <stdarg.h>
#include <wchar.h>

int vfwprintf(FILE * __restrict__ stream,
              const wchar_t * __restrict__ format, va_list arg);
int vswprintf(wchar_t * __restrict__ wcs, size_t n,
              const wchar_t * __restrict__ format, va_list arg);
int vwprintf(const wchar_t * __restrict__ format, va_list arg);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

int vfwprintf_unlocked(FILE * __restrict__ stream,
                      const wchar_t * __restrict__ format, va_list arg);
int vwprintf_unlocked(const wchar_t * __restrict__ format, va_list arg);
```

XP4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <stdarg.h>
#include <wchar.h>

int vfwprintf(FILE * __restrict__ stream,
              const wchar_t * __restrict__ format, va_list arg);
int vswprintf(wchar_t * __restrict__ wcs, size_t n,
              const wchar_t * __restrict__ format, va_list arg);
int vwprintf(const wchar_t * __restrict__ format, va_list arg);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

int vfwprintf_unlocked(FILE * __restrict__ stream,
                      const wchar_t * __restrict__ format, va_list arg);
int vwprintf_unlocked(const wchar_t * __restrict__ format, va_list arg);
```

General description

vfwprintf(), vswprintf(), and vwprintf() functions are equivalent to fprintf(), sprintf(), and printf() functions, respectively, except for the following:

- Instead of being called with a variable number of arguments, they are called with an argument list as defined in stdarg.h.
- For vswprintf(), the argument *wcs* specifies an array of type `wchar_t`, rather than an array of type `char`, into which the generated output is to be written.
- The argument *format* specifies an array of type `wchar_t`, rather than an array of type `char`, which describes how subsequent arguments are converted for output.
- `%c` without an `l` prefix means an integer argument is to be converted to `wchar_t`, as if by calling `mbtowl()`, and then written.
- `%c` with `l` prefix means a `wint_t` is converted to `wchar_t` and then written.
- `%s` without an `l` prefix means a character array containing a multibyte character sequence is to be converted to an array of `wchar_t` and written. The conversion will take place as if `mbtowl()` were called repeatedly.
- `%s` with `l` prefix means an array of `wchar_t` will be written. The array is written up to but not including the terminating NULL character, unless the precision specifies a shorter output.

For vswprintf(), a NULL wide character is written at the end of the wide characters written; the NULL wide character is not counted as part of the returned sum. If copying takes place between objects that overlap, the behavior is undefined.

Note: The vfwprintf() and vwprintf() functions have a dependency on the level of the Enhanced ASCII Extensions. See “Enhanced ASCII support ” on page 2123 for details.

vfwprintf_unlocked() and vwprintf_unlocked() are functionally equivalent to vfwprintf() and vwprintf() with the exception that they are not thread-safe. These functions may safely be used in a multithreaded application if and only if they are called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or ftrylockfile() function.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the wchar header, then you must also define the _MSE_PROTOS feature test macro to make the declaration of the vfwprintf(), vswprintf(), or vwprintf() function in the wchar header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

If successful, vfwprintf(), vswprintf(), and vwprintf() return the number of wide characters written, not counting the terminating NULL wide character.

If unsuccessful, a negative value is returned.

If *n* or more wide characters were requested to be written, vswprintf() returns a negative value and sets errno to indicate the error.

Note: In contrast to some UNIX-based implementations of the C language, the IBM z/OS C++ implementation of the vprintf() family increments the pointer to the variable arguments list. To control whether the pointer to the argument is incremented, call the va_end macro after each call to vfwprintf(), vswprintf(), or vwprintf().

Example

CELEBV06

```
/* CELEBV06 */
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <stdio.h>
#include <stdarg.h>
#include <wchar.h>

void vout(wchar_t *, size_t, wchar_t *, ...);

wchar_t *format3 = L"%S %d %S";
wchar_t *format5 = L"%S %d %S %d %S";

int main(void)
{
    wchar_t wcstr[100];

    vout(wcstr, 100, format3, L"ONE", 2L, L"THREE");
    printf("%S\n", wcstr);
    vout(wcstr, 100, format5, L"ONE", 2L, L"THREE", 4L, L"FIVE");
    printf("%S\n", wcstr);
}

void vout(wchar_t *wcs, size_t n, wchar_t *fmt, ...)
{
    va_list arg_ptr;

    va_start(arg_ptr, fmt);
    if(vswprintf(wcs, n, fmt, arg_ptr) < 0)
        perror("vswprintf() error");
    va_end(arg_ptr);
}
```

Related information

- [“stdarg.h — Access arguments in functions with variable-length argument lists” on page 60](#)
- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“fwprintf\(\), swprintf\(\), wprintf\(\) — Format and write wide characters” on page 674](#)

- [“vsprintf\(\) — Format and print data to buffer” on page 1976](#)

vfwscanf(), vwscanf(), vswscanf() — Wide-character formatted input of a STDARG argument list

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| C99 Single UNIX Specification, Version 3 Language Environment C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <stdarg.h>
#include <stdio.h>
#include <wchar.h>

int vfwscanf(FILE *__restrict__ stream,
             const wchar_t *__restrict__ format, va_list arg);

int vwscanf(const wchar_t *__restrict__ format, va_list arg);

int vswscanf(const wchar_t *__restrict__ ws,
            const wchar_t *__restrict__ format, va_list arg);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <wchar.h>

int vfwscanf_unlocked(FILE *__restrict__ stream,
                    const wchar_t *__restrict__ format, va_list arg);
int vwscanf_unlocked(const wchar_t *__restrict__ ws,
                    const wchar_t *__restrict__ format, va_list arg);
```

General description

The vfwscanf(), vswscanf(), and vwscanf() functions are equivalent to the fwscanf(), swscanf(), and wscanf() functions, respectively, except that instead of being called with a variable number of arguments, they are called with an argument list as defined in stdarg.h.

The argument list should be initialized using the va_start macro before each call. These functions do not invoke the va_end macro, but instead invoke the va_arg macro causing the value of *arg* after the return to be unspecified.

vfwscanf() and vwscanf() are not supported for files opened with a record type. They also have the same restrictions as a write immediately following a read or a read immediately following a write. This is because, between a write and a subsequent read, there must be an intervening flush or reposition and between a read and a subsequent write, there must also be an intervening flush or reposition unless EOF has been reached.

Note: In contrast to some UNIX-based implementations of the C language, the z/OS XL C/C++ implementation of the vwscanf() family increments the pointer to the variable arguments list. To control whether the pointer is incremented, call the va_end macro after each function call.

vfwscanf_unlocked() and vwscanf_unlocked() are functionally equivalent to vfwscanf() and vwscanf() with the exception that they are not thread-safe. These functions may safely be used in a multithreaded application if and only if they are called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or frylockfile() function.

Returned value

Refer to fwscanf().

Related information

- stdarg.h
- stdio.h
- wchar.h
- fwscanf()

vprintf() — Format and print data to stdout

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C XPG4.2 C99 Single UNIX Specification, Version 3 Language Environment | both | |

Format

```
#include <stdarg.h>
#include <stdio.h>

int vprintf(const char * __restrict__format, va_list arg_ptr);

#define _OPEN_SYS_UNLOCKED_EXT 1
#include <stdio.h>

int vprintf_unlocked(const char * __restrict__format, va_list arg_ptr);
```

General description

The vprintf() function is similar to printf(), except that *arg_ptr* points to a list of arguments whose number can vary from call to call in the program. These arguments should be initialized by va_start() for each call. In contrast, printf() can have a list of arguments, but the number of arguments in that list is fixed when you compile the program. For a specification of the *format* string, see [“fprintf\(\), printf\(\), sprintf\(\) — Format and write data”](#) on page 593.

vprintf() is not supported for files opened with type=record or type=blocked.

vprintf() has the same restriction as any write operation for a read immediately following a write or a write immediately following a read. Between a write and a subsequent read, there must be an intervening flush or reposition. Between a read and a subsequent write, there must also be an intervening flush or reposition unless an EOF has been reached.

vprintf_unlocked() is functionally equivalent to vprintf() with the exception that it is not thread-safe. This function can safely be used in a multithreaded application if and only if it is called while the invoking thread owns the (FILE*) object, as is the case after a successful call to either the flockfile() or frylockfile() function.

Returned value

If successful, vprintf() returns the number of characters written to *stdout*.

If unsuccessful, vprintf() returns a negative value.

Note: In contrast to some UNIX-based implementations of the C language, the z/OS XL C/C++ implementation of the `vprintf()` family increments the pointer to the variable arguments list. To control whether the pointer to the argument is incremented, call the `va_end` macro after each call to `vprintf()`.

Example

CELEBV04

```
/* CELEBV04

   This example prints out a variable number of strings to stdout,
   using &vprintf..

*/
#include <stdarg.h>
#include <stdio.h>

void vout(char *fmt, ...);
char fmt1 [] = "%s %s %s %s %s \n";

int main(void)
{
    FILE *stream;
    stream = fopen("myfile.dat", "w");

    vout(fmt1, "Mon", "Tues", "Wed", "Thurs", "Fri");
}

void vout(char *fmt, ...)
{
    va_list arg_ptr;

    va_start(arg_ptr, fmt);
    vprintf(fmt, arg_ptr);
    va_end(arg_ptr);
}
```

Output

```
Mon  Tues  Wed   Thurs  Fri
```

Related information

- [“stdarg.h – Access arguments in functions with variable-length argument lists” on page 60](#)
- [“stdio.h – Standard input and output” on page 63](#)
- [“va_arg\(\), va_copy\(\), va_end\(\), va_start\(\) – Access function arguments” on page 1960](#)
- [“vfprintf\(\) – Format and print data to stream” on page 1968](#)
- [“vsprintf\(\) – Format and print data to buffer” on page 1976](#)

vsprintf() – Format and print data to fixed length buffer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R6 |

Format

```
#define _ISOC99_SOURCE
#include <stdio.h>
#include <stdarg.h>

int vsprintf(char *__restrict__ s, size_t n,
             const char *__restrict__ format, va_list arg);
```

General description

Equivalent to sprintf(), except that instead of being called with a variable number of arguments, it is called with an argument list as defined by <stdarg.h>.

Returned value

Returns the number of characters that would have been written had *n* been sufficiently large, not counting the terminating null character, or a negative value if an encoding error occurred. Thus, the null-terminated output has been completely written if and only if the returned value is nonnegative and less than *n*.

vsprintf() – Format and print data to buffer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdarg.h>
#include <stdio.h>

int vsprintf(char * __restrict__ target-string,
             const char * __restrict__ format, va_list arg_ptr);
```

General description

The vsprintf() function is similar to sprintf(), except that *arg_ptr* points to a list of arguments whose number can vary from call to call in the program. In contrast, sprintf() can have a list of arguments, but the number of arguments in that list is fixed when you compile the program. For a specification of the *format* string, see [“fprintf\(\), printf\(\), sprintf\(\) – Format and write data” on page 593](#).

Returned value

If successful, vsprintf() returns the number of characters written *target-string*.
If unsuccessful, vsprintf() returns a negative value.

Note: In contrast to some UNIX-based implementations of the C language, the z/OS XL C/C++ implementation of the vprintf() family increments the pointer to the variable arguments list. To control whether the pointer to the argument is incremented, call the va_end macro after each call to vsprintf().

Example

CELEBV05

```
/* CELEBV05

   This example assigns a variable number of strings to string
   and prints the resultant string, using &vsprintf..

*/
#include <stdarg.h>
#include <stdio.h>

void vout(char *string, char *fmt, ...);
char fmt1 [] = "%s %s %s\n";

int main(void)
{
    char string[100];

    vout(string, fmt1, "Sat", "Sun", "Mon");
    printf("The string is: %s\n", string);
}
void vout(char *string, char *fmt, ...)
{
    va_list arg_ptr;

    va_start(arg_ptr, fmt);
    vsprintf(string, fmt, arg_ptr);
    va_end(arg_ptr);
}
```

Output

```
The string is:  Sat  Sun  Mon
```

Related information

- [“stdarg.h — Access arguments in functions with variable-length argument lists” on page 60](#)
- [“stdio.h — Standard input and output” on page 63](#)
- [“va_arg\(\), va_copy\(\), va_end\(\), va_start\(\) — Access function arguments” on page 1960](#)
- [“vfprintf\(\) — Format and print data to stream” on page 1968](#)
- [“vprintf\(\) — Format and print data to stdout” on page 1974](#)

vswprintf() — Format and write wide characters of a stdarg argument list

The information for this function is included in [“vfwprintf\(\), vswprintf\(\), vwprintf\(\) — Format and write wide characters of a STDARG argument list” on page 1970](#).

vwprintf() — Format and write wide characters of a stdarg argument list

The information for this function is included in [“vfwprintf\(\), vswprintf\(\), vwprintf\(\) — Format and write wide characters of a STDARG argument list” on page 1970](#).

wait() — Wait for a child process to end

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/wait.h>

pid_t wait(int *status_ptr);
```

General description

Suspends the calling process until any one of its child processes ends. More precisely, `wait()` suspends the calling process until the system obtains status information on the ended child. If the system already has status information on a completed child process when `wait()` is called, `wait()` returns immediately. `wait()` is also ended if the calling process receives a signal whose action is either to execute a signal handler or to end the process.

The argument `status_ptr` points to a location where `wait()` can store a status value. This status value is zero if the child process explicitly returns 0 status. If it is not zero, it can be analyzed with the status analysis macros, described in “Status Analysis Macros,” below.

The `status_ptr` pointer may also be NULL, in which case `wait()` ignores the child's return status.

The following function calls are equivalent:

```
wait(status_ptr);
waitpid(-1, status_ptr, 0);
wait3(status_ptr, 0, NULL);
```

For more information, see “[waitpid\(\) — Wait for a specific child process to end](#)” on page 1981.

Special behavior for XPG4.2: If the calling process has `SA_NOCLDWAIT` set or has `SIGCHLD` set to `SIG_IGN`, and the process has no unwaited for children that were transformed into zombie processes, it will block until all of the children terminate, and `wait()` will fail and set `errno` to `ECHILD`.

Status analysis macros: If the `status_ptr` argument is not NULL, `wait()` places the child's return status in `*status_ptr`. You can analyze this return status with the following macros, defined in the `sys/wait.h` header file:

WIFEXITED(*status_ptr)

This macro evaluates to a nonzero (true) value if the child process ended normally, that is, if it returned from `main()` or called one of the `exit()` or `_exit()` functions.

WEXITSTATUS(*status_ptr)

When `WIFEXITED()` is nonzero, `WEXITSTATUS()` evaluates to the low-order 8 bits of the child's return status passed on the `exit()` or `_exit()` function.

WIFSIGNALED(*status_ptr)

This macro evaluates to a nonzero (true) value if the child process ended because of a signal that was not caught.

WIFSTOPPED(*status_ptr)

This macro evaluates to a nonzero (true) value if the child process is currently stopped. This should only be used after a `waitpid()` with the `WUNTRACED` option.

WSTOPSIG(*status_ptr)

When `WIFSTOPPED()` is nonzero, `WSTOPSIG()` evaluates to the number of the signal that stopped the child.

WTERMSIG(*status_ptr)

When `WIFSIGNALED()` is nonzero, `WTERMSIG()` evaluates to the number of the signal that ended the child process.

Returned value

If successful, `wait()` returns a value that is the process ID (PID) of the child whose status information has been obtained.

If unsuccessful, `wait()` returns -1 and sets `errno` to one of the following values:

Error Code**Description****ECHILD**

The caller has no appropriate child processes, that is, it has no child processes whose status has not been obtained by previous calls to `wait()`, `waitid()`, `waitpid()`, or `wait3()`. `ECHILD` is also returned when the `SA_NOCLDWAIT` flag is set.

EINTR

`wait()` was interrupted by a signal. The value of `*status_ptr` is undefined.

Example**CELEBW01**

```
/* CELEBW01

   This example suspends the calling process until any child processes ends.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <sys/wait.h>
#include <unistd.h>
#include <stdio.h>
#include <time.h>

main() {
    pid_t pid;
    time_t t;
    int status;

    if ((pid = fork()) < 0)
        perror("fork() error");
    else if (pid == 0) {
        time(&t);
        printf("child (pid %d) started at %s", (int) getpid(), ctime(&t));
        sleep(5);
        time(&t);
        printf("child exiting at %s", ctime(&t));
        exit(42);
    }
    else {
        printf("parent has forked child with pid of %d\n", (int) pid);
        time(&t);
        printf("parent is starting wait at %s", ctime(&t));
        if ((pid = wait(&status)) == -1)
            perror("wait() error");
        else {
            time(&t);
            printf("parent is done waiting at %s", ctime(&t));
            printf("the pid of the process that ended was %d\n", (int) pid);
            if (WIFEXITED(status))
                printf("child exited with status of %d\n", WEXITSTATUS(status));
```

```

        else if (WIFSIGNALED(status))
            printf("child was terminated by signal %d\n",
                WTERMSIG(status));
        else if (WIFSTOPPED(status))
            printf("child was stopped by signal %d\n", WSTOPSIG(status));
        else puts("reason unknown for child termination");
    }
}
}

```

Output:

```

parent has forked child with pid of 65546
parent is starting wait at Fri Jun 16 10:53:03 2006
child (pid 65546) started at Fri Jun 16 10:53:04 2006
child exiting at Fri Jun 16 10:53:09 2006
parent is done waiting at Fri Jun 16 10:53:10 2006
the pid of the process that ended was 65546
child exited with status of 42

```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“sys/wait.h — Hold processes” on page 73](#)
- [“exit\(\) — End program” on page 449](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“waitid\(\) — Wait for child process to change state” on page 1980](#)
- [“waitpid\(\) — Wait for a specific child process to end” on page 1981](#)
- [“wait3\(\), wait4\(\) — Wait for child process to change state” on page 1984](#)

waitid() — Wait for child process to change state

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```

#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/wait.h>

int waitid(idtype_t idtype, id_t id, siginfo_t *infop, int options);

```

General description

The `waitid()` function suspends the calling process until one of its children changes state. It records the current state of a child in the structure pointed to by *infop*. If a child process changed state before the call, `waitid()` returns immediately.

The *idtype* and *id* arguments are used to specify which children `waitid()` will wait for.

If *idtype* is `P_PID` `waitid()` will wait for the child with a process ID equal to `(pid_t)id`.

If *idtype* is `P_GID` `waitid()` will wait for any child with a process group ID equal to `(pid_t)id`.

If *idtype* is `P_ALL` `waitid()` will wait for any children and *id* is ignored.

The *options* argument is used to specify which state changes to wait for. It is formed by OR-ing together one or more of the following flags:

WCONTINUED

Status will be returned for any child that has stopped and has been continued.

WEXITED

Wait for processes that have exited.

WNOHANG

Return immediately if there are no children to wait for.

WNOWAIT

Keep the process whose status is returned in *infop* in a waitable state. This will not affect the state of the process; the process may be waited for again after this call completes.

WSTOPPED

Status will be returned for any child that has stopped upon receipt of a signal.

The *infop* argument must point to a `siginfo_t` structure. If `waitid()` returns because a child process was found that specified the conditions indicated by the arguments *idtype* and *options* then the structure pointed to by *infop* will be filled in by the system with the status of the process. The `si_signo` member will always be equal to `SIGCHLD`.

Returned value

If `waitid()` returns due to the change of state of one of its children, it returns 0.

If unsuccessful, `waitid()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

ECHILD

The calling process has no existing unwaited-for child processes.

EINTR

The `waitid()` function was interrupted due to the receipt of a signal by the calling process.

EINVAL

An invalid value was specified for *options*, or *idtype* and *id* specify an invalid set of processes.

Related information

- [“sys/wait.h — Hold processes” on page 73](#)
- [“exec functions” on page 442](#)
- [“exit\(\) — End program” on page 449](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)

waitpid() — Wait for a specific child process to end

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <sys/wait.h>

pid_t waitpid(pid_t pid, int *status_ptr, int options);
```

General description

Suspends the calling process until a child process ends or is stopped. More precisely, waitpid() suspends the calling process until the system gets status information on the child. If the system already has status information on an appropriate child when waitpid() is called, waitpid() returns immediately. waitpid() is also ended if the calling process receives a signal whose action is either to execute a signal handler or to end the process.

pid_t pid

Specifies the child processes the caller wants to wait for:

- If *pid* is greater than 0, waitpid() waits for termination of the specific child whose process ID is equal to *pid*.
- If *pid* is equal to zero, waitpid() waits for termination of any child whose process group ID is equal to that of the caller.
- If *pid* is -1, waitpid() waits for any child process to end.
- If *pid* is less than -1, waitpid() waits for the termination of any child whose process group ID is equal to the absolute value of *pid*.

int *status_ptr

Points to a location where waitpid() can store a status value. This status value is zero if the child process explicitly returns zero status. Otherwise, it is a value that can be analyzed with the status analysis macros described in “Status Analysis Macros”, below.

The *status_ptr* pointer may also be NULL, in which case waitpid() ignores the child's return status.

int options

Specifies additional information for waitpid(). The *options* value is constructed from the bitwise inclusive-OR of zero or more of the following flags defined in the sys/wait.h header file:

WCONTINUED

Special behavior for XPG4.2: Reports the status of any continued child processes as well as terminated ones. The WIFCONTINUED macro lets a process distinguish between a continued process and a terminated one.

WNOHANG

Demands status information immediately. If status information is immediately available on an appropriate child process, waitpid() returns this information. Otherwise, waitpid() returns immediately with an error code indicating that the information was not available. In other words, WNOHANG checks child processes without causing the caller to be suspended.

WUNTRACED

Reports on stopped child processes as well as terminated ones. The WIFSTOPPED macro lets a process distinguish between a stopped process and a terminated one.

Special behavior for XPG4.2: If the calling process has SA_NOCLDWAIT set or has SIGCHLD set to SIG_IGN, and the process has no unwaited for children that were transformed into zombie processes, it will block until all of the children terminate, and waitpid() will fail and set errno to ECHILD.

Status analysis macros: If the *status_ptr* argument is not NULL, waitpid() places the child's return status in **status_ptr*. You can analyze this return status with the following macros, defined in the sys/wait.h header file:

WEXITSTATUS(*status_ptr)

When WIFEXITED() is nonzero, WEXITSTATUS() evaluates to the low-order 8 bits of the status argument that the child passed to the exit() or _exit() function, or the value the child process returned from main().

WIFCONTINUED(*status_ptr)

Special behavior for XPG4.2: This macro evaluates to a nonzero (true) value if the child process has continued from a job control stop. This should only be used after a waitpid() with the WCONTINUED option.

WIFEXITED(*status_ptr)

This macro evaluates to a nonzero (true) value if the child process ended normally (that is, if it returned from main(), or else called the exit() or _exit() function).

WIFSIGNALED(*status_ptr)

This macro evaluates to a nonzero (true) value if the child process ended because of a signal that was not caught.

WIFSTOPPED(*status_ptr)

This macro evaluates to a nonzero (true) value if the child process is currently stopped. This should only be used after a waitpid() with the WUNTRACED option.

WSTOPSIG(*status_ptr)

When WIFSTOPPED() is nonzero, WSTOPSIG() evaluates to the number of the signal that stopped the child.

WTERMSIG(*status_ptr)

When WIFSIGNALED() is nonzero, WTERMSIG() evaluates to the number of the signal that ended the child process.

Returned value

If successful, waitpid() returns a value of the process (usually a child) whose status information has been obtained.

If WNOHANG was given, and if there is at least one process (usually a child) whose status information is not available, waitpid() returns 0.

If unsuccessful, waitpid() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|---------------|--|
| ECHILD | The process specified by <i>pid</i> does not exist or is not a child of the calling process, or the process group specified by <i>pid</i> does not exist or does not have any member process that is a child of the calling process. |
| EINTR | waitpid() was interrupted by a signal. The value of <i>*status_ptr</i> is undefined. |
| EINVAL | The value of <i>options</i> is incorrect. |

Example**CELEBW02**

```
/* CELEBW02

The following function suspends the calling process using &waitpid.
until a child process ends.

*/
#define _POSIX_SOURCE
#include <sys/types.h>
#include <sys/wait.h>
#include <unistd.h>
#include <stdio.h>
```

```
#include <time.h>

main() {
    pid_t pid;
    time_t t;
    int status;

    if ((pid = fork()) < 0)
        perror("fork() error");
    else if (pid == 0) {
        sleep(5);
        exit(1);
    }
    else do {
        if ((pid = waitpid(pid, &status, WNOHANG)) == -1)
            perror("wait() error");
        else if (pid == 0) {
            time(&t);
            printf("child is still running at %s", ctime(&t));
            sleep(1);
        }
        else {
            if (WIFEXITED(status))
                printf("child exited with status of %d\n", WEXITSTATUS(status));
            else puts("child did not exit successfully");
        }
    } while (pid == 0);
}
```

Output:

```
child is still running at Fri Jun 16 11:05:43 2006
child is still running at Fri Jun 16 11:05:44 2006
child is still running at Fri Jun 16 11:05:45 2006
child is still running at Fri Jun 16 11:05:46 2006
child is still running at Fri Jun 16 11:05:47 2006
child is still running at Fri Jun 16 11:05:48 2006
child is still running at Fri Jun 16 11:05:49 2006
child exited with status of 1
```

Related information

- [“signal.h — Exception handling” on page 58](#)
- [“sys/types.h — typedef symbols and structures” on page 71](#)
- [“sys/wait.h — Hold processes” on page 73](#)
- [“exit\(\) — End program” on page 449](#)
- [“_exit\(\) — End a process and bypass the cleanup” on page 451](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)
- [“waitid\(\) — Wait for child process to change state” on page 1980](#)
- [“wait3\(\), wait4\(\) — Wait for child process to change state” on page 1984](#)

wait3(), wait4() — Wait for child process to change state

Standards

wait3():

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| XPG4.2 | both | |

wait4():

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

wait3():

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/wait.h>

pid_t wait3(int *stat_loc, int options, struct rusage *resource_usage);
```

wait4():

```
#define _XOPEN_SOURCE_EXTENDED 1
#define _XPLATFOM_SOURCE
#include <sys/wait.h>

pid_t wait4(pid_t pid, int *wstatus, int options, struct rusage *resource_usage);
```

General description

`wait3()` and `wait4()` functions allow the calling process to obtain status information for the specified child processes.

The following `wait3()` call:

```
wait3(stat_loc, options, resource_usage)
```

is equivalent to the call:

```
waitpid((pid_t)-1, stat_loc, options);
```

The following `wait4()` call:

```
wait4(pid, wstatus, options, resource_usage);
```

is equivalent to the call:

```
waitpid(pid, wstatus, options);
```

except that on successful completion, if the *resource_usage* argument to `wait3()` or `wait4()` is not a NULL pointer, the `rusage` structure that the third argument points to is filled in for the child process that is identified by the return value.

In other words, `wait3()` waits for any child whereas `wait4()` can be used to select a specific child or any child on which to wait. With a *pid* argument of -1, `wait4()` is equivalent to `wait3()`.

Note: This function is kept for historical reasons. It was part of the Legacy Feature in Single UNIX Specification, Version 2, but has been withdrawn and is not supported as part of Single UNIX Specification, Version 3. The `waitpid()` function is preferred for portability.

If it is necessary to continue using this function in an application written for Single UNIX Specification, Version 3, define the feature test macro `_UNIX03_WITHDRAWN` before including any standard system headers. The macro exposes all interfaces and symbols removed in Single UNIX Specification, Version 3.

Returned value

If successful, `wait3()` and `wait4()` return a value of the process (usually a child) whose status information has been obtained.

If unsuccessful, `wait3()` and `wait4()` might fail and set `errno` to one of the following values:

Error Code Description

ECHILD

The process that is specified by *pid* does not exist or is not a child of the calling process, or the process group specified by *pid* does not exist or does not have any member process that is a child of the calling process.

EINTR

`wait3()` or `wait4()` is interrupted by a signal.

EINVAL

The value of *options* is incorrect.

ECHILD

The calling process has no existing unwaited-for child processes, or if the set of processes specified by the argument *pid* can never be in the states that is specified by the argument *options*.

ESRCH

`wait4()` only: *pid* is equal to `INT_MIN`.

Related information

- [“sys/wait.h — Hold processes” on page 73](#)
- [“exec functions” on page 442](#)
- [“exit\(\) — End program” on page 449](#)
- [“fork\(\) — Create a new process” on page 577](#)
- [“pause\(\) — Suspend a process pending a signal” on page 1182](#)
- [“waitpid\(\) — Wait for a specific child process to end” on page 1981](#)
- [“wait\(\) — Wait for a child process to end” on page 1978](#)

wcpcpy() — Copy wide-character string, returning pointer to its end

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | Both | z/OS 3.2 |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <wchar.h>

wchar_t *wcpcpy(wchar_t *__restrict__ string1, const wchar_t *__restrict__
string2);
```

General description

The `wcpcpy()` function copies *string2*, including the terminating NULL wide-character (`L'\0'`), to the location that is specified by *string1*.

There must be room for at least `wcslen(string2)+1` wide-characters in the string that is pointed to by *string1*.

You cannot use a string literal for a *string1* value, although *string2* may be a string literal.

string2 and *string1* must not overlap. Otherwise, the behavior is undefined.

Returned value

`wcpncpy()` returns a pointer to the end of *string1*.

Note: No return values are reserved to indicate an error. To check for error situations, set `errno` to 0, call this function, then check `errno`.

Example

```
/*
 * This example copies the contents of wsource to wdest,
 * returning a pointer to the end of wdest.
 */

#define _POSIX_C_SOURCE 200809L
#include <stdio.h>
#include <wchar.h>

#define SIZE    40

int main(void)
{
    wchar_t wsource[ SIZE ] = L"test string";
    wchar_t wdest[ SIZE ];
    wchar_t * result;

    result = wcpncpy( wdest, wsource );

    /* use wcslen() to calculate length of wsource */
    printf( "result: \"%ls\\n", result - wcslen(wsource): \"%ls\\n\\n",
           result, result - wcslen(wsource) );
}
```

Output

```
result: "", result - wcslen(wsource): "test string"
```

wcpncpy() — Copy fixed-size wide-character string, returning pointer to its end

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | Both | z/OS 3.2 |

Format

```
#define _POSIX_C_SOURCE 200809L
#include
<wchar.h>

wchar_t *wcpncpy(wchar_t *__restrict__ string1, const wchar_t *__restrict__ string2, size_t
n);
```

General description

The `wcpncpy()` function copies at most *n* wide-characters before and including the terminating NULL wide-character (L'\0') from the string that is pointed to by *string2* to the location that is specified by *string1*.

If the string that is pointed to by *string2* is smaller than *n* wide-characters, the remaining wide-characters in the string that is pointed to by *string1* are filled with terminating NULL wide-characters (L'\0').

You cannot use a string literal for a *string1* value, although *string2* may be a string literal.

string2 and *string1* must not overlap. Otherwise, the behavior is undefined.

Returned value

`wcpncpy()` returns a pointer to the terminating NULL wide-character (L'\0') in *string1* if *string1* is null-terminated. Otherwise, `wcpncpy()` returns `&string1[n]`.

Note: No return values are reserved to indicate an error. To check for error situations, set `errno` to 0, call this function, then check `errno`.

Example

```
/*
   This example copies at most max_len wide-characters from
   wsource to wdest, returning a pointer to the end of wdest.
*/

#define _POSIX_C_SOURCE 200809L
#include <stdio.h>
#include <wchar.h>

#define SIZE    40

int main(void)
{
    wchar_t wsource[ SIZE ] = L"test string";
    wchar_t wdest[ SIZE ];
    size_t max_len = 9;
    wchar_t * result;

    result = wcpncpy( wdest, wsource, max_len );

    /* use wcsnlen() to calculate length of source string */
    printf( "result: \"%ls\\", "
            "result - wcsnlen(wsource, max_len): \"%ls\\\"\\n",
            result, result - wcsnlen(wsource, max_len) );
}
```

Output

```
result: "", result - wcsnlen(wsource, max_len): "test stri"
```

wcrtomb() – Convert a wide character to a multibyte character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XP4:

```
#include <wchar.h>

size_t wrtomb(char * __restrict__, wchar_t wchar, mbstate_t * __restrict__pss);
```

XP4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

size_t wrtomb(char *s, wchar_t wchar, mbstate_t *pss);
```

General description

If *s* is a NULL pointer, the `wrtomb()` function determines the number of bytes necessary to enter the initial shift state (zero if encodings are not state-dependent or if the initial conversion state is described). The resulting state described is the initial conversion state.

If *s* is not a NULL pointer, the `wrtomb()` function determines the number of bytes needed to represent the multibyte character that corresponds to the wide character given by *wchar* (including any shift sequences), and stores the resulting bytes in the array whose first element is pointed to by *s*. At most, `MB_CUR_MAX` bytes are stored. If *wchar* is a NULL wide character, the resulting state described is the initial conversion state.

`wrtomb()` is a “restartable” version of `wctomb()`. That is, shift state information is passed as one of the arguments and is updated on return. With `wrtomb()`, you can switch from one multibyte string to another, provided that you have kept the shift-state information for each multibyte string.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Special behavior for XP4: If you define any feature test macro specifying XP4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `wrtomb()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XP4 and other feature test macros.

Returned value

If *s* is a NULL pointer, `wrtomb()` returns the number of bytes needed to enter the initial shift state. The value returned will not be greater than that of `MB_CUR_MAX`.

If *s* is not a NULL pointer, `wrtomb()` returns the number of bytes stored in the array object (including any shift sequences) when *wchar* is a valid wide character. Otherwise, when *wchar* is not a valid wide character, an encoding error occurs, the value of the macro `EILSEQ` is stored in `errno` and `-1` is returned, but the conversion state remains unchanged.

Example

```
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    char    *string;
    wchar_t wc;
    size_t  length;
    length = wrtomb(string, wc, NULL);
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“mblen\(\) — Calculate length of multibyte character” on page 1044](#)
- [“mbrlen\(\) — Calculate length of multibyte character” on page 1046](#)
- [“mbrtowc\(\) — Convert a multibyte character to a wide character” on page 1052](#)
- [“mbsrtowcs\(\) — Convert a multibyte string to a wide-character string” on page 1056](#)
- [“wcsrtombs\(\) — Convert wide-character string to multibyte string” on page 2009](#)
- [“wctomb\(\) — Convert wide character to multibyte character” on page 2040](#)

wcscat() — Append to wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

wchar_t *wcscat(wchar_t * __restrict__string1, const wchar_t * __restrict__string2);
```

General description

Appends a copy of the string pointed to by *string2* to the end of the string pointed to by *string1*.

The `wcscat()` function operates on NULL-terminated wide-character strings. The string arguments to this function must contain a wide NULL character marking the end of the string. Bounds checking is not performed.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

`wcscat()` returns the value of *string1*.

Example

CELEBW04

```
/* CELEBW04

   This example creates the wide character string "computer
   program" using &wcscat..

*/
#include <stdio.h>
#include <wchar.h>

#define SIZE 40

int main(void)
```



```

{
    wchar_t buffer1[SIZE] = L"computer";
    wchar_t * string      = L" program";
    wchar_t * ptr;

    ptr = wcscat( buffer1, string );
    printf( "buffer1 = %ls\n", buffer1 );
}

```

Output:

```
buffer1 = computer program
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“strcat\(\) — Concatenate strings” on page 1719](#)
- [“wcschr\(\) — Search for wide-character substring” on page 1991](#)
- [“wcscmp\(\) — Compare wide-character strings” on page 1992](#)
- [“wcscpy\(\) — Copy wide-character string” on page 1995](#)
- [“wcsncpy\(\) — Find offset of first wide-character match” on page 1996](#)
- [“wcslen\(\) — Calculate length of wide-character string” on page 2000](#)
- [“wcsncat\(\) — Append to wide-character string” on page 2001](#)

wcschr() — Search for wide-character substring

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment SAA XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <wchar.h>

wchar_t *wcschr(const wchar_t *string1, wchar_t character);

```

General description

Searches *string* for the occurrence of *character*. The *character* may be a wide NULL character (`\0`). The wide NULL character at the end of *string* is included in the search. The `wcschr()` function operates on NULL-terminated wide-character strings. The argument to this function must contain a wide NULL character marking the end of the string.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

If successful, wcschr() returns a pointer to the first occurrence of *character* in *string*.
If the character is not found, wcschr() returns a NULL pointer.

Example

CELEBW05

```
/* CELEBW05

   This example finds the first occurrence of the character p in
   the wide character string "computer program" using &wcschr..

*/
#include <stdio.h>
#include <wchar.h>

#define SIZE 40

int main(void)
{
    wchar_t buffer1[SIZE] = L"computer program";
    wchar_t * ptr;
    wint_t ch = L'p';

    ptr = wcschr( buffer1, ch );
    printf( "The first occurrence of %lc in '%ls' is '%ls'\n",
           ch, buffer1, ptr );
}
```

Output:

The first occurrence of p in 'computer program' is 'puter program'

Related information

- [“wchar.h – ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h – Multibyte functions” on page 80](#)
- [“strchr\(\) – Search for character” on page 1720](#)
- [“wcscat\(\) – Append to wide-character string” on page 1990](#)
- [“wcscmp\(\) – Compare wide-character strings” on page 1992](#)
- [“wcscpy\(\) – Copy wide-character string” on page 1995](#)
- [“wcsncpy\(\) – Find offset of first wide-character match” on page 1996](#)
- [“wcslen\(\) – Calculate length of wide-character string” on page 2000](#)
- [“wcsncmp\(\) – Compare wide-character strings” on page 2003](#)

wcscmp() – Compare wide-character strings

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

int wcscmp(const wchar_t *string1, const wchar_t *string2);
```

General description

Compares two wide-character strings. The `wcscmp()` function operates on NULL-terminated wide-character strings. The string arguments to this function must contain a wide NULL character marking the end of the string.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

`wcscmp()` returns a value indicating the relationship between the two strings, as follows:

Value

Meaning

< 0

string pointed to by *string1* less than string pointed to by *string2*

= 0

string pointed to by *string1* identical to string pointed to by *string2*

> 0

string pointed to by *string1* greater than string pointed to by *string2*

Example

CELEBW06

```
/* CELEBW06

   This example compares the wide character string string1 to
   string2 using &wcscmp..

*/
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    int result;
    wchar_t string1[] = L"abcdef";
    wchar_t string2[] = L"abcdefg";

    result = wcscmp( string1, string2 );

    if ( result == 0 )
        printf( "\\%ls\\n" is identical to \\%ls\\n", string1, string2);
    else if ( result < 0 )
        printf( "\\%ls\\n" is less than \\%ls\\n", string1, string2 );
    else
        printf( "\\%ls\\n" is greater than \\%ls\\n", string1, string2);
}
```

Output:

```
"abcdef" is less than "abcdefg"
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)

- [“strcmp\(\) — Compare strings” on page 1722](#)
- [“wcscat\(\) — Append to wide-character string” on page 1990](#)
- [“wcschr\(\) — Search for wide-character substring” on page 1991](#)
- [“wcscpy\(\) — Copy wide-character string” on page 1995](#)
- [“wcscspn\(\) — Find offset of first wide-character match” on page 1996](#)
- [“wcslen\(\) — Calculate length of wide-character string” on page 2000](#)
- [“wcsncmp\(\) — Compare wide-character strings” on page 2003](#)

wscoll() — Language collation string comparison

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

int wscoll(const wchar_t *wcs1, const wchar_t *wcs2);
```

General description

Compares the wide-character string pointed to by `wcs1` to the wide-character string pointed to by `wcs2`, both interpreted as appropriate to the `LC_COLLATE` category of the current locale.

Returned value

`wscoll()` returns an integer greater than, equal to, or less than zero, according to whether the wide string pointed to by `wcs1` is greater than, equal to, or less than the wide-character string pointed to by `wcs2`, when both wide-character strings are interpreted as appropriate to the `LC_COLLATE` category of the current locale.

`wscoll()` differs from `wscmp()`. `wscoll()` function performs a comparison between two wide character strings based on language collation rules as controlled by the `LC_COLLATE` category. On the other hand, `wscmp()` performs a wide-character code to wide-character code comparison.

`wscoll()` indicates error conditions by setting `errno`; however, there is no returned value to indicate an error. To check for errors, `errno` should be set to zero, and then checked upon return from `wscoll()`. If `errno` is nonzero, an error has occurred.

The `EILSEQ` error can be set to indicate that the `wcs1` or `wcs2` arguments contain characters outside the domain of the collating sequence.

Note: The ISO/C Multibyte Support Extensions do not indicate that the `wscoll()` function may return with an error.

Example

CELEBW07

```

/* CELEBW07 */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    int result;
    wchar_t *wcs1 = L"first_wide_string";
    wchar_t *wcs2 = L"second_wide_string";

    result = wcscoll(wcs1, wcs2);

    if ( result == 0)
        printf("\'%ls\' is identical to \'%ls\'\\n", wcs1, wcs2);
    else if ( result < 0)
        printf("\'%ls\' is less than \'%ls\'\\n", wcs1, wcs2);
    else
        printf("\'%ls\' is greater than \'%ls\'\\n", wcs1, wcs2);
}

```

Output:

```
"first_wide_string" is less than "second_wide_string"
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“setlocale\(\) — Set locale” on page 1547](#)
- [“strcoll\(\) — Compare strings” on page 1724](#)

wcscopy() — Copy wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <wchar.h>

wchar_t *wcscopy(wchar_t * __restrict__string1, const wchar_t * __restrict__string2);

```

General description

Copies the contents of *string2* (including the ending wide NULL character) into *string1*. The *wcscopy()* function operates on NULL-terminated wide-character strings. The string arguments to this function must contain a wide NULL character marking the end of the string. Bounds checking is not performed.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Returned value

wcscpy() returns the value of *string1*.

Example

CELEBW08

```
/* CELEBW08

   This example copies the contents of source to destination using
   wcscpy().

*/
#include <stdio.h>
#include <wchar.h>

#define SIZE      40

int main(void)
{
    wchar_t source[ SIZE ] = L"This is the source string";
    wchar_t destination[ SIZE ] = L"And this is the destination string";
    wchar_t * return_string;

    printf( "destination is originally = \"%ls\\n", destination );
    return_string = wcscpy( destination, source );
    printf( "After wcscpy, destination becomes \"%ls\\n", destination );
}
```

Output:

destination is originally = "And this is the destination string"
After wcscpy, destination becomes "This is the source string"

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“strcpy\(\) — Copy string” on page 1725](#)
- [“wscat\(\) — Append to wide-character string” on page 1990](#)
- [“wcschr\(\) — Search for wide-character substring” on page 1991](#)
- [“wcscmp\(\) — Compare wide-character strings” on page 1992](#)
- [“wcscspn\(\) — Find offset of first wide-character match” on page 1996](#)
- [“wcslen\(\) — Calculate length of wide-character string” on page 2000](#)
- [“wcsncpy\(\) — Copy wide-character string” on page 2004](#)

wcscspn() — Find offset of first wide-character match

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

size_t wcscspn(const wchar_t *string1, const wchar_t *string2);
```

General description

Determines the number of wide characters in the initial segment of the string pointed to by *string1* that do not appear in the string pointed to by *string2*. The `wcscspn()` function operates on NULL-terminated wide-character strings. The string arguments to these functions must contain a NULL wide character marking the end of the string.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

`wcscspn()` returns the number of wide characters in the segment.

