man pages section 3: Networking Library Functions
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Preface

Both novice users and those familiar with the SunOS operating system can use online man pages to obtain information about the system and its features. A man page is intended to answer concisely the question “What does it do?” The man pages in general comprise a reference manual. They are not intended to be a tutorial.

Overview

The following contains a brief description of each man page section and the information it references:

- Section 1 describes, in alphabetical order, commands available with the operating system.
- Section 1M describes, in alphabetical order, commands that are used chiefly for system maintenance and administration purposes.
- Section 2 describes all of the system calls. Most of these calls have one or more error returns. An error condition is indicated by an otherwise impossible returned value.
- Section 3 describes functions found in various libraries, other than those functions that directly invoke UNIX system primitives, which are described in Section 2.
- Section 4 outlines the formats of various files. The C structure declarations for the file formats are given where applicable.
- Section 5 contains miscellaneous documentation such as character-set tables.
- Section 7 describes various special files that refer to specific hardware peripherals and device drivers. STREAMS software drivers, modules and the STREAMS-generic set of system calls are also described.
- Section 9E describes the DDI (Device Driver Interface)/DKI (Driver/Kernel Interface), DDI-only, and DKI-only entry-point routines a developer can include in a device driver.
- Section 9F describes the kernel functions available for use by device drivers.
- Section 9S describes the data structures used by drivers to share information between the driver and the kernel.

Below is a generic format for man pages. The man pages of each manual section generally follow this order, but include only needed headings. For example, if there are no bugs to report,
there is no BUGS section. See the intro pages for more information and detail about each section, and man(1) for more information about man pages in general.

NAME 
This section gives the names of the commands or functions documented, followed by a brief description of what they do.

SYNOPSIS 
This section shows the syntax of commands or functions. When a command or file does not exist in the standard path, its full path name is shown. Options and arguments are alphabetized, with single letter arguments first, and options with arguments next, unless a different argument order is required.

The following special characters are used in this section:

[ ] Brackets. The option or argument enclosed in these brackets is optional. If the brackets are omitted, the argument must be specified.

. . . Ellipses. Several values can be provided for the previous argument, or the previous argument can be specified multiple times, for example, “filename...”.

| Separator. Only one of the arguments separated by this character can be specified at a time.

{ } Braces. The options and/or arguments enclosed within braces are interdependent, such that everything enclosed must be treated as a unit.

PROTOCOL 
This section occurs only in subsection 3R to indicate the protocol description file.

DESCRIPTION 
This section defines the functionality and behavior of the service. Thus it describes concisely what the command does. It does not discuss OPTIONS or cite EXAMPLES. Interactive commands, subcommands, requests, macros, and functions are described under USAGE.

IOCTL 
This section appears on pages in Section 7 only. Only the device class that supplies appropriate parameters to the ioctl(2) system call is called ioctl and generates its own heading. ioctl calls for a specific device are listed alphabetically (on the man page for that specific device).
ioctl calls are used for a particular class of devices all of which have an io ending, such as mtcio(7I).

OPTIONS
This section lists the command options with a concise summary of what each option does. The options are listed literally and in the order they appear in the SYNOPSIS section. Possible arguments to options are discussed under the option, and where appropriate, default values are supplied.

OPERANDS
This section lists the command operands and describes how they affect the actions of the command.

OUTPUT
This section describes the output – standard output, standard error, or output files – generated by the command.

RETURN VALUES
If the man page documents functions that return values, this section lists these values and describes the conditions under which they are returned. If a function can return only constant values, such as 0 or -1, these values are listed in tagged paragraphs. Otherwise, a single paragraph describes the return values of each function. Functions declared void do not return values, so they are not discussed in RETURN VALUES.

ERRORS
On failure, most functions place an error code in the global variable errno indicating why they failed. This section lists alphabetically all error codes a function can generate and describes the conditions that cause each error. When more than one condition can cause the same error, each condition is described in a separate paragraph under the error code.

USAGE
This section lists special rules, features, and commands that require in-depth explanations. The subsections listed here are used to explain built-in functionality:

Commands
Modifiers
Variables
Expressions
Input Grammar

EXAMPLES
This section provides examples of usage or of how to use a command or function. Wherever possible a complete
example including command-line entry and machine response is shown. Whenever an example is given, the prompt is shown as example%, or if the user must be superuser, example#. Examples are followed by explanations, variable substitution rules, or returned values. Most examples illustrate concepts from the SYNOPSIS, DESCRIPTION, OPTIONS, and USAGE sections.

ENVIRONMENT VARIABLES  This section lists any environment variables that the command or function affects, followed by a brief description of the effect.

EXIT STATUS  This section lists the values the command returns to the calling program or shell and the conditions that cause these values to be returned. Usually, zero is returned for successful completion, and values other than zero for various error conditions.

FILES  This section lists all file names referred to by the man page, files of interest, and files created or required by commands. Each is followed by a descriptive summary or explanation.

ATTRIBUTES  This section lists characteristics of commands, utilities, and device drivers by defining the attribute type and its corresponding value. See attributes(5) for more information.

SEE ALSO  This section lists references to other man pages, in-house documentation, and outside publications.

DIAGNOSTICS  This section lists diagnostic messages with a brief explanation of the condition causing the error.

WARNINGS  This section lists warnings about special conditions which could seriously affect your working conditions. This is not a list of diagnostics.

NOTES  This section lists additional information that does not belong anywhere else on the page. It takes the form of an aside to the user, covering points of special interest. Critical information is never covered here.

BUGS  This section describes known bugs and, wherever possible, suggests workarounds.
REFERENCE

Networking Library Functions
accept (3SOCKET)

accept – accept a connection on a socket

Synopsis

```c
#include <sys/socket.h>

int accept(int s, struct sockaddr *addr, socklen_t *addrlen);
```

Description

The argument `s` is a socket that has been created with `socket(3SOCKET)` and bound to an address with `bind(3SOCKET)`, and that is listening for connections after a call to `listen(3SOCKET)`. The `accept()` function extracts the first connection on the queue of pending connections, creates a new socket with the properties of `s`, and allocates a new file descriptor, `ns`, for the socket. If no pending connections are present on the queue and the socket is not marked as non-blocking, `accept()` blocks the caller until a connection is present. If the socket is marked as non-blocking and no pending connections are present on the queue, `accept()` returns an error as described below. The `accept()` function uses the `netconfig(4)` file to determine the STREAMS device file name associated with `s`. This is the device on which the connect indication will be accepted. The accepted socket, `ns`, is used to read and write data to and from the socket that connected to `ns`. It is not used to accept more connections. The original socket (`s`) remains open for accepting further connections.

The argument `addr` is a result parameter that is filled in with the address of the connecting entity as it is known to the communications layer. The exact format of the `addr` parameter is determined by the domain in which the communication occurs.

The argument `addrlen` is a value-result parameter. Initially, it contains the amount of space pointed to by `addr`; on return it contains the length in bytes of the address returned.

The `accept()` function is used with connection-based socket types, currently with `SOCK_STREAM`.

It is possible to `select(3C)` or `poll(2)` a socket for the purpose of an `accept()` by selecting or polling it for a read. However, this will only indicate when a connect indication is pending; it is still necessary to call `accept()`.

Return Values

The `accept()` function returns −1 on error. If it succeeds, it returns a non-negative integer that is a descriptor for the accepted socket.

Errors

`accept()` will fail if:

- **EBADF**: The descriptor is invalid.
- **ECONNABORTED**: The remote side aborted the connection before the `accept()` operation completed.
- **EFAULT**: The `addr` parameter or the `addrlen` parameter is invalid.
- **EINTR**: The `accept()` attempt was interrupted by the delivery of a signal.
- **EMFILE**: The per-process descriptor table is full.
The protocol family and type corresponding to $s$ could not be found in the netconfig file.

There was insufficient user memory available to complete the operation.

There were insufficient STREAMS resources available to complete the operation.

The descriptor does not reference a socket.

The referenced socket is not of type SOCK_STREAM.

A protocol error has occurred; for example, the STREAMS protocol stack has not been initialized or the connection has already been released.

The socket is marked as non-blocking and no connections are present to be accepted.

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also poll(2), bind(3SOCKET), connect(3SOCKET), listen(3SOCKET), select(3C), socket.h(3HEAD), socket(3SOCKET), netconfig(4), attributes(5)
The `accept()` function extracts the first connection on the queue of pending connections, creates a new socket with the same socket type protocol and address family as the specified socket, and allocates a new file descriptor for that socket.

The function takes the following arguments:

- `socket`: Specifies a socket that was created with `socket(3XNET)`, has been bound to an address with `bind(3XNET)`, and has issued a successful call to `listen(3XNET)`.
- `address`: Either a null pointer, or a pointer to a `sockaddr` structure where the address of the connecting socket will be returned.
- `address_len`: Points to a `socklen_t` which on input specifies the length of the supplied `sockaddr` structure, and on output specifies the length of the stored address.

If `address` is not a null pointer, the address of the peer for the accepted connection is stored in the `sockaddr` structure pointed to by `address`, and the length of this address is stored in the object pointed to by `address_len`.

If the actual length of the address is greater than the length of the supplied `sockaddr` structure, the stored address will be truncated.

If the protocol permits connections by unbound clients, and the peer is not bound, then the value stored in the object pointed to by `address` is unspecified.

If the listen queue is empty of connection requests and O_NONBLOCK is not set on the file descriptor for the socket, `accept()` will block until a connection is present. If the `listen(3XNET)` queue is empty of connection requests and O_NONBLOCK is set on the file descriptor for the socket, `accept()` will fail and set `errno` to `EAGAIN` or `EWOULDBLOCK`.

The accepted socket cannot itself accept more connections. The original socket remains open and can accept more connections.

**Usage**

When a connection is available, `select(3C)` will indicate that the file descriptor for the socket is ready for reading.

**Return Values**

Upon successful completion, `accept()` returns the nonnegative file descriptor of the accepted socket. Otherwise, −1 is returned and `errno` is set to indicate the error.
The accept() function will fail if:

- **EAGAIN**
- **EWOULDBLOCK** O_NONBLOCK is set for the socket file descriptor and no connections are present to be accepted.
- **EBADF** The socket argument is not a valid file descriptor.
- **ECONNABORTED** A connection has been aborted.
- **EFAULT** The address or address_len parameter cannot be accessed or written.
- **EINTR** The accept() function was interrupted by a signal that was caught before a valid connection arrived.
- **EINVAL** The socket is not accepting connections.
- **EMFILE** OPEN_MAX file descriptors are currently open in the calling process.
- **ENFILE** The maximum number of file descriptors in the system are already open.
- **ENOTSOCK** The socket argument does not refer to a socket.
- **EOPNOTSUPP** The socket type of the specified socket does not support accepting connections.

The accept() function may fail if:

- **ENOBUFS** No buffer space is available.
- **ENOMEM** There was insufficient memory available to complete the operation.
- **ENOSR** There was insufficient STREAMS resources available to complete the operation.
- **EPROTO** A protocol error has occurred; for example, the STREAMS protocol stack has not been initialized.

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also: bind(3XNET), connect(3XNET), listen(3XNET), socket(3XNET), attributes(5), standards(5)
ber_decode(3LDAP)

Name
ber_decode, ber_alloc_t, ber_free, ber_bvdup, ber_init, ber_flatten, ber_get_next,
ber_skip_tag, ber_peek_tag, ber_scanf, ber_get_int, ber_get_stringa, ber_get_stringal,
ber_get_stringb, ber_get_null, ber_get_boolean, ber_get_bitstring, ber_first_element,
ber_next_element, ber_bvfree, ber_bvecfree – Basic Encoding Rules library decoding
functions

Synopsis
cc [ flag... ] file... -lldap [ library... ]
#include <ber.h>

BerElement *ber_alloc_t(int options);
struct berval *ber_bvdup(const struct berval *bv);
void ber_free(BerElement *ber, int freebuf);
BerElement *ber_init(const struct berval *bv);
int ber_flatten(BerElement *ber, struct berval **bvPtr);
ber_tag_t ber_get_next(SocketBuf *sb, ber_len_t *len, BerElement *ber);
ber_tag_t ber_skip_tag(BerElement *ber, ber_len_t *len);
ber_tag_t ber_peek_tag(BerElement *ber, ber_len_t *len);
ber_tag_t ber_get_int(BerElement *ber, ber_int_t *num);
ber_tag_t ber_get_stringb(BerElement *ber, char *buf,
    ber_len_t *len);
ber_tag_t ber_get_stringa(BerElement *ber, char **buf);
ber_tag_t ber_get_stringal(BerElement *ber, struct berval **bv);
ber_tag_t ber_get_null(BerElement *ber);
ber_tag_t ber_get_boolean(BerElement *ber, int *boolval);
ber_tag_t ber_get_bitstringa(BerElement *ber, char **buf,
    ber_len_t *len);
ber_tag_t ber_first_element(BerElement *ber, ber_len_t *len,
    char **last);
ber_tag_t ber_next_element(BerElement *ber, ber_len_t *len,
    char *last);
ber_tag_t ber_scanf(BerElement *ber, const char *fmt [, arg...]);
void ber_bvfree(struct berval *bv);
void ber_bvecfree(struct berval **bvec);

Description
These functions provide a subfunction interface to a simplified implementation of the Basic
Encoding Rules of ASN.1. The version of BER these functions support is the one defined for
the LDAP protocol. The encoding rules are the same as BER, except that only definite form
lengths are used, and bitstrings and octet strings are always encoded in primitive form. In
addition, these lightweight BER functions restrict tags and class to fit in a single octet (this means the actual tag must be less than 31). When a "tag" is specified in the descriptions below, it refers to the tag, class, and primitive or constructed bit in the first octet of the encoding. This man page describes the decoding functions in the Iber library. See ber_encode(3LDAP) for details on the corresponding encoding functions.