Example

CELEBW09

```
/* CELEBW09

   This example uses &wcscspn. to find the first occurrence of
   any of the characters a, x, l, or e in string.

*/
#include <stdio.h>
#include <wchar.h>

#define SIZE    40

int main(void)
{
    wchar_t string[ SIZE ] = L"This is the source string";
    wchar_t * substring = L"axle";

    printf( "The first %i characters in the string \"%ls\" are not in the "
           "string \"%ls\" \n", wcscspn( string, substring),
           string, substring );
}
```

Output:

```
The first 10 characters in the string "This is the source string" are not
in the string "axle"
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“strcspn\(\) — Compare strings” on page 1727](#)
- [“wcscat\(\) — Append to wide-character string” on page 1990](#)
- [“wcschr\(\) — Search for wide-character substring” on page 1991](#)
- [“wcscmp\(\) — Compare wide-character strings” on page 1992](#)
- [“wcscpy\(\) — Copy wide-character string” on page 1995](#)
- [“wcslen\(\) — Calculate length of wide-character string” on page 2000](#)

wcsftime() – Format date and time

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XPG4:

```
#include <wchar.h>

size_t wcsftime(wchar_t * __restrict__ wcs, size_t maxsize,
                const wchar_t * __restrict__ format,
                const struct tm * __restrict__ time_ptr)
```

XPG4:

```
#define _XOPEN_SOURCE
#include <wchar.h>

size_t wcsftime(wchar_t * __restrict__ wcs, size_t maxsize,
                const char * __restrict__ format,
                const struct tm * __restrict__ time_ptr)
```

XPG4 and MSE:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

size_t wcsftime(wchar_t * __restrict__ wcs, size_t maxsize,
                const wchar_t * __restrict__ format,
                const struct tm * __restrict__ time_ptr)
```

General description

Format date and time into a wide character string. The wcsftime() function is equivalent to the strftime() function, except that:

- The argument *wcs* specifies an array of a wide string into which the generated output is to be placed.
- The argument *maxsize* indicates a number of wide characters.
- The argument **format* specifies an array of wide characters comprising the format string.
- The returned value indicates a number of wide characters.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the wchar header, then the compiler assumes that your program is using the XPG4 variety of the wcsftime() function unless you also define the _MSE_PROTOS feature test macro. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

The prototype for the XPG4 variety of the wcsftime() function is:

```
size_t wcsftime(wchar_t *wcs, size_t maxsize, const char *format,
                const struct tm *time_ptr)
```


The difference between this variety and the MSE variety of the `wcsftime()` function is that the third argument *format* specifies an array of characters rather than an array of wide characters comprising the format string.

Returned value

If the total number of resulting wide characters including the terminating NULL wide character is not more than *maxsize*, `wcsftime()` returns the number of wide characters placed into the array pointed to by *wcs* not including the terminating NULL wide character.

If unsuccessful, `wcsftime()` returns 0 and the contents of the array are indeterminate.

Example

CELEBW10

```
/* CELEBW10 */
#include <stdio.h>
#include <time.h>
#include <wchar.h>

int main(void)
{
    struct tm *timeptr;
    wchar_t dest[100];
    time_t temp;
    size_t rc;

    temp = time(NULL);
    timeptr = localtime(&temp);
    rc = wcsftime(dest, sizeof(dest)-1, L" Today is %A,"
                  L" %b %d.\n Time: %I:%M %p", timeptr);
    printf("%d characters placed in string to make:\n\n%S", rc, dest);
}
```

Output:

42 characters placed in string to make:

Today is Friday, Jun 16.
Time: 01:48 pm

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“strftime\(\) — Convert to formatted time” on page 1735](#)

wcsid() — Character set ID for wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|-------------------------|----------|--------------|
| Language Environment | both | |

Format

```
#include <stdlib.h>

int wcsid(const wchar_t c)
```

External entry point: @@WCSID, __wcsid

General description

Determines the character set identifier for the specified wide character.

To avoid infringing on the user's name space, this nonstandard function has two names. One name is prefixed with two underscore characters, and one name is not. The name without the prefix underscore characters is exposed only when using the [runtime library extensions](#).

Returned value

If successful, wcsid() returns the character set identifier for the wide character.

If the wide character is not valid, wcsid() returns -1.

Example

CELEBW11

```
/* CELEBW11
   This example checks character set id for wide character.
*/
#include <locale.h>
#include <stdio.h>
#include <stdlib.h>

main() {
    wchar_t wc = L'A';
    int rc;

    rc = wcsid(wc);
    printf("wide character '%lc' is in character set id %i\n", wc, rc);
}
```

Related information

- [“stdlib.h – Standard library functions” on page 65](#)

wcslen() – Calculate length of wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h> /* or #include <wctype.h> */
size_t wcslen(const wchar_t *string);
```

General description

Computes the number of wide characters in the string pointed to by *string*.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Returned value

wcslen() returns the number of wide characters that precede the terminating wide NULL character.

Example

CELEBW12

```
/* CELEBW12

   This example computes the length of a wide-character string,
   using &wcslen.

   */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t * string = L"abcdef";

    printf( "Length of \"%ls\" is %i\n", string, wcslen( string ) );
}
```

Output:

```
Length of "abcdef" is 6
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“mblen\(\) — Calculate length of multibyte character” on page 1044](#)
- [“strlen\(\) — Determine string length” on page 1740](#)
- [“wcsncat\(\) — Append to wide-character string” on page 2001](#)
- [“wcsncmp\(\) — Compare wide-character strings” on page 2003](#)
- [“wcsncpy\(\) — Copy wide-character string” on page 2004](#)

wcsncat() — Append to wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

wchar_t *wcsncat(wchar_t * __restrict__ string1,
                 const wchar_t * __restrict__ string2, size_t count);
```

General description

Appends up to *count* wide characters from *string2* to the end of *string1* and appends a NULL wide character to the result. The `wcsncat()` function operates on NULL-terminated wide-character strings. The string arguments to this function must contain a NULL wide character marking the end of the string.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

`wcsncat()` returns *string1*.

Example

CELEBW13

```
/* CELEBW13

   This example demonstrates the difference between &wscat. and
   &wcsncat..
   &wscat. appends the entire second string to the first
   whereas &wcsncat. appends only the specified number of
   characters in the second string to the first.

*/
#include <stdio.h>
#include <wchar.h>
#include <string.h>

#define SIZE 40

int main(void)
{
    wchar_t buffer1[SIZE] = L"computer";
    wchar_t * ptr;

    /* Call wscat with buffer1 and " program" */

    ptr = wscat( buffer1, L" program" );
    printf( "wscat : buffer1 = \"%ls\\n\"", buffer1 );

    /* Reset buffer1 to contain just the string "computer" again */

    memset( buffer1, L'\0', sizeof( buffer1 ));
    ptr = wcsncpy( buffer1, L"computer" );

    /* Call wcsncat with buffer1 and " program" */
    ptr = wcsncat( buffer1, L" program", 3 );
    printf( "wcsncat: buffer1 = \"%ls\\n\"", buffer1 );
}
```

Output:

```
wscat : buffer1 = "computer program"
wcsncat: buffer1 = "computer pr"
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“strncat\(\) — Concatenate strings” on page 1743](#)
- [“wcsncmp\(\) — Compare wide-character strings” on page 2003](#)
- [“wcsncpy\(\) — Copy wide-character string” on page 2004](#)

wcsncmp() — Compare wide-character strings

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

int wcsncmp(const wchar_t *string1, const wchar_t *string2, size_t count);
```

General description

Compares up to *count* wide characters in *string1* to *string2*. The `wcsncmp()` function operates on NULL-terminated wide-character strings. The string arguments to this function must contain a NULL wide character marking the end of the string.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

`wcsncmp()` returns a value indicating the relationship between the two strings, as follows:

Value

Meaning

< 0

string pointed to by *string1* less than the string pointed to by *string2*

= 0

string pointed to by *string1* identical to string pointed to by *string2*

> 0

string pointed to by *string1* greater than string pointed to by *string2*

Example

CELEBW14

```
/* CELEBW14

   This example demonstrates the difference between &wcsncmp.
   and &wcsncmp..

*/
#include <stdio.h>
#include <wchar.h>

#define SIZE 10

int main(void)
{
    int result;
    int index = 3;
    wchar_t buffer1[SIZE] = L"abcdefg";
    wchar_t buffer2[SIZE] = L"abcfg";
    void print_result( int, wchar_t *, wchar_t * );
```

```
result = wcsncmp( buffer1, buffer2, index);
printf( "\nComparison of only the first %i characters\n", index );
printf( "    wcsncmp: " );
print_result( result, buffer1, buffer2 );
}

void print_result( int res, wchar_t * p_buffer1, wchar_t * p_buffer2 )
{
    if ( res == 0 )
        printf( "\"%ls\" is identical to \"%ls\"\n", p_buffer1, p_buffer2);
    else if ( res < 0 )
        printf( "\"%ls\" is less than \"%ls\"\n", p_buffer1, p_buffer2 );
    else
        printf( "\"%ls\" is greater than \"%ls\"\n", p_buffer1, p_buffer2 );
}
```

Output:

```
Comparison of each character
wcsncmp: "abcdefg" is less than "abcfg"

Comparison of only the first 3 characters
wcsncmp: "abcdefg" is identical to "abcfg"
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“strncmp\(\) — Compare strings” on page 1744](#)
- [“wcsncmp\(\) — Compare wide-character strings” on page 1992](#)
- [“wcsncat\(\) — Append to wide-character string” on page 2001](#)
- [“wcsncpy\(\) — Copy wide-character string” on page 2004](#)

wcsncpy() — Copy wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

wchar_t *wcsncpy(wchar_t * __restrict_string1,
                 const wchar_t * __restrict_string2, size_t count);
```

General description

Copies up to *count* wide characters from *string2* to *string1*. If *string2* is shorter than *count* characters, *string1* is padded out to *count* characters with NULL wide characters. The `wcsncpy()` function operates on

NULL-terminated wide-character strings. The string arguments to this function must contain a NULL wide character marking the end of the string.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Returned value

wcsncpy() returns *string1*.

Example

CELEBW15

```
/* CELEBW15

   This example demonstrates the difference between &wcscpy. and &wcsncpy..

*/
#include <stdio.h>
#include <wchar.h>

#define SIZE    40

int main(void)
{
    wchar_t source[ SIZE ] = L"123456789";
    wchar_t source1[ SIZE ] = L"123456789";
    wchar_t destination[ SIZE ] = L"abcdefg";
    wchar_t destination1[ SIZE ] = L"abcdefg";
    wchar_t * return_string;
    int index = 5;

    /* This is how wcscpy works */
    printf( "destination is originally = '%ls'\n", destination );
    return_string = wcscpy( destination, source );
    printf( "After wcscpy, destination becomes '%ls'\n\n", destination );

    /* This is how wcsncpy works */
    printf( "destination1 is originally = '%ls'\n", destination1 );
    return_string = wcsncpy( destination1, source1, index );
    printf( "After wcsncpy, destination1 becomes '%ls'\n", destination1 );
}
```

Output:

```
destination is originally = 'abcdefg'
After wcscpy, destination becomes '123456789'

destination1 is originally = 'abcdefg'
After wcsncpy, destination1 becomes '12345fg'
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“strncpy\(\) — Copy string” on page 1746](#)
- [“wcscpy\(\) — Copy wide-character string” on page 1995](#)
- [“wcsncat\(\) — Append to wide-character string” on page 2001](#)
- [“wcsncmp\(\) — Compare wide-character strings” on page 2003](#)

wcsnlen() — Determine fixed-size wide-character string length

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| POSIX.1-2008 Single UNIX Specification, Version 4 | both | z/OS 3.2 |

Format

```
#define _POSIX_C_SOURCE 200809L
#include <wchar.h>

size_t wcsnlen(const wchar_t *string, size_t n);
```

General description

The `wcsnlen()` function computes the smaller of the number of wide-characters in the string that is pointed to by *string*, not including the terminating NULL wide-character (L'\0'), or the value of the argument *n*. At most *n* wide-characters are compared.

Returned value

`wcsnlen()` returns the length of *string*, if that value is less than *n*, or *n* if there is no terminating NULL wide-character (L'\0) within the first *n* wide-characters of the string that is pointed to by *string*.

Example

```
/*
   This example determines the length of a
   wide-character string, up to SIZE bytes.
*/

#include _POSIX_C_SOURCE 200809L
#include <stdio.h>
#include <wchar.h>

#define SIZE    40

int main(void)
{
    wchar_t string[ SIZE ] = L"abcdefghijklmnopqrstuvwxyz";
    size_t result;

    result = wcsnlen( string, SIZE );

    printf( "Wide-character string \"%ls\" has a length of %d\n",
           string, result );
}
```

Output

```
Wide-character string "abcdefghijklmnopqrstuvwxyz" has a length of 26
```


wcpbrk() — Locate first wide characters in string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

wchar_t *wcpbrk(const wchar_t *string1, const wchar_t *string2);
```

General description

Locates the first occurrence in the string pointed to by *string1* of any character from the string pointed to by *string2*.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Returned value

If successful, wcpbrk() returns a pointer to the character.

If no wchar_t from *string2* occurs in *string1*, wcpbrk() returns NULL.

Example

CELEBW16

```
/* CELEBW16

   This example returns a pointer to the first occurrence in the
   array string of either a or b, using &wcpbrk..

*/
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t * result;
    wchar_t * string = L"The Blue Danube";
    wchar_t *chars = L"ab";

    result = wcpbrk( string, chars);
    printf("The first occurrence of any of the characters \"%ls\" in "
          "\"%ls\" is \"%ls\"\n", chars, string, result);
}
```

Output:

```
The first occurrence of any of the characters "ab" in "The Blue Danube" is "anube"
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)

- [“wcsr.h — Multibyte functions” on page 80](#)
- [“strpbrk\(\) — Find characters in string” on page 1748](#)
- [“wcschr\(\) — Search for wide-character substring” on page 1991](#)
- [“wcscmp\(\) — Compare wide-character strings” on page 1992](#)
- [“wcscspn\(\) — Find offset of first wide-character match” on page 1996](#)
- [“wcsncmp\(\) — Compare wide-character strings” on page 2003](#)
- [“wcsrchr\(\) — Locate last wide character in string” on page 2008](#)
- [“wcs wcs\(\) — Locate wide-character substring in wide-character string” on page 2035](#)

wcsrchr() — Locate last wide character in string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

wchar_t *wcsrchr(const wchar_t *string, wchar_t character);
```

General description

Locates the last occurrence of *character* in the string pointed to by *string*. The terminating NULL wide character is considered to be part of the string.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Returned value

If successful, wcsrchr() returns a pointer to the character.

If *character* does not occur in the string, wcsrchr() returns NULL.

Example

CELEBW17

```
/* CELEBW17

   This example compares the use of wcschr() and wcsrchr().
   It searches the string for the first and last occurrence of p in the
   wide character string.

*/
#include <stdio.h>
#include <wchar.h>

#define SIZE 40

int main(void)
{
```

```

wchar_t buf[SIZE] = L"computer program";
wchar_t * ptr;
int ch = 'p';

/* This illustrates wcschr */
ptr = wcschr( buf, ch );
printf( "The first occurrence of %c in '%ls' is '%ls'\n", ch, buf, ptr );

/* This illustrates wcsrchr */
ptr = wcsrchr( buf, ch );
printf( "The last occurrence of %c in '%ls' is '%ls'\n", ch, buf, ptr );
}

```

Output:

```

The first occurrence of p in 'computer program' is 'puter program'
The last occurrence of p in 'computer program' is 'program'

```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“strrchr\(\) — Find last occurrence of character in string” on page 1753](#)
- [“wcscmp\(\) — Compare wide-character strings” on page 1992](#)
- [“wcscspn\(\) — Find offset of first wide-character match” on page 1996](#)
- [“wcsncmp\(\) — Compare wide-character strings” on page 2003](#)
- [“wcsprbrk\(\) — Locate first wide characters in string” on page 2007](#)
- [“wcsvcs\(\) — Locate wide-character substring in wide-character string” on page 2035](#)

wcsrtombs() — Convert wide-character string to multibyte string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format**Non-XP4:**

```

#include <wchar.h>

size_t wcsrtombs(char * __restrict __dst,
                  const wchar_t ** __restrict __src, size_t len,
                  mbstate_t * __restrict __ps);

```

XP4:

```

#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

size_t wcsrtombs(char *dst,
                  const wchar_t **src, size_t len, mbstate_t *ps);

```

General description

Converts a sequence of wide characters from the array indirectly pointed to by *src* into a sequence of corresponding multibyte characters that begin in the shift state described by *ps*, which, if *dst* is not a NULL pointer, are then stored into the array pointed to by *dst*. Conversion continues up to and including the terminating NULL wide character; the terminating NULL wide character (byte) shall be stored.

Conversion shall stop earlier in two cases:

- When a code is reached that does not correspond to a valid multibyte character.
- If *dst* is not a NULL pointer, conversion stops when the next multibyte element would exceed the limit of *len* total bytes to be stored into the array pointed to by *dst*.

Each conversion takes places as if by a call to the `wcrtomb()` function.

If *dst* is not NULL a pointer, the object pointed to by *src* shall be assigned either a NULL pointer (if conversion stopped due to reaching a terminating NULL wide character) or the address of the code just past the last wide character converted. If conversion stopped due to reaching a terminating NULL wide character, the resulting state described shall be the initial conversion state.

`wcsrtombs()` is a “restartable” version of `wcstombs()`. That is, shift state information is passed as on of the arguments, and gets updated on exit. With `wcsrtombs()`, you may switch from one multibyte string to another, provided that you have kept the shift state information.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `wcsrtombs()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

If successful, `wcsrtombs()` returns the number of bytes in the resulting multibyte character sequence, which is the same as the number of array elements modified when *dst* is not a NULL pointer.

If the string contains an invalid wide character, an encoding error occurs. `wcsrtombs()` returns `(size_t)-1` and stores the value of the macro `EILSEQ` in `errno`, but the conversion state shall be unchanged.

Example

CELEBW18

```
/* CELEBW18 */
#include <stdio.h>
#include <string.h>
#include <wchar.h>

#define SIZE 20

int main(void)
{
    char    dest[SIZE];
    wchar_t *wcs = L"string";
    const wchar_t *ptr;
    size_t   count = SIZE;
    size_t   length;

    ptr = (wchar_t *) wcs;
    length = wcsrtombs(dest, &ptr, count, NULL);
    printf("%d characters were converted.\n", length);
    printf("The converted string is \"%s\"\n\n", dest);

    /* Reset the destination buffer */
    memset(dest, '\\0', sizeof(dest));

    /* Now convert only 3 characters */
```

```

ptr = (wchar_t *) wcs;
length = wcsrtombs(dest, &ptr, 3, NULL);
printf("%d characters were converted.\n", length);
printf("The converted string is \"%s\"\n\n", dest);
}

```

Output:

```

6 characters were converted.
The converted string is "string"

3 characters were converted.
The converted string is "str"

```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“mblen\(\) — Calculate length of multibyte character” on page 1044](#)
- [“mbrlen\(\) — Calculate length of multibyte character” on page 1046](#)
- [“mbrtowc\(\) — Convert a multibyte character to a wide character” on page 1052](#)
- [“mbsrtowcs\(\) — Convert a multibyte string to a wide-character string” on page 1056](#)
- [“wrtomb\(\) — Convert a wide character to a multibyte character” on page 1988](#)
- [“wcstombs\(\) — Convert wide-character string to multibyte character string” on page 2028](#)

wcssp() — Search for wide characters in a string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <wchar.h>

size_t wcssp(const wchar_t *string1, const wchar_t *string2);

```

General description

Computes the number of wide characters in the initial segment of the string pointed to by *string1*, which consists entirely of wide characters from the string pointed to by *string2*.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Returned value

wcssp() returns the number of wide characters in the segment.

Example

CELEBW19

```
/* CELEBW19

This example finds the first occurrence in the array string
of a character that is neither an a, b, nor c. Because the
string in this example is cabbage, &wcssp. returns 5, the
index of the segment of cabbage before a character that is
not an a, b, or c.

*/
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t * string = L"cabbage";
    wchar_t * source = L"abc";
    int index;

    index = wcssp( string, L"abc" );
    printf( "The first %d characters of \"%ls\" are found in \"%ls\"\\n",
            index, string, source );
}
```

Output:

The first 5 characters of "cabbage" are found in "abc"

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstr.h — Multibyte functions” on page 80](#)
- [“strspn\(\) — Search string” on page 1755](#)
- [“wcscat\(\) — Append to wide-character string” on page 1990](#)
- [“wcschr\(\) — Search for wide-character substring” on page 1991](#)
- [“wcscmp\(\) — Compare wide-character strings” on page 1992](#)
- [“wcscspn\(\) — Find offset of first wide-character match” on page 1996](#)
- [“wcsncmp\(\) — Compare wide-character strings” on page 2003](#)

wcsstr() — Locate a wide character sequence

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XP4:

```
#include <wchar.h>

wchar_t *wcsstr(const wchar_t *__restrict__ wcs1,
                const wchar_t *__restrict__ wcs2);
```

XPG4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

wchar_t *wcsstr(const wchar_t *__restrict__ wcs1,
                const wchar_t *__restrict__ wcs2);
```

General description

Locates the first occurrence in the wide-character string pointed to by *wcs1* of the sequence of wide characters (excluding the terminating NULL character) in the wide-character string pointed to by *wcs2*.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the *wchar* header, then you must also define the *_MSE_PROTOS* feature test macro to make the declaration of the *wcsstr()* function in the *wchar* header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

If successful, *wcsstr()* returns a pointer to the located wide string. If *wcs2* points to a wide-character string with zero length, *wcsstr()* returns *wcs1*.

If the wide-character string is not found, *wcsstr()* returns NULL.

Example**CELEBW20**

```
/* CELEBW20 */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t *wcs1 = L"needle in a haystack";
    wchar_t *wcs2 = L"hay";
    wchar_t *result;

    result = wcsstr(wcs1, wcs2);

    /* result = a pointer to "hatstack" */

    printf("result: '%S'\n", result);
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“strstr\(\) — Locate substring” on page 1756](#)

wcstod() — Convert wide-character string to a double floating-point

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

double wcstod(const wchar_t * __restrict__ nptr, wchar_t ** __restrict__ endptr);
```

General description

The `wcstod()` function converts a `wchar_t *` type floating-point number input string to a double value.

See the “*fscanf* Family of Formatted Input Functions” on `fscanf()`, `scanf()`, `sscanf()` — Read and format data for a description of special infinity and NaN sequences recognized by z/OS formatted input functions, including `wcstod()` in IEEE Binary Floating-Point mode.

Converts the initial portion of the wide-character string pointed to by *nptr* to double representation. First it decomposes the input string into three parts:

1. An initial, possibly empty, sequence of white space characters (as specified by the `iswspace()` function)
2. A subject sequence interpreted as a floating-point constant or representing infinity or a NaN.
3. A final string of one or more unrecognized characters, including the terminating NULL character of the input string.

Then it attempts to convert the subject sequence to a floating-point number, and returns the result.

The expected form of the subject sequence is an optional plus or minus sign, then one of the following:

- A non-empty sequence of decimal digits optionally containing a radix character, then an optional exponent part. Where radix character is the character that separates the integer part of a number from the fractional part.
- A 0x or 0X, then a non-empty sequence of hexadecimal digits optionally containing a radix character, then an optional binary exponent part. Where radix character is the character that separates the integer part of a number from the fractional part.
- One of INF or INFINITY, ignoring case.
- One of NANQ or NANQ(n-char-sequence), ignoring case.
- One of NANS or NANS(n-char-sequence), ignoring case.
- One of NAN or NAN(n-char-sequence), ignoring case.

The subject sequence is defined as the longest initial subsequence of the input wide-character string, starting with the first non-white space wide character, that is of the expected form. The subject sequence contains no wide characters if the input wide-character string is empty or consists entirely of white space wide characters, or if the first non-white space wide character is other than a sign, a digit, or a decimal-point wide character.

If the subject sequence has the expected form, the sequence of wide characters starting with the first digit or the decimal-point wide character (whichever occurs first) is interpreted as a floating constant according to the rules of ISO/IEC 9899: subclause 6.1.3.1, except the decimal-point wide character is used in place of a period, and if neither an exponent part nor a decimal-point wide character appears, a decimal-point is assumed to follow the last digit in the wide-character string. If the subject sequence begins with a minus sign, the value resulting from the conversion is negated. A pointer to the final wide-character string is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer.

In a locale other than the C locale, additional implementation-defined subject sequence forms may be accepted.

If the subject sequence is empty or does not have the expected form, no conversion is performed; the value of *nptr* is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Returned value

If successful, `wcstod()` returns the converted value, if any.

If no conversion could be performed, `wcstod()` returns 0.

The double value is hexadecimal floating-point or IEEE Binary Floating-Point format depending on the floating-point mode of the thread invoking `wcstod()`. The `wcstod()` function uses `__isBFP()` to determine the floating-point format (hexadecimal floating-point or IEEE Binary Floating-Point) of the invoking thread.

If the correct value is outside the range of representable values, `wcstod()` returns $\pm\text{HUGE_VAL}$ —according to the sign of the value—and the value of the macro `ERANGE` is stored in `errno`.

Example

CELEBW21

```
/* CELEBW21 */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t *wcs;
    wchar_t *stopwcs;
    double d;

    wcs = L"3.1415926This stopped it";
    d = wcstod(wcs, &stopwcs);
    printf("wcs = '%ls'\n", wcs);
    printf("    wcstod = %f\n", d);
    printf("    Stopped scan at '%ls'\n", stopwcs);
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“wcstof\(\) — Convert a wide-character string to float ” on page 2018](#)
- [“wcstold\(\) — Convert a wide-character string to long double ” on page 2024](#)

wcstod32(), wcstod64(), wcstod128() – Convert wide-character string to decimal floating point

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C/C++ DFP | both | z/OS V1.8 |

Format

```
#define __STDC_WANT_DEC_FP__
#include <wchar.h>

_Decimal32 wcstod32(const wchar_t * __restrict__ nptr,
                    wchar_t ** __restrict__ endptr);

_Decimal64 wcstod64(const wchar_t * __restrict__ nptr,
                    wchar_t ** __restrict__ endptr);

_Decimal128 wcstod128(const wchar_t * __restrict__ nptr,
                      wchar_t ** __restrict__ endptr);
```

General description

The `wcstod32()`, `wcstod64()`, and `wcstod128()` functions convert the initial portion of the wide-character string pointed to by *nptr* to `_Decimal32`, `_Decimal64`, and `_Decimal128` representation, respectively.

First, they decompose the input wide-character string into three parts:

1. An initial, possibly empty, sequence of white-space wide characters (as specified by the `iswspace()` function).
2. A subject sequence resembling a floating-point constant or representing an infinity or NaN.
3. A final wide-character string of one or more unrecognized wide characters, including the terminating null wide character of the input wide-character string.

Then, they attempt to convert the subject sequence to a floating-point number, and return the result.

The expected form of the subject sequence is an optional plus or minus sign, then one of the following:

- a nonempty sequence of decimal digits optionally containing a decimal-point wide character, then an optional exponent part
- INF or INFINITY, ignoring case
- NAN, NAN(n-char-sequence), NANQ, NANQ(n-char-sequence), NANS, or NANS(n-char-sequence), ignoring case in the NAN, NANQ, or NANS part, where n-char-sequence is one or more decimal numeric digits

Note: If the input string is not one of these forms (for example "INFINITE"), the output results are undefined.

The subject sequence is defined as the longest initial subsequence of the input wide-character string, starting with the first non-white-space wide character, that is of the expected form. The subject sequence contains no wide characters if the input wide character string is not of the expected form.

If the subject sequence has the expected form for a floating-point number, the sequence of wide characters starting with the first digit or the decimal-point wide character (whichever occurs first) is interpreted as a floating constant. If neither an exponent nor a decimal-point character appears in a decimal floating point number, an exponent with value zero is assumed to follow the last digit in the string. If the subject sequence begins with a minus sign, the sequence is interpreted as negated. A wide character sequence INF or INFINITY is interpreted as an infinity. A wide character sequence NAN,

NAN(), or NAN(n-char-sequence) is interpreted as a quiet NaN. A wide character sequence of NANS, NANS(), or NANS(n-char-sequence), is interpreted as a signalling NaN.

A pointer to the final wide-character string is stored in the object pointed to by *endptr*, provided that *endptr* is not a null pointer.

The converted value keeps the same precision as the input if possible, and the value may be denormalized. Otherwise, rounding may occur. Rounding happens after any negation.

In other than the "C" locale, additional locale-specific subject sequence forms are accepted.

If the subject sequence is empty or does not have the expected form, no conversion is performed; the value of *nptr* is stored in the object pointed to by *endptr*, provided that *endptr* is not a null pointer.

| Argument | Description |
|---------------|--|
| <i>nptr</i> | Input pointer to start of the wide-character string to be converted |
| <i>endptr</i> | NULL, or a pointer to a output pointer field that is filled in with the address of the first wide character in the input wide-character string that is not used in the conversion. |

Note: To use IEEE decimal floating-point, the hardware must have the Decimal Floating-Point Facility installed.

Returned value

The functions return the converted value, if any. If no conversion could be performed, the value +0.E0DF, +0.E0DD, or +0.E0DL is returned. If the correct value is outside the range of representable values, plus or minus HUGE_VAL_D32, HUGE_VAL_D64, or HUGE_VAL_D128 is returned (according to the return type and sign of the value), and *errno* is set to ERANGE. If the result underflows, the functions return a value whose magnitude is no greater than the smallest normalized positive number in the return type. No signal is raised at the point of returning a signaling NaN.

| errno | Description |
|--------|--|
| ERANGE | The input wide-character string represents a value too large to fit in the output Decimal Floating Point type. |

Example

See [“wcstod\(\) — Convert wide-character string to a double floating-point” on page 2014](#) for an example.

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wcstod\(\) — Convert wide-character string to a double floating-point” on page 2014](#)
- [“strtod32\(\), strtod64\(\), strtod128\(\) — Convert character string to decimal floating point” on page 1761](#)

wcstof() – Convert a wide-character string to float

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <wchar.h>

float wcstof(const wchar_t *__restrict__ nptr, wchar_t **__restrict__ endptr);
```

General description

wcstof() converts a wchar_t * floating-point number input string to a float value. The parameter *nptr* points to a sequence of wide-characters that can be interpreted as a numerical float value.

It decomposes the input wide-character string into three parts:

1. An initial, possibly empty, sequence of white-space character codes (as specified by `iswspace()`).
2. A subject sequence resembling a floating-point constant, infinity, or NaN.
3. A final wide-character string of one or more unrecognized wide-characters codes, including the terminating NULL wide-character of the input wide-character string.

The function then attempts to convert the subject string into the floating-point number, and returns the result.

The expected form of the subject sequence is an optional plus or minus sign, then one of the following:

- A non-empty sequence of decimal digits optionally containing a radix character, then an optional exponent. A radix character is the character that separates the integer part of a number from the fractional part.
- A 0x or 0X, a non-empty sequence of hexadecimal digits optionally containing a radix character, then a base 2 decimal exponent part with a p or P as prefix, a plus or minus sign, then a sequence of at least one decimal digit. (Example [-]0xh.hhhhp+/-d). A radix character is the character that separates the integer part of a number from the fractional part.
- One INF or INFINITY, ignoring case.
- One NANQ or NANQ(n-char-sequence), ignoring case.
- One NANS or NANS(n-char-sequence), ignoring case.
- One NAN or NAN(n-char-sequence), ignoring case.

See the "scanf() Family of Formatted Input Functions" for a description of special infinity and NaN sequences recognized by z/OS formatted input functions in IEEE Binary Floating-Point mode. A pointer to the final wide-character string is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer.

Returned value

If successful, wcstof() returns the converted value, if any. If no conversion could be performed, it returns 0.

The float value is a hexadecimal floating-point or IEEE Binary Floating-Point format depending on the floating-point mode of the thread invoking `wcstof()`. This function uses `__isBFP()` to determine the floating-point mode of the invoking thread.

If the correct value is outside the range of representable values, then `+/-HUGE_VALF`, according to the sign of the value, is returned and the value of the `ERANGE` macro is stored in `errno`. If the correct value would cause an underflow, 0 is returned and the value of the `ERANGE` macro is stored in `errno`.

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“wcstod\(\) — Convert wide-character string to a double floating-point” on page 2014](#)
- [“wcstold\(\) — Convert a wide-character string to long double ” on page 2024](#)
- [“wcstol\(\) — Convert a wide-character string to a long integer” on page 2022](#)
- [“wcstoul\(\) — Convert a wide-character string to an unsigned long integer” on page 2030](#)
- [“wcstoimax\(\) — Convert a wide-character string to a intmax_t” on page 2019](#)
- [“wcstoumax\(\) — Convert a wide-character string to a intmax_t” on page 2034](#)

wcstoimax() — Convert a wide-character string to a intmax_t

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <inttypes.h>

intmax_t wcstoimax(const wchar_t * __restrict__ nptr,
                  wchar_t ** __restrict__ endptr, int base);
```

Compile requirement: Function `wcstoimax()` requires `long long` to be available.

General description

The `wcstoimax()` function converts the wide-character string `nptr` to an `intmax_t` integer type. Valid input values for `base` are 0 and in the range 2-36. The `wcstoimax()` function is equivalent to `wcstol()` and `wcstoll()`. The only difference being that the return value is of type `intmax_t`. See `wcstoll()` for more information.

Returned value

If successful, `wcstoimax()` returns the converted value, if any.

If unsuccessful, `wcstoimax()` returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, `wcstoimax()` returns `INTMAX_MAX` or `INTMAX_MIN`, according to the sign of the value. If the value of `base` is not supported, `wcstoimax()` returns 0.

If unsuccessful `wcstoimax()` sets `errno` to one of the following values:

Error Code
Description

EINVAL
The value of *base* is not supported.

ERANGE
The conversion caused an overflow.

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>

int main(void)
{
    wchar_t *nptr;
    wchar_t *endptr;
    intmax_t j;
    int base = 10;
    nptr = L"10110134932";
    printf("nptr = `%ls`\n", nptr);
    j = wcstoimax(nptr, &endptr, base);
    printf("wcstoimax = %jd\n", j);
    printf("Stopped scan at `%ls`\n\n", endptr);
}
```

Output

```
nptr = `10110134932`
wcstoimax = 10110134932
Stopped scan at ``
```

Related information

- [“inttypes.h – I/O format of integer types” on page 28](#)
- [“stdint.h – Integer types” on page 60](#)
- [“imaxdiv\(\) – Quotient and remainder for intmax_t” on page 837](#)
- [“strtoimax\(\) – Convert character string to intmax_t integer type” on page 1764](#)
- [“strtoumax\(\) – Convert character string to uintmax_t integer type” on page 1777](#)
- [“wcstoumax\(\) – Convert a wide-character string to a intmax_t” on page 2034](#)

wcstok() – Break a wide-character string into tokens

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XP4:

```
#include <wchar.h>

wchar_t *wcstok(wchar_t * __restrict __wcs1,
                const wchar_t * __restrict __wcs2, wchar_t ** __restrict __ptr);
```

XP4:

```
#define _XOPEN_SOURCE
#include <wchar.h>

wchar_t *wcstok(wchar_t *wcs1, const wchar_t *wcs2);
```

XP4 and MSE:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

wchar_t *wcstok(wchar_t *wcs1,
                const wchar_t *wcs2, wchar_t **ptr);
```

General description

A sequence of calls to the `wcstok()` function breaks the wide string pointed to by `wcs1` into a sequence of tokens, each of which is delimited by a wide character from the wide string pointed to by `wcs2`. The third argument points to a caller-provided wide-character pointer into which the `wcstok()` function stores information necessary for it to continue scanning the same string.

The first call in the sequence, `wcs1` shall point to a wide-character string, while in subsequent calls for the same wide string, `wcs1` shall be a NULL pointer. If `wcs1` is a NULL pointer, the value pointed to by `ptr` shall match that set by the previous call for the same wide-character string; otherwise its value is ignored. The separator wide-character string pointed to by `wcs2` may be different from call to call.

The first call in the sequence, searches the wide-character string pointed to by `wcs1` for the first wide character that is not contained in the current separator wide-character string pointed to by `wcs2`. If no such wide character is found, then there are no tokens in the wide-character string pointed to by `wcs1` and `wcstok()` returns a NULL pointer. If such a wide character is found, it is the start of the first token.

`wcstok()` then searches from there for a wide character that is contained in the current separator wide string. If no such wide character is found, the current token extends to the end of the wide-character string pointed to by `wcs1`, and subsequent searches for a token will return a NULL pointer. If such a wide character is found, it is overwritten by a NULL character, which terminates the current token.

In all cases, the `wcstok()` function stores sufficient information in the pointer `ptr` so that subsequent calls, with a NULL pointer as the value of the first argument and the unmodified pointer value as the third, will start searching just past the end of the previously returned token (if any).

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Special behavior for XP4: If you define any feature test macro specifying XP4 behavior before the statement in your program source file to include the `wchar` header, then the compiler assumes that your program is using the XP4 variety of the `wcstok()` function, unless you also define the `_MSE_PROTOS` feature test macro. Please see [Table 2 on page 4](#) for a list of XP4 and other feature test macros.

The prototype for the XP4 variety of the `wcstok()` function is:

```
wchar_t *wcstok(wchar_t *wcs1, const wchar_t *wcs2);
```

This variety of the `wcstok()` function is missing a third parameter to specify the address of restart information in your program storage. Instead, C/370 provides comparable restart information in runtime

library storage. Please note that this library storage is provided on a per thread basis making the XPG4 wcstok() function thread-specific for a threaded application.

Returned value

If successful, wcstok() returns a pointer to the first wide character of a token.
If there is no token, wcstok() returns a NULL pointer.

Example

CELEBW22

```
/* CELEBW22 */
#include <wchar.h>
int main(void)
{
    static wchar_t str1[] = L"?a??b,,,#c";
    static wchar_t str2[] = L"\t \t";
    wchar_t *t, *ptr1, *ptr2;

    t = wcstok(str1, L"?", &ptr1);    /* t points to the token L"a" */
    t = wcstok(NULL, L",", &ptr1);    /* t points to the token L"??b" */
    t = wcstok(str2, L" \t", &ptr2);  /* t is a null pointer */
    t = wcstok(NULL, L"#", &ptr1);    /* t points to the token L"c" */
    t = wcstok(NULL, L"?", &ptr1);    /* t is a null pointer */
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“strtok\(\) — Tokenize string” on page 1765](#)
- [“strtok_r\(\) — Split string into tokens” on page 1767](#)

wcstol() — Convert a wide-character string to a long integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

long int wcstol(const wchar_t * __restrict_nptr,
                wchar_t ** __restrict_endptr, int base);
```

General description

Converts the initial portion of the wide-character string pointed to by nptr to long int representation. First it decomposes the input wide-character string into three parts:

1. An initial, possibly empty, sequence of white space wide characters (as specified by the `iswspace()` function).
2. A subject sequence resembling an integer determined by the value of `base`.
3. A final wide-character string of one or more unrecognized wide characters, including the terminating NULL character of the input wide-character string.

Then it attempts to convert the subject sequence to an integer, and returns the result.

If the value of `base` is zero, the expected form of the subject sequence is that of an integer constant as described in ISO/IEC 9899: subclause 6.1.3.2, optionally preceded by a plus or minus sign, but not including an integer suffix. If the value of `base` is between 2 and 36, the expected form of the subject sequence is a sequence of letters and digits from the portable character set representing an integer with the radix specified by `base`, optionally preceded by a plus or minus sign, but not including an integer suffix. The letters from `a` (or `A`) through `z` (or `Z`) are ascribed the values 10 to 35; only letters whose ascribed values are less than that of `base` are permitted. If the value of `base` is 16, the characters `0x` or `0X` may optionally precede the sequence of letters and digits, following the sign if present.

The subject sequence is defined as the longest initial subsequence of the input wide-character string, starting with the first non-white space wide character, that is of the expected form. The subject sequence contains no wide characters if the input wide-character string is empty or consists entirely of white space, or if the first non-white space wide character is other than a sign or a permissible letter or digit.

If the subject sequence has the expected form and the value of `base` is zero, the sequence of wide characters starting with the first digit is interpreted as an integer constant according to the rules of ISO/IEC 9899: subclause 6.1.3.2. If the subject sequence has the expected form and the value of `base` is between 2 and 36, it is used as the base for conversion, ascribing to each letter its value as given above. If the subject sequence begins with a minus sign, the value resulting from the conversion is negated. A pointer to the final wide-character string is stored in the object pointed to by `endptr`, provided that `endptr` is not a NULL pointer.

In a locale other than the C or POSIX locale, additional implementation-defined subject sequence forms may be accepted.

If the subject sequence is empty or does not have the expected form, no conversion is performed; the value of `nptr` is stored in the object pointed to by `endptr`, provided that `endptr` is not a NULL pointer.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Since 0, `{LONG_MIN}` and `{LONG_MAX}` are returned on error and are also valid returns on success, an application wishing to check for error situations should set `errno` to 0, then call `wcstol()`, then check `errno`.

Returned value

If successful, `wcstol()` returns the converted value, if any.

If unsuccessful, `wcstol()` returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, `wcstol()` returns `LONG_MAX` or `LONG_MIN`, according to the sign of the value. If the value of `base` is not supported, `wcstol()` returns 0.

If unsuccessful `wcstol()` sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of `base` is not supported.

ERANGE

The conversion caused an overflow.

Example

CELEBW23

```
/* CELEBW23 */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t *wcs;
    wchar_t *stopwcs;
    long    l;
    int     base;

    wcs = L"10110134932";
    printf("wcs = `%ls`\n", wcs);
    for (base=2; base<=8; base*=2) {
        l = wcstol(wcs, &stopwcs, base);
        printf("    wcstol = %ld\n", l);
        printf("    Stopped scan at `%ls`\n\n", stopwcs);
    }
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“strtoul\(\) — Convert character string to long” on page 1768](#)
- [“wcstoimax\(\) — Convert a wide-character string to a intmax_t” on page 2019](#)
- [“wcstoumax\(\) — Convert a wide-character string to a intmax_t” on page 2034](#)

wcstold() — Convert a wide-character string to long double

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <wchar.h>

long double wcstold(const wchar_t *__restrict__ nptr,
                    wchar_t **__restrict__ endptr);
```

General description

wcstold() converts a wchar_t * floating-point number input string to a long double value. The parameter nptr points to a sequence of wide-characters that can be interpreted as a numerical long double value. It decomposes the input wide-character string into three parts:

1. An initial, possibly empty, sequence of white-space wide-character codes (as specified by iswspace()).
2. A subject sequence resembling a floating-point constant, infinity, or NaN.
3. A final wide-character string of one or more unrecognized wide-characters codes, including the terminating NULL wide-character of the input wide-character string.

The function then attempts to convert the subject string into the floating-point number, and returns the result.

The expected form of the subject sequence is an optional plus or minus sign, then one of the following:

- A non-empty sequence of decimal digits optionally containing a radix character, then an optional exponent. A radix character is the character that separates the integer part of a number from the fractional.
- A 0x or 0X, a non-empty sequence of hexadecimal digits optionally containing a radix character, then a base 2 decimal exponent part with a p or P as prefix, a plus or minus sign, then a sequence of at least one decimal digit. (Example [-]0xh.hhhhp+/-d). A radix character is the character that separates the integer part of a number from the fractional part.
- One INF or INFINITY, ignoring case.
- One NANQ or NANQ(n-char-sequence), ignoring case.
- One NANS or NANS(n-char-sequence), ignoring case.
- One NAN or NAN(n-char-sequence), ignoring case.

See the "scanf() Family of Formatted Input Functions" for a description of special infinity and NaN sequences recognized by z/OS formatted input functions in IEEE Binary Floating-Point mode. The pointer to the final wide-character string is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer.

Returned value

If successful, `wcstold()` returns the converted value, if any. If no conversion could be performed, it returns 0.

The long double value is a hexadecimal floating-point or IEEE Binary Floating-Point format depending on the floating-point mode of the invoking thread. This function uses `__isBFP()` to determine the floating-point mode of the invoking thread.

If the correct value is outside the range of representable values, then `+/-HUGE_VALL`, according to the sign of the value, is returned and the value of the `ERANGE` macro is stored in `errno`.

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“__isBFP\(\) — Determine application floating-point format” on page 905](#)
- [“wcstof\(\) — Convert a wide-character string to float ” on page 2018](#)
- [“wcstod\(\) — Convert wide-character string to a double floating-point” on page 2014](#)
- [“wcstol\(\) — Convert a wide-character string to a long integer” on page 2022](#)
- [“wcstoul\(\) — Convert a wide-character string to an unsigned long integer” on page 2030](#)

wcstoll() — Convert a wide-character string to a long long integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| z/OS UNIX System Services C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | OS/390 V2R10 |

Format

```
#include <wchar.h>

long long wcstoll(const wchar_t * __restrict_nptr,
                  wchar_t ** __restrict_endptr, int base);
```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

Converts the initial portion of the wide-character string pointed to by *nptr* to long long representation. First it decomposes the input wide-character string into three parts:

1. An initial, possibly empty, sequence of white space wide characters (as specified by the `iswspace()` function).
2. A subject sequence resembling an integer determined by the value of *base*.
3. A final wide-character string of one or more unrecognized wide characters, including the terminating NULL character of the input wide-character string.

Then it attempts to convert the subject sequence to a long long integer, and returns the result.

If the value of *base* is zero, the expected form of the subject sequence is that of an integer constant as described in ISO/IEC 9899: subclause 6.1.3.2, optionally preceded by a plus or minus sign, but not including an integer suffix. If the value of *base* is between 2 and 36, the expected form of the subject sequence is a sequence of letters and digits from the portable character set representing an integer with the radix specified by *base*, optionally preceded by a plus or minus sign, but not including an integer suffix. The letters from a (or A) through z (or Z) are ascribed the values 10 to 35; only letters whose ascribed values are less than that of *base* are permitted. If the value of *base* is 16, the characters 0x or 0X may optionally precede the sequence of letters and digits, following the sign if present.

The subject sequence is defined as the longest initial subsequence of the input wide-character string, starting with the first non-white space wide character, that is of the expected form. The subject sequence contains no wide characters if the input wide-character string is empty or consists entirely of white space, or if the first non-white space wide character is other than a sign or a permissible letter or digit.

If the subject sequence has the expected form and the value of *base* is zero, the sequence of wide characters starting with the first digit is interpreted as an integer constant according to the rules of ISO/IEC 9899: subclause 6.1.3.2. If the subject sequence has the expected form and the value of *base* is between 2 and 36, it is used as the *base* for conversion, ascribing to each letter its value as given above. If the subject sequence begins with a minus sign, the value resulting from the conversion is negated. A pointer to the final wide-character string is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer.

In a locale other than the C or POSIX locale, additional implementation-defined subject sequence forms may be accepted.

If the subject sequence is empty or does not have the expected form, no conversion is performed; the value of *nptr* is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer. The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Since 0, {LLONG_MIN} and {LLONG_MAX} are returned on error and are also valid returns on success, an application wishing to check for error situations should set `errno` to 0, then call `wcstoll()`, then check `errno`.

Note: The `wcstoll()` function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, `wcstoll()` returns the converted value, if any.

If unsuccessful, `wcstoll()` returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, `wcstoll()` returns `LLONG_MAX` (`LONGLONG_MAX`) or `LLONG_MIN` (`LONGLONG_MIN`), according to the sign of the value. If the value of `base` is not supported, `wcstoll()` returns 0.

If unsuccessful `wcstoll()` sets `errno` to one of the following values:

Error Code

Description

EINVAL

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Example

```
/* Long Long example */
#define _LONG_LONG 1
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t *wcs;
    wchar_t *stopwcs;
    long long l;
    int base;

    wcs = L"10110134932";
    printf("wcs = `%ls`\n", wcs);
    for (base=2; base<=8; base*=2) {
        l = wcstoll(wcs, &stopwcs, base);
        printf("    wcstoll = %lld\n", l);
        printf("    Stopped scan at `%ls`\n\n", stopwcs);
    }
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“strtol\(\) — Convert character string to long” on page 1768](#)
- [“strtoll\(\) — Convert string to signed long long” on page 1772](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)
- [“strtoull\(\) — Convert string to unsigned long long” on page 1775](#)
- [“wcstoimax\(\) — Convert a wide-character string to a intmax_t” on page 2019](#)
- [“wcstol\(\) — Convert a wide-character string to a long integer” on page 2022](#)
- [“wcstoul\(\) — Convert a wide-character string to an unsigned long integer” on page 2030](#)
- [“wcstoull\(\) — Convert a wide-character string to an unsigned long long integer” on page 2031](#)
- [“wcstoumax\(\) — Convert a wide-character string to a intmax_t” on page 2034](#)

wcstombs() – Convert wide-character string to multibyte character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

size_t wcstombs(char * __restrict__dest,
                const wchar_t * __restrict__string, size_t count);
```

General description

Converts the wide-character string pointed to by *string* into the multibyte array pointed to by *dest*. The converted string begins in the initial shift state. The conversion stops after *count* bytes in *dest* are filled up or a NULL wide character is encountered.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

If unsuccessful, `mbstowcs()` returns `(size_t) -1` and sets `errno` to one of the following values:

Error Code

Description

EINVAL

The input argument is a NULL rather than a pointer to a wide character.

EILSEQ

`wcstombs()` encountered a sequence that is not a valid wide character code.

The `mbstowcs()` interface checks for an invalid input arg. If the third arg, which should be a pointer to a string of `wchar_t` elements, is NULL, the interface will set `errno` to `EINVAL` as well as returning `-1`. This clearly differentiates from the situation in which the third arg is a pointer to null, in which case should return 1 and the multibyte target string will contain a null byte.

Returned value

Returns the length in bytes of the multibyte character string, not including a terminating NULL wide character. The value `(size_t) -1` is returned if an invalid multibyte character is encountered or if **string* is a NULL pointer.

If *count* is the returned value, the array is not NULL-terminated.

If **dest* is a NULL pointer, the number of characters required to convert the wide-character string is returned.

If the area pointed to by **dest* is too small (as indicated by the value of *count*) to contain the wide character codes represented as multibyte characters, the number of bytes containing complete multibyte characters is returned.

Note: `wcstombs()` does not generate redundant shift characters between the DBCS characters. When the `wctomb()` function is called for each character, redundant shift characters are generated.

Example

CELEBW24

```
/* CELEBW24

   In this example, a wide-character string is converted to a
   char string twice. The first call converts the entire string, while
   the second call only converts three characters. The results are
   printed each time.

*/
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

#define SIZE 20

int main(void)
{
    char dest[SIZE];
    wchar_t * dptr = L"string";
    size_t count = SIZE;
    size_t length;

    length = wcstombs( dest, dptr, count );
    printf( "%d characters were converted.\n", length );
    printf( "The converted string is \"%s\"\n\n", dest );

    /* Reset the destination buffer */
    memset( dest, '\\0', sizeof(dest));

    /* Now convert only 3 characters */
    length = wcstombs( dest, dptr, 3 );
    printf( "%d characters were converted.\n", length );
    printf( "The converted string is \"%s\"\n", dest );
}
```

Output:

```
6 characters were converted.
The converted string is "string"

3 characters were converted.
The converted string is "str"
```

Related information

- [“stdlib.h – Standard library functions” on page 65](#)
- [“mbstowcs\(\) – Convert multibyte characters to wide characters” on page 1058](#)
- [“wcslen\(\) – Calculate length of wide-character string” on page 2000](#)
- [“wcsrtombs\(\) – Convert wide-character string to multibyte string” on page 2009](#)
- [“wctomb\(\) – Convert wide character to multibyte character” on page 2040](#)

wcstoul() — Convert a wide-character string to an unsigned long integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

unsigned long int wcstoul(const wchar_t * __restrict __nptr,
                        wchar_t ** __restrict __endptr, int base);
```

General description

Converts the initial portion of the wide-character string pointed to by *nptr* to unsigned long integer representation. First it decomposes the input wide-character string into three parts:

1. An initial, possibly empty, sequence of white space wide characters (as specified by the `iswspace()` function).
2. A subject sequence resembling an unsigned integer represented in some radix determined by the value of `base`.
3. A final wide-character string of one or more unrecognized wide characters, including the terminating NULL character of the input wide-character string.

Then it attempts to convert the subject sequence to an unsigned integer, and returns the result.

If the value of `base` is zero, the expected form of the subject sequence is that of an integer constant as described in ISO/IEC 9899: subclause 6.1.3.2, optionally preceded by a plus or minus sign, but not including an integer suffix. If the value of `base` is between 2 and 36, the expected form of the subject sequence is a sequence of letters and digits from the portable character set representing an integer with the radix specified by `base`, optionally preceded by a plus or minus sign, but not including an integer suffix. The letters from a (or A) through z (or Z) are ascribed the values 10 to 35; only letters whose ascribed values are less than that of `base` are permitted. If the value of `base` is 16, the characters 0x or 0X may optionally precede the sequence of letters and digits, following the sign if present.

The *subject sequence* is defined as the longest initial sub-sequence of the input wide-character string, starting with the first non-white space wide character, that is of the expected form. The subject sequence contains no wide characters if the input wide-character string is empty or consists entirely of white space, or if the first non-white space wide character is other than a sign or a permissible letter or digit.

If the subject sequence has the expected form and the value of `base` is zero, the sequence of wide characters starting with the first digit is interpreted as an integer constant according to the rules of ISO/IEC 9899: subclause 6.1.3.2. If the subject sequence has the expected form and the value of `base` is between 2 and 36, it is used as the base for conversion, ascribing to each letter its value as given above. If the subject sequence begins with a minus sign, the value resulting from the conversion is negated. A pointer to the final string is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer.

In a locale other than the C or POSIX locale, additional implementation-defined subject sequence forms may be accepted.

If the subject sequence is empty or does not have the expected form, no conversion is performed; the value of *nptr* is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Since 0 and {ULONG_MAX} are returned on error and 0 is also a valid return on success, an application wishing to check for error situations should set *errno* to 0, then call *wcstoul()*, then check *errno*.

Returned value

If successful, *wcstoul()* returns the converted value, if any.

If unsuccessful, *wcstoul()* returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, *wcstoul()* returns ULONG_MAX. If the value of *base* is not supported, *wcstoul()* returns 0.

If unsuccessful *wcstoul()* sets *errno* to one of the following values:

Error Code

Description

EINVAL

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Example

CELEBW25

```
/* CELEBW25 */
#include <stdio.h>
#include <wchar.h>

#define BASE 2

int main(void)
{
    wchar_t *wcs = L"1000e13 camels";
    wchar_t **endptr;
    unsigned long int answer;

    answer = wcstoul(wcs, endptr, BASE);
    printf("The input wide string used: '%ls'\n", wcs);
    printf("The unsigned long int produced: %lu\n", answer);
    printf("The substring of the input wide string that was not");
    printf(" converted to unsigned long: '%ls'\n", *endptr);
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“strtoul\(\) — Convert string to unsigned integer” on page 1773](#)
- [“wcstolimax\(\) — Convert a wide-character string to a intmax_t” on page 2019](#)
- [“wcstoulmax\(\) — Convert a wide-character string to a intmax_t” on page 2034](#)

wcstoull() — Convert a wide-character string to an unsigned long long integer

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| z/OS UNIX C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | OS/390 V2R10 |

Format

```
#include <wchar.h>

unsigned long long wcstoull(const wchar_t * __restrict__ nptr,
                           wchar_t ** __restrict__ endptr, int base);
```

Compile requirement: Use of this function requires the long long data type. See [z/OS XL C/C++ Language Reference](#) for information on how to make long long available.

General description

Converts the initial portion of the wide-character string pointed to by *nptr* to unsigned long long integer representation. First it decomposes the input wide-character string into three parts:

1. An initial, possibly empty, sequence of white space wide characters (as specified by the `iswspace()` function).
2. A subject sequence resembling an unsigned integer represented in some radix determined by the value of *base*.
3. A final wide-character string of one or more unrecognized wide characters, including the terminating NULL character of the input wide-character string.

Then it attempts to convert the subject sequence to an unsigned long long integer, and returns the result.

If the value of *base* is zero, the expected form of the subject sequence is that of an integer constant as described in ISO/IEC 9899: subclause 6.1.3.2, optionally preceded by a plus or minus sign, but not including an integer suffix. If the value of *base* is between 2 and 36, the expected form of the subject sequence is a sequence of letters and digits from the portable character set representing an integer with the radix specified by *base*, optionally preceded by a plus or minus sign, but not including an integer suffix. The letters from a (or A) through z (or Z) are ascribed the values 10 to 35; only letters whose ascribed values are less than that of *base* are permitted. If the value of *base* is 16, the characters 0x or 0X may optionally precede the sequence of letters and digits, following the sign if present.

The subject sequence is defined as the longest initial sub-sequence of the input wide-character string, starting with the first non-white space wide character, that is of the expected form. The subject sequence contains no wide characters if the input wide-character string is empty or consists entirely of white space, or if the first non-white space wide character is other than a sign or a permissible letter or digit.

If the subject sequence has the expected form and the value of *base* is zero, the sequence of wide characters starting with the first digit is interpreted as an integer constant according to the rules of ISO/IEC 9899: subclause 6.1.3.2. If the subject sequence has the expected form and the value of *base* is between 2 and 36, it is used as the *base* for conversion, ascribing to each letter its value as given above. If the subject sequence begins with a minus sign, the value resulting from the conversion is negated. A pointer to the final string is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer. In a locale other than the C or POSIX locale, additional implementation-defined subject sequence forms may be accepted.

If the subject sequence is empty or does not have the expected form, no conversion is performed; the value of *nptr* is stored in the object pointed to by *endptr*, provided that *endptr* is not a NULL pointer.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Since 0 and {ULLONG_MAX} are returned on error and 0 is also a valid return on success, an application wishing to check for error situations should set errno to 0, then call wcstoull(), then check errno.

Note: The wcstoull() function has a dependency on the level of the Enhanced ASCII Extensions. See [“Enhanced ASCII support”](#) on page 2123 for details.

Returned value

If successful, wcstoull() returns the converted value, if any.

If unsuccessful, wcstoull() returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, wcstoull() returns ULLONG_MAX (ULONG_LONG_MAX). If the value of base is not supported, wcstoull() returns 0.

If unsuccessful wcstoull() sets errno to one of the following values:

Error Code

Description

EINVAL

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Example

```
/* LongLong conversion */
#define _LONG_LONG 1
#include <stdio.h>
#include <wchar.h>

#define BASE 2

int main(void)
{
    wchar_t *wcs = L"1000e13 camels";
    wchar_t **endptr;
    unsigned long long answer;

    answer = wcstoull(wcs, endptr, BASE);
    printf("The input wide string used: '%ls'\n", wcs);
    printf("The unsigned long long produced: %llu\n", answer);
    printf("The substring of the input wide string that was not");
    printf(" converted to unsigned long long: '%ls'\n", *endptr);
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions”](#) on page 79
- [“strtol\(\) — Convert character string to long”](#) on page 1768
- [“strtoll\(\) — Convert string to signed long long”](#) on page 1772
- [“strtoul\(\) — Convert string to unsigned integer”](#) on page 1773
- [“strtoull\(\) — Convert string to unsigned long long”](#) on page 1775
- [“wcstoimax\(\) — Convert a wide-character string to a intmax_t”](#) on page 2019
- [“wcstol\(\) — Convert a wide-character string to a long integer”](#) on page 2022
- [“wcstoll\(\) — Convert a wide-character string to a long long integer”](#) on page 2025
- [“wcstoul\(\) — Convert a wide-character string to an unsigned long integer”](#) on page 2030
- [“wcstoumax\(\) — Convert a wide-character string to a intmax_t”](#) on page 2034

wcstoumax() – Convert a wide-character string to a intmax_t

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| C99 Single UNIX Specification, Version 3 C++ TR1 C99 | both | z/OS V1R7 |

Format

```
#define _ISOC99_SOURCE
#include <inttypes.h>

uintmax_t wcstoumax(const wchar_t * __restrict__ nptr,
                    wchar_t ** __restrict__ endptr, int base);
```

Compile requirement: Function wcstoumax() requires long long to be available.

General description

The wcstoumax() function converts the wide-character string nptr to an uintmax_t integer type. Valid input values for base are 0 and in the range 2-36. The wcstoumax() function is equivalent to wcstoul() and wcstoull(). The only difference being that the return value is of type uintmax_t. See wcstoull() for more information.

Returned value

If successful, wcstoumax() returns the converted value, if any.

If unsuccessful, wcstoumax() returns 0 if no conversion could be performed. If the correct value is outside the range of representable values, wcstoumax() returns UINTMAX_MAX. If the value of base is not supported, wcstoumax() returns 0.

If unsuccessful wcstoumax() sets errno to one of the following values:

Error Code

Description

EINVAL

The value of *base* is not supported.

ERANGE

The conversion caused an overflow.

Example

```
#define _ISOC99_SOURCE
#include <inttypes.h>
#include <stdio.h>

int main(void)
{
    wchar_t *nptr;
    wchar_t *endptr;
    uintmax_t j;
    int base = 10;
    nptr = L"10110134932";
    printf("nptr = '%ls'\n", nptr);
    j = wcstoumax(nptr, &endptr, base);
    printf("wcstoumax = %ju\n", j);
    printf("Stopped scan at '%ls'\n\n", endptr);
}
```

Output

```
nptr = `10110134932`
wcstoumax = 10110134932
Stopped scan at ``
```

Related information

- [“inttypes.h — I/O format of integer types”](#) on page 28
- [“stdint.h — Integer types”](#) on page 60
- [“imaxdiv\(\) — Quotient and remainder for intmax_t”](#) on page 837
- [“strtoimax\(\) — Convert character string to intmax_t integer type”](#) on page 1764
- [“strtoumax\(\) — Convert character string to uintmax_t integer type”](#) on page 1777
- [“wcstoimax\(\) — Convert a wide-character string to a intmax_t”](#) on page 2019

wcswcs() — Locate wide-character substring in wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

wchar_t *wcswcs(const wchar_t *string1, const wchar_t *string2);
```

General description

Locates the first occurrence in the string pointed to by *string1* of the sequence of wide characters (excluding the terminating wide NULL character) in the string pointed to by *string2*.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Note: The `wcswcs()` function has been moved to the Legacy Option group in Single UNIX Specification, Version 3 and may be withdrawn in a future version. The `wcsstr()` function is preferred for portability.

Returned value

If successful, `wcswcs()` returns a pointer to the located string.

If *string2* points to a string with zero length, `wcswcs()` returns *string1*.

If the string is not found, `wcswcs()` returns NULL.

Example

CELEBW26

```
/* CELEBW26

   This example finds the first occurrence of the wide character string pr
   in buffer1, using wcs wcs().

*/
#include <stdio.h>
#include <wchar.h>

#define SIZE 40

int main(void)
{
    wchar_t buffer1[SIZE] = L"computer program";
    wchar_t *ptr;
    wchar_t *wch = L"pr";

    ptr = wcs wcs( buffer1, wch );
    printf( "The first occurrence of %ls in '%ls' is '%ls'\n",
           wch, buffer1, ptr );
}
```

Output:

The first occurrence of pr in 'computer program' is 'program'

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“strstr\(\) — Locate substring” on page 1756](#)
- [“wcschr\(\) — Search for wide-character substring” on page 1991](#)
- [“wcscmp\(\) — Compare wide-character strings” on page 1992](#)
- [“wcsncmp\(\) — Find offset of first wide-character match” on page 1996](#)
- [“wcsrchr\(\) — Locate last wide character in string” on page 2008](#)

wcswidth() — Determine the display width of a wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

int wcswidth(const wchar_t *wcs, size_t n);
```

General description

Determines the number of printing positions that a graphic representation of n wide characters (or fewer than n wide characters, if a NULL wide character is encountered before n wide characters have been exhausted), in the wide-character string pointed to by *wcs*, occupies on a display device. The number of printing positions is independent of its location on the device.

Returned value

If successful, `wcswidth()` returns the number of printing positions occupied by the wide-character string pointed to by *wcs*.

If *wcs* points to a NULL wide character, `wcswidth()` returns 0.

If any wide character in the wide-character string pointed to by *wcs* is not a printing wide character, `wcswidth()` returns -1.

The behavior of `wcswidth()` is affected by the LC_CTYPE category.

Note: Under z/OS XL C/C++ applications, the width returned will be 1 for each single-byte character and 2 for each double-byte character.

Example

CELEBW27

```
/* CELEBW27 */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t *wcs = L"ABC";

    printf("wcs has a width of: %d\n", wcswidth(wcs,3));
}
```

Output:

```
wcs has a width of: 3
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)

wcsxfrm() — Transform a wide-character string

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>
```

```
size_t wcsxfrm(wchar_t * __restrict __wcs1,
               const wchar_t * __restrict __wcs2, size_t n);
```

General description

Transforms the wide-character string pointed to by *wcs2* to values which represent character collating weights and places the resulting wide-character string into the array pointed to by *wcs1*. The transformation is such that if the `wcscmp()` function is applied to two transformed wide-character strings, it returns a value greater than, equal to, or less than zero, corresponding to the result of the `wcscoll()` function applied to the same two original wide-character strings. No more than *n* elements are placed into the resulting array pointed to by *wcs1*, including the terminating NULL wide-character code. If *n* is zero, *wcs1* is permitted to be a NULL pointer. If copying takes place between objects that overlap, the behavior is undefined.

Since no return value is reserved to indicate an error, an application wishing to check for error situations should set `errno` to 0, then call `wcsxfrm()`, then check `errno`.

Returned value

Returns the length of the transformed wide-character string (not including the terminating NULL wide character code). If the value returned is *n* or more, the contents of the array pointed to by *wcs1* are indeterminate.

If *wcs1* is a NULL pointer, `wcsxfrm()` returns the number of elements required to contain the transformed wide string.

The transformed value of invalid wide-character codes shall be either less than or greater than the transformed values of valid wide-character codes depending on the option chosen for the particular locale definition. In this case `wcsxfrm()` returns `(size_t)-1`.

`wcsxfrm()` is controlled by the `LC_COLLATE` category.

The `EILSEQ` error may be set, indicating that the wide character string pointed to by *wcs2* contains wide character codes outside the domain of the collating sequence.

Note: The ISO/C Multibyte Support Extensions do not indicate that the `wcsxfrm()` function may return with an error.

Example

CELEBW28

```
/* CELEBW28 */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wchar_t *wcs;
    wchar_t  buffer[80];
    int      length;

    printf("Type in a string of characters.\n");
    wcs = fgetws(buffer, 80, stdin);
    length = wcsxfrm(NULL, wcs, 0);
    printf("You would need a %d element array to hold the wide string", length);
    printf("\n\n%ls\n\ntransformed according", wcs);
    printf(" to this program's locale.\n");
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“strxfrm\(\) — Transform string” on page 1778](#)

wctob() — Convert wide character to byte

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XPG4:

```
#include <wchar.h>

int wctob(wint_t c);
```

XPG4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

int wctob(wint_t c);
```

General description

Determines whether *c* corresponds to a member of the extended character set whose multibyte character corresponds to a single byte when in initial shift state.

The behavior of this wide-character function is affected by the LC_CTYPE category of the current locale. If you change the category, undefined results can occur.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `wctob()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

If successful, `wctob()` returns the single-byte representation.

If *c* does not correspond to a multibyte character with length one, `wctob()` returns EOF.

Example

CELEBW29

```
/* CELEBW29 */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wint_t wc = L'A';

    if (wctob(wc) == wc)
        printf("wc is a valid single byte character\n");
    else
        printf("wc is not a valid single byte character\n");
}
```

Output:

```
wc is a valid single-byte character
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)

wctomb() — Convert wide character to multibyte character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <stdlib.h>

int wctomb(char *string, wchar_t character);
```

General description

Converts the `wchar_t` value of *character* into a multibyte array pointed to by *string*. If the value of *character* is 0, the function is left in the initial shift state. At most, `wctomb()` stores **MB_CUR_MAX** characters in *string*.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

If successful, `wctomb()` returns the length in bytes of the multibyte character.

If *character* is not a valid multibyte character, `wctomb()` returns -1.

If *string* is a NULL pointer, `wctomb()` returns nonzero if shift-dependent encoding is used, or 0 otherwise.

Example**CELEBW30**

```
/* CELEBW30

   This example converts the wide character c to a character using wctomb().

*/
#include <stdio.h>
#include <stdlib.h>

#define SIZE 40

int main(void)
{
    static char  buffer[ SIZE ];
    wchar_t wch = L'c';
    int length;
```

```

length = wctomb( buffer, wch );
printf( "The number of bytes that comprise the multibyte "
        "character is %i\n", length );
printf( "And the converted string is \"%s\"\n", buffer );
}

```

Output:

```

The number of bytes that comprise the multibyte character is 1
And the converted string is "c"

```

Related information

- [“stdlib.h — Standard library functions” on page 65](#)
- [“mbtowc\(\) — Convert multibyte character to wide character” on page 1059](#)
- [“wctomb\(\) — Convert a wide character to a multibyte character” on page 1988](#)
- [“wcslen\(\) — Calculate length of wide-character string” on page 2000](#)
- [“wcstombs\(\) — Convert wide-character string to multibyte character string” on page 2028](#)

wctrans(), towctrans() — Transliterate wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

```

#include <wchar.h>

wctrans_t  wctrans(const char * charclass);
wint_t     towctrans(wint_t wc, wctrans_t desc);

```

General description

These two functions work together to provide transliteration of wide characters. For valid results, the setting of the LC_CTYPE category of the current locale must remain the same across the two calls. Character mapping rules are defined in the LC_CTYPE category.

The wctrans() function takes the character mapping name pointed to by *charclass* and returns a value of type wctrans_t for use as the second argument to the towctrans() function.

The towctrans() function applies the indicated mapping to wide-character code *wc* from the codeset identified in the current locale. The towctrans() function applies the mapping returned by wctrans() and passed as *desc*.

The following character mapping names are reserved by the standard and are defined in all locales: *tolower* and *toupper*.

Notes:

1. towctrans(wc, wctrans("tolower")) is equivalent to towlower(wc)
2. towctrans(wc, wctrans("toupper")) is equivalent to towupper(wc)

Returned value

If successful, `wctrans()` returns the non-zero value of type `wctrans_t` for use in calls to `towctrans()`.

If unsuccessful, `wctrans()` returns 0 and sets `errno` to `EINVAL` if the mapping name pointed to by *charclass* is not valid for the current locale.

If successful, the `towctrans()` function returns the mapped value of *wc* using the mapping described by *desc*.

If unsuccessful, `towctrans()` returns *wc* unchanged. If the value of *desc* is invalid, `towctrans()` returns 0.

Related information

- [“wctype.h – Wide character properties” on page 81](#)
- [“tolower\(\), toupper\(\) – Convert character case” on page 1883](#)

wctype() – Obtain handle for character property classification

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment XPG4 XPG4.2 C99 Single UNIX Specification, Version 3 | both | |

Format

```
#include <wchar.h>

wctype_t wctype(const char *property);
```

SUSV3:

```
#define _POSIX_C_SOURCE 200112L
#include <wctype.h>
wctype_t wctype(const char *property);
```

General description

The `wctype()` function is defined for valid property names as defined in the current locale. The *property* is a string identifying a generic character class for which code-page-specific type information is required. The function returns a value of type `wctype_t`, which can be used as the second argument to a call of `iswctype()`. The `wctype()` function determines values of `wctype_t` according to rules of the coded character set defined by character type information in the program's locale (category `LC_CTYPE`). Values returned by `wctype()` are valid until a call to `setlocale()` that modifies the category `LC_CTYPE`.

The behavior of this wide-character function is affected by the `LC_CTYPE` category of the current locale. If you change the category, undefined results can occur.

Returned value

If successful, `wctype()` returns a value of type `wctype_t` that can be used in calls to `iswctype()`.

If the given property name is not valid for the current locale (category `LC_CTYPE`), `wctype()` returns 0.

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wctype.h — Wide character properties” on page 81](#)

wcwidth() — Determine the display width of a wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

Non-XPG4:

```
#include <wchar.h>

int wcwidth(const wint_t wc);
```

XPG4:

```
#define _XOPEN_SOURCE
#include <wchar.h>

int wcwidth(const wchar_t wc);
```

General description

Determines the number of printing positions that a graphic representation of *wc* occupies on a display device. Each of the printing wide characters occupies its own number of printing positions on a display device. The number is independent of its location on the device.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then the compiler assumes that your program is using the XPG4 variety of the `wcwidth()` function. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

The prototype for the XPG4 variety of the `wcwidth()` function is:

```
int wcwidth(const wchar_t wc);
```

The difference between this variety and the C/370, non-XPG4 variety of the `wcwidth()` function is that its parameter, *wc*, is a `wchar_t` rather than a `wint_t` type.

Returned value

If successful, `wcwidth()` returns the number of printing positions occupied by *wc*.

If *wc* is a NULL or non-spacing wide character, `wcwidth()` returns 0.

If *wc* is not a printing wide character, `wcwidth()` returns -1.

The behavior of `wcwidth()` is affected by the `LC_CTYPE` category.

Notes:

1. Under z/OS XL C/C++ applications, the width returned will be zero for a NULL or non-spacing character, 1 for a single-byte character, and 2 for a double-byte character.

2. A non-spacing character is a character belonging to the charclass named `_zlc` (zero length character class) in the `LC_CTYPE` category.

Example

CELEBW31

```
/* CELEBW31 */
#include <stdio.h>
#include <wchar.h>

int main(void)
{
    wint_t wc = L'A';

    printf("wc has a width of: %d\n", wcwidth(wc));
}
```

Output:

```
wc has a width of: 1
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)

w_getmntent() – Get information on mounted file systems

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#define _OPEN_SYS
#include <sys/mntent.h>

int w_getmntent(char *buffer, int size);
```

General description

Gets information about all currently mounted file systems.

buffer

A pointer to storage that is to be filled with the retrieved information. The storage consists of a header and an entry table that correspond to one of the available mapping formats. The mappings available are defined in the `<sys/mntent.h>` header file. Each entry in the entry table contains information for a single mounted file system.

size

The length of the buffer. If *size* is zero, the total number of mount entries is returned. You can use this information to obtain a buffer large enough to hold all the information about all the entries. Use the new buffer on the subsequent call.

Three mapping formats available. Their corresponding headers are as follows:

| | Header | Eye Catcher | Entry |
|--------------|------------------------|--------------------|------------------------------|
| struct mnte3 | MNTE3H (struct mnte3h) | MNTE3H_ID ("MNT3") | W_MNTENT3 (struct w_mntent3) |
| struct mnte2 | MNTE2H (struct mnte2h) | MNTE2H_ID ("MNT2") | W_MNTENT2 (struct w_mntent2) |
| struct mnte | W_MNTH (struct w_mnth) | "MNTE" | W_MNTENT (struct w_mntent) |

The buffer should be set to zero before setting of fields or the `w_getmntent()` call. The default mapping format is struct mnte when the eyecatcher field is unset.

Using structure w_mntent3: Before calling `w_getmntent()` with the `w_mntent3` structure mapping, set the following fields in MNTE3H:

1. mnt3H_cbid eyecatcher to MNTE3H_ID
2. mnt3H_cblen to the size of struct mnte3
3. mnt3H_bodylen to the size of struct w_mntent3
4. [Optional] mh3_devno to the device number

In the header, the field `mnt3H_cblen` returns the number of bytes of data that is put in the buffer. The field `mh3_cursor` contains positioning information that `w_getmntent()` uses to store the information. If multiple calls are made, use the same buffer because the positioning information in `mh3_cursor` indicates where the function should continue with its list. The positioning information should not be changed between calls. Information about a specific file system can be obtained if the device number of that file system is known. In this case, the device number can be filled into the field `mh3_devno`, and the `w_getmntent` call returns a single entry with information about that file system. Or a device number value of `x40000000` can be used to indicate that the returned path name should be up to 64 bytes of the mount point path name at the time of the mount.

After a successful call to `w_getmntent()`, the following `w_mntent3` structure fields will be available for reference:

mnt3_fstype

The file system type.

mnt3_mode

The mount mode of the file system. A flag field that specifies the mount mode and more mount options: `mntentfsaunmount`.

mntentfsaunmount

If it is 1 after the file system is mounted, the file system will be unmounted when a system leaves the sysplex. If it is 0, then the setting of `mntentfsnoautomove` is used. See `mntentfsnoautomove` below.

mntentfsclient

If it is 0, then the file system is a sysplex client. If it is 1, then the file system is not a sysplex client.

mntentfsnoautomove

If it is 0 after the file system is mounted, it can be moved automatically. If it is 1 after the file system is mounted, it will not be moved automatically.

mntentfsmodenosec

If it is 1, then the file system will not enforce security checks. If it is 0, then the file system will enforce security checks.

mntentfsmodeexport

If it is 0, then the file system has not been exported by DFS. If it is 1, then the file system has been exported by DFS.

mntentfsmoderonly

If it is 0, then the file system is mounted as read/write. If it is 1, then the file system is mounted as read-only.

mntentfsmodenosuid

If it is 1, then the SETUID and SETGID mode flags will be ignored for programs that reside in this file system. If it is 0 then the SETUID and SETGID mode flags will be enforced for programs that reside in this file system.

mnt3_dev

Device number which stat() will return for all files in this file system.

mnt3_parentdev

st_dev of parent file system.

mnt3_rootino

The ino of the mount point.

mnt3_status

The status of the file system

mnt3_ddname

The ddname specified on mount.

mnt3_fstname

The name of the file system type that is specified by the FILESYS statement. The name for the file system that performed the mount.

mnt3_fsname

The name of the file system that was mounted.

mnt3_pathlen

The length of mount point path.

mnt3_mountpoint

The name of the directory where the file system is mounted.

mnt3_jobname

If this file system is quiesced, this is the job that made the request.

mnt3_PID

If this file system is quiesced, this is the PID that made the request.

mnt3_parmoffset

Offset of mount parameter parm_point, starting from the address of the mnt3_fstype member of the w_mnte3 struct.

mnt3_parmlen

The length of the mount parameter parm_point.

mnt3_sysname

The name of the target system.

mnt3_qsystem

The name of the quiesce system.

mnt3_fromsys

The name of the system from which the file system has moved.

mnt3_flags

The field containing the request flags.

mnt3_status2

The file system status extensions.

mnt3_readct

The number of reads done.

mnt3_writect

The number of writes done.

mnt3_diribc

The number of directory I/O blocks.

mnt3_readibc

The number of read I/O blocks.

mnt3_writeibc

The number of write I/O blocks.

mnt3_bytesreadhw

Total number of bytes read from high word.

mnt3_bytesreadlw

Total number of bytes read from low word.

mnt3_byteswrittenhw

Total number of bytes written to high word.

mnt3_byteswrittenlw

Total number of bytes written to low word.

mnt3_filetag

Mount tag.

mnt3_syslistoffset

Offset of system list.

mnt3_syslistlength

Length of system list.

mnt3_aggnamelength

Length of the aggregate name in mnt2_aggname. The length does not include the null terminating character, and is only valid if mnt3_aggnameoffset has a nonzero value.

mnt3_aggnameoffset

The offset of mnt2_aggname from w_mntent3. If the value is zero, then no aggregate name is returned.

mnt3_mntsec

The mount time in seconds when the file system was mounted.

mnt3_fstoken

This field is a virtual file system pointer for the file system.

mnt3_pfsnormalstatusoffset

This field provides the offset of the physical file system normal status string location.

mnt3_pfsnormalstatuslength

This field provides the length of the physical file system normal status string.

mnt3_pfsexcpstatuslength

This field provides the length of the exception status string of the physical file system.

mnt3_pfsexcptstatusoffset

This field provides the offset of the exception status string of the physical file system.

mnt3_fsusrmntUID

The effective UID (EUID) of the user that mounted the file system.

mnt3_unmntver

If this field is 1, the file system is automatically unmounted when no longer being used as a version file system. If this field is 0, the file system is not automatically unmounted when no longer being used as a version file system.

parm_point

This field contains the mount point parameters to be used when mounting a file system. It is a separate field in the mnte3 structure but contiguously allocated following the w_mnte3 body, its address is the sum of the address of w_mnte3 and mnt3_parmoffset.

If all entries do not fit in the buffer that is supplied, multiple calls are required. If an entry together with its mount parameter will not fit in the buffer, the entry is returned without the mount parameter. In this case, *mnt3_parmlen* contains the length of the mount parameter, and *mnt3_parmoffset* is zero.

To assure that at least one entry, including the mount parameter, is returned, it is advisable to allocate space for at least two entries.

When the final entry has been placed in the buffer, `w_getmntent()` returns no entries.

Using structure `w_mntent2`: Before calling `w_getmntent()` with the `w_mntent2` structure mapping, set the following fields in `MNTE2H`:

1. `mh2_hdr.mnth2_cbid` eyecatcher to `MNTE2H_ID`
2. `mh2_hdr.mnt2h_cblen` to the size of struct `mnte2`
3. `mh_bodylen` to the size of struct `w_mntent2`
4. [Optional] `mh2_devno` to the device number

In the header, the field `mnt2h_cblen` returns the number of bytes of data that is put in the buffer. The field `mh2_cursor` contains positioning information that `w_getmntent()` uses to store the information. If multiple calls are made, use the same buffer because the positioning information in `mh2_cursor` indicates where the function should continue with its list. The positioning information should not be changed between calls. Information about a specific file system can be obtained if the device number of that file system is known. In this case, the device number can be filled into the field `mh2_devno`, and the `w_getmntent` call returns a single entry with information about that file system. Or a device number value of `x40000000` can be used to indicate that the returned path name should be up to 64 bytes of the mount point path name at the time of the mount.

After a successful call to `w_getmntent()`, the following `w_mntent2` structure fields will be available for reference:

`mnt2_fstype`

The file system type.

`mnt2_mode`

The mount mode of the file system. A flag field that specifies the mount mode and additional mount options:

`mntentfsaunmount`

If it is 1 after the file system is mounted, the file system will be unmounted when a system leaves the sysplex. If it is 0, then the setting of `mntentfsnoautomove` is used. See `mntentfsnoautomove` below.

`mntentfsclient`

If it is 0, then the file system is a sysplex client. If it is 1, then the file system is not a sysplex client.

`mntentfsnoautomove`

If it is 0 after the file system is mounted, it can be moved automatically. If it is 1 after the file system is mounted, it will not be moved automatically.

`mntentfsmodenosec`

If it is 1, then the file system will not enforce security checks. If it is 0, then the file system will enforce security checks.

`mntentfsmodeexport`

If it is 0, then the file system has not been exported by DFS. If it is 1, then the file system has been exported by DFS.

`mntentfsmoderonly`

If it is 0, then the file system is mounted as read/write. If it is 1, then the file system is mounted as read-only.

`mntentfsmodenosuid`

If it is 1, then the `SETUID` and `SETGID` mode flags will be ignored for programs that reside in this file system. If it is 0 then the `SETUID` and `SETGID` mode flags will be enforced for programs that reside in this file system.

mnt2_dev

Device # which stat() returns for all files in this file system.

mnt2_parentdev

st_dev of parent file system.

mnt2_rootino

The ino of the mount point.

mnt2_status

status of the file system.

mnt2_ddname

The ddname that is specified on mount.

mnt2_fstype

The name of the file system type that is specified by the FILESYS statement. The name for the file system that performed the mount.

mnt2_fsname

The name of the file system that was mounted.

mnt2_pathlen

The length of mount point path.

mnt2_mountpoint

The name of the directory where the file system is mounted.

mnt2_jobname

If this file system is quiesced, this is the job that made the request.

mnt2_PID

If this file system is quiesced, this is the PID that made the request.

mnt2_parmoffset

Offset of mount parameter parm_point, starting from the address of the mnt2_fstype member of the w_mnt2 struct.

mnt2_parmlen

The length of the mount parameter parm_point.

mnt2_sysname

The name of the target system.

mnt2_qsystem

The name of the quiesce system.

mnt2_fromsys

The name of the system from which the file system has moved.

mnt2_flags

The field containing the request flags.

mnt2_status2

The file system status extensions.

mnt2_success

This field is used to return the number of successfully moved file systems when moving a collection of file systems.

mnt2_readct

The number of reads done.

mnt2_writect

The number of writes done.

mnt2_diribc

The number of directory I/O blocks.

mnt2_readibc

The number of read I/O blocks.

mnt2_writeibc

The number of write I/O blocks.

mnt2_bytesreadhw

Total number of bytes read from high word.

mnt2_bytesreadlw

Total number of bytes read from low word.

mnt2_byteswrittenhw

Total number of bytes written to high word.

mnt2_byteswrittenlw

Total number of bytes written to low word.

mnt2_filetag

Mount tag.

mnt2_syslistoffset

Offset of system list.

mnt2_syslistlength

Length of system list.

mnt2_aggnameoffset

Length of the aggregate name in mnt2_aggname. The length does not include the null terminating character, and is only valid if mnt2_aggnameoffset has a nonzero value.

mnt2_aggnameoffset

The offset of mnt2_aggname from w_mntent2. If the value is zero, then no aggregate name is returned.

parm_point

This field contains the mountpoint parameters to be used when mounting a file system. It is a separate field in the mnte2 structure but contiguously allocated following the w_mnte2 body, its address is the sum of the address of w_mnte2 and mnt2_parmoffset.

If all entries do not fit in the buffer that is supplied, multiple calls are required. If an entry together with its mount parameter will not fit in the buffer, the entry is returned without the mount parameter. In this case, *mnt2_parmlen* contains the length of the mount parameter, and *mnt2_parmoffset* is zero.

To assure that at least one entry, including the mount parameter, is returned, it is advisable to allocate space for at least two entries.

When the final entry has been placed in the buffer, *w_getmntent()* returns no entries.

Using structure w_mntent: Before calling *w_getmntent()* with the *w_mntent* structure mapping, set the following fields in *W_MNTH*:

1. *mnth_hid* to "MNTE"
2. *mnth_size* to the size of struct *mnte*
3. *mh_bodylen* to the size of struct *w_mntent*
4. [Optional] *mnth_devno* to the device number

In the header, the field *mnth_size* returns the number of bytes of data that is put in the buffer. The fields *mnth_cur1* and *mnth_cur2* contain positioning information that *w_getmntent()* uses to store the information. If multiple calls are made, use the same buffer because the positioning information in *mnth_cur1* and *mnth_cur2* indicates where the function should continue with its list. The positioning information should not be changed between calls. Information about a specific file system can be obtained if the device number of that file system is known. In this case, the device number can be filled into the field *mnth_devno*, and the *w_getmntent* call returns a single entry with information about that file system. Or a device number value of x40000000 can be used to indicate that the returned path name should be up to 64 bytes of the mount point path name at the time of the mount.

After a successful call to *w_getmntent()*, the following *w_mntent* structure fields will be available for reference:

mnt_fstype

The file system type.

mnt_mode

File system mount mode.

mnt_dev

Device # which stat() returns for all files in this file system.

mnt_parentdev

st_dev of parent file system.

mnt_rootino

The ino of the mount point.

mnt_status

The status of the file system.

mnt_ddname

The ddname that is specified on mount.

mnt_fstype

The name of the file system type that is specified by the FILESYS statement.

mnt_fsname

The file system name, which is up to 45 characters long and ends with a NULL.

mnt_pathlen

The length of mount point path.

mnt_mountpoint

The pathname of the directory where the file system is mounted. This field ends with a NULL.

If the caller of w_getmntent() lacks search authorization to one or more of the directories in the mount point pathname, *mnt_mountpoint* is returned empty. That is, *mnt_pathlen* is zero and *mnt_mountpoint* contains a NULL as the first character.

mnt_jobname

If the file system is quiesced, this is the job that made the request.

mnt_PID

If the file system is quiesced, this is the PID that made the request.

mnt_parmoffset

Offset of mount parameter from w_mntent.

mnt_parmlen

Length of mount parameter.

mnt_parm

The file-system-specific parameter that is specified on the mount() function when the file system was mounted. This field ends with a NULL.

If no parameter was specified, *mnt_parmlen* and *mnt_parmoffset* are each zero. If a parameter was specified, its address is the sum of the address of *w_mntent* and *mnt_parmoffset*.

If all entries do not fit in the buffer that is supplied, multiple calls are required. If an entry together with its mount parameter will not fit in the buffer, the entry is returned without the mount parameter. In this case, *mnt_parmlen* contains the length of the mount parameter, and *mnt_parmoffset* is zero.

To assure that at least one entry, including the mount parameter, is returned, it is advisable to allocate space for at least two entries.

When the final entry has been placed in the buffer, w_getmntent() returns no entries.

Returned value

If successful, w_getmntent() returns the number of entries in the buffer.

If unsuccessful, w_getmntent() returns -1 and sets errno to one of the following values:

Error Code
Description

EINVAL

A parameter was specified incorrectly.

ERANGE

The result is too large to fit in the available buffer space.

Example

CELEBW49

```
/* CELEBW49

This example uses w_getmntent() to retrieve information
about currently mounted systems in the MNTE3 mapping format.