Normally, the only functions that need be called by an application are ber_get_next() to get the next BER element and ber_scanf() to do the actual decoding. In some cases, ber_peek_tag() may also need to be called in normal usage. The other functions are provided for those applications that need more control than ber_scanf() provides. In general, these functions return the tag of the element decoded, or −1 if an error occurred.

The ber_get_next() function is used to read the next BER element from the given Sockbuf, sb. A Sockbuf consists of the descriptor (usually socket, but a file descriptor works just as well) from which to read, and a BerElement structure used to maintain a buffer. On the first call, the sb_ber struct should be zeroed. It strips off and returns the leading tag byte, strips off and returns the length of the entire element in len, and sets up ber for subsequent calls to ber_scanf(), and all to decode the element.

The ber_peek_tag() function returns the tag of the next element to be parsed in the BerElement argument. The length of this element is stored in the *lenPtr argument. LBER_DEFAULT is returned if there is no further data to be read. The decoding position within the ber argument is unchanged by this call; that is, the fact that ber_peek_tag() has been called does not affect future use of ber.

The ber_skip_tag() function is similar to ber_peek_tag(), except that the state pointer in the BerElement argument is advanced past the first tag and length, and is pointed to the value part of the next element. This function should only be used with constructed types and situations when a BER encoding is used as the value of an OCTET STRING. The length of the value is stored in *lenPtr.

The ber_scanf() function is used to decode a BER element in much the same way that scanf(3C) works. It reads from ber, a pointer to a BerElement such as returned by ber_get_next(), interprets the bytes according to the format string fmt, and stores the results in its additional arguments. The format string contains conversion specifications which are used to direct the interpretation of the BER element. The format string can contain the following characters.

- **Octet string.** A char ** should be supplied. Memory is allocated, filled with the contents of the octet string, null-terminated, and returned in the parameter.

- **Octet string.** A char * buffer should be supplied, followed by a pointer to an integer initialized to the size of the buffer. Upon return, the null-terminated octet string is put into the buffer, and the integer is set to the actual size of the octet string.

- **Octet string.** A struct ber_val ** should be supplied, which upon return points to a memory allocated struct berval containing the octet string and its length. ber_bvfree() can be called to free the allocated memory.
b  Boolean. A pointer to an integer should be supplied.
i  Integer. A pointer to an integer should be supplied.
B  Bitstring. A char ** should be supplied which will point to the memory allocated bits, followed by an unsigned long *, which will point to the length (in bits) of the bitstring returned.
n  Null. No parameter is required. The element is simply skipped if it is recognized.
v  Sequence of octet strings. A char *** should be supplied, which upon return points to a memory allocated null-terminated array of char *'s containing the octet strings. NULL is returned if the sequence is empty.
V  Sequence of octet strings with lengths. A struct berval *** should be supplied, which upon return points to a memory allocated, null-terminated array of struct berval *'s containing the octet strings and their lengths. NULL is returned if the sequence is empty. ber_bvecfree() can be called to free the allocated memory.
x  Skip element. The next element is skipped.
{  Begin sequence. No parameter is required. The initial sequence tag and length are skipped.
}  End sequence. No parameter is required and no action is taken.
[  Begin set. No parameter is required. The initial set tag and length are skipped.
]  End set. No parameter is required and no action is taken.

The ber_get_int() function tries to interpret the next element as an integer, returning the result in num. The tag of whatever it finds is returned on success, –1 on failure.

The ber_get_stringb() function is used to read an octet string into a pre-allocated buffer. The len parameter should be initialized to the size of the buffer, and will contain the length of the octet string read upon return. The buffer should be big enough to take the octet string value plus a terminating NULL byte.

The ber_get_stringa() function is used to allocate memory space into which an octet string is read.

The ber_get_stringal() function is used to allocate memory space into which an octet string and its length are read. It takes a struct berval **, and returns the result in this parameter.

The ber_get_null() function is used to read a NULL element. It returns the tag of the element it skips over.

The ber_get_boolean() function is used to read a boolean value. It is called the same way that ber_get_int() is called.
The ber_get_bitstringa() function is used to read a bitstring value. It takes a char ** which will hold the allocated memory bits, followed by an unsigned long *, which will point to the length (in bits) of the bitstring returned.

The ber_first_element() function is used to return the tag and length of the first element in a set or sequence. It also returns in last a magic cookie parameter that should be passed to subsequent calls to ber_next_element(), which returns similar information.

The ber_alloc_t() function constructs and returns BerElement. A null pointer is returned on error. The options field contains a bitwise-OR of options which are to be used when generating the encoding of this BerElement. One option is defined and must always be supplied:

#define LBER_USE_DER 0x01

When this option is present, lengths will always be encoded in the minimum number of octets. Note that this option does not cause values of sets and sequences to be rearranged in tag and byte order, so these functions are not suitable for generating DER output as defined in X.509 and X.680

The ber_init function constructs a BerElement and returns a new BerElement containing a copy of the data in the bv argument. The ber_init function returns the null pointer on error.

The ber_free() function frees a BerElement which is returned from the API calls ber_alloc_t() or ber_init(). Each BerElement must be freed by the caller. The second argument freebuf should always be set to 1 to ensure that the internal buffer used by the BER functions is freed as well as the BerElement container itself.

The ber_bvdup() function returns a copy of a berval. The bv_val field in the returned berval points to a different area of memory as the bv_val field in the argument berval. The null pointer is returned on error (that is, is out of memory).

The ber_flatten() function allocates a struct berval whose contents are BER encoding taken from the ber argument. The bvPtr pointer points to the returned berval, which must be freed using ber_bvfree(). This function returns 0 on success and −1 on error.

Examples

**EXAMPLE 1**

Assume the variable ber contains a lightweight BER encoding of the following ASN.1 object:

```
AlmostASearchRequest ::= SEQUENCE {
  baseObject DistinguishedName,
  scope ENUMERATED {
    baseObject (0),
    singleLevel (1),
    wholeSubtree (2)
  },
  derefAliases ENUMERATED {
    neverDerefAliases (0),
    ```
Assume the variable `ber` contains a lightweight BER encoding of the following ASN.1 object:

```asn1
{derefInSearching (1),
 derefFindingBaseObj (2),
 alwaysDerefAliases (3N),
},
 sizelimit INTEGER (0 .. 65535),
 timelimit INTEGER (0 .. 65535),
 attrsOnly BOOLEAN,
 attributes SEQUENCE OF AttributeType
}
```

The element can be decoded using `ber_scanf()` as follows.

```c
int scope, ali, size, time, attrsonly;
char *dn, **attrs;
if ( ber_scanf( ber, "{aiiiib{v}}", &dn, &scope, &ali, 
     &size, &time, &attrsonly, &attrs ) == -1 )
    /* error */
else
    /* success */
```

**Errors** If an error occurs during decoding, generally these functions return \(-1\).

**Notes** The return values for all of these functions are declared in the `<ber.h>` header. Some functions may allocate memory which must be freed by the calling application.

**Attributes** See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also** `ber_decode(3LDAP)`, `attributes(5)`


cc [flag... ] file... -lldap [ library... ]
#include <ber.h>

BerElement *ber_alloc();
ber_printf(BerElement *ber, char **fmt, arg... ]);
ber_put_int(BerElement *ber, long num, char tag);
ber_put_ostring(BerElement *ber, char **str, unsigned long len, char tag);
ber_put_string(BerElement *ber, char **str, char tag);
ber_put_null(BerElement *ber, char tag);
ber_put_boolean(BerElement *ber, int bool, char tag);
ber_put_bitstring(BerElement *ber, char *str, int blen, char tag);
ber_start_seq(BerElement *ber, char tag);
ber_start_set(BerElement *ber, char tag);
ber_put_seq(BerElement *ber);
ber_put_set(BerElement *ber);

Description These functions provide a subfunction interface to a simplified implementation of the Basic Encoding Rules of ASN.1. The version of BER these functions support is the one defined for the LDAP protocol. The encoding rules are the same as BER, except that only definite form lengths are used, and bitstrings and octet strings are always encoded in primitive form. In addition, these lightweight BER functions restrict tags and class to fit in a single octet (this means the actual tag must be less than 31). When a “tag” is specified in the descriptions below, it refers to the tag, class, and primitive or constructed bit in the first octet of the encoding. This man page describes the encoding functions in the lber library. See ber_decode(3LDAP) for details on the corresponding decoding functions.

Normally, the only functions that need be called by an application are ber_alloc(), to allocate a BER element, and ber_printf() to do the actual encoding. The other functions are provided for those applications that need more control than ber_printf() provides. In general, these functions return the length of the element encoded, or −1 if an error occurred.

The ber_alloc() function is used to allocate a new BER element.

The ber_printf() function is used to encode a BER element in much the same way that printf(3S) works. One important difference, though, is that some state information is kept with the ber parameter so that multiple calls can be made to ber_printf() to append things to the end of the BER element. ber_printf() writes to ber, a pointer to a BerElement such as
returned by \texttt{ber_alloc().} It interprets and formats its arguments according to the format string \texttt{fmt.} The format string can contain the following characters:

- \texttt{b} Boolean. An integer parameter should be supplied. A boolean element is output.
- \texttt{B} Bitstring. A \texttt{char *} pointer to the start of the bitstring is supplied, followed by the number of bits in the bitstring. A bitstring element is output.
- \texttt{i} Integer. An integer parameter should be supplied. An integer element is output.
- \texttt{n} Null. No parameter is required. A null element is output.
- \texttt{o} Octet string. A \texttt{char *} is supplied, followed by the length of the string pointed to. An octet string element is output.
- \texttt{O} Octet string. A \texttt{struct berval *} is supplied. An octet string element is output.
- \texttt{s} Octet string. A null-terminated string is supplied. An octet string element is output, not including the trailing null octet.
- \texttt{t} Tag. An int specifying the tag to give the next element is provided. This works across calls.
- \texttt{v} Several octet strings. A null-terminated array of \texttt{char *} is supplied. Note that a construct like \texttt{\{v\}} is required to get an actual sequence of octet strings.

\begin{tabular}{l}
\texttt{\{} Begin sequence. No parameter is required. \\
\texttt{\}} End sequence. No parameter is required. \\
\texttt{[} Begin set. No parameter is required. \\
\texttt{]} End set. No parameter is required. \\
\end{tabular}

The \texttt{ber_put_int()} function writes the integer element \texttt{num} to the BER element \texttt{ber}.

The \texttt{ber_put_boolean()} function writes the boolean value given by \texttt{bool} to the BER element.

The \texttt{ber_put_bitstring()} function writes \texttt{blen} bits starting at \texttt{str} as a bitstring value to the given BER element. Note that \texttt{blen} is the length in \texttt{bits} of the bitstring.

The \texttt{ber_put_ostring()} function writes \texttt{len} bytes starting at \texttt{str} to the BER element as an octet string.

The \texttt{ber_put_string()} function writes the null-terminated string (minus the terminating ”) to the BER element as an octet string.

The \texttt{ber_put_null()} function writes a NULL element to the BER element.

The \texttt{ber_start_seq()} function is used to start a sequence in the BER element. The \texttt{ber_start_set()} function works similarly. The end of the sequence or set is marked by the nearest matching call to \texttt{ber_put_seq()} or \texttt{ber_put_set()}, respectively.
The `ber_first_element()` function is used to return the tag and length of the first element in a set or sequence. It also returns in `cookie` a magic cookie parameter that should be passed to subsequent calls to `ber_next_element()`, which returns similar information.

**Examples**

**EXAMPLE 1** Assuming the following variable declarations, and that the variables have been assigned appropriately, an BER encoding of the following ASN.1 object:

```plaintext
AlmostASearchRequest := SEQUENCE {
  baseObject DistinguishedName,
  scope ENUMERATED {
    baseObject (0),
    singleLevel (1),
    wholeSubtree (2)
  },
  derefAliases ENUMERATED {
    neverDerefAliases (0),
    derefInSearching (1),
    derefFindingBaseObj (2),
    alwaysDerefAliases (3N)
  },
  sizelimit INTEGER (0 .. 65535),
  timelimit INTEGER (0 .. 65535),
  attrsOnly BOOLEAN,
  attributes SEQUENCE OF AttributeType
}
```

can be achieved like so:

```plaintext
int scope, ali, size, time, attrsonly;
char *dn, **attrs;
/* ... fill in values ... */
if ( (ber = ber_alloc( )) == NULLBER )
  /* error */
else
  if ( ber_printf( ber, "{siiiib{v}}", dn, scope, ali,
    size, time, attrsonly, attrs ) == -1 )
    /* error */
  else
    /* success */
```

**Return Values** If an error occurs during encoding, `ber_alloc()` returns NULL; other functions generally return −1.

**Attributes** See `attributes(5)` for a description of the following attributes:
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ber_decode(3LDAP), attributes(5)


Notes  The return values for all of these functions are declared in <ber.h>.
### Name
bind – bind a name to a socket

### Synopsis
```
cc [ flag ... ] file ... -lsocket -lnsl [ library ... ]
#include <sys/socket.h>

int bind(int s, const struct sockaddr *name, socklen_t namelen);
```

### Description
The `bind()` function assigns a name to an unnamed socket. When a socket is created with `socket(3SOCKET)`, it exists in a namespace (address family) but has no name assigned. The `bind()` function requests that the name pointed to by `name` be assigned to the socket.

### Return Values
Upon successful completion 0 is returned. Otherwise, −1 is returned and `errno` is set to indicate the error.

### Errors
The `bind()` function will fail if:

- **EACCES** The requested address is protected, and `{PRIV_NET_PRIVADDR}` is not asserted in the effective set of the current process.
- **EADDRINUSE** The specified address is already in use.
- **EADDRNOTAVAIL** The specified address is not available on the local machine.
- **EBADF** `s` is not a valid descriptor.
- **EINVAL** `namelen` is not the size of a valid address for the specified address family.
  - The socket is already bound to an address.
  - Socket options are inconsistent with port attributes.
- **ENOSR** There were insufficient STREAMS resources for the operation to complete.
- **ENOTSOCK** `s` is a descriptor for a file, not a socket.

The following errors are specific to binding names in the UNIX domain:

- **EACCES** Search permission is denied for a component of the path prefix of the pathname in `name`.
- **EIO** An I/O error occurred while making the directory entry or allocating the inode.
- **EISDIR** A null pathname was specified.
- **ELOOP** Too many symbolic links were encountered in translating the pathname in `name`.
- **ENOTENT** A component of the path prefix of the pathname in `name` does not exist.
- **ENOTDIR** A component of the path prefix of the pathname in `name` is not a directory.
- **EROFS** The inode would reside on a read-only file system.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  unlink(2), socket(3SOCKET), attributes(5), privileges(5), socket.h(3HEAD)

Notes  Binding a name in the UNIX domain creates a socket in the file system that must be deleted by the caller when it is no longer needed by using unlink(2).

The rules used in name binding vary between communication domains.
bind – bind a name to a socket

Synopsis

```
cc [ flag ... ] file ... -lxnet [ library ... ]
#include <sys/socket.h>

int bind(int socket, const struct sockaddr *address,
         socklen_t address_len);
```

Description

The `bind()` function assigns an address to an unnamed socket. Sockets created with `socket(3XNET)` function are initially unnamed. They are identified only by their address family.

The function takes the following arguments:

- `socket` Specifies the file descriptor of the socket to be bound.
- `address` Points to a `sockaddr` structure containing the address to be bound to the socket. The length and format of the address depend on the address family of the socket.
- `address_len` Specifies the length of the `sockaddr` structure pointed to by the `address` argument.

The socket in use may require the process to have appropriate privileges to use the `bind()` function.

Usage

An application program can retrieve the assigned socket name with the `getsockname(3XNET)` function.

Return Values

Upon successful completion, `bind()` returns 0. Otherwise, −1 is returned and `errno` is set to indicate the error.

Errors

The `bind()` function will fail if:

- **EADDRINUSE** The specified address is already in use.
- **EADDRNOTAVAIL** The specified address is not available from the local machine.
- **EAFNOSUPPORT** The specified address is not a valid address for the address family of the specified socket.
- **EBADF** The `socket` argument is not a valid file descriptor.
- **EFAULT** The `address` argument cannot be accessed.
- **EINVAL** The socket is already bound to an address, and the protocol does not support binding to a new address; or the socket has been shut down.
- **ENOTSOCK** The `socket` argument does not refer to a socket.
- **EOPNOTSUPP** The socket type of the specified socket does not support binding to an address.
If the address family of the socket is AF_UNIX, then bind() will fail if:

**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**

**EISDIR**  
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 filesystem.

The bind() function may fail if:

**EACCES**  
The specified address is protected, and {PRIV_NET_PRIVADOR} is not asserted in the effective set of the current process.

**EINVAL**  
The address_len argument is not a valid length for the address family.

**EISCONN**  
The socket is already connected.

**ENAMETOOLONG**  
Pathname resolution of a symbolic link produced an intermediate result whose length exceeds PATH_MAX.

**ENOMEM**  
Insufficient resources were available to complete the call.

**ENOSR**  
There were insufficient STREAMS resources for the operation to complete.

Attributes  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>
See Also  connect(3XNET), getsockname(3XNET), listen(3XNET), socket(3XNET),
attributes(5), privileges(5), standards(5)
byteorder(3SOCKET)

Name  byteorder, htonl, htonll, htons, ntohl, ntohll, ntohss – convert values between host and network byte order

Synopsis  

```
#include <sys/types.h>
#include <netinet/in.h>
#include <inttypes.h>

uint32_t htonl(uint32_t hostlong);
uint64_t htonl(uint64_t hostlonglong);
uint16_t htons(uint16_t hostshort);
uint32_t ntohl(uint32_t netlong);
uint64_t ntohll(uint64_t hostlonglong);
uint16_t ntohs(uint16_t netshort);
```

Description  These functions convert 16-bit, 32-bit, and 64-bit quantities between network byte order and host byte order. On some architectures these routines are defined as NULL macros in the include file <netinet/in.h>. On other architectures, the routines are functional when the host byte order is different from network byte order.

These functions are most often used in conjunction with Internet addresses and ports as returned by gethostent() and getservent(). See gethostbyname(3NSL) and getservbyname(3SOCKET).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  gethostbyname(3NSL), getservbyname(3SOCKET), inet.h(3HEAD), attributes(5)
cldap_close – dispose of connectionless LDAP pointer

Synopsis

cc [ flag... ] file... -lldap [ library... ]
#include <lber.h>
#include <ldap.h>

void cldap_close(LDAP *ld);

Description

The cldap_close() function disposes of memory allocated by cldap_open(3LDAP). It should be called when all CLDAP communication is complete.

Parameters

ld The LDAP pointer returned by a previous call to cldap_open(3LDAP).

Attributes

See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

ldap(3LDAP), cldap_open(3LDAP), cldap_search_s(3LDAP), cldap_setretryinfo(3LDAP)
**Name**
cldap_open – LDAP connectionless communication preparation

**Synopsis**
```c
cc [ flag ... ] file ... -lldap[ library... ]
#include <ber.h>
#include <ldap.h>

LDAP *cldap_open(char *host, int port);
```

**Parameters**
- `host`  The name of the host on which the LDAP server is running.
- `port`  The port number to connect.

**Description**
The `cldap_open()` function is called to prepare for connectionless LDAP communication (over `udp(7P)`). It allocates an LDAP structure which is passed to future search requests.

If the default IANA-assigned port of 389 is desired, `LDAP_PORT` should be specified for `port`. `host` can contain a space-separated list of hosts or addresses to try. `cldap_open()` returns a pointer to an LDAP structure, which should be passed to subsequent calls to `cldap_search_s(3LDAP), cldap_setretryinfo(3LDAP), and cldap_close(3LDAP)`. Certain fields in the LDAP structure can be set to indicate size limit, time limit, and how aliases are handled during operations. See `ldap_open(3LDAP)` and `<ldap.h>` for more details.

**Errors**
If an error occurs, `cldap_open()` will return `NULL` and `errno` will be set appropriately.

**Attributes**
See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**
`ldap(3LDAP), cldap_search_s(3LDAP), cldap_setretryinfo(3LDAP), cldap_close(3LDAP), attributes(5), udp(7P)`
**Name**
cldap_search_s – connectionless LDAP search

**Synopsis**
cc[ flag... ] file... -lldap[ library... ]
#include <ber.h>
#include <ldap.h>

```c
int cldap_search_s(LDAP *ld, char *base, int scope, char *filter,
                 char *attrs, int attrsonly, LDAPMessage **res, char *logdn);
```

**Description**
The `cldap_search_s()` function performs an LDAP search using the Connectionless LDAP (CLDAP) protocol.

cldap_search_s() has parameters and behavior identical to that of `ldap_search_s(3LDAP)`, except for the addition of the `logdn` parameter. `logdn` should contain a distinguished name to be used only for logging purposes by the LDAP server. It should be in the text format described by `RFC 1779; A String Representation of Distinguished Names`.

**Retransmission Algorithm**
cldap_search_s() operates using the CLDAP protocol over `udp(7P)`. Since UDP is a non-reliable protocol, a retry mechanism is used to increase reliability. The `cldap_setretryinfo(3LDAP)` function can be used to set two retry parameters: `tries`, a count of the number of times to send a search request and `timeout`, an initial timeout that determines how long to wait for a response before re-trying. `timeout` is specified in seconds. These values are stored in the `ld_cldaptries` and `ld_cldaptimeout` members of the `ld LDAP` structure, and the default values set in `ldap_open(3LDAP)` are 4 and 3 respectively. The retransmission algorithm used is:

**Step 1**
Set the current timeout to `ld_cldaptimeout` seconds, and the current LDAP server address to the first LDAP server found during the `ldap_open(3LDAP)` call.

**Step 2**
Send the search request to the current LDAP server address.

**Step 3**
Set the wait timeout to the current timeout divided by the number of server addresses found during `ldap_open(3LDAP)` or to one second, whichever is larger. Wait at most that long for a response; if a response is received, STOP. Note that the wait timeout is always rounded down to the next lowest second.

**Step 4**
Repeat steps 2 and 3 for each LDAP server address.

**Step 5**
Set the current timeout to twice its previous value and repeat Steps 2 through 5 a maximum of `tries` times.

**Examples**
Assume that the default values for `tries` and `timeout` of 4 tries and 3 seconds are used. Further, assume that a space-separated list of two hosts, each with one address, was passed to `cldap_open(3LDAP)`. The pattern of requests sent will be (stopping as soon as a response is received):

<table>
<thead>
<tr>
<th>Time</th>
<th>Search Request Sent To:</th>
</tr>
</thead>
<tbody>
<tr>
<td>+0</td>
<td>Host A try 1</td>
</tr>
<tr>
<td>+1 (0+3/2)</td>
<td>Host B try 1</td>
</tr>
<tr>
<td>+2 (1+3/2)</td>
<td>Host A try 2</td>
</tr>
</tbody>
</table>
cldap_search_s(3LDAP)

+5  (2+6/2)  Host B try 2
+8  (5+6/2)  Host A try 3
+14  (8+12/2)  Host B try 3
+20  (14+12/2)  Host A try 4
+32  (20+24/2)  Host B try 4
+44  (20+24/2)  (give up - no response)

**Errors**  
cldap_search_s() returns LDAP_SUCCESS if a search was successful and the appropriate LDAP error code otherwise. See ldap_error(3LDAP) for more information.

**Attributes**  
See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**  
ldap(3LDAP), ldap_error(3LDAP), ldap_search_s(3LDAP), cldap_open(3LDAP), cldap_setretryinfo(3LDAP), cldap_close(3LDAP), attributes(5), udp(7P)
**Name**
cldap_setretryinfo – set connectionless LDAP request retransmission parameters

**Synopsis**

c[ flag... ] file... -lldap[ library... ]

#include <lber.h>
#include <ldap.h>

void cldap_setretryinfo(LDAP *ld, int tries, int timeout);

**Parameters**

*ld*  LDAP pointer returned from a previous call to cldap_open(3LDAP).

*tries*  Maximum number of times to send a request.

*timeout*  Initial time, in seconds, to wait before re-sending a request.

**Description**
The cldap_setretryinfo() function is used to set the CLDAP request retransmission behavior for future cldap_search_s(3LDAP) calls. The default values (set by cldap_open(3LDAP)) are 4 tries and 3 seconds between tries. See cldap_search_s(3LDAP) for a complete description of the retransmission algorithm used.

**Attributes**
See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**
ldap(3LDAP), cldap_open(3LDAP), cldap_search_s(3LDAP), cldap_close(3LDAP), attributes(5)
connect (3SOCKET)

Name
connect – connect a socket

Synopsis
cc [ flag ... ] file ... -lsocket -lssl [ library ... ]
#include <sys/socket.h>

int connect(int s, const struct sockaddr *name, socklen_t namelen);

Description
The parameter s is a socket. If it is of type SOCK_DGRAM, connect ()
specifies the peer with which the socket is to be associated. This address is the address
to which datagrams are to be sent if a receiver is not explicitly
designated. This address is the only address from which
datagrams are to be received. If the socket s is of type SOCK_STREAM, connect ()
attempts to make a connection to another socket. This behavior can be
modified by the SO_PASSIVE_CONNECT socket option provided by
setsockopt(3SOCKET). The other socket is specified by name, which is
an address in the communication space of the socket. Each
communication space interprets the name parameter in its own way. If s is not bound, then s
will be bound to an address selected by the underlying transport provider. Generally, stream
sockets can successfully connect () only once. Datagram sockets can use connect ()
multiple times to change their association. Datagram sockets can
dissolve the association by connecting to a null address.

Return Values
If the connection or binding succeeds, 0 is returned. Otherwise, −1 is returned, errno
is set to indicate the error, and state of the socket is unspecified. Applications should close
the file descriptor and create a new socket before attempting to reconnect.

Errors
The call fails if:

- EACCES
  Search permission is denied for a component of the path prefix of the
  pathname in name.

- EADDRINUSE
  The address is already in use.

- EADDRNOTAVAIL
  The specified address is not available.

- EAFNOSUPPORT
  Addresses in the specified address family cannot be used with this socket.

- EALREADY
  The socket is non-blocking, and a previous connection attempt has not
  yet been completed.

- EBADF
  s is not a valid descriptor.

- ECONNREFUSED
  The attempt to connect was forcefully rejected.

- EINPROGRESS
  The socket is non-blocking, and the connection cannot be completed
  immediately. You can use select(3C) to complete the connection by
  selecting the socket for writing.

- EINTR
  The connection attempt was interrupted before any data arrived by
  the delivery of a signal. The connection, however, will be established
  asynchronously.

- EINVAL
  namelen is not the size of a valid address for the specified address family.
An I/O error occurred while reading from or writing to the file system.
The socket is already connected.
Too many symbolic links were encountered in translating the pathname in `name`.
The network is not reachable from this host.
The remote host is not reachable from this host.
A component of the path prefix of the pathname in `name` does not exist.
The socket referred to by the pathname in `name` does not exist.
There were insufficient STREAMS resources available to complete the operation.
The server exited before the connection was complete.
Connection establishment timed out without establishing a connection.
The socket is marked as non-blocking, and the requested operation would block.

The following errors are specific to connecting names in the UNIX domain. These errors might not apply in future versions of the UNIX IPC domain.
A component of the path prefix of the pathname in `name` is not a directory.
`s` is not a socket.
`name` is not a socket.
The file that is referred to by `name` is a socket of a type other than type `s`. For example, `s` is a SOCK_DGRAM socket, while `name` refers to a SOCK_STREAM socket.

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also close(2), accept(3SOCKET), getsockname(3SOCKET), select(3C), setsockopt(3SOCKET), socket(3SOCKET), socket.h(3HEAD), attributes(5)
The `connect()` function requests a connection to be made on a socket. The function takes the following arguments:

- `socket`: Specifies the file descriptor associated with the socket.
- `address`: Points to a `sockaddr` structure containing the peer address. The length and format of the address depend on the address family of the socket.
- `address_len`: Specifies the length of the `sockaddr` structure pointed to by the `address` argument.

If the socket has not already been bound to a local address, `connect()` will bind it to an address which, unless the socket’s address family is AF_UNIX, is an unused local address.

If the initiating socket is not connection-mode, then `connect()` sets the socket’s peer address, but no connection is made. For SOCK_DGRAM sockets, the peer address identifies where all datagrams are sent on subsequent `send(3XNET)` calls, and limits the remote sender for subsequent `recv(3XNET)` calls. If `address` is a null address for the protocol, the socket’s peer address will be reset.

If the initiating socket is connection-mode, then `connect()` attempts to establish a connection to the address specified by the `address` argument.

If the connection cannot be established immediately and O_NONBLOCK is not set for the file descriptor for the socket, `connect()` will block for up to an unspecified timeout interval until the connection is established. If the timeout interval expires before the connection is established, `connect()` will fail and the connection attempt will be aborted. If `connect()` is interrupted by a signal that is caught while blocked waiting to establish a connection, `connect()` will fail and set `errno` to EINTR, but the connection request will not be aborted, and the connection will be established asynchronously.

If the connection cannot be established immediately and O_NONBLOCK is set for the file descriptor for the socket, `connect()` will fail and set `errno` to EINPROGRESS, but the connection request will not be aborted, and the connection will be established asynchronously. Subsequent calls to `connect()` for the same socket, before the connection is established, will fail and set `errno` to EALREADY.

When the connection has been established asynchronously, `select(3C)` and `poll(2)` will indicate that the file descriptor for the socket is ready for writing.
The socket in use may require the process to have appropriate privileges to use the `connect()` function.

**Usage** If `connect()` fails, the state of the socket is unspecified. Portable applications should close the file descriptor and create a new socket before attempting to reconnect.

**Return Values** Upon successful completion, `connect()` returns 0. Otherwise, –1 is returned and `errno` is set to indicate the error.

**Errors** The `connect()` function will fail if:

- **EADDRNOTAVAIL** The specified address is not available from the local machine.
- **EAFNOSUPPORT** The specified address is not a valid address for the address family of the specified socket.
- **EALREADY** A connection request is already in progress for the specified socket.
- **EBAADF** The `socket` argument is not a valid file descriptor.
- **ECONNREFUSED** The target address was not listening for connections or refused the connection request.
- **EFAULT** The address parameter cannot be accessed.
- **EINPROGRESS** `O_NONBLOCK` is set for the file descriptor for the socket and the connection cannot be immediately established; the connection will be established asynchronously.
- **EINVAL** The attempt to establish a connection was interrupted by delivery of a signal that was caught; the connection will be established asynchronously.
- **ENETUNREACH** No route to the network is present.
- **ENOTSOCK** The `socket` argument does not refer to a socket.
- **EPROTOTYPE** The specified address has a different type than the socket bound to the specified peer address.
- **ETIMEOUT** The attempt to connect timed out before a connection was made.

If the address family of the socket is AF_UNIX, then `connect()` will fail if:

- **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 `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.

The connect() function may fail if:

EACCES  Search permission is denied for a component of the path prefix; or write access to the named socket is denied.

EADDRINUSE  Attempt to establish a connection that uses addresses that are already in use.

ECONNRESET  Remote host reset the connection request.

EHOSTUNREACH  The destination host cannot be reached (probably because the host is down or a remote router cannot reach it).

EINVAL  The address_len argument is not a valid length for the address family; or invalid address family in sockaddr structure.

ENAMETOOLONG  Pathname resolution of a symbolic link produced an intermediate result whose length exceeds PATH_MAX.

ENETDOWN  The local interface used to reach the destination is down.

ENOBFS  No buffer space is available.

ENOSR  There were insufficient STREAMS resources available to complete the operation.

EOPNOTSUPP  The socket is listening and can not be connected.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  close(2), poll(2), accept(3XNET), bind(3XNET), getsockname(3XNET), select(3C), send(3XNET), shutdown(3XNET), socket(3XNET), attributes(5), standards(5)
dial, undial – establish an outgoing terminal line connection

**Synopsis**
```
cc [ flag ... ] file ... -lnsl [ library ... ]
#include <dial.h>