The MNTE3 mapping format is only available on z/OS V1.10 or higher,
target value of 0x410A0000.

*/
#define _OPEN_SYS
#include <sys/mntent.h>
#include <stdio.h>

main() {
    int entries, entry;
    struct {
        MNTE3H    header;
        W_MNTENT3 mount_table[10];
    } work_area;

    memset(&work_area, 0x00, sizeof(work_area));

    /* 'header' initialization to specify MNTE3 mapping format */
    memcpy(work_area.header.mnt3H_cbid, MNTE3H_ID, 4);
    work_area.header.mnt3H_cblen = sizeof(struct mnte3);
    work_area.header.mnt3H_bodylen = sizeof(struct w_mntent3);

    do {
        if ((entries = w_getmntent((char *) &work_area,
                                   sizeof(work_area))) == -1)
            perror("w_getmntent() error");

        else for (entry=0; entry<entries; entry++) {
            printf("filesystem %s is mounted at %s\n",
                   work_area.mount_table[entry].mnt3_fsname,
                   work_area.mount_table[entry].mnt3_mountpoint);
            printf(" MNTE2 and MNTE3 common: reads done is %i, writes done is %i\n",
                   work_area.mount_table[entry].mnt3_readct,
                   work_area.mount_table[entry].mnt3_writect);
            printf(" MNTE3 specific: mount time in seconds is %i\n",
                   work_area.mount_table[entry].mnt3_mntsec);
        }
    } while (entries > 0);
}
```

Output

```
filesystem ZOS110.LPP.HFS is mounted at /usr/lpp
MNTE2 and MNTE3 common: reads done is 0, writes done is 0
MNTE3 specific: mount time in seconds is 5833
filesystem ZOS110.NLS.HFS is mounted at /usr/lib/nls
MNTE2 and MNTE3 common: reads done is 0, writes done is 0
MNTE3 specific: mount time in seconds is 5833
filesystem ZOS110.MAN.HFS is mounted at /usr/man
MNTE2 and MNTE3 common: reads done is 0, writes done is 0
MNTE3 specific: mount time in seconds is 5833
filesystem ZOS110.VAR.HFS is mounted at /SYSTEM/var
MNTE2 and MNTE3 common: reads done is 0, writes done is 0
MNTE3 specific: mount time in seconds is 5833
filesystem ZOS110.ETC.HFS is mounted at /SYSTEM/etc
MNTE2 and MNTE3 common: reads done is 0, writes done is 0
MNTE3 specific: mount time in seconds is 5833
```

```
filesystem ZOS110.ROOT.HFS is mounted at /
MNT2 and MNT3 common: reads done is 0, writes done is 0
MNT3 specific: mount time in seconds is 5833
```

CELEBW48

```
/* CELEBW48

   This example uses w_getmntent() to retrieve information
   about currently mounted systems in the MNT2 mapping format.

*/
#define _OPEN_SYS
#include <sys/mntent.h>
#include <stdio.h>

main() {
    int entries, entry;
    struct {
        MNT2H    header;
        W_MNTENT2 mount_table[10];
    } work_area;

    memset(&work_area, 0x00, sizeof(work_area));

    /* 'header' initialization to specify MNT2 mapping format */
    memcpy(work_area.header.mh2_hdr.mnt2h_cbid, MNT2H_ID, 4);
    work_area.header.mh2_hdr.mnt2h_cblen = sizeof(struct mnt2);
    work_area.header.mh_bodylen = sizeof(struct w_mntent2);

    do {
        if ((entries = w_getmntent((char *) &work_area,
                                   sizeof(work_area))) == -1)
            perror("w_getmntent() error");

        else for (entry=0; entry<entries; entry++) {
            printf("filesystem %s is mounted at %s\n",
                   work_area.mount_table[entry].mnt2_fsname,
                   work_area.mount_table[entry].mnt2_mountpoint);
            printf("  MNT2 specific: reads done is %i, writes done is %i\n",
                   work_area.mount_table[entry].mnt2_readct,
                   work_area.mount_table[entry].mnt2_writect);
        }
    } while (entries > 0);
}
```

Output

```
filesystem ZOS110.LPP.HFS is mounted at /usr/lpp
MNT2 specific: reads done is 0, writes done is 0
filesystem ZOS110.NLS.HFS is mounted at /usr/lib/nls
MNT2 specific: reads done is 0, writes done is 0
filesystem ZOS110.MAN.HFS is mounted at /usr/man
MNT2 specific: reads done is 0, writes done is 0
filesystem ZOS110.VAR.HFS is mounted at /SYSTEM/var
MNT2 specific: reads done is 0, writes done is 0
filesystem ZOS110.ETC.HFS is mounted at /SYSTEM/etc
MNT2 specific: reads done is 0, writes done is 0
filesystem ZOS110.ROOT.HFS is mounted at /
MNT2 specific: reads done is 0, writes done is 0
```

CELEBW32

```
/* CELEBW32

   This example uses w_getmntent() to retrieve information
   about currently mounted systems in the MNT2 mapping format.

*/
#define _OPEN_SYS
#include <sys/mntent.h>
#include <stdio.h>

main() {
    int entries, entry;
    struct {
        struct w_mnth    header;
        struct w_mntent mount_table[10];
    }
```

```
    } work_area;

    memset(&work_area, 0x00, sizeof(work_area));
    do {
        if ((entries = w_getmntent((char *) &work_area,
                                   sizeof(work_area))) == -1)
            perror("w_getmntent() error");

        else for (entry=0; entry<entries; entry++) {
            printf("filesystem %s is mounted at %s\n",
                   work_area.mount_table[entry].mnt_fsname,
                   work_area.mount_table[entry].mnt_mountpoint);
        }
    } while (entries > 0);
}
```

Output

```
filesystem ZOS110.LPP.HFS is mounted at /usr/lpp
filesystem ZOS110.NLS.HFS is mounted at /usr/lib/nls
filesystem ZOS110.MAN.HFS is mounted at /usr/man
filesystem ZOS110.VAR.HFS is mounted at /SYSTEM/var
filesystem ZOS110.ETC.HFS is mounted at /SYSTEM/etc
filesystem ZOS110.ROOT.HFS is mounted at /
```

Related information

- [“sys/mntent.h — w_getmntent\(\) function and related structures and constants” on page 69](#)
- [“statvfs\(\) — Get file system information” on page 1712](#)
- [“w_statfs\(\) — Get the file system status” on page 2079](#)

w_getpsent(), w_getpsent64() — Get process data

Standards

| Table 73. Standards | | |
|------------------------|----------|--------------|
| Standards / Extensions | C or C++ | Dependencies |
| z/OS UNIX | both | |

Format

w_getpsent:

```
#include <sys/ps.h>

int w_getpsent(int token, W_PSPROC *bufptr, size_t length);
```

w_getpsent64:

```
#define _LARGE_TIME_API
#include <sys/ps.h>

int w_getpsent64(int token, W_PSPROC64 *bufptr, size_t length);
```

Compile requirement: Use of the w_getpsent64 function requires the long long data type. For more information on how to make the long long data type available, see [z/OS XL C/C++ Language Reference](#).

General description

Provides information about the status of any process that the calling process has access to.

token

A relative number that identifies the relative position of a process in the system. Zero represents the first process in the system. On the first call to `w_getpsent()`, pass the token 0; the function then returns the token that identifies the next process to which the caller has access. Use that token on the next call.

bufptr

The address of the buffer where the data is to be stored.

length

The length of the buffer.

The data returned is described in the `ps.h` header file. See [Table 74 on page 2055](#) for the format of the structure stored in the buffer.

Table 74. Variables Stored in Structure Returned by `w_getpsent()` or `w_getpsent64()`

| Variable Type | Variable Name | General Description |
|---------------|---------------|-----------------------------|
| unsigned int | ps_state | Process state |
| pid_t | ps_pid | Process ID |
| pid_t | ps_ppid | Parent ID |
| pid_t | ps_sid | Session ID (leader) |
| pid_t | ps_pgid | Process group ID |
| pid_t | ps_fgid | Foreground process group ID |
| uid_t | ps_euid | Effective user ID |
| uid_t | ps_ruid | Real user ID |
| uid_t | ps_suid | Saved set user ID |
| gid_t | ps_egid | Effective group ID |
| gid_t | ps_rgid | Real group ID |
| gid_t | ps_sgid | Saved set group ID |
| long | ps_size | Total size |
| time_t 1 | ps_starttime | Starting time |
| time64_t 2 | | |
| clock_t | ps_usertime | User CPU time |
| clock_t | ps_systime | System CPU time |
| int | ps_conttylen | Length of ContTTY |
| char | *ps_conttyptr | Controlling terminal |
| int | ps_pathlen | Length of <i>arg0</i> |
| char | *ps_pathptr | File name |
| int | ps_cmdlen | Length of command |
| char | *ps_cmdptr | Command and arguments |

Note:

1. This variable type is supported by `w_getpsent()` only.
2. This variable type is supported by `w_getpsent64()` only.

Note: The `ps_cmdlen` and `ps_cmdptr` elements of `W_PSPROC` identify the length and location where `w_getpsent()` is to return the command and arguments used to start the process. As of z/OS V1R11, the maximum length in bytes, including the null terminator, that can be returned is defined by `PS_CMDBLEN_LONG`. The actual maximum length of the command and arguments returned is `PS_CMDBLEN_LONG` minus the length of the path. Prior to z/OS V1R11, the maximum length in bytes, including the null terminator, that can be returned is defined by `PS_CMDBLEN`. The actual maximum length of the command and arguments returned can be less than `PS_CMDBLEN` and depends on the number of arguments. The system will truncate the command and arguments as needed to allow for the null terminator. Both `PS_CMDBLEN_LONG` and `PS_CMDBLEN` are defined in `<sys/ps.h>`.

Usage notes

1. `ps_usertime` reports the user's CPU time consumed for the address space the process is running within. When only one process is running in the address space, this CPU time represents the accumulated user CPU time for that process. When more than one process is running in an address space, the information returned is actually the accumulated CPU time consumed by the address space. It is the sum of the CPU time used by all of the work running in that address space not including the system time.
2. `ps_systime` reports the system's CPU time consumed for the address space the process is running within. When only one process is running in the address space, this time represents the accumulated system CPU time for that process. However, when more than one process is running in an address space, the information returned is actually the accumulated system CPU time consumed by all of the work running in the address space.

The `w_getpsent64()` function behaves exactly like `w_getpsent()` except it uses struct `w_psproc64` instead of struct `w_psproc` to support time beyond 03:14:07 UTC on January 19, 2038.

Returned value

If successful, `w_getpsent()` returns the process token for the next process for which the caller has access. For the last active process to which the user has access, `w_getpsent()` returns 0, indicating there are no more processes to be accessed.

If unsuccessful, `w_getpsent()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

An incorrect process token or NULL buffer address was specified.

E2BIG

An insufficient buffer length was provided.

ESRCH

No process can be accessed by the active user.

Example

CELEBW33

```
/* CELEBW33
   This example provides status information, using w_getpsent().
*/
#define _OPEN_SYS
#include <stdlib.h>
#include <stdio.h>
#include <sys/ps.h>
#include <sys/types.h>
#include <pwd.h>
#include <time.h>
#include <string.h>
```

```

int main(void) {
    int token;
    W_PSPROC buf;
    struct passwd *pw;

    token = 0;

    memset(&buf, 0x00, sizeof(buf));
    buf.ps_conttyptr = (char *) malloc(buf.ps_conttylen = PS_CONTTYBLEN);
    buf.ps_pathptr = (char *) malloc(buf.ps_pathlen = PS_PATHBLEN);
    buf.ps_cmdptr = (char *) malloc(buf.ps_cmdlen = PS_CMDBLEN_LONG);
    if ((buf.ps_conttyptr == NULL) ||
        (buf.ps_pathptr == NULL) ||
        (buf.ps_cmdptr == NULL))
        perror("buffer allocation error");

    else do {
        if ((token = w_getpsent(token, &buf, sizeof(buf))) == -1)
            perror("w_getpsent() error");
        else if (token > 0)
            if ((pw = getpwuid(buf.ps_ruid)) == NULL)
                perror("getpwuid() error");
            else printf("token %d: pid %10d, user %8s, started %s", token,
                        (int) buf.ps_pid, pw->pw_name,
                        ctime(&buf.ps_starttime));
        } while (token > 0);
    return 0;
}

```

Output:

```

token 2: pid      131074, user   MVSUSR1, started Fri Jun 16 08:09:17 2006
token 3: pid      65539, user   MVSUSR1, started Fri Jun 16 08:09:41 2006
token 6: pid      589830, user  MVSUSR1, started Fri Jun 16 10:29:17 2006
token 7: pid      851975, user  MVSUSR1, started Fri Jun 16 10:30:04 2006

```

Related information

- [“sys/ps.h — w_getpsent\(\) function and w_psproc structure” on page 70](#)

w_iocctl(), __w_piocctl() — Control of devices

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | OS/390 V2R8 |

General Format

```

#define _OPEN_SYS
#include <termios.h>

int w_iocctl(int fildes, int cmd, int arglen, void *arg);
int __w_piocctl(const char *pathname, int cmd, int arglen, void *arg);

```

ACL format:

```

#define _OPEN_SYS
#include <termios.h>
#include <sys>

int w_iocctl(int fildes, int cmd, int arglen, void arg);
int __w_piocctl(const char pathname, int cmd, int arglen, void arg);

```

General description

The `w_ioctl()` and `__w_piocctl()` functions are general entry points for device-specific commands. The specific actions specified by `w_ioctl()` and `__w_piocctl()` vary with the device, and they are defined by the device driver.

files

A descriptor for an open character special file (used by `w_ioctl()`).

pathname

The pathname of a file (used by `__w_piocctl()`).

cmd

The command to be passed to the device driver as an integer value.

Command

Description

SIOCGPARTNERINFO

Provides an interface for an application to retrieve security information about its partner. For more information, see [z/OS Communications Server: IP Programmer's Guide and Reference](#).

arglen

The length of the argument passed to the device driver.

arg

The address of the buffer where the argument to be passed to the device driver is stored.

`w_ioctl()` and `__w_piocctl()` pass the *cmd*, *arglen*, and *arg* arguments to the device driver to be interpreted and processed. When `w_ioctl()` and `__w_piocctl()` complete successfully, the device driver returns *arglen* and *arg*, if appropriate.

Note: The `__w_piocctl()` function has a dependency on the level of the Enhanced ASCII Extensions. See “Enhanced ASCII support ” on page 2123 for details.

Returned value

If successful, `w_ioctl()` returns 0.

If unsuccessful, `w_ioctl()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EACCES

Permission is denied.

EINVAL

One of the following situations occurred:

- An incorrect length was specified for *arglen*. The correct argument length range is 0 to 50,000.
- An invalid message queue was specified when command `_IOCC_REGFILEINT` was used.

ENAMETOOLONG

The length of the *pathname* argument exceeds **PATH_MAX**, or a *pathname* component is longer than **NAME_MAX** and `{_POSIX_NO_TRUNC}` is in effect for that file. For symbolic links, the length of the pathname string substituted for a symbolic link exceeds **PATH_MAX**. **PATH_MAX** and **NAME_MAX** values can be determined by using `pathconf()`.

ENODEV

The device does not exist. The function is not supported by the device driver.

ENOENT

Either there is no file named *pathname* or *pathname* is an empty string.

ENOTDIR

A component of the *pathname* prefix is not a directory.

ENOTSUP

Operation not supported. The following occurred:

Command _IOCC_REGFILEINT was used and *fildev* (*w_iocctl*) or *pathname* (*__w_piocctl*) refers to a file residing in a R/W file system that is shared across a sysplex with zFS, or is accessed through an NFS Client. In these cases, the file is able to be changed on a remote system without the local system being aware. Because the program would not receive notification, this operation is rejected.

Use *__errno2()* to obtain more diagnostic information.

ENOTTY

An incorrect file descriptor was specified. *fildev* was not a character special file.

ACLs description

The *w_iocctl()* and *__w_piocctl()* functions are general entry points for SETFACL and GETFACL commands. SETFACL is used to set information into an access control list. GETFACL is used to retrieve information from an Access Control List.

fildev

A descriptor for an open character special file (used by *w_iocctl*).

pathname

The *pathname* of a file (used by *__w_piocctl*).

cmd

The command to be passed to the device driver as an integer value, either SETFACL or GETFACL.

arglen

The length of the user buffer passed to the HFS device driver as a value from 1 to 50,000 bytes. *arglen* is the combined size of the struct *ACL_buf* and the array of struct *ACL_entries*.

arg

arg specifies the user buffer which is mapped by struct *ACL_buf* followed immediately by an array of struct *ACL_entries*. See [z/OS UNIX System Services Programming: Assembler Callable Services Reference](#) for more information about *ACL_buf* and the *ACL_entries*.

w_iocctl() and *__w_piocctl()* pass the *cmd*, *arglen*, and *arg* arguments to the device driver to be interpreted and processed. When *w_iocctl()* and *__w_piocctl()* complete successfully, the device driver returns *arglen* and *arg*, if appropriate.

ACLs returned value

If successful, *w_iocctl()* returns 0.

If unsuccessful, *w_iocctl()* returns -1 and sets *errno* to one of the following values:

Error Code**Description****EBADF**

The *fildev* parameter is not a valid file descriptor.

EINVAL

The request is invalid or not supported.

EMVSPARM

Incorrect parameters were passed to the service.

ENODEV

The device is incorrect. The function is not supported by the device driver.

Example

CELEBW34

```
/* CELEBW34

   This example shows a general entry point for device-specific commands.

*/
#include <termios.h>
#include <stdio.h>

main() {
    char buf[256];
    int  ret;

    memset(buf, 0x00, sizeof(buf));
    if ((ret = w_iocctl(0, 1, sizeof(buf), buf)) != 0)
        perror("w_iocctl() error");
    else
        printf("w_iocctl() returned '%s'\n", buf);
}
```

Output:

```
w_iocctl() error: Invalid argument
```

Note: w_iocctl() is dependent upon the file system device driver.

Related information

- [“termios.h – POSIX terminal I/O functions” on page 74](#)
- [“iocctl\(\) – Control device” on page 872](#)
- [“tcdrain\(\) – Wait until output has been transmitted” on page 1816](#)
- [“tcflow\(\) – Suspend or resume data flow on a terminal” on page 1818](#)
- [“tcflush\(\) – Flush input or output on a terminal” on page 1821](#)
- [“tcgetattr\(\) – Get the attributes for a terminal” on page 1823](#)
- [“tcgetpgrp\(\) – Get the foreground process group ID” on page 1827](#)
- [“tcsendbreak\(\) – Send a break condition to a terminal” on page 1833](#)
- [“tcsetattr\(\) – Set the attributes for a terminal” on page 1835](#)
- [“tcsetpgrp\(\) – Set the foreground process group ID” on page 1847](#)

wmemchr() – Locate wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XP4:

```
#include <wchar.h>

wchar_t *wmemchr(const wchar_t *s, wchar_t c, size_t n);
```

XPG4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

wchar_t *wmemchr(const wchar_t *s, wchar_t c, size_t n);
```

General description

Locates the first occurrence of the wide character *c* in the initial *n* wide chars of the object pointed to by *s*. If *n* has the value 0, `wmemchr()` finds no occurrence of *c* and returns a NULL pointer.

Note: The function is now available as a built-in function under ARCH(7) when LP64 is not used.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `wmemchr()` function in the `wchar` header available when you compile your program. See [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

If successful, `wmemchr()` returns a pointer to the first occurrence of the wide character *c* in object *s*.

If the wide character *c* does not occur within the first *n* wide characters of *s*, `wmemchr()` returns the NULL pointer.

Example

```
#include <stdio>
#include <wchar>

main()
{
    wchar_t  *in = L"1234ABCD";
    wchar_t  *ptr;
    wchar_t  fnd = L'A';

    printf("\nEXPECTED: ABCD");
    ptr = wmemchr(in, L'A', 6);
    if (ptr == NULL)
        printf("\n** ERROR ** ptr is NULL, char L'A' not found\n");
    else
        printf("\nRECEIVED: %ls \n",ptr);
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wmemcmp\(\) — Compare wide character” on page 2062](#)
- [“wmemcpy\(\) — Copy wide character” on page 2063](#)
- [“wmemmove\(\) — Move wide character” on page 2064](#)
- [“wmemset\(\) — Set wide character” on page 2066](#)

wmemcmp() – Compare wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XPG4:

```
#include <wchar.h>

int wmemcmp(const wchar_t * __restrict__s1,
            const wchar_t * __restrict__s2, size_t n);
```

XPG4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

int wmemcmp(const wchar_t *s1, const wchar_t *s2, size_t n);
```

General description

Compares the first n wide chars of the object pointed to by $s1$ to the first n wide chars of the object pointed to by $s2$.

If n has the value 0, `wmemcmp()` returns 0.

Note: The function is now available as a built-in function under ARCH(7) when LP64 is not used.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `wmemcmp` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

`wmemcmp()` returns an integer that is:

< 0

If $s1$ is less than $s2$.

= 0

If $s1$ is equal to $s2$.

> 0

If $s1$ is greater than $s2$.

Example

```
#include <wchar.h>
#include <stdio.h>

main()
{
    int      ptr;
    wchar_t  *in  = L"12345678";
```



```

wchar_t *out = L"12AAAAAB";

printf("\nGREATER is the expected result");
ptr = wmemcmp(in, out, 3);
if (ptr == 0)
    printf("\nArrays are EQUAL %ls %ls \n", in, out);
else
{
    if (ptr > 0)
        printf("\nArray %ls GREATER than %ls \n", in, out);
    else
        printf("\nArray %ls LESS than %ls \n", in, out);
}
}

```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wmemchr\(\) — Locate wide character” on page 2060](#)
- [“wmemcpy\(\) — Copy wide character” on page 2063](#)
- [“wmemmove\(\) — Move wide character” on page 2064](#)
- [“wmemset\(\) — Set wide character” on page 2066](#)

wmemcpy() — Copy wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XPG4:

```

#include <wchar.h>

wchar_t *wmemcpy(wchar_t * __restrict__ s1,
                 const wchar_t * __restrict__ s2, size_t n);

```

XPG4:

```

#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

wchar_t *wmemcpy(wchar_t *s1, const wchar_t *s2, size_t n);

```

General description

Copies *n* wide chars of the object pointed to by *s2* to the object pointed to by *s1*.

Result of the copy is unpredictable if *s1* and *s2* overlap. If *n* has the value 0, *wmemcpy* copies zero wide characters.

Note: The function is now available as a built-in function under ARCH(7) when LP64 is not used.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the *wchar* header, then you must also define the *_MSE_PROTOS* feature test macro to make the declaration of the *wmemcpy* function in the *wchar* header

available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

wmemcpy() returns the value of s1.

Example

```
#include <wchar.h>
#include <stdio.h>

main()
{
    wchar_t  *in    = L"12345678";
    wchar_t  *out   = L"ABCDEFGH";
    wchar_t  *ptr;

    printf("-nExpected result: First 4 chars of in change");
    printf(" and are the same as first 4 chars of out");
    ptr = wmemcpy(in, out, 4);
    if (ptr == in)
        printf("-nArray in %ls array out %ls -n",in, out);
    else
    {
        printf("-n*** ERROR ***");
        printf(" returned pointer wrong");
    }
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wmemchr\(\) — Locate wide character” on page 2060](#)
- [“wmemcmp\(\) — Compare wide character” on page 2062](#)
- [“wmemmove\(\) — Move wide character” on page 2064](#)
- [“wmemset\(\) — Set wide character” on page 2066](#)

wmemmove() — Move wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XPG4:

```
#include <wchar.h>

wchar_t *wmemmove(wchar_t *s1, const wchar_t *s2, size_t n);
```

XPG4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>
```

```
wchar_t *wmemmove(wchar_t *s1, const wchar_t *s2, size_t n);
```

General description

Copies n wide chars of the object pointed to by $s2$ to the object pointed to by $s1$. Copying takes place as if the n wide characters from $s2$ are first copied into a temporary array of n wide characters that does not overlay the objects pointed to by $s1$ and $s2$, and then copied from the temporary array into the object pointed to by $s1$.

If n has the value 0, `wmemmove()` copies zero wide characters.

Special behavior for XPG4: If you define any feature test macro specifying XPG4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `wmemmove()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XPG4 and other feature test macros.

Returned value

`wmemmove()` returns the value of $s1$.

Example

```
#include <wchar.h>
#include <stdio.h>

main()
{
    wchar_t *in    = L"12345678";
    wchar_t *out   = L"ABCDEFGH";

    wchar_t *ptr;

    printf("\nExpected result: First 4 chars of in and out the same");
    ptr = wmemmove(in, out, 4);
    if (ptr == in)
        printf("\nArray in %ls array out %ls \n", in, out);
    else
    {
        printf("\n*** ERROR ***");
        printf("    Returned pointer not correct.\n");
    }
}
```

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wmemchr\(\) — Locate wide character” on page 2060](#)
- [“wmemcmp\(\) — Compare wide character” on page 2062](#)
- [“wmemcpy\(\) — Copy wide character” on page 2063](#)
- [“wmemset\(\) — Set wide character” on page 2066](#)

wmemset() — Set wide character

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| ISO C Amendment C99 Single UNIX Specification, Version 3 | both | |

Format

Non-XP4:

```
#include <wchar.h>

wchar_t *wmemset(wchar_t *s, wchar_t c, size_t n);
```

XP4:

```
#define _XOPEN_SOURCE
#define _MSE_PROTOS
#include <wchar.h>

wchar_t *wmemset(wchar_t *s, wchar_t c, size_t n);
```

General description

Copies the value of *c* into the first *n* wide chars of the object pointed to by *s*.

If *n* has the value 0, `wmemset()` copies zero wide characters.

Note: The function is now available as a built-in function under ARCH(7) when LP64 is not used.

Special behavior for XP4: If you define any feature test macro specifying XP4 behavior before the statement in your program source file to include the `wchar` header, then you must also define the `_MSE_PROTOS` feature test macro to make the declaration of the `wmemset()` function in the `wchar` header available when you compile your program. Please see [Table 2 on page 4](#) for a list of XP4 and other feature test macros.

Returned value

`wmemset()` returns the value of *s*.

Example

```
#include <wchar.h>
#include <stdio.h>

void main()
{
    wchar_t *in = L"1234ABCD";
    wchar_t *ptr;

    printf("\nEXPECTED: AAAAAACD");
    ptr = wmemset(in, L'A', 6);
    if (ptr == in)
        printf("\nResults returned - %ls \n", ptr);
    else
    {
        printf("\n** ERROR ** wrong pointer returned\n");
    }
}
```

}

Related information

- [“wchar.h — ISO/C Multibyte Support extensions” on page 79](#)
- [“wmemchr\(\) — Locate wide character” on page 2060](#)
- [“wmemcmp\(\) — Compare wide character” on page 2062](#)
- [“wmemcpy\(\) — Copy wide character” on page 2063](#)
- [“wmemmove\(\) — Move wide character” on page 2064](#)

wordexp() — Perform shell word expansions

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | POSIX(ON) |

Format

```
#define _XOPEN_SOURCE
#include <wordexp.h>

int wordexp(const char *__restrict__ words,
            wordexp_t *__restrict__ pwordexp, int flags);

void wordfree(wordexp_t *pwordexp);
```

General description

The `wordexp()` function performs word expansions as described in *X/Open CAE Specification, Commands and Utilities, Issue 4, Version 2 (XCU) Section 2.6 , Word Expansions*, subject to quoting as in the **XCU** specification, **Section 2.2 , Quoting**, and places the list of expanded words into the structure pointed to by `pwordexp`.

The `words` argument is a pointer to a string containing one or more words to be expanded. The expansions will be the same as would be performed by the shell described by the **XCU** specification if `words` were the part of a command line representing the arguments to a utility. Therefore, `words` must not contain an unquoted <newline> or any of the unquoted special shell characters:

```
|  &  ;  <  >
```

except in the context of command substitution as specified in the **XCU** specification, **Section 2.6.3 , Command Substitution**. It also must not contain unquoted parentheses or braces, except in the context of command or variable substitution.

The structure type **wordexp_t** is defined in the header **<wordexp.h>** and includes the following members:

| Member Type | Member Name | Description |
|-------------|-------------|---|
| size_t | we_wordc | Count of words matched by <code>words</code> . |
| char ** | we_wordv | Pointer to list of expanded words. |
| size_t | we_offs | Slots to reserve at the beginning of <code>pwordexp->we_wordv</code> . |

The `wordexp()` function stores the number of generated words into `pwordexp->we_wordc` and a pointer to a list of pointers to words in `pwordexp->we_wordv`. Each individual field created during field splitting (see

the **XCU** specification, **Section 2.6.5 , Field Splitting**) or pathname expansion (see the **XCU** specification, **Section 2.6.6 , Pathname Expansion**) is a separate word in the *pwordexp->we_wordv* list. The words are in order as described in the **XCU** specification, **Section 2.6 , Word Expansions**. The first pointer after the last word pointer will be a NULL pointer. The expansion of special parameters described in the **XCU** specification, **Section 2.5.2 , Special Parameters** is unspecified.

It is the caller's responsibility to allocate the storage pointed to by *pwordexp*. The *wordexp()* function allocates the other space as needed, including memory pointed to by *pwordexp->we_wordv*. The *wordfree()* function frees any memory associated with *pwordexp* from a previous call to *wordexp()*.

The *flags* argument is used to control the behavior of *wordexp()*. The value of *flags* is the bitwise inclusive-OR or zero or more of the following constants, which are defined in `<wordexp.h>`:

WRDE_APPEND

Append words generated to the ones from a previous call to *wordexp()*.

WRDE_DOOFFS

Make use of *pwordexp->we_offs*. If this flag is set, *pwordexp->we_offs* is used to specify how many NULL pointers to add to the beginning of *pwordexp->we_wordv*. In other words, *pwordexp->we_wordv* will point to *pwordexp->we_offs* NULL pointers followed by *pwordexp->we_wordc* word pointers, followed by a NULL pointer.

WRDE_NOCMD

Fail if command substitution, as specified in the **XCU** specification, **Section 2.6.3 , Command Substitution**, is requested.

WRDE_REUSE

The *pwordexp* argument was passed to a previous successful call to *wordexp()*, and has not been passed to *wordfree()*. The result will be the same as if the application had called *wordfree()* and then called *wordexp()* without *WRDE_REUSE*.

WRDE_SHOWERR

Do not redirect stderr to `/dev/null`.

WRDE_UNDEF

Report error on an attempt to expand an undefined shell variable.

The *WRDE_APPEND* flag can be used to append a new set of words to those generated by a previous call to *wordexp()*. The following rules apply when two or more calls to *wordexp()* are made with the same value of *pwordexp* and without intervening calls to *wordfree()*:

1. The first such call must not set *WRDE_APPEND*. All subsequent calls must set it.
2. All of the calls must set *WRDE_DOOFFS*, or all must not set it.
3. After the second and each subsequent call, *pwordexp->we_wordv* will point to a list containing the following:
 - a. zero or more NULL pointers, as specified by *WRDE_DOOFFS* and *pwordexp->we_offs*
 - b. pointers to the words that were in the *pwordexp->we_wordv* list before the call, in the same order as before
 - c. pointers to the new words generated by the latest call, in the specified order
4. The count returned in *pwordexp->we_wordc* will be the total number of words from all of the calls.
5. The application can change any of the fields after a call to *wordexp()*, but if it does, it must reset them to the original value before a subsequent call, using the same *wordexp* value, to *wordfree()* or *wordexp()* with the *WRDE_APPEND* or *WRDE_REUSE* flag.

If *words* contains an unquoted

```
<newline> | & ; < > ( ) { }
```

in an inappropriate context, *wordexp()* will fail, and the number of expanded words will be 0.

Unless `WRDE_SHOWERR` is set in *flags*, `wordexp()` will redirect `stderr` to `/dev/null` for any utilities executed as a result of command substitution while expanding *words*. If `WRDE_SHOWERR` is set, `wordexp()` may write messages to `stderr` if syntax errors are detected while expanding *words*.

If `WRDE_DOOFFS` is set, then `pwordexp->we_offs` must have the same value for each `wordexp()` call and `wordfree()` call using a given `pwordexp`.

The following constants are defined in `<wordexp.h>` as error return values:

WRDE_BADCHAR

One of the unquoted characters:

```
<newline> | & ; < > ( ) { }
```

appears in *words* in an inappropriate context.

WRDE_BADVAL

Reference to undefined shell variable when `WRDE_UNDEF` is set in *flags*.

WRDE_CMDSUB

Command substitution requested when `WRDE_NOCMD` is set in *flags*.

WRDE_NOSPACE

Attempt to allocate memory failed.

WRDE_SYNTAX

Shell syntax error, such as unbalanced parentheses or unterminated string.

WRDE_NOSYS

POSIX shell not available.

WRDE_EOPEN

`wordexp()` was invoked in an environment that does not supported a multi-threaded fork, or `wordexp()` was invoked from a multithreaded process in TSO or MVS batch.

WRDE_INTRUPT

`wordexp()` was interrupted by a signal, such as an alarm. In this event, the caller may re-issue `wordexp()`.

For further information about the cause of a failure, please refer to `__errno2()` and `errno` in addition to the above error return values.

Returned value

If successful, `wordexp()` returns 0.

If unsuccessful, `wordexp()` returns a nonzero value, as defined in `<wordexp.h>` and described above, to indicate an error. If `wordexp()` returns the value `WRDE_NOSPACE`, then `pwordexp->we_wordc`, and `pwordexp->we_wordv` will be updated to reflect any words that were successfully expanded. In other cases, they will not be modified.

Related information

- [“wordexp.h — Word expansion types”](#) on page 81

wordfree() — Free shell word expansion memory

Standards

| Standards / Extensions | C or C++ | Dependencies |
|--|----------|--------------|
| XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _XOPEN_SOURCE
#include <wordexp.h>

int wordexp(const char *words, wordexp_t *pwordexp, int flags);

void wordfree(wordexp_t *pwordexp);
```

General description

The wordfree() function frees any memory associated with *pwordexp* from a previous call to wordexp(). Please refer to the description of wordexp() for the rules governing use of wordexp() and wordfree().

Returned value

wordfree() returns no values.

Related information

- [“wordexp.h — Word expansion types” on page 81](#)

[__w_piocltl\(\) — Control of devices](#)

The information for this function is included in [“w_iocltl\(\), __w_piocltl\(\) — Control of devices” on page 2057](#).

[wprintf\(\) — Format and write wide characters](#)

The information for this function is included in [“fwprintf\(\), swprintf\(\), wprintf\(\) — Format and write wide characters” on page 674](#).

[write\(\) — Write data on a file or socket](#)

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| POSIX.1 XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

```
#define _POSIX_SOURCE
#include <unistd.h>

ssize_t write(int fs, const void *buf, size_t N);
```

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <unistd.h>

ssize_t write(int fs, const void *buf, ssize_t N);
```


Berkeley sockets:

```
#define _OE_SOCKETS
#include <unistd.h>

ssize_t write(int fs, const void *buf, ssize_t N);
```

General description

Writes N bytes from *buf* to the file or socket associated with *fs*. N should not be greater than `INT_MAX` (defined in the `limits.h` header file). If N is zero, `write()` simply returns 0 without attempting any other action.

If *fs* refers to a regular file or any other type of file on which a process can seek, `write()` begins writing at the file offset associated with *fs*. A successful `write()` increments the file offset by the number of bytes written. If the incremented file offset is greater than the previous length of the file, the length of the file is set to the new file offset.

If *fs* refers to a file on which a process cannot seek, `write()` begins writing at the current position. There is no file offset associated with such a file.

If `O_APPEND` (defined in the `fcntl.h` header file) is set for the file, `write()` sets the file offset to the end of the file before writing the output.

If there is not enough room to write the requested number of bytes (for example, because there is not enough room on the disk), `write()` outputs as many bytes as the remaining space can hold.

If `write()` is interrupted by a signal, the effect is one of the following:

- If `write()` has not written any data yet, it returns -1 and sets `errno` to `EINTR`.
- If `write()` has successfully written some data, it returns the number of bytes it wrote before it was interrupted.

Write operations on pipes or FIFO special files are handled in the same way a write operation on a regular file, with the following exceptions:

- A pipe has no associated file offset, so every write appends to the end of the pipe.
- If N is less than or equal to `PIPE_BUF`, the output is not interleaved with data written by other processes that are writing to the same pipe. If N is greater than `PIPE_BUF` bytes, the output can be interleaved with other data (regardless of the setting of `O_NONBLOCK`, which is defined in the `fcntl.h` header file). A write to a pipe never returns with `errno` set to `EINTR` if it has transferred any data.
- If `O_NONBLOCK` (defined in the `fcntl.h` header file) is not set, `write()` may block process execution until normal completion.
- If `O_NONBLOCK` is set, `write()` does not block process execution. If N is less than or equal to `PIPE_BUF`, `write()` succeeds completely and returns the value of N , or else it writes nothing, sets `errno` to `EAGAIN`, and returns -1. If N is greater than `PIPE_BUF`, `write()` writes as many bytes as it can and returns this number as its result, or else it writes nothing, sets `errno` to `EAGAIN`, and returns -1.

With other files that support nonblocking writes and cannot accept data immediately, the effect is one of the following:

- If `O_NONBLOCK` is not set, `write()` blocks until the data can be written.
- If `O_NONBLOCK` is set, `write()` does not block the process. If some data can be written without blocking the process, `write()` writes what it can and returns the number of bytes written. Otherwise, it sets `errno` to `EAGAIN` and returns -1.

`write()` causes the signal `SIGTTOU` to be sent if all of these conditions are true:

- The process is attempting to write to its controlling terminal and `TOSTOP` is set as a terminal attribute.
- The process is running in a background process group and the `SIGTTOU` signal is not blocked or ignored.
- The process is not an orphan.

A successful `write()` updates the change and modification times for the file.

If `fs` refers to a socket, `write()` is equivalent to `send()` with no flags set.

Behavior for sockets: The `write()` function writes data from a buffer on a socket with descriptor `fs`. The socket must be a connected socket. This call writes up to `N` bytes of data.

| Parameter | Description |
|-----------|-------------|
|-----------|-------------|

fs

The file or socket descriptor.

buf

The pointer to the buffer holding the data to be written.

N

The length in bytes of the buffer pointed to by the `buf` parameter.

If there is not enough available buffer space to hold the socket data to be transmitted, and the socket is in blocking mode, `write()` blocks the caller until additional buffer space becomes available. If the socket is in nonblocking mode, `write()` returns -1 and sets the error code to `EWOULDBLOCK`. See [“fcntl\(\) — Control open file descriptors” on page 483](#) or [“ioctl\(\) — Control device” on page 872](#) for a description of how to set the nonblocking mode.

When the socket is not ready to accept data and the process is trying to write data to the socket:

- Unless `FNDELAY` or `O_NONBLOCK` is set, `write()` blocks until the socket is ready to accept data.
- If `FNDELAY` is set, `write()` returns 0.
- If `O_NONBLOCK` is set, `write()` does not block the process. If some data can be written without blocking the process, `write()` writes what it can and returns the number of bytes written. Otherwise, it sets the error code to `EAGAIN` and returns -1.

For datagram sockets, this call sends the entire datagram, provided that the datagram fits into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application program wishes to send 1000 bytes, each call to this function can send 1 byte or 10 bytes or the entire 1000 bytes. Therefore, application programs using stream sockets should place this call in a loop, calling this function until all data has been sent.

Special behavior for C++ and sockets: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED 1` feature test macro.

Large file support for z/OS UNIX files: Large z/OS UNIX files are supported automatically for AMODE 64 C/C++ applications. AMODE 31 C/C++ applications must be compiled with the [long long data type support](#) enabled and define the `_LARGE_FILES` feature test macro before any headers are included to enable this function to operate on z/OS UNIX files that are larger than 2 GB in size. File size and offset fields are enlarged to 63 bits in width. Therefore, any other function operating on the file is required to define the `_LARGE_FILES` feature test macro as well.

Returned value

If successful, `write()` returns the number of bytes actually written, less than or equal to `N`.

A value of 0 or greater indicates the number of bytes sent. However, this does not assure that data delivery was complete. A connection can be dropped by a peer socket and a SIGPIPE signal generated at a later time if data delivery is not complete.

If unsuccessful, `write()` returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EAGAIN

Resources temporarily unavailable. Subsequent requests may complete normally.

EBADF

fs is not a valid file or socket descriptor.

ECONNRESET

A connection was forcibly closed by a peer.

EDESTADDRREQ

The socket is not connection-oriented and no peer address is set.