int dial(CALL call);
void undial(int fd);
```

**Description**
The `dial()` function returns a file-descriptor for a terminal line open for read/write. The argument to `dial()` is a CALL structure (defined in the header `<dial.h>`).

When finished with the terminal line, the calling program must invoke `undial()` to release the semaphore that has been set during the allocation of the terminal device.

CALL is defined in the header `<dial.h>` and has the following members:

```c
struct termio *attr; /* pointer to termio attribute struct */
int baud; /* transmission data rate */
int speed; /* 212A modem: low=300, high=1200 */
char *line; /* device name for out-going line */
char *telno; /* pointer to tel-no digits string */
int modem; /* specify modem control for direct lines */
char *device; /* unused */
int dev_len; /* unused */
```

The CALL element `speed` is intended only for use with an outgoing dialed call, in which case its value should be the desired transmission baud rate. The CALL element `baud` is no longer used.

If the desired terminal line is a direct line, a string pointer to its device-name should be placed in the `line` element in the CALL structure. Legal values for such terminal device names are kept in the Devices file. In this case, the value of the `baud` element should be set to -1. This value will cause `dial` to determine the correct value from the `<Devices>` file.

The `telno` element is for a pointer to a character string representing the telephone number to be dialed. Such numbers may consist only of these characters:

- `0-9` dial 0-9
- `*` dial *
- `#` dial #
- `=` wait for secondary dial tone
- `-` delay for approximately 4 seconds

The CALL element `modem` is used to specify modem control for direct lines. This element should be non-zero if modem control is required. The CALL element `attr` is a pointer to a termio structure, as defined in the header `<termio.h>`. A NULL value for this pointer element may be
passed to the dial function, but if such a structure is included, the elements specified in it will be set for the outgoing terminal line before the connection is established. This setting is often important for certain attributes such as parity and baud-rate.

The CALL elements device and dev_len are no longer used. They are retained in the CALL structure for compatibility reasons.

**Return Values** On failure, a negative value indicating the reason for the failure will be returned. Mnemonics for these negative indices as listed here are defined in the header <dial.h>.

```
INTRPT −1 /* interrupt occurred */
D_HUNG −2 /* dialer hung (no return from write) */
NO_ANS −3 /* no answer within 10 seconds */
ILL_BD −4 /* illegal baud-rate */
A_PROB −5 /* acu problem (open( ) failure) */
L_PROB −6 /* line problem (open( ) failure) */
NO_Ldev −7 /* can't open Devices file */
DV_NT_A −8 /* requested device not available */
DV_NT_K −9 /* requested device not known */
NO_BD_A −10 /* no device available at requested baud */
NO_BD_K −11 /* no device known at requested baud */
DV_NT_E −12 /* requested speed does not match */
BAD_SYS −13 /* system not in Systems file*/
```

**Files**

```
/etc/uucp/Devices
/etc/uucp/Systems
/var/spool/uucp/LCK..tty-device
```

**Attributes** See attributes(5) for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>
```

**See Also**

uucp(1C), alarm(2), read(2), write(2), attributes(5), termio(7I)

**Notes**

Including the header <dial.h> automatically includes the header <termio.h>. An alarm(2) system call for 3600 seconds is made (and caught) within the dial module for the purpose of “touching” the LCK.. file and constitutes the device allocation semaphore for the terminal device. Otherwise, uucp(1C) may simply delete the LCK.. entry on its 90-minute clean-up rounds. The alarm may go off while the user program is in a read(2) or write(2) function, causing an apparent error return. If the user program expects to be around for an hour or more, error returns from read() should be checked for (errno==EINTR), and the read() possibly reissued.

This interface is unsafe in multithreaded applications. Unsafe interfaces should be called only from the main thread.
Name dlpi_arptype – convert a DLPI MAC type to an ARP hardware type

Synopsis

```
cc [ flag... ] file... -ldlpi [ library... ]
#include <libdlpi.h>
uint_t dlpi_arptype(uint_t dlpitype);
```

Description

The `dlpi_arptype()` function converts a DLPI MAC type to an ARP hardware type defined in `<netinet/arp.h>`.

Return Values

Upon success, the corresponding ARP hardware type is returned. Otherwise, zero is returned.

Attributes

See `attributes(5)` for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also `libdlpi(3LIB), attributes(5)`
dlpi_bind(3DLPI)

Name
dlpi_bind – bind DLPI handle

Synopsis
cc [-I flag ...] file ... -ldlpi [ -I library ... ]
#include <stdlib.h>

int dlpi_bind(dlpi_handle_t dh, uint_t sap, uint_t *boundsap);

Description
The dlpi_bind() function attempts to bind the DLPI handle dh to the SAP sap. The handle
must be in the DL_UNBOUND DLPI state and will transition to the DL_IDLE DLPI state upon
success. Some DLPI MAC types can bind to a different SAP than the SAP requested, in which
case boundsap returns the actual bound SAP. If boundsap is set to NULL, dlpi_bind() fails if
the bound SAP does not match the requested SAP. If the caller does not care which SAP is
chosen, DLPI_ANY_SAP can be specified for sap. This is primarily useful in conjunction with
dlpi_promisc() and DL_PROMISC_SAP to receive traffic from all SAPs. If DLPI_ANY_SAP is
specified, any transmitted messages must explicitly specify a SAP using dlpi_send(3DLPI).

Upon success, the caller can use dlpi_recv(3DLPI) to receive data matching the bound SAP
that is sent to the DLPI link associated with dh. In addition, the caller can use
dlpi_send(3DLPI) to send data over the bound SAP address associated with DLPI handle dh.
The physical address of the bound handle can be retrieved with dlpi_info(3DLPI).

Return Values
Upon success, DLPI_SUCCESS is returned. If DL_SYSERR is returned, errno contains the specific
UNIX system error value. Otherwise, a DLPI error value defined in <sys/dlpi.h> or an error
value listed in the following section is returned.

Errors
DLPI_EBADMSG  Bad DLPI message
DLPI_EINHANDLE  Invalid DLPI handle
DLPI_ETIMEDOUT  DLPI operation timed out
DLPI_EUNAVAILSAP  Unavailable DLPI SAP

Attributes
See attributes(5) for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also
dlpi_info(3DLPI), dlpi_recv(3DLPI), dlpi_send(3DLPI), dlpi_unbind(3DLPI),
libdlpi(3LIB), attributes(5)
The `dlpi_close()` function closes the open DLPI link instance associated with `dh` and destroys `dh` after closing the DLPI link instance.

**Attributes**

See `attributes(5)` for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**

`dlpi_open(3DLPI), libdlpi(3LIB), attributes(5)`
dlpi_disabnotify(3DLPI)

Name  dlpi_disabnotify – disable DLPI notification

Synopsis  cc [ flag... ] file... -ldlpi [ library... ]
#include <libdlpi.h>

int dlpi_disabnotify(dlpi_handle_t dh, dlpi_notifyid_t id,
    void **argp);

Description  The dlpi_disabnotify() function disables the notification registration associated with
identifier id. If argp is not NULL, the argument arg that was passed to
dlpi_enabnotify(3DLPI) during registration is also returned. This operation can be
performed in any DLPI state of a handle.

Closing the DLPI handle dh will also remove all associated callback functions.

Return Values  Upon success, DLPI_SUCCESS is returned. If DL_SYSERR is returned, errno contains the specific
UNIX system error value. Otherwise, a DLPI error value defined in <sys/dlpi.h> or an error
value listed in the following section is returned.

Errors  DLPI_EINHANDLE  A DLPI handle is invalid.
DLPI_EINVAL  An argument is invalid.
DLPI_ENOTEPIDINVAL  The DLPI notification ID is invalid.
DLPI_FAILURE  The DLPI operation failed.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  dlpi_enabnotify(3DLPI), libdlpi(3LIB), attributes(5)
**Name**  dlpi_enabmulti, dlpi_disabmulti -- enable or disable DLPI multicast messages for an address

**Synopsis**  
```c
cc [ flag... ] file... -ldlpi [ library... ]
#include <libdlpi.h>

int dlpi_enabmulti(dlpi_handle_t dh, const void *addrp, size_t addrlen);
int dlpi_disabmulti(dlpi_handle_t dh, const void *addrp, size_t addrlen);
```

**Description**  
The `dlpi_enabmulti()` function enables reception of messages destined to the multicast address pointed to by `addrp` on the DLPI link instance associated with DLPI handle `dh`. The DLPI link instance will pass up only those messages destined for enabled multicast addresses. This operation can be performed in any DLPI state of a handle.

The `dlpi_disabmulti()` function disables a specified multicast address pointed to by `addrp` on the DLPI link instance associated with DLPI handle `dh`. This operation can be performed in any DLPI state of a handle.

**Return Values**  
Upon success, `DLPI_SUCCESS` is returned. If `DL_SYSERR` is returned, `errno` contains the specific UNIX system error value. Otherwise, a DLPI error value defined in `<sys/dlpi.h>` or `DLPI_EINHANDLE` is returned.

**Errors**  
- `DLPI_EBADMSG`  Bad DLPI message
- `DLPI_EINHANDLE`  Invalid DLPI handle
- `DLPI_EINVAL`  Invalid argument
- `DLPI_ETIMEDOUT`  DLPI operation timed out

**Attributes**  
See `attributes(5)` for description of the following attributes:

<table>
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<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
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<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  
`libdlpi(3LIB), attributes(5)`
dlpi_enabnotify – enable DLPI notification

```
#include <libdlpi.h>

int dlpi_enabnotify(dlpi_handle_t dh, uint_t notes,
    dlpi_notifyfunc_t *funcp, void *arg, dlpi_notifyid_t *id);
```

typedef void dlpi_notifyfunc_t(dlpi_handle_t,
    dlpi_notifyinfo_t *, void *);

**Description**

The `dlpi_enabnotify()` function enables a notification callback for the set of events specified in `notes`, which must be one or more (by a logical OR operation) of the DLPI notifications documented in `dlpi(7P)`. The callback function `funcp` is registered with the DLPI handle `dh` and is invoked when `dh` receives notification for any of the specified event types. Upon success, `id` contains the identifier associated with the registration.

Multiple event types can be registered for a callback function on the DLPI handle `dh`. Similarly, the same event type can be registered multiple times on the same handle.

Once a callback has been registered, `libdlpi` will check for notification events on the DLPI handle `dh`, when exchanging DLPI messages with the underlying DLPI link instance. The `dlpi_recv(3DLPI)` function will always check for notification events, but other `libdlpi` operations may also lead to an event callback being invoked. Although there may be no expected data messages to be received, `dlpi_recv()` can be called, as shown below, with a null buffer to force a check for pending events on the underlying DLPI link instance.

```
dlpi_recv(dh, NULL, NULL, NULL, NULL, 0, NULL);
```

When a notification event of interest occurs, the callback function is invoked with the arguments `arg`, originally passed to `dlpi_disabnotify(3DLPI)`, and `infop`, whose members are described below.

```
uint_t dni_note
        Notification event type.

uint_t dni_speed
        Current speed, in kilobits per second, of the DLPI link. Valid only for DL_NOTE_SPEED.

uint_t dni_size
        Current maximum message size, in bytes, that the DLPI link is able to accept for transmission. Valid only for DL_NOTE_SDU_SIZE.

uchar_t dni_physaddrlen
        Link-layer physical address length, in bytes. Valid only for DL_NOTE_PHYS_ADDR.

uchar_t dni_physaddr[]
        Link-layer physical address of DLPI link. Valid only for DL_NOTE_PHYS_ADDR.
```

The `libdlpi` library will allocate and free the `dlpi_notifyinfo_t` structure and the caller must not allocate the structure or perform any operations that require its size to be known.
The callback is not allowed to block. This precludes calling `dlpi_enabnotify()` from a callback, but non-blocking `libdlpi` functions, including `dlpi_disabnotify()`, can be called.

**Return Values** Upon success, `DLPI_SUCCESS` is returned. If `DL_SYSERR` is returned, `errno` contains the specific UNIX system error value. Otherwise, a DLPI error value defined in `<sys/dlpi.h>` or an error value listed in the following section is returned.

**Errors**
- `DLPI_EINHANDLE` A DLPI handle is invalid.
- `DLPI_EINVAL` An argument is invalid.
- `DLPI_ENOTEIDINVAL` The DLPI notification ID is invalid.
- `DLPI_ENOTENOTSUP` The DLPI notification is not supported by the link.
- `DLPI_ETIMEDOUT` The DLPI operation timed out.
- `DLPI_FAILURE` The DLPI operation failed.

**Attributes** See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
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</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
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<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also** `dlpi_disabnotify(3DLPI), dlpi_recv(3DLPI), libdlpi(3LIB), attributes(5), dlpi(7P)`
The `dlpi_fd()` function returns the integer file descriptor that can be used to directly operate on the open DLPI stream associated with the DLPI handle `dh`. This file descriptor can be used to perform non-DLPI operations that do not alter the state of the DLPI stream, such as waiting for an event using `poll(2)`, or pushing and configuring additional STREAMS modules, such as `pfmod(7M)`. If DLPI operations are directly performed on the file descriptor, or a STREAMS module is pushed that alters the message-passing interface such that DLPI operations can no longer be issued, future operations on `dh` might not behave as documented.

The returned file descriptor is managed by `libdlpi(3LIB)` and the descriptor must not be closed.

**Return Values**  
The function returns the integer file descriptor associated with the DLPI handle `dh`. If `dh` is invalid, -1 is returned.

**Attributes**  
See `attributes(5)` for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  
`poll(2), libdlpi(3LIB), attributes(5), dlpi(7P), pfmod(7M)`
dlpi_get_physaddr(3DLPI)

Name          dlpi_get_physaddr – get physical address using DLPI

Synopsis       cc [ flag... ] file... -ldlpi [ library... ]
               #include <libdlpi.h>

int dlpi_get_physaddr(dlpi_handle_t dh, uint_t type,
                       void *addrp, size_t *addrlenp);

Description    The dlpi_get_physaddr() function gets a physical address from the DLPI link instance
                associated with DLPI handle dh. The retrieved address depends upon type, which can be:

                DL_FACT_PHYS_ADDR  Factory physical address
                DL_CURR_PHYS_ADDR  Current physical address

                The operation can be performed in any DLPI state of dh.

                The caller must ensure that addrp is at least DLPI_PHYSADDR_MAX bytes in size and addrlenp
                must contain the length of addrp. Upon success, addrp contains the specified physical address,
                and addrlenp contains the physical address length. If a physical address is not available, addrp
                is not filled in and addrlenp is set to zero.

Return Values  Upon success, DLPI_SUCCESS is returned. If DL_SYSERR is returned, errno contains the specific
                UNIX system error value. Otherwise, a DLPI error value defined in <sys/dlpi.h> or an error
                value listed in the following section is returned.

Errors         DLPI_EBADMSG    Bad DLPI message
                DLPI EINVALHANDLE Invalid DLPI handle
                DLPI EINVAL     Invalid argument
                DLPI_ETIMEDOUT  DLPI operation timed out

Attributes     See attributes(5) for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also         dlpi_set_physaddr(3DLPI), libdlpi(3LIB), attributes(5)
Name  dlpi_iftype – convert a DLPI MAC type to a BSD socket interface type

Synopsis  cc [ flag... ] file... -ldlpi [ library... ]
          #include <libdlpi.h>

          uint_t dlpi_iftype(uint_t dlpitype);

Description  The dlpi_iftype() function converts a DLPI MAC type to a BSD socket interface type
defined in <net/if_types.h>.

Return Values  Upon success, the corresponding BSD socket interface type is returned. Otherwise, zero is
returned.

Attributes  See attributes(5) for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
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<td>Safe</td>
</tr>
</tbody>
</table>

See Also  libdlpi(3LIB), attributes(5)
**Name**
dlpi_info – get DLPI information

**Synopsis**
```
c c [ flag ... ] file ... -ldlpi [ library ... ]
#include <libdlpi.h>

int dlpi_info(dlpi_handle_t dh, dlpi_info_t *infop,
              uint_t version);
```

**Description**
The `dlpi_info()` function provides DLPI information about the open DLPI link instance associated with DLPI handle `dh`. DLPI information can be retrieved in any state of `dh`, but some of the information might not be available if `dh` is in the DL_UNBOUND DLPI state. The DLPI information received is copied into `infop`, which must point to a `dlpi_info_t` allocated by the caller. The `version` argument specifies the version of the `dlpi_info_t` structure expected by the caller. Callers can use the macro `DLPI_INFO_VERSION` to specify the default version, which is currently 0. Callers can request version 1 of the `dlpi_info_t` structure by defining `DLPI_INFO_VERSION` to 1 before including `<libdlpi.h>` and passing the defined `DLPI_INFO_VERSION` value of 1 as the version argument. See the description of `di_linkname` below for the difference between version 0 and 1.

The `dlpi_info_t` is a structure defined in `<libdlpi.h>` as follows:

```
typedef struct {
    uint_t di_opts;
    uint_t di_max_sdu;
    uint_t di_min_sdu;
    uint_t di_state;
    uchar_t di_mactype;
    char   di_linkname[DLPI_LINKNAME_MAX];
    uchar_t di_physaddr[DLPI_PHYSADDR_MAX];
    uchar_t di_physaddrlen;
    uchar_t di_bcastaddr[DLPI_PHYSADDR_MAX];
    uchar_t di_bcastaddrlen;
    uint_t di_sap;
    int   di_timeout;
    dl_qos_cl_sel1_t di_qos_sel;
    dl_qos_cl_range1_t di_qos_range;
} dlpi_info_t;
```

**di_opts**
Reserved for future `dlpi_info_t` expansion.

**di_max_sdu**
Maximum message size, in bytes, that the DLPI link is able to accept for transmission. The value is guaranteed to be greater than or equal to `di_min_sdu`.

**di_min_sdu**
Minimum message size, in bytes, that the DLPI link is able to accept for transmission. The value is guaranteed to be greater than or equal to one.
Current DLPI state of dh; either DL_UNBOUND or DL_IDLE.

MAC type supported by the DLPI link associated with dh. See <sys/dlpi.h> for the list of possible MAC types.

Link name associated with DLPI handle dh. If the caller specifies the default version argument value of 0, the size of this field is DLPI_LINKNAME_MAX. If the caller defines DLPI_INFO_VERSION to value 1 before including <libdlpi.h>, the size of this field is MAXLKNAMESPECIFIER. See dlpi(7P) for information on link names and the supported maximum length of DLPI link names.

Link-layer physical address of bound dh. If dh is in the DL_UNBOUND DLPI state, the contents of di_physaddr are unspecified.

Physical address length, in bytes. If dh is in the DL_UNBOUND DLPI state, di_physaddrlen is set to zero.

Link-layer broadcast address. If the di_mactype of the DLPI link does not support broadcast, the contents of di_bcastaddr are unspecified.

Link-layer broadcast address length, in bytes. If the di_mactype of the DLPI link does not support broadcast, di_bcastaddrlen is set to zero.

SAP currently bound to handle. If dh is in the DL_UNBOUND DLPI state, di_sap is set to zero.

Current timeout value, in seconds, set on the dlpi handle.

Current QOS parameters supported by the DLPI link instance associated with dh. Unsupported QOS parameters are set to DL_UNKNOWN.

Available range of QOS parameters supported by a DLPI link instance associated with the DLPI handle dh. Unsupported QOS range values are set to DL_UNKNOWN.

Upon success, DLPI_SUCCESS is returned. If DL_SYSERR is returned, errno contains the specific UNIX system error value. Otherwise, a DLPI error value defined in <sys/dlpi.h> or an error value listed in the following section is returned.
DLPI_EBADMSG    Bad DLPI message
DLPI_EINHANDLE  Invalid DLPI handle
DLPI_EINVAL     Invalid argument
DLPI_EMODENOTSUP Unsupported DLPI connection mode
DLPI_ETIMEDOUT  DLPI operation timed out
DLPI_EVERNOTSUP Unsupported DLPI Version
DLPI_FAILURE    DLPI operation failed

**Examples**

**EXAMPLE 1** Get link-layer broadcast address

The following example shows how `dlpi_info()` can be used.

```
#include <libdlpi.h>

uchar_t *
get_bcastaddr(const char *linkname, uchar_t *baddrlenp)
{
    dlpi_handle_t dh;
    dlpi_info_t dlinfo;
    uchar_t *baddr;

    if (dlpi_open(linkname, &dh, 0) != DLPI_SUCCESS)
        return (NULL);

    if (dlpi_info(dh, &dlinfo, 0) != DLPI_SUCCESS) {
        dlpi_close(dh);
        return (NULL);
    }

    *baddrlenp = dlinfo.di_bcastaddrlen;
    if ((baddr = malloc(*baddrlenp)) == NULL)
        return (NULL);

    return (memcpy(baddr, dlinfo.di_bcastaddr, *baddrlenp));
}
```

**Attributes**

See attributes(5) for description of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>
dlpi_info(3DLPI)

See Also dlpi_bind(3DLPI), libdlpi(3LIB), attributes(5), dlpi(7P)
dlpi_linkname(3DLPI)

Name    dlpi_linkname – get DLPI link name

Synopsis cc [ flag ... ] file ... -ldlpi [ library ... ]
#include <libdlpi.h>

    const char *dlpi_linkname(dlpi_handle_t dh);

Description The dlpi_linkname() function returns a pointer to the link name of the DLPI link instance
associated with the DLPI handle dh.

   The returned string is managed by libdlpi and must not be modified or freed by the caller.

Return Values Upon success, the function returns a pointer to the link name associated with the DLPI
handle.