EFAULT

Using the *buf* and *N* parameters would result in an attempt to access storage outside the caller's address space.

EFBIG

Writing to the output file would exceed the maximum file size supported by the implementation.

An attempt was made to write a file that exceeds the system established maximum file size or the process's file size limit.

The file is a regular file, *nbyte* is greater than 0 and the starting position is greater than or equal to the offset maximum established in the open file description associated with *fields*.

EINTR

`write()` was interrupted by a signal before it had written any output.

EINVAL

The request is invalid or not supported. The STREAM or multiplexer referenced by *fs* is linked (directly or indirectly) downstream from a multiplexer.

EIO

The process is in a background process group and is attempting to write to its controlling terminal, but TOSTOP (defined in the `termios.h` header file) is set, the process is neither ignoring nor blocking SIGTTOU signals, and the process group of the process is orphaned. An I/O error occurred.

EMSGSIZE

The message was too big to be sent as a single datagram.

ENOBUFS

Buffer space is not available to send the message.

ENOSPC

There is no available space left on the output device.

ENOTCONN

The socket is not connected.

ENXIO

A hang-up occurred on the STREAM being written to.

EPIPE

`write()` is trying to write to a pipe that is not open for reading by any other process. This error also generates a SIGPIPE signal. For a connected stream socket the connection to the peer socket has been lost.

ERANGE

The transfer request size was outside the range supported by the STREAMS file associated with *fs*.

EWOULDBLOCK

socket is in nonblocking mode and no data buffers are available or the `SO_SNDTIMEO` timeout value was reached before buffers became available.

A write to a STREAMS file may fail if an error message has been received at the STREAM head. In this case, `errno` is set to the value included in the error message.

Note: z/OS UNIX System Services does not supply any STREAMS devices or pseudodevices. It is impossible for `write()` to write any data on a STREAM. None of the STREAMS `errno`s will be visible to the invoker. See [“open\(\) — Open a file”](#) on page 1157

Example

CELEBW35

```

/* CELEBW35

   This example writes a certain amount of bytes to a file, using write().

   */
#define _POSIX_SOURCE
#include <fcntl.h>
#include <sys/stat.h>
#include <sys/types.h>
#include <unistd.h>
#undef _POSIX_SOURCE
#include <stdlib.h>
#include <stdio.h>

#define mega_string_len 1000000

main() {
    char *mega_string;
    int fd, ret;
    char fn[]="write.file";

    if ((mega_string = (char*) malloc(mega_string_len)) == NULL)
        perror("malloc() error");
    else if ((fd = creat(fn, S_IWUSR)) < 0)
        perror("creat() error");
    else {
        memset(mega_string, '0', mega_string_len);
        if ((ret = write(fd, mega_string, mega_string_len)) == -1)
            perror("write() error");
        else printf("write() wrote %d bytes\n", ret);
        close(fd);
        unlink(fn);
    }
}

```

Output:

```
write() wrote 1000000 bytes
```

Related information

- [“fcntl.h — POSIX functions for file operations” on page 23](#)
- [“termios.h — POSIX terminal I/O functions” on page 74](#)
- [“unistd.h — Implementation-specific functions” on page 77](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“creat\(\) — Create a new file or rewrite an existing one” on page 342](#)
- [“dup\(\) — Duplicate an open file descriptor” on page 404](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“fwrite\(\) — Write items” on page 678](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“lseek\(\) — Change the offset of a file” on page 1023](#)
- [“open\(\) — Open a file” on page 1157](#)
- [“pipe\(\) — Create an unnamed pipe” on page 1188](#)
- [“pwrite\(\) — Write data on a file or socket without file pointer change” on page 1366](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)

- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“writev\(\) — Write data on a file or socket from an array” on page 2076](#)

__writedown() — Query or change the setting of the write-down privilege of an ACEE.

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | z/OS V1R5 |

Format

```
#define _OPEN_SYS
#include <sys/stat.h>
int __writedown ( int writedownop, int writedownscope);
```

General description

The `__writedown()` function will enable callers to query or change the setting of the write-down privilege of an ACEE (access control environment element) at the address space level or task level. User's having write-down privilege can write data to a resource protected by a seclabel of lower authority then that of the seclabel represented in the address space level ACEE.

To activate the write-down privilege the userid in the target ACEE must be permitted to the IRR.WRITEDOWN.BYUSER profile in the FACILITY class. The FACILITY class must be active and RACLISTed, and the SETROPTS MLS option must be active.

See *z/OS V1R5 Planning for Multilevel Security* for more details on the usage of this function.

writedownop

The operation to be performed

__WD_QUERY

Query the current setting of the write-down privilege

__WD_ACTIVATE

Activate the write-down privilege

__WD_INACTIVATE

Inactivate the write-down privilege

__WD_RESET

Reset the write-down privilege to the users original default value.

writedownscope

Scope of the write-down operation.

- __WD_SCOPE_AS**
Perform write-down operation on the address space level ACEE.
- __WD_SCOPE_THD**
Perform write-down operation on the task level ACEE.

Returned value

For the __writedown() activate, inactivate, and reset operations:
If successful, __writedown() returns 0.
For the __writedown() query operation:
If successful, __writedown() returns one of the following values indicating the state of the current setting of the writedown privelege.
__WD_IS_ACTIVE
The write-down privilege is active for the ACEE.
__WD_IS_INACTIVE
The write-down privilege is inactive for the ACEE.
For all __writedown() operations:
If unsuccessful, all __writedown() operations return -1 and sets errno to EINVAL.

Related information

writew() – Write data on a file or socket from an array

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| XP4.2 Single UNIX Specification, Version 3 | both | |

Format

X/Open:

```
#define _XOPEN_SOURCE_EXTENDED 1
#include <sys/uio.h>

ssize_t writew(int fs, const struct iovec *iov, int iovcnt);
```

Berkeley sockets:

```
#define _OE_SOCKETS
#include <sys/uio.h>

int writew(int fs, struct iovec *iov, int iovcnt);
```

General description

The writew() function writes data to a file or socket with descriptor fs from a set of buffers. The data is gathered from the buffers specified by iov[0]...iov[iovcnt-1]. When the descriptor refers to a socket, it must be a connected socket.

**Parameter
Description**

fs

The file or socket descriptor.

iovA pointer to an array of **iovec** buffers.***iovcnt***The number of buffers pointed to by the *iov* parameter.The **iovec** structure is defined in **uio.h** and contains the following fields:

| Element | Description |
|---------|-------------|
|---------|-------------|

iov_base

Pointer to the buffer.

iov_len

Length of the buffer.

This call writes the sum of the *iov_len* bytes of data.

If there is not enough available buffer space to hold the socket data to be transmitted, and the socket is in blocking mode, `writev()` blocks the caller until additional buffer space becomes available. If the socket is in a nonblocking mode, `writev()` returns -1 and sets the error code to `EWOULDBLOCK`. See [“fcntl\(\) — Control open file descriptors” on page 483](#) or [“ioctl\(\) — Control device” on page 872](#) for a description of how to set nonblocking mode.

When the socket is not ready to accept data and the process is trying to write data to the socket:

- Unless `FNDELAY` or `O_NONBLOCK` is set, `writev()` blocks until the socket is ready to accept data.
- If `FNDELAY` is set, `writev()` returns a 0.
- If `O_NONBLOCK` is set, `writev()` does not block the process. If some data can be written without blocking the process, `writev()` writes what it can and returns the number of bytes written. Otherwise, it sets the error code to `EAGAIN` and returns -1.

For datagram sockets, this call sends the entire datagram, provided that the datagram fits into the TCP/IP buffers. Stream sockets act like streams of information with no boundaries separating data. For example, if an application program wishes to send 1000 bytes, each call to this function can send 1 byte, or 10 bytes, or the entire 1000 bytes. Therefore, application programs using stream sockets should place this call in a loop, calling this function until all data has been sent.

Special behavior for C++: To use this function with C++, you must use the `_XOPEN_SOURCE_EXTENDED` 1 feature test macro.

Returned value

If successful, `writev()` returns the number of bytes written from the buffer.

A value of 0 or greater indicates the number of bytes sent, however, this does not assure that data delivery was complete. A connection can be dropped by a peer socket and a `SIGPIPE` signal generated at a later time if data delivery is not complete.

If unsuccessful, `writev()` returns -1 and sets `errno` to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

EAGAIN

Resources temporarily unavailable. Subsequent requests may complete normally.

EBADF*fs* is not a valid file or socket descriptor.**ECONNRESET**

A connection was forcibly closed by a peer.

EDESTADDRREQ

The socket is not connection-oriented and no peer address is set.

EFAULT

Using the *iov* and *iovcnt* parameters would result in an attempt to access storage outside the caller's address space.

EINTR

A signal interrupted `writew()` before any data was transmitted.

EINVAL

An incorrect value for *iovcnt* was detected.

EMSGSIZE

The message was too big to be sent as a single datagram.

ENOBUFS

Buffer space is not available to send the message.

ENOTCONN

The socket is not connected.

EPIPE

For a connected stream socket the connection to the peer socket has been lost. A SIGPIPE signal is sent to the calling process.

EPROTOTYPE

The protocol is the wrong type for this socket. A SIGPIPE signal is sent to the calling process.

EWOULDBLOCK

socket is in nonblocking mode and no data buffers are available or the SO_SNDTIMEO timeout value was reached before buffers became available.

Related information

- [“sys/uio.h — Vector I/O operations” on page 73](#)
- [“connect\(\) — Connect a socket” on page 312](#)
- [“fcntl\(\) — Control open file descriptors” on page 483](#)
- [“getsockopt\(\) — Get the options associated with a socket” on page 778](#)
- [“ioctl\(\) — Control device” on page 872](#)
- [“read\(\) — Read from a file or socket” on page 1380](#)
- [“readv\(\) — Read data on a file or socket and store in a set of buffers” on page 1393](#)
- [“recv\(\) — Receive data on a socket” on page 1401](#)
- [“recvfrom\(\) — Receive messages on a socket” on page 1404](#)
- [“recvmsg\(\) — Receive messages on a socket and store in array of message headers” on page 1407](#)
- [“select\(\), pselect\(\) — Monitor activity on files or sockets and message queues” on page 1472](#)
- [“selectex\(\) — Monitor activity on files or sockets and message queues” on page 1480](#)
- [“send\(\) — Send data on a socket” on page 1493](#)
- [“sendmsg\(\) — Send messages on a socket” on page 1499](#)
- [“sendto\(\) — Send data on a socket” on page 1504](#)
- [“setsockopt\(\) — Set options associated with a socket” on page 1573](#)
- [“socket\(\) — Create a socket” on page 1677](#)
- [“write\(\) — Write data on a file or socket” on page 2070](#)

__wsinit() – Reinitialize writable static

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| C Library | both | |

Format

```
#include <unistd.h>

int __wsinit(void (*func_ptr)());
```

General description

The `__wsinit()` function reinitializes the writable static area of a module that was loaded by the `fetch()` library call. *func_ptr* must be a valid fetch pointer returned by `fetch()` or `fetchep()`. If the module contains C++, `__wsinit()` first runs any C++ static destructors, then `__wsinit()` runs the static constructors that are present in the load module.

Program variables with the static or extern storage class and writable strings receive the initial value defined in the program, if any initial value was assigned. The C header files contain external variable declarations for those variables defined by the POSIX, XPG4 and XPG4.2 standards. If the fetched module contains these variables, `__wsinit()` reinitializes them as described in [z/OS XL C/C++ Programming Guide](#).

Returned value

If successful, `__wsinit()` returns 0.

If unsuccessful, `__wsinit()` returns -1 and sets `errno` to one of the following values:

Error Code

Description

EINVAL

func_ptr is not a valid fetch pointer.

Related information

- [“unistd.h — Implementation-specific functions”](#) on page 77
- [“fetch\(\) — Get a load module”](#) on page 516

w_statfs() – Get the file system status

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```
#include <sys/statfs.h>

int w_statfs(const char *filesystem, struct w_statfs *statbuf, size_t length);
```

General description

Gets status about a specific file system.

filesystem

The name of the file system for which status is being retrieved. This file system name can be one of the following:

- The name specified in the FILESYSTEM parameter of the ROOT or MOUNT statements in the BPXPRMxx parmlib member.
- The name specified in a TSO/E MOUNT command.
- The name returned on a previous call to w_getmntent().

statbuf

A buffer that the status information is put into. The status information is mapped by the sys/statfs.h header file.

int statfs_len

Length of *statfs*

int statfs_blksize

Block size

unsigned int statfs_total_space

Total space in block size units

unsigned int statfs_used_space

Allocated space in block size units

unsigned int statfs_free_space

Space available to unprivileged users in block size units

length

The length of the buffer. The length of the buffer and the length of the structure are compared, and the shorter of the two is used to determine how much information to return in the buffer.

If the buffer length is zero, only the return value is returned. A process can use a length of zero to detect if a file system exists or not.

Special behavior for XPG4.2: w_statfs() is replaced by w_statvfs().

Returned value

If successful, w_statfs() returns the length of the data in the buffer.

If unsuccessful, w_statfs() returns -1 and sets errno to one of the following values:

Error Code

Description

EINVAL

A parameter was incorrectly specified.

Example

CELEBW36

```
/* CELEBW36 */
#define _OPEN_SYS
#include <sys/statfs.h>
#include <stdio.h>

main() {
    char fs[]="POSIX.ROOT.FS";
    struct w_statfs buf;

    if (w_statfs(fs, &buf, sizeof(buf)) == -1)
        perror("w_statfs() error");
    else {
```

```

printf("each block in %s is %d bytes big\n", fs,
      buf.statfs_blksize);
printf("there are %d blocks in use out of a total of %d\n",
      buf.statfs_used_space, buf.statfs_total_space);
printf("in bytes, that's %.0f bytes used out of a total of %.0f\n",
      ((double)buf.statfs_used_space * buf.statfs_blksize),
      ((double)buf.statfs_total_space * buf.statfs_blksize));
}
}

```

Output:

```

each block in POSIX.ROOT.FS is 4096 bytes big
there are 2089 blocks in use out of a total of 2400
in bytes, that's 8556544 bytes used out of a total of 9830400

```

Related information

- [“sys/statfs.h — File system status” on page 71](#)
- [“mount\(\) — Make a file system available” on page 1098](#)
- [“w_getmntent\(\) — Get information on mounted file systems” on page 2044](#)

w_statvfs() — Get the file system status

Standards

| Standards / Extensions | C or C++ | Dependencies |
|------------------------|----------|--------------|
| z/OS UNIX | both | |

Format

```

#define _OPEN_SOURCE 2
#include <sys/statvfs.h>

int w_statvfs(const char *filesystem, struct statvfs *buffer, size_t buflen);

```

General description

The `w_statvfs()` function gets status about a specific file system.

filesystem

The name of the file system for which status is being retrieved. This file system name can be one of the following:

- The name specified in the FILESYSTEM parameter of the ROOT or MOUNT statements in the BPXPRMxx parmlib member.
- The name specified in a TSO/E MOUNT command.
- The name returned on a previous call to `w_getmntent()`.

buffer

A buffer that the status information is put into. The information is returned in a `statvfs` structure, as defined in the `sys/statvfs.h` header file. The elements of this structure are described in [“statvfs\(\) — Get file system information” on page 1712](#).

buflen

The length of the buffer. The length of the buffer and the length of the structure are compared, and the shorter of the two is used to determine how much information to return in the buffer.

If the buffer length is zero, only the return value is returned. A process can use a length of zero to detect if a file system exists or not.

Returned value

If successful, w_statvfs() returns the length of the data in the buffer.
If unsuccessful, w_statvfs() returns -1 and sets errno to one of the following values:

| Error Code | Description |
|------------|-------------|
|------------|-------------|

| | |
|---------------|---|
| EINVAL | A parameter was specified incorrectly. For example, the file system name (<i>filesystem</i>) was not found. |
|---------------|---|

Example

```
#define _OPEN_SOURCE 2
#include <sys/statvfs.h>
#include <stdio.h>

main() {
    char fs[]="POSIX.ROOT.FS";
    struct statvfs buf;

    if (w_statvfs(fs, &buf, sizeof(buf)) == -1)
        perror("w_statvfs() error");
    else {
        printf("each block in %s is %d bytes big\n", fs,
            buf.f_frsize);
        printf("there are %d blocks available out of a total of %d\n",
            buf.f_bavail, buf.f_blocks);
        printf("in bytes, that's %.0f bytes free out of a total of %.0f\n",
            ((double)buf.f_bavail * buf.f_frsize),
            ((double)buf.f_blocks * buf.f_frsize));
    }
}
```

Output:

```
each block in POSIX.ROOT.FS is 4096 bytes big
there are 2089 blocks available out of a total of 2400
in bytes, that's 8556544 bytes free out of a total of 9830400
```

Related information

- [“sys/statvfs.h – File system status” on page 71](#)
- [“fstatvfs\(\) – Get file system information” on page 654](#)
- [“mount\(\) – Make a file system available” on page 1098](#)
- [“statvfs\(\) – Get file system information” on page 1712](#)
- [“w_getmntent\(\) – Get information on mounted file systems” on page 2044](#)

y0(), y1(), yn() – Bessel functions of the second kind

Standards

| Standards / Extensions | C or C++ | Dependencies |
|---|----------|--------------|
| SAA XPG4 XPG4.2 Single UNIX Specification, Version 3 | both | |

Format

SAA:

```
#include <math.h>

double y0(double x);
double y1(double x);
double yn(int n, double x);
```

This function must be used with the [runtime library extensions](#) or under the [SAA based language constructs](#).

General description

Bessel functions are solutions to certain types of differential equations.

The `y0()`, `y1()`, and `yn()` functions are Bessel functions of the *second kind*, for orders 0, 1, and n , respectively. The argument x must be positive. The argument n should be greater than or equal to zero. If n is less than zero, there will be a negative exponent in the result.

Note: This function works in both IEEE Binary Floating-Point and hexadecimal floating-point formats. See [“IEEE binary floating-point”](#) on page 97 for more information about IEEE Binary Floating-Point.

Returned value

If successful, the function returns the calculated value.

For `y0()`, `y1()`, or `yn()`, if x is negative, the function sets `errno` to `EDOM` and returns `-HUGE_VAL`.

For `y0()`, `y1()`, or `yn()`, if x causes overflow, the function sets `errno` to `ERANGE` and returns `-HUGE_VAL`.

Special behavior for IEEE: If x is negative, `y0()`, `y1()`, and `yn()` return the value `NaNQ`. If x is 0, `y0()`, `y1()`, and `yn()` return the value `-HUGE_VAL`. In all cases, `errno` remains unchanged.

Example

CELEBY01

```
/* CELEBY01

   This example computes y to be the order 0 Bessel function of the first
   kind for x and z to be the order 3 Bessel function of the second kind for x.

*/
#include <math.h>
#include <stdio.h>

int main(void)
{
    double x, y, z;
    x = 4.27;

    y = y0(x);          /* y = -0.3660 is the order 0 bessel */
                        /* function of the first kind for x */
    z = yn(3,x);         /* z = -0.0875 is the order 3 bessel */
                        /* function of the second kind for x */
    printf("x = %f\n y = %f\n z = %f\n", x, y, z);
}
```

Related information

- [“math.h — Floating-point math functions”](#) on page 40
- [“erf\(\), erfc\(\), erff\(\), erfl\(\), erfcf\(\), erfcl\(\) — Calculate error and complementary error functions”](#) on page 432
- [“gamma\(\) — Calculate gamma function”](#) on page 683
- [“j0\(\), j1\(\), jn\(\) — Bessel functions of the first kind”](#) on page 929

Library functions for the system programming C (SPC) facilities

Restriction: The SPC facility is not supported in AMODE 64.

The library functions specific to the System Programming C (SPC) environment are described in [z/OS XL C/C++ Programming Guide](#). These system programming functions are as follows:

- `__xhotc()`
- `__xhotl()`
- `__xhott()`
- `__xhotu()`
- `__xregs()`
- `__xsacc()`
- `__xsrv()`
- `__xusr()`
- `__xusr2()`
- `__24malc()`
- `__4kmalc()`

Chapter 4. Using high performance libraries

The z/OS XL C/C++ compilers are shipped with a set of libraries for high-performance mathematical computing:

- The [Mathematical Acceleration Subsystem \(MASS\)](#) is a set of libraries of tuned mathematical intrinsic functions that provide improved performance over the corresponding standard system math library functions.
- The [Automatically Tuned Linear Algebra Software \(ATLAS\)](#) is a set of high-performance, processor-tuned linear algebra libraries.
- The [OpenBLAS](#) library is a BLAS (Basic Linear Algebra Subroutines) library, which contains a set of routines that provide matrix/vector linear algebra functions.

Using the Mathematical Acceleration Subsystem (MASS) libraries

The IBM z/OS C/C++ compilers are shipped with a set of Mathematical Acceleration Subsystem (MASS) libraries for high-performance mathematical computing. The MASS libraries consist of:

- A [library of scalar C functions](#) that is tuned for specific architectures.
- A [vector library](#) that is tuned for specific architectures.
- A [SIMD library](#) that is tuned for specific architectures.

You can [compile and link](#) a program that uses the MASS libraries and selectively use the MASS scalar library functions in conjunction with the regular system libraries.

Notes:

- Accuracy and exception handling might not be identical between MASS functions and system library functions.
- To use the MASS libraries on IBM z16[®] servers, z/OS 2.4 or later with all the following PTFs are required: [UI96552](#), [UI96655](#), [UI96656](#). Additionally, the following PTFs are required for each z/OS operating system:
 - z/OS 3.1 with the PTF [UI96659](#) installed.
 - z/OS 2.5 with the PTF [UI96658](#) installed.
 - z/OS 2.4 with the PTF [UI96657](#) installed.

Using the MASS scalar library

The MASS scalar library contains an accelerated set of frequently used math intrinsic functions. They are compatible with 31-bit C linkage, 31-bit XPLINK, and 64-bit. If you want to explicitly call the MASS scalar functions, you can take the following steps:

1. Provide the prototypes for the functions by including `math.h` and `mass.h` in your source files. See the following table for the location of header files.
2. Link the appropriate scalar library with your application. Names of libraries are described in the following table.

Table 75. Header files and library names for the MASS scalar library

| | System environment | |
|---|--|--|
| | z/OS UNIX | MVS |
| Header file location | /usr/include/math.h /usr/include/mass.h | CEE.SCEEH.H |
| Library name for z16 | /usr/lpp/cbclib/lib/ libmass.arch14.a | CBC.SCCNM14 (for functions that overlap with <math.h>) CBC.SCCNN14 (for functions that are only introduced in <mass.h>) |
| Library name for z15[®] | /usr/lpp/cbclib/lib/ libmass.arch13.a | CBC.SCCNM13 (for functions that overlap with <math.h>) CBC.SCCNN13 (for functions that are only introduced in <mass.h>) |
| Library name for z14 | /usr/lpp/cbclib/lib/ libmass.arch12.a | CBC.SCCNM12 (for functions that overlap with <math.h>) CBC.SCCNN12 (for functions that are only introduced in <mass.h>) |
| Library name for z13[®]/ z13s[®] | /usr/lpp/cbclib/lib/ libmass.arch11.a | CBC.SCCNM11 (for functions that overlap with <math.h>) CBC.SCCNN11 (for functions that are only introduced in <mass.h>) |
| Library name for zEC12/ zBC12 | /usr/lpp/cbclib/lib/ libmass.arch10.a | CBC.SCCNM10 (for functions that overlap with <math.h>) CBC.SCCNN10 (for functions that are only introduced in <mass.h>) |

Note: MASS scalar functions can run on IBM zEC12/zBC12 or newer machine models only. A set of libraries that are tuned for each machine model group is provided.

The MASS scalar functions accept double-precision parameters and return a double-precision result, or accept single-precision parameters and return a single-precision result, except sincos, which gives 2 double-precision results. They are summarized in [Table 76 on page 2086](#)

Table 76. MASS scalar functions

| Double-precision function | Single-precision function | Description | Double-precision function prototype | Single-precision function prototype |
|---------------------------|---------------------------|--|-------------------------------------|-------------------------------------|
| acos | acosf | Returns the arc cosine of x | double acos (double x); | float acosf (float x); |
| acosh | acoshf | Returns the arc hyperbolic cosine of x | double acosh (double x); | float acoshf (float x); |

| Table 76. MASS scalar functions (continued) | | | | |
|---|---------------------------|---|---------------------------------------|-------------------------------------|
| Double-precision function | Single-precision function | Description | Double-precision function prototype | Single-precision function prototype |
| | anint ^t | Returns the nearest integer to x (as a float) | | float anint (float x); |
| asin | asinf | Returns the arc sine of x | double asin (double x); | float asinf (float x); |
| asinh | asinhf | Returns the arc hyperbolic sine of x | double asinh (double x); | float asinhf (float x); |
| atan2 | atan2f | Returns the arc tangent of x/y | double atan2 (double x, double y); | float atan2f (float x, float y); |
| atan | atanf | Returns the arc tangent of x | double atan (double x); | float atanf (float x); |
| atanh | atanhf | Returns the arc hyperbolic tangent of x | double atanh (double x); | float atanhf (float x); |
| cbrt | cbrtf | Returns the cube root of x | double cbrt (double x); | float cbrtf (float x); |
| copysign | copysignf | Returns x with the sign of y | double copysign (double x, double y); | float copysignf (float x); |
| cos | cosf | Returns the cosine of x | double cos (double x); | float cosf (float x); |
| cosh | coshf | Returns the hyperbolic cosine of x | double cosh (double x); | float coshf (float x); |
| cosisin | | Returns a complex number with the real part cosine of x and the imaginary part sine of x. | double_Complex cosisin (double); | |
| dnint ^t | | Returns the nearest integer to x (as a double) | double dnint (double x); | |
| erf | erff | Returns the error function of x | double erf (double x); | float erff (float x); |
| erfc | erfcf | Returns the complementary error function of x | double erfc (double x); | float erfcf (float x); |
| exp | expf | Returns the exponential function of x | double exp (double x); | float expf (float x); |
| expm1 | expm1f | Returns (the exponential function of x) - 1 | double expm1 (double x); | float expm1f (float x); |
| hypot | hypotf | Returns the square root of $x^2 + y^2$ | double hypot (double x, double y); | float hypotf (float x, float y); |

| Table 76. MASS scalar functions (continued) | | | | |
|---|---------------------------|--|---|-------------------------------------|
| Double-precision function | Single-precision function | Description | Double-precision function prototype | Single-precision function prototype |
| lgamma | lgammaf | Returns the natural logarithm of the absolute value of the Gamma function of x | double lgamma (double x); | float lgammaf (float x); |
| log | logf | Returns the natural logarithm of x | double log (double x); | float logf (float x); |
| log10 | log10f | Returns the base 10 logarithm of x | double log10 (double x); | float log10f (float x); |
| log1p | log1pf | Returns the natural logarithm of (x + 1) | double log1p (double x); | float log1pf (float x); |
| pow | powf | Returns x raised to the power y | double pow (double x, double y); | float powf (float x, float y); |
| rint | rintf | Returns the nearest integer to x (as a double) | double rint (double x); | float rintf (float x); |
| rsqrt ^t | rsqrtf ^u | Returns the reciprocal of the square root of x | double rsqrt (double x); | float rsqrtf (float x); |
| sin | sinf | Returns the sine of x | double sin (double x); | float sinf (float x); |
| sincos ^t | | Sets *s to the sine of x and *c to the cosine of x | void sincos (double x, double* s, double* c); | |
| sinh | sinhf | Returns the hyperbolic sine of x | double sinh (double x); | float sinhf (float x); |
| sqrt | sqrtf ^u | Returns the square root of x | double sqrt (double x); | float sqrtf (float x); |
| tan | tanf | Returns the tangent of x | double tan (double x); | float tanf (float x); |
| tanh | tanhf | Returns the hyperbolic tangent of x | double tanh (double x); | float tanhf (float x); |

Notes:

- Functions denoted as function-name^t are declared in <mass.h>, and all other functions are declared in <math.h>.
- Functions denoted as function-name^u are supported under the [processor architecture](#) of IBM z15 or newer
- The trigonometric functions (sin, cos, tan) return NaN (Not-a-Number) for large arguments (where the absolute value is greater than 2⁵⁰pi).
- The pow function accepts negative x arguments with integer y arguments according to the C standard.
- In some cases, the MASS functions are not as precise as the system library, and they might handle edge cases differently (sqrt(Inf), for example).

Using the MASS vector library

The MASS vector library provides a set of functions that compute the same mathematical function for vectors of operands. If you want to explicitly call the MASS vector functions, take the following steps:

1. Provide the prototypes for the functions by including `massv.h` in your source files. See the following table for the location of header files.
2. Link the appropriate library with your application. Names of libraries are described in the following table.

| Table 77. Header files and library names for the MASS vector library | | |
|--|--|--------------------------|
| | System environment | |
| | z/OS UNIX | MVS (z/OS XL C/C++ only) |
| Header file location | <code>/usr/include/massv.h</code> | <code>CEE.SCEEH.H</code> |
| Library name for z16 | <code>/usr/lpp/cbclib/lib/libmassv.arch14.a</code> | <code>CBC.SCCNN14</code> |
| Library name for z15 | <code>/usr/lpp/cbclib/lib/libmassv.arch13.a</code> | <code>CBC.SCCNN13</code> |
| Library name for z14 | <code>/usr/lpp/cbclib/lib/libmassv.arch12.a</code> | <code>CBC.SCCNN12</code> |
| Library name for z13/z13s | <code>/usr/lpp/cbclib/lib/libmassv.arch11.a</code> | <code>CBC.SCCNN11</code> |
| Library name for zEC12/zBC12 | <code>/usr/lpp/cbclib/lib/libmassv.arch10.a</code> | <code>CBC.SCCNN10</code> |

Note: MASS vector functions can run on IBM zEC12/zBC12 or newer machine models only. A set of libraries that are tuned for each machine model group is provided .

The single-precision and double-precision floating-point functions that are contained in the vector library are summarized in [Table 78 on page 2090](#). Note that in C and C++ applications, only call by reference is supported, even for scalar arguments. Except for a few functions (described in the following paragraph), all of the floating-point functions in the vector library accept three parameters:

- A double-precision (for double-precision functions) or single-precision (for single-precision functions) vector output parameter
- A double-precision (for double-precision functions) or single-precision (for single-precision functions) vector input parameter
- An integer vector-length parameter

Except for the special cases listed below, the functions are of the form:

```
function_name (y,x,n)
```

where *y* is the target vector, *x* is the source vector, and *n* is the pointer to the vector length. The parameters *y* and *x* are assumed to be double-precision for functions with the prefix *v*, and single-precision for functions with the prefix *vs*. For example, the following code:

```
#include <massv.h>

double x[500], y[500];
int n;
n = 500;
...
vexp (y, x, &n);
```

outputs a vector *y* of length 500 whose elements are $\exp(x[i])$, where $i=0, \dots, 499$.

The functions `vdiv`, `vsincos`, `vpow`, and `vatan2` (and their single-precision versions, `vsdiv`, `vssincos`, `vspow`, and `vsatan2`) take four arguments. The functions `vdiv`, `vpow`, and `vatan2` take the arguments (z, x, y, n) . The function `vdiv` outputs a vector z whose elements are $x[i]/y[i]$, where $i=0, \dots, *n-1$. The function `vpow` outputs a vector z whose elements are $x[i]^{y[i]}$, where $i=0, \dots, *n-1$. The function `vatan2` outputs a vector z whose elements are $\text{atan}(x[i]/y[i])$, where $i=0, \dots, *n-1$. The function `vsincos` takes the arguments (y, z, x, n) , and outputs two vectors, y and z , whose elements are $\sin(x[i])$ and $\cos(x[i])$, respectively.

Note: Some of the MASS floating point vector functions are only available when compiled under the processor architecture of IBM z13[®] or newer. These functions are denoted by having a superscript ^t after their name (for example, "function^t" in the following table.)

| Table 78. MASS floating-point vector functions | | | | |
|--|---------------------------------|--|--|--|
| Double-precision function | Single-precision function | Description | Double-precision function prototype | Single-precision function prototype |
| <code>vacos</code> | <code>vsacos</code> | Sets $y[i]$ to the arc cosine of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vacos (double y[], double x[], int *n);</code> | <code>void vsacos (float y[], float x[], int *n);</code> |
| <code>vacosh</code> | <code>vsacosh</code> | Sets $y[i]$ to the hyperbolic arc cosine of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vacosh (double y[], double x[], int *n);</code> | <code>void vsacosh (float y[], float x[], int *n);</code> |
| <code>vasin</code> | <code>vsasin</code> | Sets $y[i]$ to the arc sine of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vasin (double y[], double x[], int *n);</code> | <code>void vsasin (float y[], float x[], int *n);</code> |
| <code>vasinh</code> | <code>vsasinh</code> | Sets $y[i]$ to the hyperbolic arc sine of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vasinh (double y[], double x[], int *n);</code> | <code>void vsasinh (float y[], float x[], int *n);</code> |
| <code>vatan2</code> | <code>vsatan2</code> | Sets $z[i]$ to the arc tangent of $x[i]/y[i]$, for $i=0, \dots, *n-1$ | <code>void vatan2 (double z[], double x[], double y[], int *n);</code> | <code>void vsatan2 (float z[], float x[], float y[], int *n);</code> |
| <code>vatan^t</code> | <code>vsatan^t</code> | Sets $y[i]$ to the arc tangent of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vatan (double y[], double x[], int *n);</code> | <code>void vsatan (float y[], float x[], int *n);</code> |
| <code>vatanh</code> | <code>vsatanh</code> | Sets $y[i]$ to the hyperbolic arc tangent of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vatanh (double y[], double x[], int *n);</code> | <code>void vsatanh (float y[], float x[], int *n);</code> |
| <code>vcbrt</code> | <code>vscbrt</code> | Sets $y[i]$ to the cube root of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vcbrt (double y[], double x[], int *n);</code> | <code>void vscbrt (float y[], float x[], int *n);</code> |
| <code>vcos</code> | <code>vscos</code> | Sets $y[i]$ to the cosine of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vcos (double y[], double x[], int *n);</code> | <code>void vscos (float y[], float x[], int *n);</code> |
| <code>vcosh</code> | <code>vscosh</code> | Sets $y[i]$ to the hyperbolic cosine of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vcosh (double y[], double x[], int *n);</code> | <code>void vscosh (float y[], float x[], int *n);</code> |
| <code>vcosisin</code> | <code>vscosisin</code> | Sets the real part of $y[i]$ to the cosine of $x[i]$ and the imaginary part of $y[i]$ to the sine of $x[i]$, for $i=0, \dots, *n-1$ | <code>void vcosisin (double _Complex y[], double x[], int *n);</code> | <code>void vscosisin (float _Complex y[], float x[], int *n);</code> |

| Table 78. MASS floating-point vector functions (continued) | | | | |
|--|---------------------------|---|--|--|
| Double-precision function | Single-precision function | Description | Double-precision function prototype | Single-precision function prototype |
| vdint | | Sets $y[i]$ to the integer truncation of $x[i]$, for $i=0,...,n-1$ | void vdint (double y[], double x[], int *n); | |
| vdiv | vsdiv | Sets $z[i]$ to $x[i]/y[i]$, for $i=0,...,n-1$ | void vdiv (double z[], double x[], double y[], int *n); | void vsdiv (float z[], float x[], float y[], int *n); |
| vdnint | | Sets $y[i]$ to the nearest integer to $x[i]$, for $i=0,...,n-1$ | void vdnint (double y[], double x[], int *n); | |
| verf ^t | vserf ^t | Sets $y[i]$ to the error function of $x[i]$, for $i=0,...,n-1$ | void verf (double y[], double x[], int *n) | void vs erf (float y[], float x[], int *n) |
| verfc ^t | vserfc ^t | Sets $y[i]$ to the complimentary error function of $x[i]$, for $i=0,...,n-1$ | void verfc (double y[], double x[], int *n) | void vs erf c (float y[], float x[], int *n) |
| vexp | vsexp | Sets $y[i]$ to the exponential function of $x[i]$, for $i=0,...,n-1$ | void vexp (double y[], double x[], int *n); | void vsexp (float y[], float x[], int *n); |
| vexp2 ^t | vsexp2 ^t | Sets $y[i]$ to 2 raised to the power of $x[i]$, for $i=1,...,n-1$ | void vexp2 (double y[], double x[], int *n); | void vsexp2 (float y[], float x[], int *n); |
| vexpm1 | vsexpm1 | Sets $y[i]$ to (the exponential function of $x[i]$)-1, for $i=0,...,n-1$ | void vexpm1 (double y[], double x[], int *n); | void vsexpm1 (float y[], float x[], int *n); |
| vexp2m1 ^t | vsexp2m1 ^t | Sets $y[i]$ to (2 raised to the power of $x[i]$) - 1, for $i=1,...,n-1$ | void vexp2m1 (double y[], double x[], int *n); | void vsexp2m1 (float y[], float x[], int *n); |
| vhypot ^t | vshypot ^t | Sets $z[i]$ to the square root of the sum of the squares of $x[i]$ and $y[i]$, for $i=0,...,n-1$ | void vhypot (double z[], double x[], double y[], int *n) | void vshypot (float z[], float x[], float y[], int *n) |
| vlog | vslog | Sets $y[i]$ to the natural logarithm of $x[i]$, for $i=0,...,n-1$ | void vlog (double y[], double x[], int *n); | void vslog (float y[], float x[], int *n); |
| vlog2 ^t | vslog2 ^t | Sets $y[i]$ to the base-2 logarithm of $x[i]$, for $i=1,...,n-1$ | void vlog2 (double y[], double x[], int *n); | void vslog2 (float y[], float x[], int *n); |
| vlog10 | vslog10 | Sets $y[i]$ to the base-10 logarithm of $x[i]$, for $i=0,...,n-1$ | void vlog10 (double y[], double x[], int *n); | void vslog10 (float y[], float x[], int *n); |
| vlog1p | vslog1p | Sets $y[i]$ to the natural logarithm of ($x[i]+1$), for $i=0,...,n-1$ | void vlog1p (double y[], double x[], int *n); | void vslog1p (float y[], float x[], int *n); |

| Table 78. MASS floating-point vector functions (continued) | | | | |
|--|---------------------------|--|--|--|
| Double-precision function | Single-precision function | Description | Double-precision function prototype | Single-precision function prototype |
| vlog21p ^t | vslog21p ^t | Sets y[i] to the base-2 logarithm of (x[i]+1), for i=1,...,*n-1 | void vlog21p (double y[], double x[], int *n); | void vslog21p (float y[], float x[], int *n); |
| vpow | vspow | Sets z[i] to x[i] raised to the power y[i], for i=0,...,*n-1 | void vpow (double z[], double x[], double y[], int *n); | void vspow (float z[], float x[], float y[], int *n); |
| vqdrft | vsqdrft | Sets y[i] to the fourth root of x[i], for i=0,...,*n-1 | void vqdrft (double y[], double x[], int *n); | void vsqdrft (float y[], float x[], int *n); |
| vrcbrt | vsrbrt | Sets y[i] to the reciprocal of the cube root of x[i], for i=0,...,*n-1 | void vrcbrt (double y[], double x[], int *n); | void vsrbrt (float y[], float x[], int *n); |
| vrec | vsrec | Sets y[i] to the reciprocal of x[i], for i=0,...,*n-1 | void vrec (double y[], double x[], int *n); | void vsrec (float y[], float x[], int *n); |
| vrqdrft | vsrqdrft | Sets y[i] to the reciprocal of the fourth root of x[i], for i=0,...,*n-1 | void vrqdrft (double y[], double x[], int *n); | void vsrqdrft (float y[], float x[], int *n); |
| vsqrt | vsrsqrt | Sets y[i] to the reciprocal of the square root of x[i], for i=0,...,*n-1 | void vsqrt (double y[], double x[], int *n); | void vsrsqrt (float y[], float x[], int *n); |
| vsin | vssin | Sets y[i] to the sine of x[i], for i=0,...,*n-1 | void vsin (double y[], double x[], int *n); | void vssin (float y[], float x[], int *n); |
| vsincos | vssincos | Sets y[i] to the sine of x[i] and z[i] to the cosine of x[i], for i=0,...,*n-1 | void vsincos (double y[], double z[], double x[], int *n); | void vssincos (float y[], float z[], float x[], int *n); |
| vsinh | vssinh | Sets y[i] to the hyperbolic sine of x[i], for i=0,...,*n-1 | void vsinh (double y[], double x[], int *n); | void vssinh (float y[], float x[], int *n); |
| vsqrt | vssqrt | Sets y[i] to the square root of x[i], for i=0,...,*n-1 | void vsqrt (double y[], double x[], int *n); | void vssqrt (float y[], float x[], int *n); |
| vtan | vstan | Sets y[i] to the tangent of x[i], for i=0,...,*n-1 | void vtan (double y[], double x[], int *n); | void vstan (float y[], float x[], int *n); |
| vtanh | vstanh | Sets y[i] to the hyperbolic tangent of x[i], for i=0,...,*n-1 | void vtanh (double y[], double x[], int *n); | void vstanh (float y[], float x[], int *n); |

Integer functions are of the form *function_name* (x[], *n), where x[] is a vector of 4-byte (for vpopcnt4) or 8-byte (for vpopcnt8) numeric objects (integral or floating-point), and *n is the vector length.

| Table 79. MASS integer vector functions | | |
|---|--|---|
| Function | Description | Prototype |
| vpopcnt4 | Returns the total number of 1 bits in the concatenation of the binary representation of $x[i]$, for $i=0, \dots, *n-1$, where x is a vector of 32-bit objects. | unsigned int vpopcnt4 (void *x, int *n) |
| vpopcnt8 | Returns the total number of 1 bits in the concatenation of the binary representation of $x[i]$, for $i=0, \dots, *n-1$, where x is a vector of 64-bit objects. | unsigned int vpopcnt8 (void *x, int *n) |

Overlap of input and output vectors

In most applications, the MASS vector functions are called with disjoint input and output vectors; that is, the two vectors do not overlap in memory. Another common usage scenario is to call them with the same vector for both input and output parameters (for example, `vsin (y, y, &n)`). For other kinds of overlap, be sure to observe the following restrictions, to ensure correct operation of your application:

- For calls to vector functions that take one input and one output vector (for example, `vsin (y, x, &n)`):

The vectors $x[0:n-1]$ and $y[0:n-1]$ must be either disjoint or identical, or the address of $x[0]$ must be greater than the address of $y[0]$. That is, if x and y are not the same vector, the address of $y[0]$ must not fall within the range of addresses spanned by $x[0:n-1]$, or unexpected results may be obtained.

- For calls to vector functions that take two input vectors (for example, `vtan2 (y, x1, x2, &n)`):

The previous restriction applies to both pairs of vectors $y, x1$ and $y, x2$. That is, if y is not the same vector as $x1$, the address of $y[0]$ must not fall within the range of addresses spanned by $x1[0:n-1]$; if y is not the same vector as $x2$, the address of $y[0]$ must not fall within the range of addresses spanned by $x2[0:n-1]$.

- For calls to vector functions that take two output vectors (for example, `vsincos (x, y1, y2, &n)`):

The preceding restriction applies to both pairs of vectors $y1, x$ and $y2, x$. That is, if $y1$ and x are not the same vector, the address of $y1[0]$ must not fall within the range of addresses spanned by $x[0:n-1]$; if $y2$ and x are not the same vector, the address of $y2[0]$ must not fall within the range of addresses spanned by $x[0:n-1]$. Also, the vectors $y1[0:n-1]$ and $y2[0:n-1]$ must be disjoint.

Using the MASS SIMD library

The MASS SIMD library contains a set of frequently used math intrinsic functions that provide improved performance over the corresponding standard scalar system library functions, and operate on and return vector data types. If you want to explicitly call the MASS SIMD functions, take the following steps:

1. Link the appropriate scalar library with your application by using information in the following table.
2. Provide the prototypes for the functions by including `mass_simd.h` in your source files. The default installation location of these files is as follows:
 - In z/OS UNIX, `mass_simd.h` can be found in `/usr/include`.
 - Under the MVS environment (batch mode), the headers are found in `CEE.SCEEH.H`.
3. Link the appropriate SIMD library with your application by using information in the following table.

| Table 80. Header files and library names for the MASS SIMD library | | |
|--|---|--------------------------|
| | System environment | |
| | z/OS UNIX | MVS (z/OS XL C/C++ only) |
| Header file location | /usr/include/mass_simd.h | CEE.SCEEH.H |
| Library name for z16 | /usr/lpp/cbclib/lib/libmass_simd.arch14.a | CBC.SCCNN14 |
| Library name for z15 | /usr/lpp/cbclib/lib/libmass_simd.arch13.a | CBC.SCCNN13 |
| Library name for z14 | /usr/lpp/cbclib/lib/libmass_simd.arch12.a | CBC.SCCNN12 |
| Library name for z13/z13s | /usr/lpp/cbclib/lib/libmass_simd.arch11.a | CBC.SCCNN11 |

Note: MASS SIMD functions can run on IBM zEC12/zBC12 or newer machine models only.

The double-precision MASS SIMD functions have arguments and return values of type `vector double`. The available MASS SIMD functions are summarized in [Table 81 on page 2094](#).

| Table 81. MASS SIMD functions | | |
|-------------------------------|---|---|
| Double-precision function | Description | Double-precision function prototype |
| cosd2 | Computes the cosine of each element of vx. | vector double cosd2 (vector double vx); |
| divd2 | Computes the quotient vx/vy. | vector double divd2 (vector double vx, vector double vy); |
| expd2 | Computes the exponential function of each element of vx. | vector double expd2 (vector double vx); |
| logd2 | Computes the natural logarithm of each element of vx. | vector double logd2 (vector double vx); |
| powd2 | Computes each element of vx raised to the power of the corresponding element of vy. | vector double powd2 (vector double vx, vector double vy); |
| recipd2 | Computes the reciprocal of each element of vx. | vector double recipd2 (vector double vx); |
| sind2 | Computes the sine of each element of vx. | vector double sind2 (vector double vx); |
| sqrt2 | Computes the square root of each element of vx. | vector double sqrt2 (vector double vx); |

Compiling and linking a program with MASS

This section describes the specifics of compiling and linking your application with the MASS libraries. The MASS libraries cannot be used with the prelinker.

Required compiler features

To compile a program that utilizes any MASS functions, you need to enable the following compiler features:

- [Exception trapping disabled](#)
- [IEEE floating point representation](#)
- [Long external names](#)
- [Round-to-nearest rounding mode](#)
- [The processor architecture of IBM zEnterprise® EC12 \(zEC12\)\) and IBM zEnterprise BC12 \(zBC12\)\) or newer](#)

To use MASS SIMD functions, you need to enable the following compiler features:

- [The processor architecture of IBM z13 or newer](#)
- [Vector programming support](#)

Note: While you might still be able to compile your MASS application without satisfying the above requirements, the program will likely not give correct results.

Compilation step - MASS headers

To use MASS functions in your application, you need to include the appropriate MASS header(s) for the type of MASS function being used (for a complete list of MASS functions available, see [“Using the MASS scalar library”](#) on page 2085, [“Using the MASS vector library”](#) on page 2089, and [“Using the MASS SIMD library”](#) on page 2093).

The default installation of MASS places the MASS headers in your default header search path. If you cannot find the MASS headers in your default search path, contact your system programmer.

The following examples demonstrate the relationship among MASS functions, headers, and libraries, and show how to use MASS in your source program.

Sample 1