Attributes See attributes(5) for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also libdlpi(3LIB), attributes(5)
Name  dlpi_mactype – convert a DLPI MAC type to a string

Synopsis  cc [ flag ... ] file ... -ldlpi [ library ... ]
          #include <libdlpi.h>

          const char *dlpi_mactype(uint_t mactype);

Description  The dlpi_mactype() function returns a pointer to a string that describes
              the specified mactype. Possible MAC types are defined in <sys/dlpi.h>. The string is not dynamically
              allocated and must not be freed by the caller.

Return Values  Upon success, the function returns a pointer string that describes the MAC type. If mactype is
               unknown, the string "Unknown MAC Type" is returned.

Attributes  See attributes(5) for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
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<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  libdlpi(3LIB), attributes(5)
Name  dlpi_open – open DLPI link

Synopsis  
```c
cc [ flag ... ] file ... -ldlpi [ library ... ]
#include <libdlpi.h>

int dlpi_open(const char *linkname, dlpi_handle_t *dhp,
        uint_t flags);
```

Description  The `dlpi_open()` function creates an open instance of the DLPI Version 2 link named by `linkname` and associates it with a dynamically-allocated `dlpi_handle_t`, which is returned to the caller in `dhp` upon success. The DLPI handle is left in the `DL_UNBOUND` DLPI state after a successful open of the DLPI link. The DLPI handles can only be used by one thread at a time, but multiple handles can be used by multiple threads. This function can open both `DL_STYLE1` and `DL_STYLE2` DLPI links.

By default (if `DLPI_DEVIPNET` is not set in `flags`), the `dlpi_open()` function scans the `/dev/net` and `/dev` directories for DLPI links, in order. Within each scanned directory, `dlpi_open()` first looks for a matching `DL_STYLE1` link, then for a matching `DL_STYLE2` link. If `provider` is considered the `linkname` with its trailing digits removed, a matching `DL_STYLE1` link has a filename of `linkname`, and a matching `DL_STYLE2` link has a filename of `provider`. If a `DL_STYLE2` link is opened, `dlpi_open()` automatically performs the necessary DLPI operations to place the DLPI link instance and the associated DLPI handle in the `DL_UNBOUND` state. See `dlpi(7P)` for the definition of `linkname` and the maximum supported length of the Solaris DLPI `linkname`.

If `DLPI_DEVIPNET` is set in `flags`, `dlpi_open()` opens the file `linkname` in `/dev/ipnet` as a `DL_STYLE1` DLPI device and does not look in any other directories.

The value of `flags` is constructed by a bitwise-inclusive-OR of the flags listed below, defined in `<libdlpi.h>`.

- **DLPI_DEVIPNET**  Specify that the named DLPI device is an IP observability device (see `ipnet(7D)`), and `dl_open()` will open the device from the `/dev/ipnet` directory.
- **DLPI_IPNETINFO**  This flag is applicable only when opening IP Observability devices (with `DLPI_DEVIPNET` or by opening the `/dev/lo0` device). This flag causes the `ipnet` driver to prepend an `ipnet` header to each received IP packet. See `ipnet(7D)` for the contents of this header.
- **DLPI_NATIVE**  Enable DLPI native mode (see `DL_IOC_NATIVE` in `dlpi(7P)`) on a DLPI link instance. Native mode persists until the DLPI handle is closed by `dlpi_close(3DLPI)`.
- **DLPI_PASSIVE**  Enable DLPI passive mode (see `DL_PASSIVE_REQ` in `dlpi(7P)`) on a DLPI link instance. Passive mode persists until the DLPI handle is closed by `dlpi_close(3DLPI)`.
Enable DLPI raw mode (see \texttt{DLIOCRAW} in \texttt{dlpi(7P)}) on a DLPI link instance. Raw mode persists until the DLPI handle is closed by \texttt{dlpi\_close(3DLPI)}.

Each DLPI handle has an associated timeout value that is used as a timeout interval for certain \texttt{libdlpi} operations. The default timeout value ensures that \texttt{DLPI\_ETIMEDOUT} is returned from a \texttt{libdlpi} operation only in the event that the DLPI link becomes unresponsive. The timeout value can be changed with \texttt{dlpi\_set\_timeout(3DLPI)}, although this should seldom be necessary.

Upon success, \texttt{DLPI\_SUCCESS} is returned. If \texttt{DL\_SYSERR} is returned, \texttt{errno} contains the specific UNIX system error value. Otherwise, a DLPI error value defined in \texttt{<sys/dlpi.h>} or listed in the following section is returned.

The \texttt{dlpi\_open()} function will fail if:

- \texttt{DLPI\_EBADLINK} Bad DLPI link
- \texttt{DLPI\_EIPNETINFONOTSUP} The DLPI \texttt{IPNETINFO} flag was set but the device opened does not support the DLIOCIPNETINFO ioctl.
- \texttt{DLPI\_ELINKNAMEINVAL} Invalid DLPI linkname
- \texttt{DLPI\_ENOLINK} DLPI link does not exist
- \texttt{DLPI\_ERAWNOTSUP} DLPI raw mode not supported
- \texttt{DLPI\_ETIMEDOUT} DLPI operation timed out
- \texttt{DLPI\_FAILURE} DLPI operation failed

See \texttt{attributes(5)} for description of the following attributes:

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\texttt{dlpi\_close(3DLPI)}, \texttt{dlpi\_set\_timeout(3DLPI)}, \texttt{libdlpi(3LIB)}, \texttt{attributes(5)}, \texttt{dlpi(7P)}, \texttt{ipnet(7D)}
The `dlpi_promiscon()` function enables promiscuous mode on a DLPI link instance associated with DLPI handle `dh`, at the specified `level`. After enabling promiscuous mode, the caller will be able to receive all messages destined for the DLPI link instance at the specified `level`. This operation can be performed in any DLPI state of a handle.

The `dlpi_promiscoff()` function disables promiscuous mode on a DLPI link instance associated with DLPI handle `dh`, at the specified level. This operation can be performed in any DLPI state of a handle in which promiscuous mode is enabled at the specified `level`.

The `level` modes are:

- `DL_PROMISC_PHYS` Promiscuous mode at the physical level
- `DL_PROMISC_SAP` Promiscuous mode at the SAP level
- `DL_PROMISC_MULTI` Promiscuous mode for all multicast addresses

Upon success, `DLPI_SUCCESS` is returned. If `DLPI_SYSERR` is returned, `errno` contains the specific UNIX system error value. Otherwise, a DLPI error value defined in `<sys/dlpi.h>` or an error value listed in the following section is returned.

**Errors**

- `DLPI_BADMSG` Bad DLPI message
- `DLPI_EINHANDLE` Invalid DLPI handle
- `DLPI EINVAL` Invalid argument
- `DLPI_ETIMEDOUT` DLPI operation timed out

**Attributes**

See `attributes(5)` for description of the following attributes:

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</table>

**See Also**

- `dlpi(3DLPI)`, `attributes(5)`
dlpi_recv(3DLPI)

**Name**
dlpi_recv – receive a data message using DLPI

**Synopsis**
```
cc [ flag ... ] file ... -ldlpi [ library ... ]
#include <libdlpi.h>

int dlpi_recv(dlpi_handle_t dh, void *saddrp,
              size_t * saddrlenp, void *msgbuf, size_t *msglenp,
              int msec, dlpi_recvinfo_t *recvp);
```

**Description**
The `dlpi_recv()` function attempts to receive data messages over the DLPI link instance associated with the DLPI handle `dh`. If `dh` is not in the DL_IDLE DLPI state, the attempt fails. The caller must ensure that `msgbuf` is at least `msglenp` bytes in size. Upon success, `msgbuf` contains the data message received, `msglenp` contains the number of bytes placed in `msgbuf`.

The caller must ensure that `saddrp` is at least DLPI_PHYSADDR_MAX bytes in size and `saddrlenp` must contain the length of `saddrp`. Upon success, `saddrp` contains the address of the source sending the data message and `saddrlenp` contains the source address length. If the caller is not interested in the source address, both `saddrp` and `saddrlenp` can be left as NULL. If the source address is not available, `saddrp` is not filled in and `saddrlenp` is set to zero.

The `dlpi_recvinfo_t` is a structure defined in `<libdlpi.h>` as follows:
```
typedef struct {
    uchar_t   dri_destaddr[DLPI_PHYSADDR_MAX];
    uchar_t   dri_destaddrlen;
    dlpi_addrtype_t dri_destaddrtype;
    size_t    dri_totmsglen;
} dlpi_recvinfo_t;
```

Upon success, if `recvp` is not set to NULL, `dri_destaddr` contains the destination address, `dri_destaddrlen` contains the destination address length, and `dri_totmsglen` contains the total length of the message received. If the destination address is unicast, `dri_destaddrtype` is set to DLPI_ADDRTYPE_UNICAST. Otherwise, it is set to DLPI_ADDRTYPE_GROUP.

The values of `msglenp` and `dri_totmsglen` might vary when a message larger than the size of `msgbuf` is received. In that case, the caller can use `dri_totmsglen` to determine the original total length of the message.

If the handle is in raw mode, as described in `dlpi_open(3DLPI)`, `msgbuf` starts with the link-layer header. See `dlpi(7P)`. The values of `saddrp`, `saddrlenp`, and all the members of `dlpi_recvinfo_t` except `dri_totmsglen` are invalid because the address information is already included in the link-layer header returned by `msgbuf`.

If no message is received within `msec` milliseconds, `dlpi_recv()` returns DLPI_ETIMEDOUT. If `msec` is 0, `dlpi_recv()` does not block. If `msec` is -1, `dlpi_recv()` does block until a data message is received.
Upon success, DLPI_SUCCESS is returned. If DL_SYSERR is returned, *errno* contains the specific UNIX system error value. Otherwise, a DLPI error value defined in `<sys/dlpi.h>` or an error value listed in the following section is returned.

**Errors**
- DLPI_EBADMSG: Bad DLPI message
- DLPI_EINHANDLE: Invalid DLPI handle
- DLPI_EINVAL: Invalid argument
- DLPI_ETIMEDOUT: DLPI operation timed out
- DLPI_EUNAVAILSAP: Available DLPI SAP
- DLPI_FAILURE: DLPI operation failed

**Attributes**
See `attributes(5)` for description of the following attributes:

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</table>

**See Also**
- `dlpi_bind(3DLPI), dlpi_open(3DLPI), libdlpi(3LIB), attributes(5), dlpi(7P)`
The `dlpi_send()` function attempts to send the contents of `msgbuf` over the DLPI link instance associated with the DLPI handle `dh` to the destination address specified by `daddrp`. The size of `msgbuf` and `daddrp` are provided by the `msglen` and `daddrlen` arguments, respectively. The attempt will fail if `dh` is not in the DL_IDLE DLPI state, the address named by `daddrp` is invalid, `daddrlen` is larger than DLPI_PHYSADDR_MAX, or `msglen` is outside the range reported by `dlpi_info(3DLPI)`. If the `sendp` argument is NULL, data is sent using the bound SAP associated with `dh` (see `dlpi_bind(3DLPI)`) and with default priority. Otherwise, `sendp` must point to a `dlpi_sendinfo_t` structure defined in `<libdlpi.h>` as follows:

```c
typedef struct {
    uint_t dsi_sap;
    dl_priority_t dsi_prio;
} dlpi_sendinfo_t;
```

The `dsi_sap` value indicates the SAP to use for the message and the `dsi_prio` argument indicates the priority. The priority range spans from 0 to 100, with 0 being the highest priority. If one wishes to only alter the SAP or priority (but not both), the current SAP can be retrieved using `dlpi_info(3DLPI)`, and the default priority can be specified by using the `DL_QOS_DONT_CARE` constant.

If the handle is in raw mode (see `DLPI_RAW` in `dlpi_open(3DLPI)`), `msgbuf` must start with the link-layer header (see `dlpi(7P)`). In raw mode, the contents of `daddrp` and `sendp` are ignored, as they are already specified by the link-layer header in `msgbuf`.

If `msgbuf` is accepted for delivery, no error is returned. However, because only unacknowledged connectionless service (DL_CLDLS) is currently supported, a successful return does not guarantee that the data will be successfully delivered to `daddrp`.

Upon success, `DLPI_SUCCESS` is returned. If `DL_SYSERR` is returned, `errno` contains the specific UNIX system error value. Otherwise, a DLPI error value defined in `<sys/dlpi.h>` or an error value listed in the following section is returned.

### Errors
- `DLPI_EINHANDLE` Invalid DLPI handle
- `DLPI EINVAL` Invalid argument
Attributes  See attributes(5) for description of the following attributes:

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See Also  dlpi_bind(3DLPI), dlpi_info(3DLPI), dlpi_open(3DLPI), libdlpi(3LIB), attributes(5), dlpi(7P)
dlpi_set_physaddr – set physical address using DLPI

Synopsis

```
cc [ flag... ] file... -ldlpi [ library... ]
#include <libdlpi.h>

int dlpi_set_physaddr(dlpi_handle_t dh, uint_t type,
                       const void *addrp, size_t *addrlen);
```

Description

The `dlpi_set_physaddr()` function sets the physical address via DLPI handle `dh` associated with the DLPI link instance. Upon success, the physical address is set to `addrp` with a length of `addrlen` bytes.

In this release, `type` must be set to `DL_CURR_PHYS_ADDR`, which sets the current physical address.

Return Values

Upon success, `DLPI_SUCCESS` is returned. If `DL_SYSERR` is returned, `errno` contains the specific UNIX system error value. Otherwise, a DLPI error value defined in `<sys/dlpi.h>` or an error value listed in the following section is returned.