```
/* sample1.c: using the MASS-only scalar function 'rsqrt' */
#include <math.h>
#include <mass.h> /* The 'rsqrt' function is declared in <mass.h>, not <math.h> */

int main(void) {
    double input = 16;
    double output;

    output = rsqrt(input);

    /* ... Code to utilize the results in "output" goes here */
}
```

To compile sample1.c with z/OS XL C/C++, run the following command:

```
xlc -qARCH=10 -qFLOAT=IEEE -c sample1.c
```

Sample 2

```
/* sample2.c: using the MASS scalar function 'pow' */
#include <math.h> /* The 'pow' function is declared in <math.h>, not <mass.h> */
#include <mass.h>

int main(void) {
    double base = 3;
    double exponent = 2;
    double output;

    output = pow(base, exponent);
}
```

```

/* ... Code to utilize the results in "output" goes here */
}

```

To compile sample2.c with Open XL C/C++ for z/OS, run the following command:

```

ibm-clang64 -march=zEC12 -c sample2.c

```

Sample 3

```

/* sample3.c: call the MASS vector function 'vlog2' */
#include <massv.h>

int main(void) {
    int size = 1000;
    double input[size];
    double output[size];

    input[0] = 8;
    input[1] = 16;
    ...
    input[999] = 42;

    vlog2(output, input, &size);

    /* ... Code to utilize the results in "output[]" goes here */
}

```

To compile sample3.c with z/OS XL C/C++, run the following command:

```

xlc -qARCH=11 -qFLOAT=IEEE -c sample3.c

```

Sample 4

```

/* sample4.c: all the MASS SIMD function 'powd2' */
#include <mass_simd.h>

int main(void) {
    vector double bases = {0, 1};
    vector double exponents = {2, 2};
    vector double output;

    output = powd2(bases, exponents);

    /* ... Code to utilize the results in "output" goes here */
}

```

To compile sample4.c with Open XL C/C++ for z/OS, run the following command:

```

ibm-clang64 -march=z14 -mzvector -c sample4.c

```

Sample 5

```

/* sample5.c: call the MASS scalar functions 'pow' and 'rsqrt', and
the vector function 'vlog10'
Compile command: xlc -qARCH=10 -qFLOAT=IEEE -c sample5.c
*/
#include <math.h>      /* This includes the prototype for 'pow' */
#include <mass.h>      /* This includes the prototype for 'rsqrt' */
#include <massv.h>     /* This includes the prototype for 'vlog10' */

int main(void) {
    int size = 1000;
    double input[size];
    double result[size];
    int i;

    for (i = 0; i < size; i++) {
        input[i] = i; /* Trivially initialize the input vector */
    }
}

```

```

    vlog10(result, input, &size);
    double output = pow(result[27], result[525]);

    output = rsqrt(output);

    /* ... Code to utilize the results in "output" goes here */
}

```

To compile `sample5.c` with z/OS XL C/C++, run the following command:

```
xlc -qARCH=10 -qFLOAT=IEEE -c sample5.c
```

Link step - MASS libraries

IBM provides the MASS library in both z/OS UNIX and MVS. There is no performance difference based on where the library resides. This is simply to allow z/OS UNIX users to link with MASS in z/OS UNIX, and MVS users to link with MASS in MVS.

Although z/OS UNIX users can link with the copy of the MASS libraries which resides in PDS's (and vice-versa), IBM does not recommend this because it does not provide a performance gain, and it adds unnecessary complexity to your build process.

Linking in z/OS UNIX

To link your program with the MASS library, include the appropriate library name(s) with the **-l** linker option, depending on which type of MASS functions are used, as well as which processor architecture is specified.

For MASS scalar functions

`-lmass.arch10`, `-lmass.arch11`, `-lmass.arch12`, `-lmass.arch13`, or `-lmass.arch14`

For MASS vector functions

`-lmassv.arch10`, `-lmassv.arch11`, `-lmassv.arch12`, `-lmassv.arch13`, or `-lmassv.arch14`

For MASS SIMD functions

`-lmass_simd.arch11`, `-lmass_simd.arch12`, `-lmass_simd.arch13`, or
`-lmass_simd.arch14`

Sample 1

Assume `sample1.o` was compiled under the processor architecture of zEC12 and zBC12, to link the MASS-only scalar function `rsqrt`, run the following command.

In Open XL C/C++ for z/OS:

```
ibm-clang64 sample1.o -lmass.arch10
```

Sample 2

Assume `sample2.o` was compiled under the processor architecture of zEC12 and zBC12, to link the MASS scalar function `pow`, run the following command.

In z/OS XL C/C++:

```
xlc sample2.o -lmass.arch10
```

Sample 3

Assume `sample3.o` was compiled under the processor architecture of IBM z13, to link the MASS vector function `vlog2`, run the following command.

In Open XL C/C++ for z/OS:

```
ibm-clang64 sample3.o -lmassv.arch11
```

Sample 4

Assume sample4.o was compiled under the [processor architecture](#) of IBM z15, to link the MASS SIMD function powd2, run the following command.

In z/OS XL C/C++:

```
xlc sample4.o -lmass_simd.arch13
```

Sample 5

Assume sample5.o was compiled under the [processor architecture](#) of zEC12 and zBC12, to link the MASS scalar function pow and rsqrt, run the following command.

In Open XL C/C++ for z/OS:

```
ibm-clang64 sample5.o -lmass.arch10 -lmassv.arch10
```

Linking in MVS

To link your program with the MASS library under the [MVS environment](#) in batch mode, you must append the MASS library you want to use to your SYSLIB concatenation.

The MVS library names for applications that are compiled under the [processor architecture](#) of zEC12 and zBC12 and newer are:

- CBC.SCCNM10 if you are using MASS scalar functions which are also available through <math.h>
- CBC.SCCNN10 for all other MASS functions

The MVS library names for applications that are compiled under the [processor architecture](#) of IBM z13 and newer are:

- CBC.SCCNM11 if you are using MASS scalar functions which are also available through <math.h>
- CBC.SCCNN11 for all other MASS functions

The MVS library names for applications that are compiled under the [processor architecture](#) of IBM z14 and newer are:

- CBC.SCCNM12 if you are using MASS scalar functions which are also available through <math.h>
- CBC.SCCNN12 for all other MASS functions

The MVS library names for applications that are compiled under the [processor architecture](#) of IBM z15 and newer are:

- CBC.SCCNM13 if you are using MASS scalar functions which are also available through <math.h>
- CBC.SCCNN13 for all other MASS functions

For example, if your current SYSLIB concatenation is:

```
//SYSLIB DD DSN=CEE.SCEELKEX,DISP=SHR
// DD DSN=CEE.SCEELKED,DISP=SHR
// DD DSN=CBC.SCCN0BJ,DISP=SHR
```

and you want to link each of the sample programs presented above (using NOXPLINK), here are the SYSLIB concatenations you would use:

Sample 1

```
//SYSLIB DD DSN=CBC.SCCNN10,DISP=SHR
// DD DSN=CEE.SCEELKEX,DISP=SHR
// DD DSN=CEE.SCEELKED,DISP=SHR
// DD DSN=CBC.SCCN0BJ,DISP=SHR
```

Sample 2

```
//SYSLIB DD DSN=CBC.SCCNM10,DISP=SHR
// DD DSN=CEE.SCEELKEX,DISP=SHR
// DD DSN=CEE.SCEELKED,DISP=SHR
// DD DSN=CBC.SCCN0BJ,DISP=SHR
```

Sample 3

```
//SYSLIB DD DSN=CBC.SCCNN11,DISP=SHR
//      DD DSN=CEE.SCEELKEX,DISP=SHR
//      DD DSN=CEE.SCEELKED,DISP=SHR
//      DD DSN=CBC.SCCNOBJ,DISP=SHR
```

Sample 4

```
//SYSLIB DD DSN=CBC.SCCNN13,DISP=SHR
//      DD DSN=CEE.SCEELKEX,DISP=SHR
//      DD DSN=CEE.SCEELKED,DISP=SHR
//      DD DSN=CBC.SCCNOBJ,DISP=SHR
```

Sample 5

```
//SYSLIB DD DSN=CBC.SCCNM10,DISP=SHR
//      DD DSN=CBC.SCCNN10,DISP=SHR
//      DD DSN=CEE.SCEELKEX,DISP=SHR
//      DD DSN=CEE.SCEELKED,DISP=SHR
//      DD DSN=CBC.SCCNOBJ,DISP=SHR
```

If you wanted to link the above examples with XPLINK and/or LP64, you would include the exact same data sets for MASS, except your initial SYSLIB would have CEE . SCEEBND2 instead of CEE . SCEELKEX and CEE . SCEELKED.

```
//SYSLIB DD DSN=CEE.SCEEBND2,DISP=SHR
//      DD DSN=CBC.SCCNOBJ
```

Using the Automatically Tuned Linear Algebra Software (ATLAS) libraries

The compilers are shipped with a set of Automatically Tuned Linear Algebra Software (ATLAS) libraries for algebra high-performance computing. This documentation is intended only as a high level description of ATLAS and the IBM specific extensions and naming convention. For more in depth information about ATLAS, consult the ATLAS documentation at the [ATLAS home page \(math-atlas.sourceforge.net\)](http://math-atlas.sourceforge.net).

Description and functionality provided

The ATLAS libraries contain all the Basic Linear Algebra Subprograms (BLAS) and a subset of the Linear Algebra Package (LAPACK) routines with interfaces provided for both C and Fortran F77 versions of the routines across platforms and architectures. Versions are provided and tuned herein for both the single-threaded and multi-threaded execution on IBM zEC12/zBC12 and IBM z13 hardware models. C and C++ calling programs are supported, with 31-bit C linkage, 31-bit XPLINK linkage, or 64-bit linkage.

Note: ATLAS is only provided as a z/OS UNIX package.

If you want to call ATLAS functionality in your program, take the following steps:

- Provide the prototype for the functions by including the appropriate header file (see [“Supplied ATLAS libraries and their corresponding header files”](#) on page 2099 for header file names).

Note: For C++, you must enclose the appropriate header files within an `extern "C"` declaration.

- Link with the appropriate ATLAS libraries (see [“Supplied ATLAS libraries and their corresponding header files”](#) on page 2099 for library names).
- Use the appropriate compiler and linker flags (see [“Required compiler features”](#) on page 2101).

Supplied ATLAS libraries and their corresponding header files

The following main libraries are provided with ATLAS.

Note: In the subsequent names, replace * with any specific name (specific header file name or library file name).

ATLAS main library

ATLAS main library contains ATLAS specific variants of the BLAS, CBLAS, and LAPACK routines.

Table 82. Sample interface routine provided: *ATL_dgemm*

| | Operation type | |
|--|-------------------------------|--------------------|
| | Single threaded | Multithreaded |
| Library name for z14 | libatlas.arch12.a | libtatlas.arch12.a |
| Library name for z13/z13s | libatlas.arch11.a | libtatlas.arch11.a |
| Library name for zEC12/zBC12 | libatlas.arch10.a | libtatlas.arch10.a |
| Library location | /usr/lpp/cbclib/lib/atlas | |
| Header files to be used with the library | Various atlas_*.h | |
| Header file location | /usr/lpp/cbclib/include/atlas | |

CBLAS library

CBLAS library contains the implementation of the C routines of the BLAS algorithms - also known as the CBLAS interface.

Table 83. Sample interface routine provided: *cblas_dgemm*

| | Operation type | |
|--|-------------------------------|--------------------|
| | Single threaded | Multithreaded |
| Library name for z14 | libcblas.arch12.a | libtcblas.arch12.a |
| Library name for z13/z13s | libcblas.arch11.a | libtcblas.arch11.a |
| Library name for zEC12/zBC12 | libcblas.arch10.a | libtcblas.arch10.a |
| Library location | /usr/lpp/cbclib/lib/atlas | |
| Header files to be used with the library | cblas.h | |
| Header file location | /usr/lpp/cbclib/include/atlas | |

LAPACK library

LAPACK library contains the implementation of the C routines of the LAPACK algorithms - also known as the CLAPACK interface.

Table 84. Sample interface routine provided: *clapack_dgesv*

| | Operation type | |
|--|-------------------------------|---------------------|
| | Single threaded | Multithreaded |
| Library name for z14 | liblapack.arch12.a | libtlapack.arch12.a |
| Library name for z13/z13s | liblapack.arch11.a | libtlapack.arch11.a |
| Library name for zEC12/zBC12 | liblapack.arch10.a | libtlapack.arch10.a |
| Library location | /usr/lpp/cbclib/lib/atlas | |
| Header files to be used with the library | clapack.h | |
| Header file location | /usr/lpp/cbclib/include/atlas | |

Fortran BLAS library

Fortran BLAS library contains the implementation of the Fortran 77 routines of the BLAS algorithms - also known as the BLAS interface.

| Table 85. Sample interface routine provided: <i>dgemm_</i> | | |
|--|-------------------------------|---------------------|
| | Operation type | |
| | Single threaded | Multithreaded |
| Library name for z14 | lib77blas.arch12.a | libt77blas.arch12.a |
| Library name for z13/z13s | lib77blas.arch11.a | libt77blas.arch11.a |
| Library name for zEC12/zBC12 | lib77blas.arch10.a | libt77blas.arch10.a |
| Library location | /usr/lpp/cbclib/lib/atlas | |
| Header files to be used with the library | Various atlas_*f77*.h | |
| Header file location | /usr/lpp/cbclib/include/atlas | |

Notes:

- For each of the above mentioned base libraries, the single-threaded and multi-threaded versions of the same base library contain the same list of functions.
- Only static libraries are provided.
- The libraries (archives) contain 31-bit C linkage, 31-bit XPLink linkage, and 64-bit linkage objects. The linker, based on supplied options and/or environment variables will choose the appropriate archive members of specified libraries.
- For C++, you must enclose the appropriate header files within an extern "C" declaration. For example:

```
extern "C"
{
    #include <cbblas.h>
}
```

Required compiler features

The following compiler features are required to compile and link a program that utilizes ATLAS functionality.

- [IEEE floating point representation](#)
- [Round-to-nearest rounding mode](#)
- The [processor architecture](#) level of IBM zEnterprise EC12 (zEC12)) and IBM zEnterprise BC12 (zBC12)) or newer
- The [processor architecture](#) of IBM z13 or newer to enable ATLAS vector functionality
- [Vector programming support](#) to enable ATLAS vector functionality
- The [target operating system release](#) of z/OS 2.1 or newer

Note: You might still be able to compile and link your ATLAS application without satisfying the above requirements, but the program will likely not give the correct results.

Examples - Compiling, linking, and running a simple matrix multiplication ATLAS program

This simple sample achieves a multiplication of two matrices, A and B. A and B have elements randomly generated with values between 0 and 1. The multiplication is achieved in the following ways:

- By calling dgemm/cblas_dgemm BLAS functionality provided by ATLAS
- By a manual calculation of the same

The resulting matrices C and D contain the same elements.

Sample output produced by all executables across all platforms and architectures should look like this:

```
Matrix A has 3 rows and 6 columns:
0.566 0.974 0.202 0.941 0.294 0.427
0.580 0.539 0.772 0.248 0.832 0.848
0.080 0.533 0.434 0.163 0.576 0.416
```

```
Matrix B has 6 rows and 4 columns:
0.309 0.316 0.569 0.182
0.725 0.389 0.472 0.649
0.448 0.368 0.354 0.665
0.994 0.740 0.649 0.616
0.133 0.906 0.447 0.590
0.773 0.774 0.893 0.913
```

```
Matrix C has 3 rows and 4 columns:
2.276 1.926 1.978 2.013
1.928 2.270 2.148 2.387
1.165 1.356 1.185 1.469
```

```
Matrix D has 3 rows and 4 columns:
2.276 1.926 1.978 2.013
1.928 2.270 2.148 2.387
1.165 1.356 1.185 1.469
```

Pay attention to the fact that matrices C and D are congruent.

Also note that matrix data is organized or ordered in the Fortran way, namely columns major.

Sample 1

This program contains a C invocation of the Fortran BLAS function dgemm_ provided by the ATLAS framework.

Observation: In this sample, the invocation of dgemm_ has no previously declared prototype, hence the compiler might issue a warning message. Prototypes may be declared by including the atlas_f77 header files, but source files might not have these header files specified (i.e. old source code written prior to ATLAS).

Source code:

```
#include <stdio.h>
#include <time.h>
#include <stdlib.h>

void init(double* matrix, int row, int column)
{
    for (int j = 0; j < column; j++){
        for (int i = 0; i < row; i++){
            matrix[j*row + i] = ((double)rand())/RAND_MAX;
        }
    }
}

void print(const char * name, const double* matrix, int row, int column)
{
    printf("Matrix %s has %d rows and %d columns:\n", name, row, column);
    for (int i = 0; i < row; i++){
        for (int j = 0; j < column; j++){
            printf("%.3f ", matrix[j*row + i]);
        }
        printf("\n");
    }
    printf("\n");
}

int main(int argc, char * argv[])
```



```

{
    int rowsA, colsB, common;
    int i,j,k;

    if (argc != 4){
        printf("Using defaults\n");
        rowsA = 2; colsB = 4; common = 6;
    }
    else{
        rowsA = atoi(argv[1]); colsB = atoi(argv[2]); common = atoi(argv[3]);
    }

    double A[rowsA * common]; double B[common * colsB];
    double C[rowsA * colsB]; double D[rowsA * colsB];

    char transA = 'N', transB = 'N';
    double one = 1.0, zero = 0.0;

    srand(time(NULL));

    init(A, rowsA, common); init(B, common, colsB);

    dgemm_(&transA, &transB, &rowsA, &colsB, &common, &one, A,
        &rowsA, B, &common, &zero, C, &rowsA);

    for(i=0;i<colsB;i++){
        for(j=0;j<rowsA;j++){
            D[i*rowsA+j]=0;
            for(k=0;k<common;k++){
                D[i*rowsA+j]+=A[k*rowsA+j]*B[k+common*i];
            }
        }
    }

    print("A", A, rowsA, common); print("B", B, common, colsB);
    print("C", C, rowsA, colsB); print("D", D, rowsA, colsB);

    return 0;
}

```

In z/OS XL C/C++

You can use the following commands to compile and link the program in z/OS XL C/C++:

To compile the program for ARCH(10):

```

xlc -c -qfloat=ieee -qround=n -qarch=10 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.c

```

To link the program for ARCH(10):

```

xlc sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch10
-latlas.arch10 -lf2c.arch10 -qfloat=ieee -o sample

```

To compile the program for ARCH(11):

```

xlc -c -qfloat=ieee -qround=n -qarch=11 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.c

```

To link the program for ARCH(11):

```

xlc sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch11
-latlas.arch11 -lf2c.arch11 -qfloat=ieee -o sample

```

To compile the program for ARCH(12) and higher ARCHITECTURE levels:

```

xlc -c -qfloat=ieee -qround=n -qarch=12 -qtarget=zosv2r3 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.c

```

To link the program for ARCH(12) and higher ARCHITECTURE levels:

```

xlc sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch12
-latlas.arch12 -lf2c.arch12 -qfloat=ieee -o sample

```

In Open XL C/C++ for z/OS

You can use the following commands to compile and link the program in Open XL C/C++ for z/OS:

To compile the program for **-march=zEC12**:

```
ibm-clang64 -c -fno-rounding-math -march=zEC12 -mzos-target=zosv2r4 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.c
```

To link the program for **-march=zEC12**:

```
ibm-clang64 sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch10
-latlas.arch10 -lf2c.arch10 -o sample
```

To compile the program for **-march=z13**:

```
ibm-clang64 -c -fno-rounding-math -march=z13 -mzos-target=zosv2r4 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.c
```

To link the program for **-march=z13**:

```
ibm-clang64 sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch11
-latlas.arch11 -lf2c.arch11 -o sample
```

To compile the program for **-march=z14** and higher:

```
ibm-clang64 -c -fno-rounding-math -march=z14 -mzos-target=zosv2r5 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.c
```

To link the program for **-march=z14** and higher:

```
ibm-clang64 sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch12
-latlas.arch12 -lf2c.arch12 -o sample
```

Sample 2

This program contains a C++ invocation of the Fortran BLAS function `dgemm_` provided by the ATLAS framework.

Observation: As opposed to sample 1, the compiler must be explicitly instructed that the function `dgemm_` has C linkage and thus no mangling should be attempted. This can be achieved either as specified, or by including the appropriate header file with the extern "C" designation.

Source code:

```
#include <stdio.h>
#include <time.h>
#include <stdlib.h>

extern "C"
{
    int dgemm_(char *, char *, int *, int *, int *, double *, double *, int *,
              double *, int *, double *, double *, int *);
}

void init(double* matrix, int row, int column)
{
    for (int j = 0; j < column; j++){
        for (int i = 0; i < row; i++){
            matrix[j*row + i] = ((double)rand())/RAND_MAX;
        }
    }
}

void print(const char * name, const double* matrix, int row, int column)
{
    printf("Matrix %s has %d rows and %d columns:\n", name, row, column);
    for (int i = 0; i < row; i++){
        for (int j = 0; j < column; j++){
            printf("%.3f ", matrix[j*row + i]);
        }
    }
}
```

```

    }
    printf("\n");
}
printf("\n");
}

int main(int argc, char * argv[])
{
    int rowsA, colsB, common;
    int i,j,k;

    if (argc != 4){
        printf("Using defaults\n");
        rowsA = 2; colsB = 4; common = 6;
    }
    else{
        rowsA = atoi(argv[1]); colsB = atoi(argv[2]); common = atoi(argv[3]);
    }

    double A[rowsA * common]; double B[common * colsB];
    double C[rowsA * colsB]; double D[rowsA * colsB];

    char transA = 'N', transB = 'N';
    double one = 1.0, zero = 0.0;

    srand(time(NULL));

    init(A, rowsA, common); init(B, common, colsB);

    dgemm_(&transA, &transB, &rowsA, &colsB, &common, &one, A,
        &rowsA, B, &common, &zero, C, &rowsA);

    for(i=0;i<colsB;i++){
        for(j=0;j<rowsA;j++){
            D[i*rowsA+j]=0;
            for(k=0;k<common;k++){
                D[i*rowsA+j]+=A[k*rowsA+j]*B[k+common*i];
            }
        }
    }

    print("A", A, rowsA, common); print("B", B, common, colsB);
    print("C", C, rowsA, colsB); print("D", D, rowsA, colsB);

    return 0;
}

```

In z/OS XL C/C++

You can use the following commands to compile and link the program in z/OS XL C/C++:

To compile the program for ARCH(10):

```

xlC -c -qfloat=ieee -qround=n -qarch=10 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.C

```

To link the program for ARCH(10):

```

xlC sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch10
-latlas.arch10 -lf2c.arch10 -qfloat=ieee -o sample

```

To compile the program for ARCH(11):

```

xlC -c -qfloat=ieee -qround=n -qarch=11 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.C

```

To link the program for ARCH(11):

```

xlC sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch11
-latlas.arch11 -lf2c.arch11 -qfloat=ieee -o sample

```

To compile the program for ARCH(12) and higher ARCHITECTURE levels:

```

xlC -c -qfloat=ieee -qround=n -qarch=12 -qtarget=zosv2r3 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.C

```

To link the program for ARCH(12) and higher ARCHITECTURE levels:

```
xlc sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch12
-latlas.arch12 -lf2c.arch12 -qfloat=ieee -o sample
```

In Open XL C/C++ for z/OS

You can use the following commands to compile and link the program in Open XL C/C++ for z/OS:

To compile the program for **-march=zEC12**:

```
ibm-clang++64 -c -fno-rounding-math -march=zEC12 -mzos-target=zosv2r4 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.C
```

To link the program for **-march=zEC12**:

```
ibm-clang++64 sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch10
-latlas.arch10 -lf2c.arch10 -o sample
```

To compile the program for **-march=z13**:

```
ibm-clang++64 -c -fno-rounding-math -march=z13 -mzos-target=zosv2r4 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.C
```

To link the program for **-march=z13**:

```
ibm-clang++64 sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch11
-latlas.arch11 -lf2c.arch11 -o sample
```

To compile the program for **-march=z14** and higher:

```
ibm-clang++64 -c -fno-rounding-math -march=z14 -mzos-target=zosv2r5 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.C
```

To link the program for **-march=z14** and higher:

```
ibm-clang++64 sample.o -L /usr/lpp/cbclib/lib/atlas -lf77blas.arch12
-latlas.arch12 -lf2c.arch12 -o sample
```

Sample 3

This program contains a C invocation of the CBLAS function `cbblas_dgemm_` provided by the ATLAS framework.

Observation: Same result and functionality as if `dgemm_` would be called, but this program uses the CBLAS version of the functions.

Source code:

```
#include <time.h>
#include <stdlib.h>
#include <cbblas.h>

void init(double* matrix, int row, int column)
{
    for (int j = 0; j < column; j++){
        for (int i = 0; i < row; i++){
            matrix[j*row + i] = ((double)rand())/RAND_MAX;
        }
    }
}

void print(const char * name, const double* matrix, int row, int column)
{
    printf("Matrix %s has %d rows and %d columns:\n", name, row, column);
    for (int i = 0; i < row; i++){
        for (int j = 0; j < column; j++){
            printf("%.3f ", matrix[j*row + i]);
        }
        printf("\n");
    }
}
```

```

    }
    printf("\n");
}

int main(int argc, char * argv[])
{
    int rowsA, colsB, common;
    int i,j,k;

    if (argc != 4){
        printf("Using defaults\n");
        rowsA = 2; colsB = 4; common = 6;
    }
    else{
        rowsA = atoi(argv[1]); colsB = atoi(argv[2]); common = atoi(argv[3]);
    }

    double A[rowsA * common]; double B[common * colsB];
    double C[rowsA * colsB]; double D[rowsA * colsB];

    enum CBLAS_ORDER order = CblasColMajor;
    enum CBLAS_TRANSPOSE transA = CblasNoTrans;
    enum CBLAS_TRANSPOSE transB = CblasNoTrans;

    double one = 1.0, zero = 0.0;

    srand(time(NULL));

    init(A, rowsA, common); init(B, common, colsB);

    cblas_dgemm(order,transA,transB, rowsA, colsB, common ,1.0,A,
                rowsA ,B, common ,0.0,C, rowsA);

    for(i=0;i<colsB;i++){
        for(j=0;j<rowsA;j++){
            D[i*rowsA+j]=0;
            for(k=0;k<common;k++){
                D[i*rowsA+j]+=A[k*rowsA+j]*B[k+common*i];
            }
        }
    }

    print("A", A, rowsA, common); print("B", B, common, colsB);
    print("C", C, rowsA, colsB); print("D", D, rowsA, colsB);

    return 0;
}

```

In z/OS XL C/C++

You can use the following commands to compile and link the program in z/OS XL C/C++:

To compile the program for ARCH(10):

```

xlc -c -qfloat=ieee -qround=n -qarch=10 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.c

```

To link the program for ARCH(10):

```

xlc sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch10
-latlas.arch10 -qfloat=ieee -o sample

```

To compile the program for ARCH(11):

```

xlc -c -qfloat=ieee -qround=n -qarch=11 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.c

```

To link the program for ARCH(11):

```

xlc sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch11
-latlas.arch11 -qfloat=ieee -o sample

```

To compile the program for ARCH(12) and higher ARCHITECTURE levels:

```
xlc -c -qfloat=ieee -qround=n -qarch=12 -qtarget=zosv2r3 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.c
```

To link the program for ARCH(12) and higher ARCHITECTURE levels:

```
xlc sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch12
-latlas.arch12 -qfloat=ieee -o sample
```

In Open XL C/C++ for z/OS

You can use the following commands to compile and link the program in Open XL C/C++ for z/OS:

To compile the program for **-march=zEC12**:

```
ibm-clang64 -c -fno-rounding-math -march=zEC12 -mzos-target=zosv2r4 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.c
```

To link the program for **-march=zEC12**:

```
ibm-clang64 sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch10
-latlas.arch10 -lf2c.arch10 -o sample
```

To compile the program for **-march=z13**:

```
ibm-clang64 -c -fno-rounding-math -march=z13 -mzos-target=zosv2r4 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.c
```

To link the program for **-march=z13**:

```
ibm-clang64 sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch11
-latlas.arch11 -o sample
```

To compile the program for **-march=z14** and higher:

```
ibm-clang64 -c -fno-rounding-math -march=z14 -mzos-target=zosv2r5 -I
/usr/lpp/cbclib/include/atlas -o sample.o sample.c
```

To link the program for **-march=z14** and higher:

```
ibm-clang64 sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch12
-latlas.arch12 -o sample
```

Sample 4

This program contains a C++ invocation of the CBLAS function `cbblas_dgemm_` provided by the ATLAS framework.

Observation: Same result and functionality as if `dgemm_` would be called, but this program uses the CBLAS version of the functions.

Source code:

```
#include <time.h>
#include <stdlib.h>

extern "C"
{
#include <cbblas.h>
}

void init(double* matrix, int row, int column)
{
    for (int j = 0; j < column; j++){
        for (int i = 0; i < row; i++){
            matrix[j*row + i] = ((double)rand())/RAND_MAX;
        }
    }
}
```

```

void print(const char * name, const double* matrix, int row, int column)
{
    printf("Matrix %s has %d rows and %d columns:\n", name, row, column);
    for (int i = 0; i < row; i++){
        for (int j = 0; j < column; j++){
            printf("%.3f ", matrix[j*row + i]);
        }
        printf("\n");
    }
    printf("\n");
}

int main(int argc, char * argv[])
{
    int rowsA, colsB, common;
    int i,j,k;

    if (argc != 4){
        printf("Using defaults\n");
        rowsA = 2; colsB = 4; common = 6;
    }
    else{
        rowsA = atoi(argv[1]); colsB = atoi(argv[2]); common = atoi(argv[3]);
    }

    double A[rowsA * common]; double B[common * colsB];
    double C[rowsA * colsB]; double D[rowsA * colsB];

    enum CBLAS_ORDER order = CblasColMajor;
    enum CBLAS_TRANSPOSE transA = CblasNoTrans;
    enum CBLAS_TRANSPOSE transB = CblasNoTrans;

    double one = 1.0, zero = 0.0;

    srand(time(NULL));

    init(A, rowsA, common); init(B, common, colsB);

    cblas_dgemm(order,transA,transB, rowsA, colsB, common ,1.0,A,
                rowsA ,B, common ,0.0,C, rowsA);

    for(i=0;i<colsB;i++){
        for(j=0;j<rowsA;j++){
            D[i*rowsA+j]=0;
            for(k=0;k<common;k++){
                D[i*rowsA+j]+=A[k*rowsA+j]*B[k+common*i];
            }
        }
    }

    print("A", A, rowsA, common); print("B", B, common, colsB);
    print("C", C, rowsA, colsB); print("D", D, rowsA, colsB);

    return 0;
}

```

In z/OS XL C/C++

You can use the following commands to compile and link the program in z/OS XL C/C++:

To compile the program for ARCH(10):

```

xlC -c -qfloat=ieee -qround=n -qarch=10 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.C

```

To link the program for ARCH(10):

```

xlC sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch10
-latlas.arch10 -qfloat=ieee -o sample

```

To compile the program for ARCH(11):

```

xlC -c -qfloat=ieee -qround=n -qarch=11 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.C

```

To link the program for ARCH(11):

```
xlC sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch11  
-latlas.arch11 -qfloat=ieee -o sample
```

To compile the program for ARCH(12) and higher ARCHITECTURE levels:

```
xlC -c -qfloat=ieee -qround=n -qarch=12 -qtarget=zosv2r3 -I  
/usr/lpp/cbclib/include/atlas -qfloat=ieee -o sample.o sample.C
```

To link the program for ARCH(12) and higher ARCHITECTURE levels:

```
xlC sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch12  
-latlas.arch12 -qfloat=ieee -o sample
```

In Open XL C/C++ for z/OS

You can use the following commands to compile and link the program in Open XL C/C++ for z/OS:

To compile the program for **-march=zEC12**:

```
ibm-clang++64 -c -fno-rounding-math -march=zEC12 -mzos-target=zosv2r4 -I  
/usr/lpp/cbclib/include/atlas -o sample.o sample.C
```

To link the program for **-march=zEC12**:

```
ibm-clang++64 sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch10  
-latlas.arch10 -o sample
```

To compile the program for **-march=z13**:

```
ibm-clang++64 -c -fno-rounding-math -march=z13 -mzos-target=zosv2r4 -I  
/usr/lpp/cbclib/include/atlas -o sample.o sample.C
```

To link the program for **-march=z13**:

```
ibm-clang++64 sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch11  
-latlas.arch11 -o sample
```

To compile the program for **-march=z14** and higher:

```
ibm-clang++64 -c -fno-rounding-math -march=z14 -mzos-target=zosv2r5 -I  
/usr/lpp/cbclib/include/atlas -o sample.o sample.C
```

To link the program for **-march=z14** and higher:

```
ibm-clang++64 sample.o -L /usr/lpp/cbclib/lib/atlas -lcblas.arch12  
-latlas.arch12 -o sample
```

Examples - Compiling, linking, and running a complex ATLAS sample

This section assumes that a complex test sample, `inv tst.c`, ships with the ATLAS source code. This program is a complex sample that combines ATLAS specific, CBLAS, and LAPACK functionality that has to be compiled using the C compiler.

Example of ATLAS specific functions being called in this sample: `ATL_flushcache`, `ATL_assert`, `ATL_DivBySize`, and `ATL_MulBySize`.

Example of CBLAS specific functions being called in this sample: `cblas_asum`, `cblas_sasum`, `cblas_dzasum`, `cblas_copy`, `cblas_gemm`, `cblas_symm`, and `cblas_hemm`.

ATLAS header files being used: `atlas_misc.h`, `atlas_lapack.h`, `cblas.h`, `atlas_cblastypealias.h`, `atlas_tst.h`, `atlas_level3.h`, and `clapack.h`.

You can use the following commands to compile and link the program in z/OS XL C/C++:

To compile `invstst.c` for ARCH(10):

```
xlc -c -qfloat=ieee -qround=n -qarch=10 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qlANGLVL=EXTC99 -DL2SIZE=4194304
-DAdd_ -DF77_INTEGER=int -DStringSunStyle -DATL_NCPU=20 -DATLCINT
-DSREAL -DWALL -DATL_CPUMHZ=5564 -DATL_OS_s390 -o invstst.o invstst.c
```

To link the program for ARCH(10):

```
xlc invstst.o -L /usr/lpp/cbclib/lib/atlas -ltstatlas.arch10
-llapack.arch10 -lcbblas.arch10 -lf77blas.arch10 -latlas.arch10
-lf2c.arch10 -o invstst
```

To compile `invstst.c` for ARCH(11):

```
xlc -c -qfloat=ieee -qround=n -qarch=11 -qtarget=zosv2r1 -I
/usr/lpp/cbclib/include/atlas -qlANGLVL=EXTC99 -DL2SIZE=4194304
-DAdd_ -DF77_INTEGER=int -DStringSunStyle -DATL_NCPU=20 -DATLCINT
-DSREAL -DWALL -DATL_CPUMHZ=5564 -DATL_OS_s390 -o invstst.o invstst.c
```

To link the program for ARCH(11):

```
xlc invstst.o -L /usr/lpp/cbclib/lib/atlas -ltstatlas.arch11
-llapack.arch11 -lcbblas.arch11 -lf77blas.arch11 -latlas.arch10
-lf2c.arch11 -o invstst
```

To compile `invstst.c` for ARCH(12) and higher ARCHITECTURE levels:

```
xlc -c -qfloat=ieee -qround=n -qarch=12 -qtarget=zosv2r3 -I
/usr/lpp/cbclib/include/atlas -qlANGLVL=EXTC99 -DL2SIZE=4194304
-DAdd_ -DF77_INTEGER=int -DStringSunStyle -DATL_NCPU=20 -DATLCINT
-DSREAL -DWALL -DATL_CPUMHZ=5564 -DATL_OS_s390 -o invstst.o invstst.c
```

To link the program for ARCH(12) and higher ARCHITECTURE levels:

```
xlc invstst.o -L /usr/lpp/cbclib/lib/atlas -ltstatlas.arch12
-llapack.arch12 -lcbblas.arch12 -lf77blas.arch12 -latlas.arch12
-lf2c.arch12 -o invstst
```

where:

- L2SIZE represents the size of the L2 cache on the target machine, namely the machine on which the executable will be run.
- Add_, F77_INTEGER, and StringSunStyle are Fortran defines outlining the inter-language interaction between C and Fortran code on z/OS.
- ATL_NCPU represents the number of CPUs on the target hardware where the executable will be run.
- ATLCINT and SREAL are ATLAS specific defines.
- WALL instructs the ATLAS framework to issue all possible warnings.
- ATL_CPUMHZ represents the speed of the target architecture where the executable will be run.
- ATL_OS_s390 instructs ATLAS that a z/OS operating system is used for compile operations.

When ran, the executable will produce the following output:

| NREPS | ORDER | UPLD | N | LDA | TIME | MFLOP | RESID |
|--|-------|-------|-------|-------|-------|---------|--------------|
| ===== | ===== | ===== | ===== | ===== | ===== | ===== | ===== |
| 0 | Col | GE | 100 | 100 | 0.027 | 73.97 | 8.918092e-03 |
| 0 | Col | GE | 200 | 200 | 0.005 | 3024.80 | 6.950735e-03 |
| 0 | Col | GE | 300 | 300 | 0.015 | 3535.71 | 8.034554e-03 |
| 0 | Col | GE | 400 | 400 | 0.034 | 3783.16 | 9.250009e-03 |
| 0 | Col | GE | 500 | 500 | 0.063 | 3937.21 | 7.678587e-03 |
| 0 | Col | GE | 600 | 600 | 0.107 | 4046.78 | 9.520883e-03 |
| 0 | Col | GE | 700 | 700 | 0.167 | 4097.17 | 8.519278e-03 |
| 0 | Col | GE | 800 | 800 | 0.247 | 4148.75 | 8.575264e-03 |
| 0 | Col | GE | 900 | 900 | 0.346 | 4217.16 | 1.272196e-02 |
| 0 | Col | GE | 1000 | 1000 | 0.471 | 4247.66 | 8.753754e-03 |
| 10 cases: 10 passed, 0 skipped, 0 failed | | | | | | | |

Related external information

For details about the ATLAS libraries, such as lists of functions included in the various libraries, visit the [ATLAS home page \(math-atlas.sourceforge.net\)](http://math-atlas.sourceforge.net).

Using OpenBLAS library

OpenBLAS library is a BLAS (Basic Linear Algebra Subroutines) library, which contains a set of routines that provide matrix/vector linear algebra functions. OpenBLAS runs on IBM z14® or newer and supports dynamic linking to it.

Installation location

- /usr/lpp/cbclib/lib/
 - Dynamic library: libopenblas.dll
 - Side deck: libopenblas.x
- /usr/lpp/cbclib/include/openblas/
 - Header files: cblas.h and others (not included as MVS data sets)

Using OpenBLAS with an application running unauthorized

You can compile your program with the OpenBLAS library. For example, in Open XL C/C++ for z/OS:

```
ibm-clang64 main.c -c -I/usr/lpp/cbclib/include/openblas/
```

You can use the following command to link the OpenBLAS library in Open XL C/C++ for z/OS.

```
ibm-clang64 main.o /usr/lpp/cbclib/include/openblas/
```

Set the LIBPATH environment variable.

```
export LIBPATH=$LIBPATH:/usr/lpp/cbclib/lib/
```

Then, run the executable file.

```
a.out
```

Using OpenBLAS with an application running authorized

When running authorized, certain operations, such as printing, are restricted. OpenBLAS might need to print error messages under certain circumstances, so it is good practice to supply your print functions for OpenBLAS to call instead of the default print functions when running authorized; otherwise, OpenBLAS might abend if an error condition is encountered.

To supply alternative functions, take the following steps:

1. Write your alternative functions for `printf`, `fprintf`, `vfprintf`, and `pererror`, which use authorized services only and have the same prototypes as the original functions. The alternative functions must handle errors in a way that is appropriate for the application. For example, they can write to a job log by using authorized services, such as Write To Operator, or they can send a return code to the calling program.
2. In your application program, include `cblas.h` and `common.h`.
3. In your application program, before calling any other OpenBLAS functions, call the following functions to set OpenBLAS to use your alternative functions instead of the defaults, passing each a pointer to your corresponding alternative function:
 - `__openblas_set_printf`

- `__openblas_set_fprintf`
- `__openblas_set_vfprintf`
- `__openblas_set_perror`

4. Specify the following compile options when compiling your application program:

```
-DzOS -D__OPENBLAS_AUTHORIZED_ZOS
```

Example

The following example shows how an application program calls OpenBLAS running authorized.

```
/* main.c */

#include <stdio.h>
#include <stdarg.h>
#include "cblas.h"
#include "common.h"

// User-supplied alternative print functions for running authorized
// Note: The commented-out calls to vprintf, fprintf, and perror must be replaced by
//      user-supplied code that uses only authorized services.

// User-supplied alternative function for printf
int my_printf (const char *fmt, ...) {
    va_list args;
    va_start (args, fmt);
    /* vprintf (fmt, args); */ // Replace with code using only authorized services
    va_end (args);
    return 0;
}

// User-supplied alternative function for fprintf
int my_fprintf (FILE *fp, const char *fmt, ...) {
    va_list args;
    va_start (args, fmt);
    /* fprintf (fp, fmt, args); */ // Replace with code using only authorized services
    va_end (args);
    return 0;
}

// User-supplied alternative function for vfprintf
int my_vfprintf (FILE *fp, const char *fmt, char **args) {
    /* vfprintf (fp, fmt, args); */ // Replace with code using only authorized services
    return 0;
}

// User-supplied alternative function for perror
void my_perror (const char *msg) {
    extern int errno;
    /* printf ("my_perror: %s errno=%d\n", msg, errno); */ // Replace with code using only
    authorized services
}

main(){
    // Set OpenBLAS to use the alternative print functions
    __openblas_set_printf (&my_printf);
    __openblas_set_fprintf (&my_fprintf);
    __openblas_set_vfprintf (&my_vfprintf);
    __openblas_set_perror (&my_perror);

    // Application code that calls OpenBLAS goes here
}
```

Compiling, linking, and running an application running authorized that uses OpenBLAS

You can compile your program with the OpenBLAS library. For example, in Open XL C/C++ for z/OS:

```
ibm-clang64 main.c -DzOS -D__OPENBLAS_AUTHORIZED_ZOS -c -I/usr/lpp/cbclib/include/openblas/
```

You can use the following command to link the OpenBLAS library. For example, in Open XL C/C++ for z/OS:

```
ibm-clang64 main.o /usr/lpp/cbclib/lib/libopenblas.x
```

Set the LIBPATH environment variable.

```
export LIBPATH=$LIBPATH:/usr/lpp/cbclib/lib/
```

Then, run the executable file.