Errors

- `DLPI_EBADMSG`  Bad DLPI message
- `DLPI_EINHANDLE`  Invalid DLPI handle
- `DLPI_EINVAL`  Invalid argument
- `DLPI_ETIMEDOUT`  DLPI operation timed out

Attributes

See attributes(5) for description of the following attributes:

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<th>ATTRIBUTE TYPE</th>
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<td>Safe</td>
</tr>
</tbody>
</table>

See Also

`dlpi_get_physaddr(3DLPI), libdlpi(3LIB), attributes(5)`
### dlpi_set_timeout(3DLPI)

**Synopsis**

```c
cc [ flag ... ] file ... -ldlpi [ library ... ]
#include <libdlpi.h>

int dlpi_set_timeout(dlpi_handle_t dh, int sec);
```

**Description**

The `dlpi_set_timeout()` function sets the timeout interval to `sec` seconds on DLPI handle `dh`. This timeout is used by `libdlpi(3LIB)` functions that require explicit acknowledgment from the associated DLPI link, and bounds the number of seconds that a function will wait for an acknowledgment before returning `DLPI_ETIMEDOUT`. Except for `dlpi_recv(3DLPI)`, which has a `timeout` argument, any function that is documented to return `DLPI_ETIMEDOUT` can take up to the `timeout` interval to complete.

Callers that do not require an upper bound on timeouts are strongly encouraged to never call `dlpi_set_timeout()`, and allow `libdlpi` to use its default `timeout` value. The default `timeout` value is intended to ensure that `DLPI_ETIMEDOUT` will only be returned if the DLPI link has truly become unresponsive. The default `timeout` value is intended to ensure that `DLPI_ETIMEDOUT` will be returned only if the DLPI link has truly become unresponsive.

Callers that do require an explicit upper bound can specify that value at any time by calling `dlpi_set_timeout()`. However, note that values less than 5 seconds may trigger spurious failures on certain DLPI links and systems under high load, and thus are discouraged. Attempts to set the `timeout` value to less than 1 second will fail.

If `sec` is set to `DLPI_DEF_TIMEOUT`, the default `timeout` value is restored.

**Return Values**

Upon success, `DLPI_SUCCESS` is returned. Otherwise, a DLPI error value is returned.

**Errors**

`DLPI_EINHANDLE`  Invalid DLPI handle

**Attributes**

See `attributes(5)` for description of the following attributes:

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</table>

**See Also**

`libdlpi(3LIB), attributes(5)`
The `dlpi_strerror()` function maps the error code in `err` into an error message string and returns a pointer to that string.

If `err` is `DL_SYSERR`, a string that describes the current value of `errno` is returned. Otherwise, if `err` corresponds to an error code listed in `<libdlpi.h>` or `<sys/dlpi.h>`, a string which describes that error is returned.

The string is not dynamically allocated and must not be freed by the caller.

Upon success, the function returns a pointer to the error message string. If the error code is unknown, the string "Unknown DLPI error" is returned.

See attributes(5) for description of the following attributes:

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See Also `libdlpi(3LIB), attributes(5)`
### dlpi_unbind(3DLPI)

**Name**  
dlpisunbind – unbind DLPI handle

**Synopsis**  
```c
cc [ flag ... ] file ... -ldlpi [ library ... ]
#include <libdlpi.h>

int dlpi_unbind(dlpi_handle_t dh);
```

**Description**  
The `dlpi_unbind()` function unbinds to bind the DLPI handle `dh` from the bound SAP. The handle must be in the `DL_IDLE` DLPI state and upon success, the handle transitions to the `DL_UNBOUND` state.

Upon success, the caller will no longer be able to send or receive data using the DLPI link associated with `dh`.

**Return Values**  
Upon success, `DLPI_SUCCESS` is returned. If `DL_SYSERR` is returned, `errno` contains the specific UNIX system error value. Otherwise, a DLPI error value defined in `<sys/dlpi.h>` or an error value `DLPI_ETIMEDOUT` will be returned.

**Errors**  
- `DLPI_EBADMSG`: Bad DLPI message
- `DLPI_EINHANDLE`: Invalid DLPI handle
- `DLPI_ETIMEDOUT`: DLPI operation timed out

**Attributes**  
See [attributes(5)](attributes(5)) for description of the following attributes:

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</table>

**See Also**  
dlpisunbind(3DLPI), libdlpi(3LIB), attributes(5)
dlpi_walk(3DLPI)

Name dlpi_walk – traverse DLPI links

Synopsis

cc [ flag... ] file... -ldlpi [ library... ]
#include <libdlpi.h>

void dlpi_walk(dlpi_walkfunc_t *fn, void *arg, uint_t flags);

typedef boolean_t dlpi_walkfunc_t(const char *name, void *arg);

Parameters

fn Function to invoke for each link. Arguments are:

name The name of the DLPI interface.

arg The arg parameter passed in to dlpi_walk().

arg An opaque argument that is passed transparently to the user-supplied fn() function.

flags This parameter is reserved for future use. The caller should pass in 0.

Description

The dlpi_walk() function visits all DLPI links in the current zone. The walk does not visit
DLPI links in the non-global zones when called from the global zone. For each link visited, the
user-supplied fn() function is invoked. The walk terminates either when all links have been
visited or when fn() returns B_TRUE.

Attributes

See attributes(5) for descriptions of the following attributes:

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See Also

libdlpi(3LIB), attributes(5)
DNSServiceBrowse – browse service instances with DNS

Synopsis

cc [ flag ... ] file ... -ldns_sd [ library ... ]
#include <dns_sd.h>

DNSServiceErrorType DNSServiceBrowse(DNSServiceRef *sdRef,
    DNSServiceFlags flags, uint32_t interfaceIndex,
    const char *regtype, const char *domain,
    DNSServiceBrowseReply callBack, void *context);

typedef void(*DNSServiceBrowseReply)(DNSServiceRef sdRef,
    DNSServiceFlags flags, uint32_t interfaceIndex,
    DNSServiceErrorType errorCode, const char *serviceName,
    const char *regtype, const char *replyDomain,
    void *context);

Description

The DNSServiceBrowse() function is used to browse for service instances of a particular service and protocol type. The sdRef argument points to an uninitialized DNSServiceRef. If the call to DNSServiceBrowse succeeds sdRef is initialized. The flags argument to DNSServiceBrowse() is currently unused and reserved for future use. A nonzero value to interfaceIndex indicates DNSServiceBrowse() should do a browse on all interfaces. Most applications will use an interfaceIndex value of 0 to perform a browse on all interfaces. See the section “Constants for specifying an interface index” in <dns_sd.h> for more details.

The callback function is invoked for every service instance found matching the service type and protocol. The call back argument points to a function of type DNSServiceBrowseReply listed above. The DNSServiceBrowse() call returns browse results asynchronously. The service browse call can be terminated by applications with a call to DNSServiceRefDeallocate().

The regtype parameter is used to specify the service type and protocol (e.g., ftp, tcp). The protocol type must be TCP or UDP. The domain argument to DNSServiceBrowse() specifies the domain on which to browse for services. Most applications will not specify a domain and will perform a browse on the default domain(s). The context argument can be NULL and points to a value passed to the callback function.

The sdRef argument passed to the callback function is initialized by DNNServiceBrowse() call. The possible values passed to flags in the callback function are:
kDNSServiceFlagsMoreComing and kDNSServiceFlagsAdd. The kDNSServiceFlagsMoreComing value indicates to a callback that at least one more result is immediately available. The kDNSServiceFlagsAdd value indicates that a service instance was found. The errorCode argument will be kDNSServiceErr_NoError on success. Otherwise, failure is indicated. The discovered service name is returned to the callback via the serviceName argument. The regtype argument in the callback holds the service type of the found service instance. The discovered service type can be different from the requested service type in the browse request when the discovered service type has subtypes. The domain argument to the callback holds the domain name of the discovered service instance. The
service type and the domain name must be stored and passed along with the service name to resolve a service instance using DNSServiceResolve().

**Return Values** The DNSServiceBrowse function returns kDNSServiceErr_NoError on success. Otherwise, an error code defined in `<dns_sd.h>` is returned to indicate an error has occurred. When an error is returned by DNSServiceBrowse, the callback function is not invoked and the DNSServiceRef argument is not initialized.

**Attributes** See attributes(5) for description of the following attributes:

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</table>

**See Also** DNSServiceRefDeallocate(3DNS_SD), DNSServiceResolve(3DNS_SD), attributes(5)
The `DNSServiceConstructFullName()` concatenates a three-part domain name that consists of a service name, service type, and domain name into a fully escaped full domain name.

**Attributes**

See `attributes(5)` for description of the following attributes:

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**See Also** `attributes(5)`
DNSServiceCreateConnection

Name
DNSServiceCreateConnection, DNSServiceRegisterRecord, DNSServiceAddRecord,
DNSServiceUpdateRecord, DNSServiceRemoveRecord – registering multiple records

Synopsis
cc [ flag ... ] file ... -ldns_sd [ library ... ]
#include <dns_sd.h>

DNSServiceErrorType DNSServiceCreateConnection(DNSServiceRef *sdRef);

DNSServiceErrorType DNSServiceRegisterRecord(DNSServiceRef sdRef,
DNSServiceRecordRef *RecordRef, DNSServiceFlags flags,
uint32_t interfaceIndex, const char *fullname,
uint16_t rrtype, uint16_t rclass, uint16_t rdlen,
const void *rdata, uint32_t ttl,
DNSServiceServiceRegisterRecordReply callBack,
void *context);

typedef void(*DNSServiceRegisterRecordReply)(DNSServiceRef sdRef,
DNSServiceRecordRef RecordRef, DNSServiceFlags flags,
DNSServiceErrorType errorCode, void *context);

DNSServiceErrorType DNSServiceAddRecord(DNSServiceRef sdRef,
DNSServiceRecordRef *RecordRef, DNSServiceFlags flags,
uint16_t rrtype, uint16_t rclass, const void *rdata,
uint32_t ttl);

DNSServiceErrorType DNSServiceUpdateRecord(DNSServiceRef sdRef,
DNSServiceRecordRef RecordRef, DNSServiceFlags flags,
uint16_t rdlen, const void *rdata,
uint32_t ttl);

DNSServiceErrorType DNSServiceRemoveRecord(DNSServiceRef sdRef,
DNSServiceRecordRef RecordRef, DNSServiceFlags flags);

Description
The DNSServiceCreateConnection() function allows the creation of a connection to the
mDNS daemon in order to register multiple individual records.

The DNSServiceRegisterRecord() function uses the connection created by
DNSServiceCreateConnection() to register a record. Name conflicts that occur from this
function should be handled by the client in the callback.

The DNSServiceAddRecord() call adds a DNS record to a registered service. The name of the
record is the same as registered service name. The RecordRef argument to
DNSServiceAddRecord() points to an uninitialized DNSRecordRef. After successful
completion of DNSServiceAddRecord(), the DNS record can be updated or deregistered by
passing the DNSRecordRef initialized by DNSServiceAddRecord() to
DNSServiceUpdateRecord() or to DNSServiceRemoveRecord().

The DNSServiceUpdateRecords() call updates the DNS record of the registered service. The
DNS record must be the primary resource record registered using DNSServiceRegister() or a
record added to a registered service using DNSServiceAddRecord() or an individual record
added via DNSServiceRegisterRecord().
The `DNSServiceRemoveRecord()` call removes a record that was added using `DNSServiceAddRecord()` or `DNSServiceRegisterRecord()`.

The `sdRef` argument points to `DNSServiceRef` initialized from a call to `DNSServiceRegister()`. If the `sdRef` argument is passed to `DNSServiceRefDeallocate()` and the service is deregistered DNS records added via `DNSServiceAddRecord()` are invalidated and cannot be further used. The `flags` argument is currently ignored and reserved for future use.

The `rrtype` parameter value indicates the type of the DNS record. Suitable values for the `rrtype` parameter are defined in `<dns_sd.h>`: `kDNSServiceType_TXT`, for example. The `rdata` argument points to the raw rdata to be contained in the resource record. The `ttl` value indicates the time to live of the resource record in seconds. A `ttl` value of 0 should be passed to use a default value.

**Return Values**

The `DNSServiceCreateConnection` function returns `kDNSServiceErr_NoError` on success. Otherwise, an error code defined in `<dns_sd.h>` is returned to indicate the specific failure that occurred.

**Attributes**

See `attributes(5)` for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**

`DNSServiceRefDeallocate(3DNS_SD)`, `DNSServiceRegister(3DNS_SD)`, `attributes(5)`
DNSServiceEnumerateDomains(3DNS_SD)

Name  
DNSServiceEnumerateDomains – enumerate recommended domains

Synopsis  
cc [ flag ... ] file ... -ldns_sd [ library ... ]

#include <dns_sd.h>

DNSServiceErrorType DNSServiceEnumerateDomains(DNSServiceRef *sdRef,
    DNSServiceFlags flags, uint32_t interfaceIndex,
    DNSServiceDomainEnumReply callback, void *context);

typedef void(‘DNSServiceDomainEnumReply)(DNSServiceRef sdRef,
    DNSServiceFlags flags, uint31_t interfaceIndex,
    DNSServiceErrorType errorCode, const char *replyDomain,
    void *context);

Description  
The DNSServiceEnumerateDomains() function allows applications to determine recommended browsing and registration domains for performing service discovery DNS queries. The callback argument points to a function to be called to return results or if the asynchronous call to DNSServiceEnumerateDomains() fails. The callback function should point to a function of type DNSServiceDomainEnumReply listed above.