```
a.out
```

Related information

- For a list of OpenBLAS functions and code examples of calling the functions, see [code examples \(github.com/xianyi/OpenBLAS/wiki/User-Manual#code-examples\)](https://github.com/xianyi/OpenBLAS/wiki/User-Manual#code-examples).
- For description of the authorized program facility, see [Authorized Program Facility and Access Method Services](#).
- For a list of services that are provided when running authorized, see [Library function support](#).

Appendix A. IBM z/OS C/C++ compiler feature reference

The following table describes the usage of the supported features by the z/OS XL C/C++ and Open XL C/C++ for z/OS compilers.

| Feature | z/OS XL C/C++ | Open XL C/C++ for z/OS |
|---|--|--|
| 31-bit addressing mode | Specify ILP32 to select the 31-bit addressing mode, under which the compiler generates AMODE 31 code. | Specify -m32n , -m32n-d11 , or -m32 to select the 31-bit addressing mode, under which the compiler generates AMODE 31 code. |
| 64-bit addressing mode | Specify LP64 to select the 64-bit addressing mode, under which the compiler generates AMODE 64 code. | Specify -m64 to select the 64-bit addressing mode, under which the compiler generates AMODE 64 code. |
| C11 standard based compilation | Specify LANGLVL(EXTC1X) for C11 standard-based compilation, invoking all the currently supported C11 features and other implementation-specific language extensions. | Specify -std=c11 for ISO C 2011 standard based compilation or -std=gnu11 for ISO C 2011 standard based compilation with GNU extensions. |
|  C++ exception handling | C++ exception handling is enabled by default. Specify NOEXH to disable C++ exception handling support. | C++ exception handling is enabled by default. You can disable C++ exception handling support with the -fignore-exceptions option. |
| Compiler option to define macros | Specify DEFINE to define a macro. . | Specify -D to define a macro. |
| Extended language level | Specify LANGLVL(EXTENDED) to enable the extended language level. See detail . | Additional z/OS library functions are available only when the macro <code>_EXT</code> is defined. |
| Generate object code for DLLs or DLL applications | Specify DLL to generate object code for DLLs or DLL applications. | Specify -m32 or -m64 to enable the XPLINK linkage, which supports DLL by default; or specify -m32n to enable the DLL linkage in 31-bit addressing mode. |
| Generate reentrant code | Specify NORENT to not generate reentrant code from non-reentrant code. Any naturally reentrant code remains reentrant. | Specify -mno-rent to not generate reentrant code from non-reentrant code. Any naturally reentrant code remains reentrant. |
| Hexadecimal floating-point representation | Specify FLOAT(HEX) for hexadecimal floating-point representation. | Specify -mzos-float-kind=hex for hexadecimal floating-point representation. |
| IEEE decimal floating-point types | Specify DFP to enable support for decimal floating-point types. | Not supported. |
| IEEE floating-point representation | Specify FLOAT(IEEE) for IEEE floating-point representation. | Specify -mzos-float-kind=ieee for IEEE floating-point representation. |

| Feature | z/OS XL C/C++ | Open XL C/C++ for z/OS |
|--|---|---|
| ISO C/C++ compliant | Specify LANGLVL(ANSI) and later ISO standards and extensions to compile code that is ISO C/C++ compliant. | Supports specific language standards under the -std=<standard_version> option. |
| List stored line numbers | Specify GONUMBER NOGONUMBER to generate line number tables that correspond to the input source file for Debug Tool and CEEDUMP processing. | Not supported. |
| List function relative offset addresses | Specify OFFSET to list offset addresses relative to entry points of functions. | Not supported. |
| Long external names | Specify LONGNAME or any language level that supports the <code>long long</code> data type (such as C99 and later) to support external names of mixed case and up to 1024 characters long. | The compiler supports long external names by default. Specify -mshort-name to enable support for short names. |
| <code>long long</code> data type support | Specify LANGLVL(LONGLONG) or any language level of C99 and newer to support the <code>long long</code> data type. | Always supported. |
| MVS environment | Compile your programs in a batch environment, which runs a batch job and uses dataset-based files for input or output. | Compile your programs in a batch environment, which runs a batch job and uses dataset-based files for input or output. |
| Operating system parameter list | Specify PLIST(OS) to make the original operating system parameter list available. | Not supported. |
| Processor architecture | Specify ARCHITECTURE to generate code for a specific processor architecture. | Specify -march to generate code for a specific processor architecture. |
| Round-to-nearest rounding mode | Specify ROUND(N) to enable the round-to-nearest rounding mode. | Specify -fno-rounding-math and -march=zEC12 or higher to enable the round-to-nearest rounding mode. |
| Runtime library extensions | Additional z/OS library functions are available only when the macro <code>_EXT</code> is defined or LANGLVL(EXTENDED) is specified. | Additional z/OS library functions are available only when the macro <code>_EXT</code> is defined. |
| SAA-based language constructs | Specify LANGLVL(SAA) or LANGLVL(SAAL2) to enable the SAA or SAAL2 language level. | Not supported. |
| Target operating system release | Specify TARGET to generate an object module for the target operating system or runtime library. | Specify -mzos-target (www.ibm.com/docs/en/open-xl-c-cpp-zos/latest?topic=options-mzos-target) to control which z/OS level is assumed for running your program. |





| Feature | z/OS XL C/C++ | Open XL C/C++ for z/OS |
|-------------------------------|--|---|
| Vector programming support | See VECTOR on how to enable vector programming support. | Specify the following options to enable vector programming support: -mvx , -mzvector , -fvectorize , or -fslp-vectorize . |
| XPLINK linkage | Specify XPLINK to use the XPLINK linkage that is designed to increase performance on z/OS. | Specify -m32 and -m64 to generate XPLINK linkage code. |
| z/OS UNIX invocation commands | Provides two basic invocation commands, xlc and xlc (xlc++) , along with several other compiler invocation commands to support various C/C++ language levels and compilation environments under z/OS UNIX. | Provides the ibm-clang and ibm-clang64 invocation commands to compile and link C programs and the ibm-clang++ and ibm-clang++64 invocation commands to compile and link C++ programs. . |

Related information

- For more information about the features and options that are supported by the Open XL C/C++ for z/OS compiler, see the [Open XL C/C++ for z/OS documentation](#).

z/OS XL C/C++ feature reference

The following table describes the features of z/OS XL C/C++.

| Feature | Description |
|--|--|
| 31-bit addressing mode | Specify ILP32 to select the 31-bit addressing mode, under which the compiler generates AMODE 31 code. |
| 64-bit addressing mode | Specify LP64 to select the 64-bit addressing mode, under which the compiler generates AMODE 64 code. |
| C11 standard based compilation | Specify LANGLVL(EXTC1X) for C11 standard-based compilation, invoking all the currently supported C11 features and other implementation-specific language extensions. |
|  C++ exception handling | C++ exception handling is enabled by default. You can disable C++ exception handling support with the NOEXH option. |
| Compiler option to define macros | Specify DEFINE to define a macro. |
| Extended language level | <ul style="list-style-type: none">  LANGLVL(EXTENDED) indicates that all language constructs are available with z/OS XL C. It enables language extensions to the ISO C standard.  LANGLVL(EXTENDED) indicates that all language constructs are available with z/OS XL C++. It enables language extensions to the ISO C++ standard. |
| Generate object code for DLLs or DLL applications | Specify DLL to generate object code for DLLs or DLL applications. |
| Generate reentrant code |  Specify NORENT to not generate reentrant code from non-reentrant code. Any naturally reentrant code remains reentrant. |
| Hexadecimal floating-point representation | Specify FLOAT(HEX) for hexadecimal floating-point representation. |


| Feature | Description |
|---|---|
| IEEE decimal floating-point types | Specify DFP to enable support for decimal floating-point types. |
| IEEE floating-point representation | Specify FLOAT(IEEE) for IEEE floating-point representation. |
| ISO C/C++ compliant | Specify LANGLVL(ANSI) and later ISO standards and extensions to compile code that is ISO C/C++ compliant. |
| List stored line numbers | Specify GONUMBER NOGONUMBER to generate line number tables that correspond to the input source file for Debug Tool and CEEDUMP processing. |
| List function relative offset addresses | Specify OFFSET to list offset addresses relative to entry points of functions. |
| Long external names | Specify LONGNAME or any language level that supports the long long data type (such as C99 and later) to support external names of mixed case and up to 1024 characters long. |
| long long data type support | Specify LANGLVL(LONGLONG) or any language level of C99 and newer to support the long long data type. |
| MVS environment | Compile your programs in a batch environment, which runs a batch job and uses dataset-based files for input or output. |
| Operating system parameter list | Specify PLIST(OS) to make the original operating system parameter list available. |
| Processor architecture | Specify ARCHITECTURE to generate code for a specific processor architecture. |
| Round-to-nearest rounding mode | Specify ROUND(N) to enable the round-to-nearest rounding mode. |
| Runtime library extensions | Additional z/OS library functions are available only when the macro <code>_EXT</code> is defined or LANGLVL(EXTENDED) is specified. |
| SAA-based language constructs | Specify LANGLVL(SAA) or LANGLVL(SAAL2) to indicate language constructs that are defined by SAA or SAA Level 2. |
| Target operating system release | Specify TARGET to generate an object module for the target operating system or runtime library. |
| Vector programming support | See VECTOR on how to enable vector programming support. |
| XPLINK linkage | Specify XPLINK to use the XPLINK linkage that is designed to increase performance on z/OS. |
| z/OS UNIX invocation commands | Provides two basic invocation commands, xlc and xlc (xlc+) , along with several other compiler invocation commands to support various C/C++ language levels and compilation environments under z/OS UNIX. |

Related information

[Compiler options](#)

Open XL C/C++ 2.1 for z/OS feature reference

The following table describes the features of Open XL C/C++ 2.1 for z/OS.

| Feature | Description |
|--|--|
| 31-bit addressing mode | Specify -m32n , -m32n-d11 , or -m32 to select the 31-bit addressing mode, under which the compiler generates AMODE 31 code. |
| 64-bit addressing mode | Specify -m64 to select the 64-bit addressing mode, under which the compiler generates AMODE 64 code. |
| C11 standard based compilation | Specify -std=c11 for ISO C 2011 standard based compilation or -std=gnu11 for ISO C 2011 standard based compilation with GNU extensions. |
|  C++ exception handling | C++ exception handling is enabled by default. You can disable C++ exception handling support with the -fignore-exceptions option. |
| Compiler option to define macros | Specify the -D compiler option to define a macro. |
| Extended language level | Additional z/OS library functions are available only when the macro <code>_EXT</code> is defined. |
| Generate object code for DLLs or DLL applications | Specify -m32 or -m64 to enable the XPLINK linkage, which supports DLL by default; or specify -m32n to enable the DLL linkage in 31-bit addressing mode. |
| Generate reentrant code | Specify -mno-rent to not generate reentrant code from non-reentrant code. Any naturally reentrant code remains reentrant. |
| Hexadecimal floating-point representation | Specify -mzos-float-kind=hex for hexadecimal floating-point representation. |
| IEEE decimal floating-point types | Not supported. |
| IEEE floating-point representation | Specify -mzos-float-kind=ieee for IEEE floating-point representation. |
| ISO C/C++ compliant | Supports specific language standards under the -std=<standard_version> option. |
| List stored line numbers | Not supported. |
| List function relative offset addresses | Not supported. |
| Long external names | The compiler supports long external names by default. Specify -mshort-name to enable support for short names. |
| long long data type support | Always supported. |
| MVS environment | Compile your programs in a batch environment, which runs a batch job and uses dataset-based files for input or output. |
| Operating system parameter list | Not supported. |
| Processor architecture | Specify -march to generate code for a specific processor architecture. |
| Round-to-nearest rounding mode | Specify -fno-rounding-math and -march=zEC12 or higher to enable the round-to-nearest rounding mode. |
| Runtime library extensions | Additional z/OS library functions are available only when the macro <code>_EXT</code> is defined. |
| SAA-based language constructs | Not supported. |


| Feature | Description |
|---------------------------------|--|
| Target operating system release | Specify -mzos-target (www.ibm.com/docs/en/open-xl-c-cpp-zos/latest?topic=options-mzos-target) to control which z/OS level is assumed for running your program. |
| Vector programming support | Specify the following options to enable vector programming support: -mvx , -mzvector , -fvectorize , or -fslp-vectorize . |
| XPLINK linkage | Specify -m32 and -m64 to generate XPLINK linkage code. |
| z/OS UNIX invocation commands | Provides the ibm-clang and ibm-clang64 invocation commands to compile and link C programs and the ibm-clang++ and ibm-clang++64 invocation commands to compile and link C++ programs. |

Related information

- For more information about the features and options that are supported by the Open XL C/C++ 2.1 for z/OS compiler, see the [Open XL C/C++ 2.1 for z/OS documentation](#).

Open XL C/C++ 1.1 for z/OS feature reference

The following table describes the features of Open XL C/C++ 1.1 for z/OS.

| Feature | Description |
|--|---|
| 64-bit addressing mode | Specify -m64 to select the 64-bit addressing mode, under which the compiler generates AMODE 64 code. |
| C11 standard based compilation | Specify -std=c11 for ISO C 2011 standard based compilation or -std=gnu11 for ISO C 2011 standard based compilation with GNU extensions. |
|  C++ exception handling | C++ exception handling is enabled by default. You can disable C++ exception handling support with the -fignore-exceptions option. |
| Compiler option to define macros | Specify the -D compiler option to define a macro. |
| Extended language level | Additional z/OS library functions are available only when the macro <code>_EXT</code> is defined. |
| Generate object code for DLLs or DLL applications | The compiler generates XPLINK linkage code by default and does not require an option to enable DLL support. |
| Generate reentrant code | Specify -mno-rent to not generate reentrant code from non-reentrant code. Any naturally reentrant code remains reentrant. |
| Hexadecimal floating-point representation | Not supported. |
| IEEE decimal floating-point types | Not supported. |
| IEEE floating-point representation | The compiler generates an IEEE floating-point representation. |
| ISO C/C++ compliant | Supports specific language standards under the -std=<standard_version> option. |
| List stored line numbers | Not supported. |
| List function relative offset addresses | Not supported. |

| Feature | Description |
|---------------------------------|---|
| Long external names | Supported |
| long long data type support | Always supported. |
| MVS environment | Not supported. |
| Operating system parameter list | Not supported. |
| Processor architecture | Specify -march to generate code for a specific processor architecture. |
| Round-to-nearest rounding mode | Specify -fno-rounding-math and -march=zEC12 or higher to enable the round-to-nearest rounding mode. |
| Runtime library extensions | Additional z/OS library functions are available only when the macro <code>_EXT</code> is defined. |
| SAA-based language constructs | Not supported. |
| Target operating system release | Specify -mzos-target (www.ibm.com/docs/en/open-xl-c-cpp-zos/latest?topic=options-mzos-target) to control which z/OS level is assumed for running your program. |
| Vector programming support | Specify the following options to enable vector programming support: -mvx , -mzvector , -fvectorize , or -fslp-vectorize . |
| XPLINK linkage | The compiler generates XPLINK linkage code. |
| z/OS UNIX invocation commands | Provides the ibm-clang and ibm-clang64 invocation commands to compile and link C programs and the ibm-clang++ and ibm-clang++64 invocation commands to compile and link C++ programs. |

Related information

- For more information about the features and options that are supported by the Open XL C/C++ 1.1 for z/OS compiler, see the [Open XL C/C++ 1.1 for z/OS documentation](#).

Appendix B. Function support table

Preinitialized environments for authorized programs

Preinitialized Environments for Authorized Programs is a new feature of z/OS Language Environment. It is intended to provide support for authorized components or products to create preinitialized environments that are capable of executing C, C++, and Language Environment-conforming assembler code in supervisor state, on a TCB or an SRB, or in cross-memory mode (with some restrictions).

Table 87 on page 2125 lists all the functions in the z/OS XL C/C++ Runtime Library and their support of Preinitialized Environments for Authorized Programs.

Note: The function table does not include compiler built-in functions (builtin.h).

Enhanced ASCII support

Restriction: Enhanced ASCII and __LIBASCII are independent, and should not be used together. Using Enhanced ASCII and __LIBASCII together is not supported.

Enhanced ASCII support provides the means to write z/OS XL C/C++ applications which will execute with ASCII data representation.

Enhanced ASCII support makes it easier to port internationalized C/C++ applications developed on or for ASCII platforms to z/OS platforms by providing conversion from ASCII to EBCDIC and EBCDIC to ASCII.

In order to use Enhanced ASCII support, a C or C++ module must be compiled specifying ASCII as the data representation. Application compile units will be bound to ASCII versions of external variables and interfaces at compile time if they:

1. Use headers to declare external variables and interfaces used in compile unit source.
2. Are compiled with the ASCII option.

New ASCII function-versions and other support functions have been added to the z/OS XL C/C++ Runtime Library to handle ASCII data in files, data manipulations, and conversions between ASCII and EBCDIC. The compile-time binding will determine which ASCII or EBCDIC function version is called during runtime execution.

Table 87 on page 2125 lists all the functions in the z/OS XL C/C++ Runtime Library and their support of Enhanced ASCII processing.

Note: The function table does not include compiler built-in functions (builtin.h).

Table 86 on page 2123 lists all the External Variables and their support status in Enhanced ASCII. For other information about these variables, see [“External variables”](#) on page 98.

Table 86. Status of External Variables in Enhanced ASCII

| External Variable | Enhanced ASCII Support Level |
|-------------------|------------------------------|
| daylight | Neutral |
| environ | Yes |
| errno | Neutral |
| getdate_err | Neutral |
| h_errno | Neutral |
| locs | No |
| loc1 | No |

Table 86. Status of External Variables in Enhanced ASCII (continued)

| External Variable | Enhanced ASCII Support Level |
|-------------------|------------------------------|
| __loc1 | Neutral |
| loc2 | No |
| optarg | Neutral |
| opterr | Neutral |
| optind | Neutral |
| optopt | Neutral |
| signgam | Neutral |
| stderr | Neutral |
| stdin | Neutral |
| stdout | Neutral |
| t_errno | Neutral |
| timezone | Neutral |
| tzname | Yes |

For a description of Limitations to the use of Enhanced ASCII, see [z/OS XL C/C++ Programming Guide](#).

Enhanced ASCII extensions

Applications compiled ASCII were permitted to use library functions that did not have ASCII support for character data with the understanding that all ASCII to EBCDIC conversion was the responsibility of the application.

As service updates or new releases extend Enhanced ASCII to previously unsupported functions, it is necessary to protect the ASCII applications that have been calling those functions (with user-supplied character conversions).

A new feature test macro is defined to control the exposure of extensions to Enhanced ASCII. This feature test macro is `_ENHANCED_ASCII_EXT` and should be set to a non-zero, numeric value indicating the level of Enhanced ASCII support desired. Otherwise, the default value of 0x41020000 is assumed, which will limit exposure to only the Enhanced ASCII support provided in the z/OS V1R2 base. Numeric values less than the default will behave as if the default were specified. The special value 0xFFFFFFFF provides exposure to all Enhanced ASCII support, regardless of the service level, available for the TARGET release.

Functions whose Enhanced ASCII support exposure is controlled by values of this feature test macro, other than the default value or the special 0xFFFFFFFF value, will have the specific value documented in [Table 87 on page 2125](#).

Note: Functions which are introduced in a release, and include Enhanced ASCII support, are not controlled using this macro. For example, `getnameinfo()` first appears in z/OS V1R4 base and has Enhanced ASCII support. It is always available in its ASCII form since there was no prior release containing the function.

[Table 87 on page 2125](#) lists all the functions in the z/OS XL C/C++ Runtime Library and their support of Enhanced ASCII processing.

Library function support

[Table 87 on page 2125](#) shows all the z/OS XL C/C++ Runtime Library functions in alphabetical order, their support of Enhanced ASCII processing and their support of Preinitialized Environments for Authorized Programs.

Enhanced ASCII

Each function is identified by the extent to which it supports Enhanced ASCII processing:

- Yes = supports Enhanced ASCII.
- No = does not support Enhanced ASCII.
- Neutral = not sensitive to the issue of ASCII/EBCDIC character encoding.

Following is a list of values for feature test macro `_ENHANCED_ASCII_EXT`:

0x41020000

z/OS V1.2 base support plus all functions first introduced in subsequent releases. This is the default.

0x41020010

Includes support added with APAR PQ63405

0x41060000

Includes support added in z/OS V1.6.

0x41070000

Includes support added in z/OS V1.7

0x410A0000

Includes support added in z/OS V1.10

0xFFFFFFFF

Exposes all Enhanced ASCII support regardless of service level for the TARGET release.

Each higher value includes all support exposed with the lesser values.

Functions which are used for conversion to ASCII or EBCDIC are labelled with those data types.

Preinitialized Environments for Authorized Programs

Each function is identified by the extent to which it supports Preinitialized Environments for Authorized Programs:

Yes

the function supports Preinitialized Environments for Authorized Programs.

No

the function does not support Preinitialized Environments for Authorized Programs.

| Table 87. Library function support table | | | | |
|--|------------------------------|---|---|-------|
| Function | Enhanced ASCII Support Level | Minimum Value for <code>_ENHANCED_ASCII_EXT</code> Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
| <code>abort()</code> | Neutral | | Yes | 4 |
| <code>abs()</code> | Neutral | | Yes | |
| <code>absf()</code> | Neutral | | Yes | |
| <code>absl()</code> | Neutral | | Yes | |
| <code>accept()</code> | Yes | 0x41020010 | Yes | 2,3,8 |
| <code>accept_and_recv()</code> | Yes | 0x41020010 | No | 3 |
| <code>access()</code> | Yes | | No | |
| <code>acl_create_entry()</code> | Neutral | | No | |
| <code>acl_delete_entry()</code> | Neutral | | No | |
| <code>acl_delete_fd()</code> | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| acl_delete_file() | Neutral | | No | |
| acl_first_entry() | Neutral | | No | |
| acl_free() | Neutral | | No | |
| acl_from_text() | Neutral | | No | |
| acl_get_entry() | Neutral | | No | |
| acl_get_fd() | Neutral | | No | |
| acl_get_file() | Neutral | | No | |
| acl_init() | Neutral | | No | |
| acl_set_fd() | Neutral | | No | |
| acl_set_file() | Neutral | | No | |
| acl_sort() | Neutral | | No | |
| acl_to_text() | Neutral | | No | |
| acl_update_entry() | Neutral | | No | |
| acl_valid() | Neutral | | No | |
| acos() | Neutral | | Yes | |
| acosd32(), acosd64(), acosd128() | Neutral | | No | |
| acosf() | Neutral | | Yes | |
| acosh() | Neutral | | Yes | |
| acoshd32(), acoshd64(), acoshd128() | Neutral | | No | |
| acoshf() | Neutral | | Yes | |
| acoshl() | Neutral | | Yes | |
| acosl() | Neutral | | Yes | |
| advance() | No | | No | |
| __ae_correstbl_query() | Yes | | No | |
| aio_cancel() | No | | No | |
| aio_error() | No | | No | |
| aio_read() | No | | No | |
| aio_return() | No | | No | |
| aio_suspend() | No | | No | |
| aio_write() | No | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---|------------------------------|--|---|-------|
| alarm() | Neutral | | No | |
| alloca() | Neutral | | Yes | |
| asctime(), asctime64() | Yes | | Yes | |
| asctime_r(), asctime64_r() | Yes | | Yes | |
| asin() | Neutral | | Yes | |
| asind32(), asind64(), asind128() | Neutral | | No | |
| asinf() | Neutral | | Yes | |
| asinh() | Neutral | | Yes | |
| asinhd32(), asinhd64(), asinhd128() | Neutral | | No | |
| asinhf() | Neutral | | Yes | |
| asinhf_l() | Neutral | | Yes | |
| asinl() | Neutral | | Yes | |
| assert() | Neutral | | No | |
| atan() | Neutral | | Yes | |
| atand32(), atand64(), atand128(), atan2d32(), atan2d64(), atan2d128() | Neutral | | No | |
| atanf() | Neutral | | Yes | |
| atanh() | Neutral | | Yes | |
| atanhd32(), atanh64(), atanh128() | Neutral | | No | |
| atanhf() | Neutral | | Yes | |
| atanhf_l() | Neutral | | Yes | |
| atanl() | Neutral | | Yes | |
| __atanpid32(), __atanpid64(), __atanpid128() | Neutral | | No | |
| atan2() | Neutral | | Yes | |
| atan2f() | Neutral | | Yes | |
| atan2l() | Neutral | | Yes | |
| atexit() | Neutral | | Yes | |
| __atoe() | ASCII | | No | |
| __atoe_l() | ASCII | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--------------------------------|------------------------------|--|---|-------|
| atof() | Yes | | Yes | |
| atoi() | Yes | | Yes | |
| atol() | Yes | | Yes | |
| atoll() | Yes | | No | |
| __a2e_l() | ASCII | | No | |
| __a2e_s() | ASCII | | No | |
| a64l() | Yes | | Yes | |
| basename() | Yes | | Yes | |
| bcmp() | Neutral | | Yes | |
| bcopy() | Neutral | | Yes | |
| bind() | Yes | 0x41020010 | Yes | 2,3,8 |
| bind2addrsel() | Neutral | | Yes | 8 |
| brk() | Neutral | | No | |
| bsd_signal() | Neutral | | No | |
| bsearch() | Neutral | | Yes | |
| btowc() | Yes | | Yes | |
| bzero() | Neutral | | Yes | |
| c16rtomb() | Neutral | | No | |
| c32rtomb() | Neutral | | No | |
| __cabend() | No | | No | |
| calloc() | Neutral | | Yes | |
| catclose() | Neutral | | No | |
| catgets() | Yes | | No | |
| catopen() | Yes | | No | |
| cbrt() | Neutral | | Yes | |
| cbrtd32() cbrtd64() cbrtd128() | Neutral | | No | |
| cbrtf() | Neutral | | Yes | |
| cbrtl() | Neutral | | Yes | |
| cclass() | No | | Yes | |
| __CcsidType() | Yes | | No | |
| cds() | Neutral | | Yes | |
| cdump() | Yes | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|----------------------------------|------------------------------|--|---|-------|
| ceil() | Neutral | | Yes | |
| ceild32(), ceild64(), ceild128() | Neutral | | No | |
| ceilf() | Neutral | | Yes | |
| ceill() | Neutral | | Yes | |
| __certificate() | No | | No | |
| cfgetispeed() | No | | No | |
| cfgetospeed() | No | | No | |
| cfsetispeed() | No | | No | |
| cfsetospeed() | No | | No | |
| __chattr() | Yes | | No | |
| chaudit() | Yes | | No | |
| chdir() | Yes | | No | |
| __check_resource_auth_np() | Yes | | No | |
| CheckSchEnv() | Yes | | No | |
| chmod() | Yes | | No | |
| chown() | Yes | | No | |
| chpriority() | Neutral | | No | |
| chroot() | Yes | | No | |
| clearenv() | Neutral | | Yes | |
| clearerr(), clearerr_unlocked() | Neutral | | Yes | |
| clock() | Neutral | | No | |
| close() | Neutral | | Yes | 8 |
| closedir() | Neutral | | No | |
| closelog() | Neutral | | No | |
| clrmemf() | Neutral | | Yes | |
| __cnvblk() | Neutral | | No | |
| collequiv() | No | | Yes | |
| collorder() | No | | Yes | |
| collrange() | No | | Yes | |
| colltostr() | No | | Yes | |
| compile() | No | | No | |
| confstr() | Yes | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| connect() | Yes | 0x41020010 | Yes | 2,3,8 |
| ConnectExportImport() | No | | No | |
| ConnectServer() | Yes | | No | |
| ConnectWorkMgr() | Yes | | No | |
| __console() | Yes | | No | |
| __console2() | No | | No | |
| ContinueWorkUnit() | Neutral | | No | |
| __convert_id_np() | No | | No | |
| copysign() | Neutral | | Yes | |
| copysign32(), copysign64(), copysign128() | Neutral | | No | |
| copysignf() | Neutral | | Yes | |
| copysignl() | Neutral | | Yes | |
| cos() | Neutral | | Yes | |
| cosd32(), cosd64(), cosd128() | Neutral | | No | |
| cosf() | Neutral | | Yes | |
| cosh() | Neutral | | Yes | |
| coshd32(), coshd64(), coshd128() | Neutral | | No | |
| coshf() | Neutral | | Yes | |
| coshl() | Neutral | | Yes | |
| cosl() | Neutral | | Yes | |
| __cospid32(), __cospid64(), __cospid128() | Neutral | | No | |
| __cotan() | Neutral | | No | |
| __cotanf() | Neutral | | No | |
| __cotanl() | Neutral | | No | |
| __cpl() | Neutral | | No | |
| creat() | Yes | | No | |
| CreateWorkUnit() | Yes | | No | |
| crypt() | Yes | | Yes | |
| cs() | Neutral | | Yes | |
| csid() | Yes | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--------------------------|------------------------------|--|---|-------|
| __CSNameType() | Yes | | No | |
| csnap() | Yes | | No | |
| __csplist | No | | No | |
| ctdli() | Neutral | | No | |
| ctermid() | Yes | | No | |
| ctest() | Yes | | Yes | |
| ctime(), ctime64() | Yes | | Yes | |
| ctime_r(), ctime64_r() | Yes | | Yes | |
| ctrace() | Yes | | No | |
| cuserid() | Yes | | No | |
| dbm_clearerr() | Neutral | | No | |
| dbm_close() | Neutral | | No | |
| dbm_delete() | Neutral | | No | |
| dbm_error() | Neutral | | No | |
| dbm_fetch() | Neutral | | No | |
| dbm_firstkey() | Neutral | | No | |
| dbm_nextkey() | Neutral | | No | |
| dbm_open() | Yes | | No | |
| dbm_store() | Neutral | | No | |
| decabs() | Neutral | | Yes | |
| decchk() | Neutral | | Yes | |
| decfix() | Neutral | | Yes | |
| DeleteWorkUnit() | Neutral | | No | |
| difftime(), difftime64() | Neutral | | Yes | |
| dirfd() | Neutral | | No | |
| dirname() | Yes | | No | |
| __discarddata() | Neutral | | No | |
| DisconnectServer() | Neutral | | No | |
| div() | Neutral | | Yes | |
| dlclose() | Neutral | | No | |
| dLError() | Yes | | No | |
| dllfree() | Neutral | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---------------|------------------------------|--|---|-------|
| dllload() | Yes | | Yes | 7 |
| dllqueryfn() | Yes | | Yes | |
| dllqueryvar() | Yes | | Yes | |
| dlopen() | Yes | | No | 7 |
| dlsym() | Yes | | No | |
| dn_comp() | Yes | 0x41020010 | No | |
| dn_expand() | Yes | 0x41020010 | No | |
| dn_find() | Yes | 0x41020010 | No | |
| dn_skipname() | Yes | 0x41020010 | No | |
| drand48() | Neutral | | Yes | |
| dup() | Neutral | | No | |
| dup2() | Neutral | | No | |
| dynalloc() | Yes | 0x41020010 | No | |
| dynfree() | Yes | 0x41020010 | No | |
| dyninit() | No | | No | |
| ecvt() | Yes | | Yes | |
| encrypt() | Neutral | | Yes | |
| endgrent() | Neutral | | No | |
| endhostent() | Neutral | | No | |
| endnetent() | Neutral | | No | |
| endprotoent() | Neutral | | No | |
| endpwent() | Neutral | | No | |
| endservent() | Neutral | | No | |
| endutxent() | Neutral | | No | |
| erand48() | Neutral | | Yes | |
| erf() | Neutral | | Yes | |
| erfc() | Neutral | | Yes | |
| erfcf() | Neutral | | Yes | |
| erfcl() | Neutral | | Yes | |
| erff() | Neutral | | Yes | |
| erfl() | Neutral | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| erfd32(), erfd64(), erfd128(), erfcd32(), erfcd64(), erfcd128() | Neutral | | No | |
| __errno2() | Neutral | | Yes | |
| __err2ad() | Neutral | | Yes | |
| __etoa() | EBCDIC | | No | |
| __etoa_l() | EBCDIC | | No | |
| execl() | Yes | | No | |
| execle() | Yes | | No | |
| execvp() | Yes | | No | |
| execv() | Yes | | No | |
| execve() | Yes | | No | |
| execvp() | Yes | | No | |
| exit() | Neutral | | Yes | |
| _exit() | Neutral | | No | |
| _Exit() | Neutral | | No | |
| exp() | Neutral | | Yes | |
| expd32(), expd64(), expd128() | Neutral | | No | |
| expm1d32() expm1d64() expm1d128() | Neutral | | No | |
| exp2() | Neutral | | Yes | |
| exp2d32() exp2d64() exp2d128() | Neutral | | No | |
| exp2f() | Neutral | | Yes | |
| exp2l() | Neutral | | Yes | |
| expf() | Neutral | | Yes | |
| expl() | Neutral | | Yes | |
| expm1() | Neutral | | Yes | |
| expm1f() | Neutral | | Yes | |
| expm1l() | Neutral | | Yes | |
| ExportWorkUnit() | Neutral | | No | |
| extlink_np() | Yes | | No | |
| ExtractWorkUnit() | Neutral | | No | |
| __e2a_l() | EBCDIC | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-------------------------------------|------------------------------|--|---|-------|
| __e2a_s() | EBCDIC | | No | |
| fabs() | Neutral | | Yes | |
| fabsd32(), fabsd64(), fabsd128() | Neutral | | No | |
| fabsl() | Neutral | | Yes | |
| fattach() | No | | No | |
| __fbuysize() | Neutral | | No | |
| __fchattr() | Neutral | | No | |
| fchaudit() | Neutral | | No | |
| fchdir() | Neutral | | No | |
| fchmod() | Neutral | | No | |
| fchown() | Neutral | | No | |
| fclose() | Neutral | | No | |
| fcntl() | Neutral | | No | |
| fcvt() | Yes | | Yes | |
| fdatasync() | Neutral | | | |
| fdelrec(), fdelrec_unlocked() | Neutral | | No | |
| fdetach() | No | | No | |
| fdim() | Neutral | | Yes | |
| fdimd32(), fdimd64(), fdimd128() | Neutral | | No | |
| fdimf() | Neutral | | Yes | |
| fdiml() | Neutral | | Yes | |
| fdopen() | Yes | | No | |
| fe_dec_getround() | Neutral | | No | |
| fe_dec_setround() | Neutral | | No | |
| fegetround() | Neutral | | No | |
| feof(), feof_unlocked() | Neutral | | No | |
| ferror(), ferror_unlocked() | Neutral | | No | |
| fesetenv() | Neutral | | No | |
| fetch() | Yes | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|----------------------------------|------------------------------|--|---|-------|
| fetchep() | Neutral | | Yes | |
| fetestexcept() | Neutral | | No | |
| fflush(), fflush_unlocked() | Neutral | | No | |
| ffs() | Neutral | | Yes | |
| fgetc(), fgetc_unlocked() | Neutral | | No | |
| fgetpos(), fgetpos_unlocked() | Neutral | | No | |
| fgets(), fgets_unlocked() | Yes | | No | |
| fgetwc(), fgetwc_unlocked() | Yes | | No | |
| fgetws(), fgetws_unlocked() | Yes | | No | |
| fileno(), fileno_unlocked() | Neutral | | No | |
| finite() | Neutral | | Yes | |
| __flbf() | Neutral | | No | |
| fldata(), fldata_unlocked() | Yes | | No | |
| flocate(), flocate_unlocked() | Neutral | | No | |
| flockfile() | Neutral | | No | |
| floor() | Neutral | | Yes | |
| floor32(), floor64(), floor128() | Neutral | | No | |
| floorf() | Neutral | | Yes | |
| floorl() | Neutral | | Yes | |
| _flushlbf() | Neutral | | No | |
| fmad32() fmad64() fmad128() | Neutral | | No | |
| fmaxd32(), fmaxd64(), fmaxd128() | Neutral | | No | |
| fmod() | Neutral | | Yes | |
| fmodd32() fmodd64() fmodd128() | Neutral | | No | |
| fmodf() | Neutral | | Yes | |
| fmodl() | Neutral | | Yes | |
| fmtmsg() | Yes | | No | |
| fnmatch() | Yes | | Yes | |
| fopen() | Yes | | No | |
| fork() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-------------------------------------|------------------------------|--|---|-------|
| fortrc() | Neutral | | No | |
| fp_clr_flag() | Neutral | | Yes | |
| fp_raise_xcp() | Neutral | | Yes | |
| fp_read_flag() | Neutral | | Yes | |
| fp_read_rnd() | Neutral | | Yes | |
| fp_swap_rnd() | Neutral | | Yes | |
| fpathconf() | Neutral | | No | |
| __fpending() | Neutral | | No | |
| fprintf(), fprintf_unlocked() | Yes | | No | |
| __fpurge() | Neutral | | No | |
| fputc(), fputc_unlocked() | Yes | | No | |
| fputs(), fputs_unlocked() | Yes | | No | |
| fputwc(), fputwc_unlocked() | Yes | | No | |
| fputws(), fputws_unlocked() | Yes | | No | |
| fread(), fread_unlocked() | Yes | | No | |
| __freable() | Neutral | | No | |
| __freadahead | Neutral | | No | |
| __freading() | Neutral | | No | |
| free() | Neutral | | Yes | |
| freeaddrinfo() | Neutral | | No | |
| freopen() | Yes | | No | |
| frexp() | Neutral | | Yes | |
| frexpd32(), frexpd64(), frexpd128() | Neutral | | No | |
| frexpf() | Neutral | | Yes | |
| frexpl() | Neutral | | Yes | |
| fscanf(), fscanf_unlocked() | Yes | | No | |
| fseek(), fseek_unlocked() | Neutral | | No | |
| fseeko(), fseeko_unlocked() | Neutral | | No | |
| __fseterr() | Neutral | | No | |
| __fsetlocking() | Neutral | | No | |
| fsetpos(), fsetpos_unlocked() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---------------------------------|------------------------------|--|---|-------|
| fstat() | Neutral | | No | |
| fstatvfs() | Neutral | | No | |
| fsync() | Neutral | | No | |
| ftell(), ftell_unlocked() | Neutral | | No | |
| ftello(), ftello_unlocked() | Neutral | | No | |
| ftime() | Neutral | | Yes | |
| ftok() | Yes | | No | |
| ftruncate() | Neutral | | No | |
| ftrylockfile() | Neutral | | No | |
| ftw() | Yes | | No | |
| funlockfile() | Neutral | | No | |
| fupdate(), fupdate_unlocked() | Neutral | | No | |
| futimes() | Neutral | | No | |
| fwide(), fwide_unlocked() | Neutral | | No | |
| fwprintf(), fwprintf_unlocked() | Yes | 0x41070000 | No | |
| __fwritable() | Neutral | | No | |
| fwrite(), fwrite_unlocked() | Yes | | No | |
| __fwriting() | Neutral | | No | |
| fwscanf(), fwscanf_unlocked() | Yes | | No | |
| gai_strerror | Yes | | No | |
| gamma() | Neutral | | Yes | |
| gcvt() | Yes | | Yes | |
| getaddrinfo() | Yes | | No | |
| getc() | Neutral | | No | |
| getc_unlocked() | Neutral | | No | |
| getchar() | Neutral | | No | |
| getchar_unlocked() | Neutral | | No | |
| getclientid() | No | | No | |
| __getclientid() | No | | No | |
| getcontext() | Neutral | | No | |
| __get_cpuid() | No | | Yes | |
| getcwd() | Yes | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|------------------------|------------------------------|--|---|-------|
| getdate(), getdate64() | Yes | | Yes | |
| getdtablesize() | Neutral | | No | |
| getegid() | Neutral | | No | |
| getenv() | Yes | | Yes | |
| __getenv() | Yes | 0x41060000 | Yes | |
| geteuid() | Neutral | | No | |
| getgid() | Neutral | | No | |
| getgrent() | Yes | | No | |
| getgrgid() | Yes | | No | |
| __getgrgid1 | Yes | | No | |
| getgrgid_r() | Yes | | No | |
| getgrnam() | Yes | | No | |
| __getgrnam1 | Yes | | No | |
| getgrnam_r() | Yes | | No | |
| getgroups() | Neutral | | No | |
| getgroupsbyname() | Yes | | No | |
| gethostbyaddr() | Yes | | No | 2 |
| gethostbyname() | Yes | | No | 2 |
| gethostent() | Yes | | No | 2 |
| gethostid() | Neutral | | No | |
| gethostname() | Yes | | No | |
| getibmopt() | No | | No | |
| getibmsockopt() | No | | No | |
| __getipc() | No | | No | |
| getipv4sourcefilter() | Neutral | | No | |
| getitimer() | Neutral | | No | |
| getlogin() | Yes | | No | 1 |
| getlogin_r() | Yes | | No | |
| __getlogin1() | No | | No | |
| getmccoll() | No | | Yes | |
| getmsg() | No | | No | |
| getnameinfo() | Yes | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-------------------------|------------------------------|--|---|-------|
| getnetbyaddr() | Yes | | No | 2 |
| getnetbyname() | Yes | | No | 2 |
| getnetent() | Yes | | No | 2 |
| getopt() | Yes | | Yes | |
| getpagesize() | Neutral | | Yes | |
| getpass() | Yes | | No | |
| getpeername() | Yes | 0x41020010 | No | 2,3 |
| getpgid() | Neutral | | No | |
| getpgrp() | Neutral | | No | |
| getpid() | Neutral | | No | |
| getpmsg() | No | | No | |
| getppid() | Neutral | | No | |
| getpriority() | Neutral | | No | |
| getprotobyname() | Yes | | No | 2 |
| getprotobynumber() | Yes | | No | 2 |
| getprotoent() | Yes | | No | 2 |
| getpwent() | Yes | | No | |
| getpwnam() | Yes | | No | |
| getpwnam_r() | Yes | | No | |
| getpwuid() | Yes | | No | |
| getpwuid_r() | Yes | | No | |
| getrlimit() | Neutral | | No | |
| getrusage() | Neutral | | No | |
| gets(), gets_unlocked() | Yes | | No | |
| getservbyname() | Yes | | No | 2 |
| getservbyport() | Yes | | No | 2 |
| getservent() | Yes | | No | 2 |
| getsid() | Neutral | | No | |
| getsockname() | Yes | 0x41020010 | Yes | 2,3,8 |
| getsockopt() | No | | Yes | 8 |
| getsourcefilter() | Neutral | | No | |
| getstablesizes() | No | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| getsubopt() | No | | Yes | |
| getsyntax() | No | | Yes | |
| __get_system_settings() | No | | No | |
| gettimeofday(), gettimeofday64() | Yes | | Yes | |
| getuid() | Neutral | | No | |
| __getuserid() | No | | No | |
| getutxent() | Neutral | | No | |
| getutxid() | No | | No | |
| getutxline() | No | | No | |
| getw() | Neutral | | No | |
| getwc(), getwc_unlocked() | Yes | | No | |
| getwchar(), getwchar_unlocked() | Yes | | No | |
| getwd() | Yes | | No | |
| getwmccoll() | No | | Yes | |
| givesocket() | No | | No | |
| glob() | Yes | | No | |
| globfree() | Neutral | | No | |
| gmtime(), gmtime64() | Yes | | Yes | |
| gmtime_r(), gmtime64_r() | Yes | | Yes | |
| grantpt() | Neutral | | No | |
| hcreate() | Neutral | | Yes | |
| hdestroy() | Neutral | | Yes | |
| __heaprpt() | Neutral | | No | |
| hsearch() | Neutral | | Yes | |
| htonl() | Neutral | | No | |
| htons() | Neutral | | No | |
| hypot() | Neutral | | Yes | |
| hypotd32(), hypotd64(), hypotd128() | Neutral | | No | |
| hypotf() | Neutral | | Yes | |
| hypotl() | Neutral | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| ibmsflush() | Neutral | | No | |
| iconv() | Neutral | | No | |
| iconv_close() | Neutral | | No | |
| iconv_open() | Yes | | No | |
| if_freenameindex() | Neutral | | No | |
| if_indextoname() | Yes | | No | |
| if_nameindex() | Yes | | No | |
| if_nametoindex() | Yes | | No | |
| ilogb() | Neutral | | Yes | |
| ilogbd32(), ilogbd64(), ilogbd128() | Neutral | | No | |
| imaxabs() | Neutral | | No | |
| imaxdiv() | Neutral | | No | |
| ImportWorkUnit() | Neutral | | No | |
| index() | Neutral | | Yes | |
| inet6_is_srcaddr() | Neutral | | No | |
| inet6_opt_append() | Neutral | | No | |
| inet6_opt_find() | Neutral | | No | |
| inet6_opt_finish() | Neutral | | No | |
| inet6_opt_get_val() | Neutral | | No | |
| inet6_opt_init() | Neutral | | No | |
| inet6_opt_next() | Neutral | | No | |
| inet6_opt_set_val() | Neutral | | No | |
| inet6_rth_add() | Neutral | | No | |
| inet6_rth_getaddr() | Neutral | | No | |
| inet6_opt_init() | Neutral | | No | |
| inet6_rth_reverse() | Neutral | | No | |
| inet6_rth_segments() | Neutral | | No | |
| inet6_rth_space() | Neutral | | No | |
| inet_addr() | Yes | 0x41020010 | No | 2 |
| inet_lnaof() | Neutral | | No | |
| inet_makeaddr() | No | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|------------------|------------------------------|--|---|-------|
| inet_netof() | Neutral | | No | |
| inet_network() | Yes | 0x41020010 | No | 2 |
| inet_ntoa() | Yes | 0x41020010 | No | 2 |
| inet_ntop() | Yes | 0x41020010 | Yes | 8 |
| inet_pton() | Yes | 0x41020010 | Yes | 8 |
| initgroups() | Yes | | No | |
| initstate() | No | | Yes | |
| insque() | Neutral | | Yes | |
| ioctl() | No | | Yes | 8 |
| __ipdbcs() | No | | No | |
| __ipDomainName() | No | | No | |
| __ipdspix() | No | | No | |
| __iphost() | No | | No | |
| __ipmsgc() | No | | No | |
| __ipnode() | No | | No | |
| __iptcpn() | No | | No | |
| isalnum() | Yes | | Yes | |
| isalpha() | Yes | | Yes | |
| isascii() | Neutral | | Yes | |
| isastream() | Neutral | | No | |
| isatty() | Neutral | | No | |
| __isBFP() | Neutral | | No | |
| isblank() | Yes | 0x41070000 | Yes | |
| iscics() | Neutral | | No | |
| iscntrl() | Yes | | Yes | |
| isdigit() | Yes | | Yes | |
| isgraph() | Yes | | Yes | |
| islower() | Yes | | Yes | |
| ismccollet() | No | | Yes | |
| isnan() | Neutral | | Yes | |
| __isPosixOn() | Neutral | | No | |
| isprint() | Yes | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-------------------------------------|------------------------------|--|---|-------|
| ispunct() | Yes | | Yes | |
| isspace() | Yes | | Yes | |
| isupper() | Yes | | Yes | |
| iswalnum() | Yes | | Yes | |
| iswalpha() | Yes | | Yes | |
| iswblank() | Yes | 0x41070000 | Yes | |
| iswcntrl() | Yes | | Yes | |
| iswctype() | Yes | | Yes | |
| iswdigit() | Yes | | Yes | |
| iswgraph() | Yes | | Yes | |
| iswlower() | Yes | | Yes | |
| iswprint() | Yes | | Yes | |
| iswpunct() | Yes | | Yes | |
| iswspace() | Yes | | Yes | |
| iswupper() | Yes | | Yes | |
| iswxdigit() | Yes | | Yes | |
| isxdigit() | Yes | | Yes | |
| itoa() | Yes | | Yes | |
| jn() | Neutral | | Yes | |
| JoinWorkUnit() | Neutral | | No | |
| jrand48() | Neutral | | Yes | |
| j0() | Neutral | | Yes | |
| j1() | Neutral | | Yes | |
| kill() | Neutral | | No | |
| killpg() | Neutral | | No | |
| labs() | Neutral | | Yes | |
| __lchattr() | Yes | | No | |
| lchown() | Yes | | No | |
| lcong48() | Neutral | | Yes | |
| ldexp() | Neutral | | Yes | |
| ldexpd32(), ldexpd64(), ldexpd128() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---|------------------------------|--|---|-------|
| ldexpf() | Neutral | | Yes | |
| ldexpl() | Neutral | | Yes | |
| ldiv() | Neutral | | Yes | |
| LeaveWorkUnit() | Neutral | | No | |
| __le_cib_get() | No | | No | |
| __le_ceegtjs() | No | | No | |
| __le_ceemict() | No | | Yes | |
| __le_ceedsgd() | No | | No | |
| __le_condition_token_build() | No | | No | |
| __le_msg_add_insert() | No | | No | |
| __le_msg_get() | No | | No | |
| __le_msg_get_and_write() | No | | No | |
| __le_msg_write() | No | | No | |
| __le_traceback() | Neutral | | No | |
| lfind() | Neutral | | Yes | |
| lgamma() | Neutral | | Yes | |
| lgammad32(), lgammad64(), lgammad128() | Neutral | | No | |
| lgammaf() | Neutral | | Yes | |
| lgammal() | Neutral | | Yes | |
| __librel() | Neutral | | Yes | |
| link() | Yes | | No | |
| listen() | Neutral | | Yes | 8 |
| llabs() | Neutral | | Yes | |
| lldiv() | Neutral | | Yes | |
| llroundd32(), llroundd64(), llroundd128() | Neutral | | No | |
| lltoa() | Yes | | Yes | |
| localdtconv() | No | | No | |
| localeconv() | Yes | | No | |
| localtime(), localtime64() | Yes | | Yes | |
| localtime_r(), localtime64_r() | Yes | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| lockf() | Neutral | | No | |
| log() | Neutral | | Yes | |
| logb() | Neutral | | Yes | |
| logbd32(), logbd64(), logbd128() | Neutral | | No | |
| logd32(), logd64(), logd128() | Neutral | | No | |
| log1pd32() log1pd64() log1pd128() | Neutral | | No | |
| log2d32() log2d64() log2d128() | Neutral | | No | |
| log10d32(), log10d64(), log10d128() | Neutral | | No | |
| logf() | Neutral | | Yes | |
| __login(), __login_applid() | Yes | | No | |
| logl() | Neutral | | Yes | |
| log1p() | Neutral | | Yes | |
| log1pf() | Neutral | | Yes | |
| log1pl() | Neutral | | Yes | |
| log10() | Neutral | | Yes | |
| log10f() | Neutral | | Yes | |
| log10l() | Neutral | | Yes | |
| log2() | Neutral | | Yes | |
| log2f() | Neutral | | Yes | |
| log2l() | Neutral | | Yes | |
| longjmp() | Neutral | | Yes | |
| _longjmp() | Neutral | | No | |
| lrand48() | Neutral | | Yes | |
| lrintd32(), lrintd64(), lrintd128() and llrintd32(), llrintd64(), llrintd128() | Neutral | | No | |
| lround() | Neutral | | Yes | |
| lroundd32(), lroundd64(), lroundd128() | Neutral | | No | |
| lroundf() | Neutral | | Yes | |
| lsearch() | Neutral | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-----------------------|------------------------------|--|---|-------|
| lseek() | Neutral | | No | |
| lstat() | Yes | | No | |
| l64a() | Yes | | Yes | |
| ltoa() | Yes | | Yes | |
| lutimes() | Yes | | No | |
| m_create_layout() | No | | Yes | 5 |
| m_destroy_layout() | No | | Yes | |
| m_getvalues_layout() | No | | Yes | |
| m_setvalues_layout() | No | | Yes | |
| m_transform_layout() | No | | Yes | |
| m_wtransform_layout() | No | | Yes | |
| makecontext() | Neutral | | No | |
| malloc() | Neutral | | Yes | |
| __malloc24() | Neutral | | Yes | |
| __malloc31() | Neutral | | Yes | |
| __map_init() | Neutral | | No | |
| __map_service() | Neutral | | No | |
| maxcoll() | No | | Yes | |
| maxdesc() | Neutral | | No | |
| mblen() | Yes | | Yes | |
| mbrlen() | No | | Yes | |
| mbrtoc16() | Neutral | | No | |
| mbrtoc32() | Neutral | | No | |
| mbrtowc() | No | | Yes | |
| mbsinit() | No | | Yes | |
| mbsrtowcs() | No | | Yes | |
| mbstowcs() | Yes | | Yes | |
| mbtowc() | Yes | | Yes | |
| memccpy() | Neutral | | Yes | |
| memchr() | Neutral | | Yes | |
| memcmp() | Neutral | | Yes | |
| memcpy() | Neutral | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|----------------------------------|------------------------------|--|---|-------|
| memmove() | Neutral | | Yes | |
| memset() | Neutral | | Yes | |
| mkdir() | Yes | | No | |
| mkfifo() | Yes | | No | |
| mknod() | Yes | | No | |
| mkstemp() | Yes | | No | |
| mktemp() | Yes | | No | |
| mktime(), mktime64() | Yes | | Yes | |
| __mlockall() | Neutral | | No | |
| mmap() | Neutral | | No | |
| modf() | Neutral | | Yes | |
| modfd32(), modfd64(), modfd128() | Neutral | | No | |
| modff() | Neutral | | Yes | |
| modfl() | Neutral | | Yes | |
| moservices() | Neutral | | Yes | |
| mount() | Yes | | No | |
| __mount() | No | | No | |
| mprotect() | Neutral | | No | |
| rand48() | Neutral | | Yes | |
| msgctl() | Neutral | | No | |
| msgget() | Neutral | | No | |
| msgrcv() | Yes | | No | |
| __msgrcv_timed() | No | | No | |
| msgsnd() | Yes | | No | |
| msgxrcv() | Yes | | No | |
| msync() | Neutral | | No | |
| munmap() | Neutral | | No | |
| __must_stay_clean() | Neutral | | No | |
| nan(), nanf(), nanl() | Yes | 0x410A0000 | No | |
| nand32(), nand64(), nand128() | Yes | 0x410A0000 | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---|------------------------------|--|---|-------|
| nearbyintd32(), nearbyintd64(), nearbyintd128() | Neutral | | No | |
| nextafter() | Neutral | | Yes | |
| nextafterd32(), nextafterd64(), nextafterd128() | Neutral | | No | |
| nexttowarddd32(), nexttowarddd64(), nexttowarddd128() | Neutral | | No | |
| nftw() | Yes | | No | |
| nice() | Neutral | | No | |
| nl_langinfo() | Yes | | Yes | |
| nlist() | Yes | | No | |
| rand48() | Neutral | | Yes | |
| ntohl() | Neutral | | No | |
| ntohs() | Neutral | | No | |
| open() | Yes | | No | |
| __open_stat() | Yes | | No | |
| opendir() | Yes | | No | |
| __opendir2() | Yes | | No | |
| openlog() | Neutral | | No | |
| __osname() | Yes | | Yes | |
| __passwd(), __passwd_applid() | Yes | | No | |
| pathconf() | Yes | | No | |
| pause() | Neutral | | No | |
| pclose() | Neutral | | No | |
| perror(), perror_unlocked() | Yes | | No | |
| __pid_affinity() | Neutral | | No | |
| pipe() | Neutral | | No | |
| __poe | Neutral | | No | |
| poll() | Neutral | | No | |
| popen() | Yes | | No | |
| posix_openpt() | Neutral | | No | |
| pow() | Neutral | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-------------------------------|------------------------------|--|---|-------|
| powd32(), powd64(), powd128() | Neutral | | No | |
| powf() | Neutral | | Yes | |
| powl() | Neutral | | Yes | |
| pread() | Neutral | | No | |
| printf(), printf_unlocked() | Yes | | No | |
| pselect() | Neutral | | No | |
| pthread_atfork() | Neutral | | No | |
| pthread_attr_destroy() | Neutral | | No | |
| pthread_attr_getdetachstate() | Neutral | | No | |
| pthread_attr_getguardsize() | Neutral | | No | |
| pthread_attr_getschedparam() | Neutral | | No | |
| pthread_attr_getstack() | Neutral | | No | |
| pthread_attr_getstackaddr() | Neutral | | No | |
| pthread_attr_getstacksize() | Neutral | | No | |
| pthread_attr_getsynctype_np() | Neutral | | No | |
| pthread_attr_getweight_np() | Neutral | | No | |
| pthread_attr_init() | Neutral | | No | |
| pthread_attr_setdetachstate() | Neutral | | No | |
| pthread_attr_setguardsize() | Neutral | | No | |
| pthread_attr_setschedparam() | Neutral | | No | |
| pthread_attr_setstack() | Neutral | | No | |
| pthread_attr_setstackaddr() | Neutral | | No | |
| pthread_attr_setstacksize() | Neutral | | No | |
| pthread_attr_setsynctype_np() | Neutral | | No | |
| pthread_attr_setweight_np() | Neutral | | No | |
| pthread_cancel() | Neutral | | No | |
| pthread_cleanup_pop() | Neutral | | No | |
| pthread_cleanup_push() | Neutral | | No | |
| pthread_cond_broadcast() | Neutral | | No | |
| pthread_cond_destroy() | Neutral | | No | |
| pthread_cond_init() | Neutral | | No | |
| pthread_cond_signal() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---------------------------------------|------------------------------|--|---|-------|
| pthread_cond_timedwait() | Neutral | | No | |
| pthread_cond_wait() | Neutral | | No | |
| pthread_condattr_destroy() | Neutral | | No | |
| pthread_condattr_getkind_np() | Neutral | | No | |
| pthread_condattr_getpshared() | Neutral | | No | |
| pthread_condattr_init() | Neutral | | No | |
| pthread_condattr_setkind_np() | Neutral | | No | |
| pthread_condattr_setpshared() | Neutral | | No | |
| pthread_create() | Neutral | | No | |
| pthread_detach() | Neutral | | No | |
| pthread_equal() | Neutral | | No | |
| pthread_exit() | Neutral | | No | |
| pthread_getconcurrency() | Neutral | | No | |
| pthread_getspecific() | Neutral | | No | |
| pthread_getspecific_d8_np() | Neutral | | No | |
| pthread_join() | Neutral | | No | |
| pthread_join_d4_np() | Neutral | | No | |
| pthread_key_create() | Neutral | | No | |
| pthread_key_delete() | Neutral | | No | |
| pthread_kill() | Neutral | | No | |
| pthread_mutex_destroy() | Neutral | | No | |
| pthread_mutex_init() | Neutral | | No | |
| pthread_mutex_lock() | Neutral | | No | |
| pthread_mutex_trylock() | Neutral | | No | |
| pthread_mutex_unlock() | Neutral | | No | |
| pthread_mutexattr_destroy() | Neutral | | No | |
| pthread_mutexattr_getkind_np() () | Neutral | | No | |
| pthread_mutexattr_getpshared() () | Neutral | | No | |
| pthread_mutexattr_gettype() | Neutral | | No | |
| pthread_mutexattr_init() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| pthread_mutexattr_setkind_np() | Neutral | | No | |
| pthread_mutexattr_setpshared() | Neutral | | No | |
| pthread_mutexattr_settype() | Neutral | | No | |
| pthread_once() | Neutral | | No | |
| pthread_rwlock_destroy() | Neutral | | No | |
| pthread_rwlock_init() | Neutral | | No | |
| pthread_rwlock_rdlock() | Neutral | | No | |
| pthread_rwlock_tryrdlock() | Neutral | | No | |
| pthread_rwlock_trywrlock() | Neutral | | No | |
| pthread_rwlock_unlock() | Neutral | | No | |
| pthread_rwlock_wrlock() | Neutral | | No | |
| pthread_rwlockattr_destroy() | Neutral | | No | |
| pthread_rwlockattr_getpshared() | Neutral | | No | |
| pthread_rwlockattr_init() | Neutral | | No | |
| pthread_rwlockattr_setpshared() | Neutral | | No | |
| pthread_security_np(), pthread_security_applid_np() | Yes | | No | |
| pthread_self() | Neutral | | No | |
| pthread_setcancelstate() | Neutral | | No | |
| pthread_setcanceltype() | Neutral | | No | |
| pthread_setconcurrency() | Neutral | | No | |
| pthread_set_limit_np() | Neutral | | No | |
| pthread_setintr() | Neutral | | No | |
| pthread_setintrtype() | Neutral | | No | |
| pthread_setspecific() | Neutral | | No | |
| pthread_sigmask() | Neutral | | No | |
| pthread_tag_np() | No | | No | |
| pthread_testcancel() | Neutral | | No | |
| pthread_testintr() | Neutral | | No | |
| pthread_yield() | Neutral | | No | |
| ptsname() | Yes | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| putc() | Yes | | No | |
| putc_unlocked() | Yes | | No | |
| putchar() | Yes | | No | |
| putchar_unlocked() | Yes | | No | |
| putenv() | Yes | | Yes | |
| putmsg() | No | | No | |
| putpmsg() | No | | No | |
| puts(), puts_unlocked() | Yes | | No | |
| pututxline() | No | | No | |
| putw() | Neutral | | No | |
| putwc(), putwc_unlocked() | Yes | | No | |
| putwchar(), putwchar_unlocked() | Yes | | No | |
| pwrite() | Neutral | | No | |
| qsort() | Neutral | | Yes | |
| quantexpd32(), quantexpd64(), quantexpd128() | Neutral | | No | |
| quantized32(), quantized64(), quantized128() | Neutral | | No | |
| QueryMetrics() | Yes | | No | |
| QuerySchEnv() | Yes | | No | |
| QueryWorkUnitClassification() | No | | No | |
| read() | Neutral | | No | |
| raise() | Neutral | | Yes | 6 |
| rand() | Neutral | | Yes | |
| rand_r() | Neutral | | Yes | |
| random() | Neutral | | Yes | |
| readdir() | Yes | | No | |
| readdir_r() | Yes | | No | |
| __readdir2() | Yes | | No | |
| readlink() | Yes | | No | |
| readv() | Neutral | | No | |
| realloc() | Neutral | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---|------------------------------|--|---|-------|
| realpath() | Yes | | No | |
| re_comp() | No | | No | |
| recv() | No | | Yes | 8 |
| recvfrom() | Yes | 0x41020010 | No | 2,3 |
| recvmsg() | Yes | 0x41020010 | No | 2,3 |
| re_exec() | No | | No | |
| regcmp() | No | | No | |
| regcomp() | Yes | | Yes | |
| regerror() | Yes | | Yes | |
| regex() | No | | No | |
| regexec() | Yes | | Yes | |
| regfree() | Yes | | Yes | |
| release() | Neutral | | Yes | |
| remainder() | Neutral | | Yes | |
| remainderd32(), remainderd64(), remainderd128() | Neutral | | No | |
| remainderf() | Neutral | | Yes | |
| remainderl() | Neutral | | Yes | |
| remove() | Yes | | No | |
| remque() | Neutral | | Yes | |
| remquo() | Neutral | | Yes | |
| __remquod32() __remquod64() __remquod128() | Neutral | | No | |
| remquof() | Neutral | | Yes | |
| remquol() | Neutral | | Yes | |
| rename() | Yes | | No | |
| __reset_exception_handler() | No | | No | |
| res_init() | Yes | | No | |
| res_mkquery() | Yes | 0x41020010 | No | |
| res_query() | Yes | 0x41020010 | No | |
| res_querydomain() | Yes | 0x41020010 | No | |
| res_search() | Yes | 0x41020010 | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| res_send() | Yes | 0x41020010 | No | |
| rewind(), rewind_unlocked() | Neutral | | No | |
| rewinddir() | Neutral | | No | |
| rexec() | Yes | 0x41060000 | No | |
| rexec_af() | Yes | 0x41060000 | No | |
| rindex() | Neutral | | Yes | |
| rint() | Neutral | | Yes | |
| rintd32(), rintd64(), rintd128() | Neutral | | No | |
| rmdir() | Yes | | No | |
| roundd32(), roundd64(), roundd128() | Neutral | | No | |
| rpmatch() | Yes | | No | |
| samequantumd32(), samequantumd64(), samequantumd128() | Neutral | | No | |
| sbrk() | Neutral | | No | |
| scalb() | Neutral | | Yes | |
| scalbn() | Neutral | | Yes | |
| scalbnd32(), scalbnd64(), scalbnd128() and scalblnd32(), scalblnd64(), scalblnd128() | Neutral | | No | |
| scanf(), scanf_unlocked() | Yes | | No | |
| sched_yield() | Neutral | | No | |
| seed48() | Neutral | | Yes | |
| seekdir() | Neutral | | No | |
| select() | No | | Yes | 8 |
| selectex() | No | | No | |
| semctl() | Neutral | | No | |
| semget() | Neutral | | No | |
| semop() | Neutral | | No | |
| __semop_timed() | Neutral | | No | |
| send() | No | | Yes | 8 |
| send_file() | No | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-----------------------------|------------------------------|--|---|-------|
| sendmsg() | Yes | 0x41020010 | No | 2,3 |
| sendto() | Yes | 0x41020010 | No | 2,3 |
| __server_classify() | Yes | | No | |
| __server_classify_create() | Neutral | | No | |
| __server_classify_destroy() | Neutral | | No | |
| __server_classify_reset() | Neutral | | No | |
| __server_init() | Yes | | No | |
| __server_pwu() | Yes | | No | |
| __server_threads_query() | Neutral | | No | |
| setbuf() | Neutral | | No | |
| setcontext() | Neutral | | No | |
| setegid() | Neutral | | No | |
| setenv() | Yes | | Yes | |
| seteuid() | Neutral | | No | |
| __set_exception_handler() | Neutral | | No | |
| setgid() | Neutral | | No | |
| setgrent() | Neutral | | No | |
| setgroups() | Neutral | | No | |
| sethostent() | Neutral | | No | |
| setibmopt() | No | | No | |
| setibmsockopt() | No | | No | |
| setipv4sourcefilter() | Neutral | | No | |
| setitimer() | Neutral | | No | |
| setjmp() | Neutral | | Yes | |
| _setjmp() | Neutral | | No | |
| setkey() | No | | Yes | |
| setlocale() | Yes | | Yes | 5 |
| setlogmask() | Neutral | | Yes | |
| setnetent() | Neutral | | No | |
| set_new_handler() | Neutral | | Yes | |
| setpeer() | No | | No | |
| setpgid() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---------------------------|------------------------------|--|---|-------|
| setpgrp() | Neutral | | No | |
| setpriority() | Neutral | | No | |
| setprotoent() | Neutral | | No | |
| setpwent() | Neutral | | No | |
| setregid() | Neutral | | No | |
| setreuid() | Neutral | | No | |
| setrlimit() | Neutral | | No | |
| setservent() | Neutral | | No | |
| setsid() | Neutral | | No | |
| setsockopt() | No | | Yes | 8 |
| setsourcefilter() | Neutral | | No | |
| setstate() | No | | Yes | |
| set_terminate() | Neutral | | Yes | |
| _SET_THLIIPADDR() | Neutral | | No | |
| setuid() | Neutral | | No | |
| set_unexpected() | Neutral | | Yes | |
| setutxent() | Neutral | | No | |
| setvbuf() | Neutral | | No | |
| shmat() | Neutral | | No | |
| shmctl() | Neutral | | No | |
| shmdt() | Neutral | | No | |
| shmget() | Neutral | | No | |
| shutdown() | Neutral | | No | |
| __shutdown_registration() | Neutral | | No | |
| sigaction() | Neutral | | No | |
| __sigactionset() | Neutral | | No | |
| sigaddset() | Neutral | | No | |
| sigaltstack() | Neutral | | No | |
| sigdelset() | Neutral | | No | |
| sigemptyset() | Neutral | | No | |
| sigfillset() | Neutral | | No | |
| sighold() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---|------------------------------|--|---|-------|
| sigignore() | Neutral | | No | |
| siginterrupt() | Neutral | | No | |
| sigismember() | Neutral | | No | |
| siglongjmp() | Neutral | | No | |
| signal() | Neutral | | No | |
| __signgam() | Neutral | | No | |
| sigpause() | Neutral | | No | |
| sigpending() | Neutral | | No | |
| sigprocmask() | Neutral | | No | |
| sigqueue() | Neutral | | No | |
| sigrelse() | Neutral | | No | |
| sigset() | Neutral | | No | |
| sigsetjmp() | Neutral | | No | |
| sigstack() | Neutral | | No | |
| sigsuspend() | Neutral | | No | |
| sigtimedwait() | Neutral | | No | |
| sigwait() | Neutral | | No | |
| sigwaitinfo() | Neutral | | No | |
| sin() | Neutral | | Yes | |
| sind32(), sind64(), sind128() | Neutral | | No | |
| sinf() | Neutral | | Yes | |
| sinh() | Neutral | | Yes | |
| sinhd32(), sinhd64(), sinhd128() | Neutral | | No | |
| sinhf() | Neutral | | Yes | |
| sinhl() | Neutral | | Yes | |
| sinl() | Neutral | | Yes | |
| __sinpid32(), __sinpid64(), __sinpid128() | Neutral | | No | |
| sleep() | Neutral | | No | |
| __smf_record() | No | | No | |
| snprintf() | Yes | | Yes | |
| socketatmark() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---------------------------------|------------------------------|--|---|-------|
| sock_debug() | Neutral | | No | |
| sock_debug_bulk_perf0() | Neutral | | No | |
| sock_do_bulkmode() | Neutral | | No | |
| sock_do_teststor() | Neutral | | No | |
| socket() | Neutral | | Yes | 8 |
| socketpair() | Neutral | | No | |
| spawn() | Yes | | No | |
| spawnp() | Yes | | No | |
| __spawnp2() | Yes | | No | |
| __spawn2() | Yes | | No | |
| sprintf() | Yes | | Yes | |
| sqrt() | Neutral | | Yes | |
| sqrtd32(), sqrtd64(), sqrt128() | Neutral | | No | |
| sqrtf() | Neutral | | Yes | |
| sqrtl() | Neutral | | Yes | |
| srand() | Neutral | | Yes | |
| srandom() | Neutral | | Yes | |
| srand48() | Neutral | | Yes | |
| sscanf() | Yes | | Yes | |
| stat() | Yes | | No | |
| statvfs() | Yes | | No | |
| step() | No | | No | |
| stpcpy() | Neutral | | No | |
| stpncpy() | Neutral | | No | |
| strcasecmp() | Yes | | Yes | |
| strcat() | Neutral | | Yes | |
| strchr() | Neutral | | Yes | |
| strchrnul() | Neutral | | Yes | |
| strcmp() | Neutral | | Yes | |
| strcoll() | Yes | | Yes | |
| strcpy() | Neutral | | Yes | |
| strcspn() | Neutral | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|--|------------------------------|--|---|-------|
| strdup() | Neutral | | Yes | |
| strerror() | Yes | | Yes | |
| strerror_r() | Yes | | No | |
| strfmon() | Yes | | Yes | |
| strftime() | Yes | | Yes | |
| strlen() | Neutral | | Yes | |
| strncasecmp() | Yes | | Yes | |
| strncat() | Neutral | | Yes | |
| strncmp() | Neutral | | Yes | |
| strncpy() | Neutral | | Yes | |
| strnlen() | Neutral | | No | |
| strpbrk() | Neutral | | Yes | |
| strptime() | Yes | | Yes | |
| strrchr() | Neutral | | Yes | |
| strsignal() | Yes | | No | |
| strspn() | Neutral | | Yes | |
| strstr() | Neutral | | Yes | |
| strtocoll() | No | | Yes | |
| strtod() | Yes | | Yes | |
| strtof() | Yes | | No | |
| strtoimax() | Yes | | No | |
| strtok() | Neutral | | Yes | |
| strtok_r() | Neutral | | Yes | |
| strtod32(), strtod64(), strtod128() | Yes | | No | |
| strtol() | Yes | | Yes | |
| strtold() | Yes | | No | |
| strtoll() | Yes | | Yes | |
| strtoul() | Yes | | Yes | |
| strtoull() | Yes | | Yes | |
| strtoumax() | Yes | | No | |
| strxfrm() | Yes | | Yes | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-----------------|------------------------------|--|---|-------|
| __superkill() | Neutral | | No | |
| svc99() | No | | No | |
| swab() | Neutral | | Yes | |
| swapcontext() | Neutral | | No | |
| swprintf() | Yes | | Yes | |
| swscanf() | Yes | | Yes | |
| symlink() | Yes | | No | |
| sync() | Neutral | | No | |
| sysconf() | Neutral | | No | |
| syslog() | Yes | | No | |
| system() | Yes | | No | |
| t_accept() | No | | No | |
| t_alloc() | No | | No | |
| t_bind() | No | | No | |
| tcgetattr() | Yes | 0x41020010 | No | |
| __tcgetcp() | Yes | 0x41020010 | No | |
| t_close() | Neutral | | No | |
| t_connect() | No | | No | |
| tcsetattr() | Yes | 0x41020010 | No | |
| __tcsetcp() | Yes | 0x41020010 | No | |
| t_error() | No | | No | |
| t_free() | No | | No | |
| t_getinfo() | No | | No | |
| t_getprotaddr() | No | | No | |
| t_getstate() | Neutral | | No | |
| t_listen() | No | | No | |
| t_look() | Neutral | | No | |
| t_open() | No | | No | |
| t_optmgmt() | No | | No | |
| t_rcv() | No | | No | |
| t_rcvconnect() | No | | No | |
| t_rcvdis() | No | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|----------------------------------|------------------------------|--|---|-------|
| t_rcvrel() | Neutral | | No | |
| t_rcvudata() | No | | No | |
| t_rcvuderr() | No | | No | |
| t_snd() | No | | No | |
| t_snddis() | No | | No | |
| t_sndrel() | Neutral | | No | |
| t_sndudata() | No | | No | |
| t_strerror() | No | | No | |
| t_sync() | Neutral | | No | |
| t_unbind() | Neutral | | No | |
| takesocket() | No | | No | |
| tan() | Neutral | | Yes | |
| tand32(), tand64(), tand128() | Neutral | | No | |
| tanf() | Neutral | | Yes | |
| tanh() | Neutral | | Yes | |
| tanhd32(), tanhd64(), tanhd128() | Neutral | | No | |
| tanhf() | Neutral | | Yes | |
| tanhl() | Neutral | | Yes | |
| tanl() | Neutral | | Yes | |
| tcdrain() | Neutral | | No | |
| tcflow() | Neutral | | No | |
| tcflush() | Neutral | | No | |
| tcgetattr() | Yes | | No | |
| __tcgetcp() | Yes | | No | |
| tcgetpgrp() | Neutral | | No | |
| tcgetsid() | Neutral | | No | |
| tcperror() | No | | No | |
| tcsendbreak() | Neutral | | No | |
| tcsetattr() | Yes | | No | |
| __tcsetcp() | Yes | | No | |
| tcsetpgrp() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---|------------------------------|--|---|-------|
| __tcsettables() | No | | No | |
| tdelete() | Neutral | | Yes | |
| telldir() | Neutral | | No | |
| tempnam() | Yes | | No | |
| terminate() | Neutral | | No | |
| tfind() | Neutral | | Yes | |
| tgamma() | Neutral | | Yes | |
| tgammad32(), tgammad64(), tgammad128() | Neutral | | No | |
| tgammaf() | Neutral | | Yes | |
| tgammal() | Neutral | | Yes | |
| time(), time64() | Neutral | | Yes | |
| times() | Neutral | | No | |
| tinit() | No | | No | |
| tmpfile() | Neutral | | No | |
| tmpnam() | Yes | | No | |
| toascii() | Neutral | | Yes | |
| __toCcsid() | Yes | | No | |
| __toCSName() | Yes | | No | |
| tolower() | Yes | | Yes | |
| _tolower() | Yes | | No | |
| toupper() | Yes | | Yes | |
| _toupper() | Yes | | No | |
| towlower() | Yes | | Yes | |
| towupper() | Yes | | Yes | |
| trunc() | Neutral | | Yes | |
| truncate() | Yes | | No | |
| truncd32(), truncd64(), truncd128() | Neutral | | No | |
| truncf() | Neutral | | Yes | |
| truncl() | Neutral | | Yes | |
| tsched() | No | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-------------------------------|------------------------------|--|---|-------|
| tsearch() | Neutral | | Yes | |
| tsyncro() | Neutral | | No | |
| tterm() | Neutral | | No | |
| ttynname() | Yes | | No | |
| ttynname_r() | Yes | | No | |
| ttyslot() | Neutral | | No | |
| twalk() | Neutral | | Yes | |
| tzset() | Yes | | No | |
| ualarm() | Neutral | | No | |
| __ucreate() | Neutral | | No | |
| __ufree() | Neutral | | No | |
| __uheapreport() | Neutral | | No | |
| ulimit() | Neutral | | No | |
| ulltoa() | Yes | | No | |
| ultoa() | Yes | | No | |
| __umalloc() | Neutral | | No | |
| umask() | Neutral | | No | |
| umount() | Yes | | No | |
| uname() | Yes | | No | |
| uncaught_exception() | Neutral | | Yes | |
| UnDoExportWorkUnit() | Neutral | | No | |
| UnDoImportWorkUnit() | Neutral | | No | |
| unexpected() | Neutral | | Yes | |
| ungetc(), ungetc_unlocked() | Neutral | | No | |
| ungetwc(), ungetwc_unlocked() | Yes | | No | |
| unlink() | Yes | | No | |
| unlockpt() | Neutral | | No | |
| unsetenv() | Yes | | No | |
| usleep() | Neutral | | No | |
| utime() | Yes | | No | |
| utimes() | Yes | | No | |
| __utmpxname() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-----------------------------------|------------------------------|--|---|-------|
| utoa() | Yes | | Yes | |
| va_arg() | Neutral | | Yes | |
| va_copy() | Neutral | | Yes | |
| va_end() | Neutral | | Yes | |
| va_start() | Neutral | | Yes | |
| valloc() | Neutral | | No | |
| vfork() | Neutral | | No | |
| vfprintf(), vfprintf_unlocked() | Yes | | No | |
| vfscanf(), vfscanf_unlocked() | Yes | | No | |
| vfwprintf(), vfwprintf_unlocked() | Yes | 0x41070000 | No | |
| vfwscanf(), vfwscanf_unlocked() | Yes | | No | |
| vprintf(), vprintf_unlocked() | Yes | | No | |
| vsprintf() | Yes | | Yes | |
| vsprintf() | Yes | | Yes | |
| vscanf(), vscanf_unlocked() | Yes | | No | |
| vsscanf() | Yes | | Yes | |
| vswprintf() | Yes | | Yes | |
| vswscanf() | Yes | | No | |
| vwprintf(), vwprintf_unlocked() | Yes | 0x41070000 | No | |
| vwscanf(), vwscanf_unlocked() | Yes | | No | |
| w_getmntent() | Yes | | No | |
| w_getpsent() | Yes | | No | |
| w_iocctl() | No | | No | |
| w_statfs() | Yes | | No | |
| w_statvfs() | Yes | | No | |
| wait() | Neutral | | No | |
| waitid() | Neutral | | No | |
| waitpid() | Neutral | | No | |
| wait3() | Neutral | | No | |
| wcpncpy() | Neutral | | No | |
| wcpncpy() | Neutral | | No | |
| wcrtomb() | No | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|-------------------------------------|------------------------------|--|---|-------|
| wcscat() | Neutral | | No | |
| wcschr() | Neutral | | No | |
| wcscmp() | Neutral | | No | |
| wcscoll() | Yes | | No | |
| wcscpy() | Neutral | | No | |
| wcscspn() | Neutral | | No | |
| wcsftime() | Yes | | No | |
| wcsid() | Yes | | No | |
| wcslenn() | Neutral | | No | |
| wcsncat() | Neutral | | No | |
| wcsncmp() | Neutral | | No | |
| wcsncpy() | Neutral | | No | |
| wcsnlen() | Neutral | | No | |
| wcspbrk() | Neutral | | No | |
| wcsrchr() | Neutral | | No | |
| wcsrtombs() | No | | No | |
| wcsspn() | Neutral | | No | |
| wcsstr() | Neutral | | No | |
| wcstod() | Yes | | No | |
| wcstod32(), wcstod64(), wcstod128() | Yes | | No | |
| wcstof() | Yes | | No | |
| wcstoimax() | Yes | | No | |
| wcstok() | Neutral | | No | |
| wcstol() | Yes | | No | |
| wcstold() | Yes | | No | |
| wcstoll() | Yes | 0x41070000 | No | |
| wcstombs() | Yes | | No | |
| wcstoul() | Yes | | No | |
| wcstoull() | Yes | 0x41070000 | No | |
| wcstoumax() | Yes | | No | |
| wcswcs() | Neutral | | No | |

Table 87. Library function support table (continued)

| Function | Enhanced ASCII Support Level | Minimum Value for _ENHANCED_ASCII_EXT Feature Test Macro | Preinitialized Environments for Authorized Programs Support Level | Notes |
|---------------|------------------------------|--|---|-------|
| wcswidth() | Yes | | No | |
| wcsxfrm() | Yes | | No | |
| wctob() | Yes | | No | |
| wctomb() | Yes | | No | |
| wctype() | Yes | | No | |
| wcwidth() | Yes | | No | |
| wmemchr() | Neutral | | No | |
| wmemcmp() | Neutral | | No | |
| wmemcpy() | Neutral | | No | |
| wmemmove() | Neutral | | No | |
| wmemset() | Neutral | | No | |
| wordexp() | No | | No | |
| wordfree() | No | | No | |
| __w_pioctl() | Yes | 0x41020010 | No | |
| wprintf() | Yes | 0x41070000 | No | |
| write() | Neutral | | No | |
| __writedown() | Neutral | | No | |
| writev() | Neutral | | No | |
| wscanf() | Yes | | No | |
| __wsinit() | Neutral | | No | |
| yn() | Neutral | | Yes | |
| y0() | Neutral | | Yes | |
| y1() | Neutral | | Yes | |

Notes:

1. ASCII support provided only for XPG4 (or higher) interface.
2. ASCII support provided only for X/Open Sockets interface.
3. ASCII support is for the sun_path element of struct sockaddr_un when working with the AF_UNIX address family.
4. Preinitialized Environments for Authorized Programs support provided only for non-posix signals.
5. Preinitialized Environments for Authorized Programs support provided only if locale file resides in a dataset, not in a z/OS UNIX file system.
6. Preinitialized Environments for Authorized Programs support provided only for non-posix form of the function.

7. Preinitialized Environments for Authorized Programs support provided only for non z/OS UNIX file system DLLs.
8. Preinitialized Environments for Authorized Programs support provided only when dispatchable unit mode is task and cross memory mode is PASN=HASN=SASN. In addition, the RECOVERY=ESTAE parameter must be used on the CELAAUTH macro invocation.
9. This function table does not include compiler built-in functions (builtin.h).

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