A pointer to an uninitialized DNSServiceRef, sdRef must be passed to DNSServiceEnumerateDomains(). If the call succeeds, sdRef is initialized and kDNSServiceErr_NoError is returned. The enumeration call runs indefinitely until the client terminates the call. The enumeration call must be terminated by passing the DNSServiceRef initialized by the enumeration call to DNSServiceRefDeallocate() when no more domains are to be found.

The value of flags is constructed by a bitwise-inclusive-OR of the flags used in DNNService functions and defined in <dns_sd.h>. Possible values for flags to the DNSServiceEnumerateDomains() call are: kDNSServiceFlagsBrowseDomains and kDNSServiceFlagsRegistrationDomains. The kDNSServiceFlagsBrowseDomains value is passed to enumerate domains recommended for browsing. The kDNSServiceFlagsRegistrationDomains value is passed to enumerate domains recommended for registration. Possible values of flags returned in the callback function are: kDNSServiceFlagsMoreComing, kDNSServiceFlagsAdd, and kDNSServiceFlagsDefault.

The interfaceIndex parameter to the enumeration call specifies the interface index searched for domains. Most applications pass 0 to enumerate domains on all interfaces. See the section "Constants for specifying an interface index" in <dns_sd.h> for more details. The context parameter can be NULL and is passed to the enumeration callback function. The interfaceIndex value passed to the callback specifies the interface on which the domain exists.

Return Values  
The DNSServiceEnumerateDomains() function returns kDNSServiceErr_NoError on success. Otherwise, the function returns an error code defined in <dns_sd.h>. The callback is not invoked on error and the DNSServiceRef that is passed is not initialized. Upon a successful call to DNSServiceEnumerateDomains(), subsequent asynchronous errors are delivered to the callback.
Attributes  See attributes(5) for description of the following attributes:

<table>
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<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</tbody>
</table>

See Also  DNSServiceRefDeallocate(3DNS_SD), attributes(5)
The `DNSServiceProcessResult()` call reads the returned results from the mDNS daemon and invokes the specified application callback. The `sdRef` points to a `DNSServiceRef` initialized by any of the `DNSService` calls that take a `callback` parameter. The `DNSServiceProcessResult()` call blocks until data is received from the mDNS daemon. The application is responsible for ensuring that `DNSServiceProcessResult()` is called whenever there is a reply from the daemon. The daemon may terminate its connection with a client that does not process the daemon’s responses.

The `DNSServiceProcessResult()` call returns `kDNSServiceErr_NoError` on success. Otherwise, an error code defined in `<dns_sd.h>` is returned to indicate the specific failure that has occurred.

### Attributes
See attributes(5) for description of the following attributes:

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</tr>
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</table>

### See Also
`DNSServiceBrowse(3DNS_SD), DNSServiceRegister(3DNS_SD), attributes(5)`
DNSServiceQueryRecord(3DNS_SD)

Name
DNSServiceQueryRecord – query records from DNS

Synopsis
cc [ flag ... ] file ... -ldns_sd [ library ... ]
#include <dns_sd.h>

DNSServiceErrorType DNSServiceQueryRecord(DNSServiceRef *sdRef,
DNSServiceFlags flags, uint32_t interfaceIndex, const char *fullname,
uint16_t rrtype, uint16_t rclass,
DNSServiceServiceQueryRecordReply callBack, void *context);

typedef void(*DNSServiceQueryRecordReply)(DNSServiceRef DNSServiceRef,
DNSServiceFlags flags, uint32_t interfaceIndex,
DNSServiceErrorType errorCode, const char *fullname,
uint16_t rrtype, uint16_t rclass, uint16_t rdlen,
const void *data, uint32_t ttl, void *context);

Description
The DNSServiceQueryRecord() function is used to query the daemon for any DNS resource record type. The callback argument to DNSServiceQueryRecord() points to a function of type DNSServiceQueryRecordReply() listed above. The sdRef parameter in DNSServiceQueryRecord() points to an uninitialized DNSServiceRef. The DNSServiceQueryRecord() function returns kDNSServiceErr_NoError and initializes sdRef on success. The query runs indefinitely until the client terminates by passing the initialized sdRef from the query call to DNSServiceRefDeallocate().

The flag kDNSServiceFlagsLongLivedQuery should be passed in the flags argument of DNSServiceQueryRecord() to create a “long-lived” unicast query in a non-local domain. This flag has no effect on link local multicast queries. Without this flag, unicast queries will be one-shot and only the results that are available at the time of the query will be returned. With long-lived queries, add or remove events that are available after the first call generate callbacks. The interfaceIndex argument specifies the interface on which to issue the query. Most applications will pass a 0 as the interfaceIndex to make the query on all interfaces. See the section “Constants for specifying an interface index” in <dns_sd.h>. The fullname argument indicates the full domain name of the resource record to be queried. The rrtype argument indicates the resource record type: kDNSServiceType_PTR, for example. The rclass argument holds the class of the resource record to be queried (kDNSServiceClass_IN). The context argument can be NULL and points to a value passed to the callback function.

The sdRef argument passed to the callback function is initialized by the call to DNSServiceQueryRecord(). Possible values for the flags parameter to the callback function are kDNSServiceFlagsMoreComing and kDNSServiceFlagsAdd. The kDNSServiceFlagsMoreComing value is set to indicate that additional results are immediately available. The kDNSServiceFlagsAdd value indicates that the results returned to the callback function are for a valid DNS record. If kDNSServiceFlagsAdd is not set, the results returned are for a delete event. The errorCode passed to the callback is kDNSServiceErr_NoError on success. Otherwise, failure is indicated and other parameter values are undefined. The fullname parameter indicates the full domain name of the resource record. The rrtype indicates the resource record type. The rclass indicates the class of the DNS resource record.
The `rdlen` parameter indicates the length of the resource record `rdata` in bytes. The `rdata` parameter points to raw `rdata` of the resource record. The `ttl` parameter indicates the time to live of the resource record in seconds. The `context` parameter points to the value passed by the application in the `context` argument to the `DNSServiceQueryRecord()` call.

**Return Values** The `DNSServiceQueryRecord` function returns `kDNSServiceErr_NoError` on success. Otherwise, an error code defined in `<dns_sd.h>` is returned to indicate the specific failure that occurred.

**Attributes** See `attributes(5)` for description of the following attributes:

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**See Also** `DNSServiceBrowse(3DNS_SD)`, `DNSServiceRegister(3DNS_SD)`, `DNSServiceResolve(3DNS_SD)`, `attributes(5)`
# DNSServiceReconfirmRecord

## Name

DNSServiceReconfirmRecord – verify DNS record

## Synopsis

```c
cc [ flag ... ] file ... -ldns_sd [ library ... ]
#include <dns_sd.h>

void DNSServiceRefSockFD (DNSServiceFlags flags, uint32_t interfaceIndex,
       const char * fullname, uint16_t rrtype, uint16_t rrclass,
       uint16_t rrlen const void *rdata);
```

## Description

The DNSServiceReconfirmRecord() function allows callers to verify whether a DNS record is valid. If an invalid record is found in the cache, the daemon flushes the record from the cache and from the cache of other daemons on the network.

## Return Values

The DNSServiceReconfirmRecord() function returns kDNSServiceErr_NoError on success. Otherwise, an error code defined in <dns_sd.h> is returned to indicate the specific failure that occurred.

## Attributes

See attributes(5) for description of the following attributes:

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</tbody>
</table>

## See Also

DNSServiceBrowse(3DNS_SD), DNSServiceQueryRecord(3DNS_SD), DNSServiceRegister(3DNS_SD), DNSServiceResolve(3DNS_SD), attributes(5)
DNSServiceDeallocate (3DNS_SD)

**Name**  
DNSServiceDeallocate – close connection

**Synopsis**  
```c
cc [ flag ... ] file ... -ldns_sd [ library ... ]
#include <dns_sd.h>

void DNSServiceDeallocate (DNSServiceRef sdRef);
```

**Description**  
The `DNSServiceDeallocate()` call terminates connection to the mDNS daemon. Any services and resource records registered with the `DNSServiceRef` are de-registered. Any browse or resolve queries initiated using the `DNSServiceRef` are also terminated.

**Attributes**  
See attributes(5) for description of the following attributes:

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</table>

**See Also**  
DNSServiceBrowse(3DNS_SD), DNSServiceRegister(3DNS_SD), attributes(5)
**Name**  
DNSServiceRefSockFD – access underlying UNIX domain socket descriptor

**Synopsis**  
```c
cc [ flag ... ] file ... -ldns_sd [ library ... ]
#include <dns_sd.h>
DNSServiceRefSockFD(DNSServiceRef *sdRef);
```

**Description**  
Access the underlying UNIX domain socket from the initialized `DNSServiceRef` returned from DNS Service calls. Applications should only access the underlying UNIX domain socket to poll for results from the mDNS daemon. Applications should not directly read or write to the socket. When results are available, applications should call `DNSServiceProcessResult()`. The application is responsible for processing the data on the socket in a timely fashion. The daemon can terminate its connection with a client that does not clear its socket buffer.

**Return Values**  
The underlying UNIX domain socket descriptor of the `DNSServiceRef` or `-1` is returned in case of error.

**Attributes**  
See `attributes(5)` for description of the following attributes:

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**See Also**  
`DNSServiceBrowse(3DNS_SD), DNSServiceRegister(3DNS_SD), attributes(5)`
The `DNSServiceRegister` function is used by clients to advertise a service that uses DNS. The service is registered with multicast DNS if the domain name is .local or the interface requested is local only. Otherwise, the service registration is attempted with the unicast DNS server. The callback argument should point to a function of type `DNSServiceRegisterReply` listed above.

The `sdRef` parameter points to an uninitialized `DNSServiceRef` instance. If the `DNSServiceRegister()` call succeeds, `sdRef` is initialized and `kDNSServiceErr_NoError` is returned. The service registration remains active until the client terminates the registration by passing the initialized `sdRef` to `DNSServiceRefDeallocate()`. The `interfaceIndex` when non-zero specifies the interface on which the service should be registered. Most applications pass 0 to register the service on all interfaces. See the section "Constants for specifying an interface index" in `<dns_sd.h>` for more details. The `flags` parameter determines the renaming behavior on a service name conflict. Most applications pass 0 to allow auto-rename of the service name in case of a name conflict. Applications can pass the flag `kDNSServiceFlagsNoAutoRename` defined in `<dns_sd.h>` to disable auto-rename.

The `regtype` indicates the service type followed by the protocol, separated by a dot, for example "_ftp._tcp.". The service type must be an underscore that is followed by 1 to 14 characters that can be letters, digits, or hyphens. The transport protocol must be _tcp or _udp. New service types should be registered at [http://www.dns-sd.org/ServiceTypes.html](http://www.dns-sd.org/ServiceTypes.html). The `domain` parameter specifies the domain on which a service is advertised. Most applications leave the `domain` parameter NULL to register the service in default domains. The `host` parameter specifies the SRV target host name. Most applications do not specify the host parameter value. Instead, the default host name of the machine is used. The port value on which the service accepts connections must be passed in network byte order. A value of 0 for a port is passed to register placeholder services. Placeholder services are not found when browsing, but other clients cannot register with the same name as the placeholder service.
The `txtLen` parameter specifies the length of the passed `txtRecord` in bytes. The value must be zero if the `txtRecord` passed is NULL. The `txtRecord` points to the TXT record rdata. A non-NULL `txtRecord` must be a properly formatted DNSTXT record. For more details see the `DNSServiceRegister` call defined in `<dns_sd.h>`. The callback argument points to a function to be called when registration completes or when the call asynchronously fails. The client can pass NULL for the callback and not be notified of the registration results or asynchronous errors. The client may not pass the `NoAutoRename` flag if the callback is NULL. The client can unregister the service at any time via `DNSServiceRefDeallocate()`.

The callback function argument `sdRef` is initialized by `DNSServiceRegister()`. The `flags` argument in the callback function is currently unused and reserved for future use. The error code returned to the callback is `kDNSServiceErr_NoError` on success. Otherwise, an error code defined in `<dns_sd.h>` is returned to indicate an error condition such as a name conflict in `kDNSServiceFlagsNoAutoRename` mode. The `name` argument holds the registered service name and the `regtype` argument is the registered service type passed to `DNSServiceRegister()`. The domain argument returned in the callback indicates the domain on which the service was registered.

**Return Values**  The `DNSServiceRegister` function returns `kDNSServiceErr_NoError` on success. Otherwise, an error code defined in `<dns_sd.h>` is returned. Upon registration, any subsequent asynchronous errors are delivered to the callback.

**Attributes**  See attributes(5) for description of the following attributes:

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</table>

**See Also**  `DNSServiceRefDeallocate(3DNS_SD), attributes(5)`
DNSServiceResolve(3DNS_SD)

Name
DNSServiceResolve – resolve service instances with DNS

Synopsis
cc [ flag ... ] file ... -ldns_sd [ library ... ]
#include <dns_sd.h>

DNSServiceErrorType DNSServiceResolve(DNSServiceRef *sdRef,
    DNSServiceFlags flags, uint32_t interfaceIndex, const char *name,
    const char *regtype, const char *domain,
    DNSServiceServiceResolveReply callback, void *context);

typedef void (*DNSServiceResolveReply)(DNSServiceRef sdRef,
    DNSServiceFlags flags, uint32_t interfaceIndex,
    DNSServiceErrorType errorCode, const char *fullname,
    const char *hosttarget, uint16_t port, uint16_t txtLen,
    const char *txtRecord, void *context);

Description
The DNSServiceResolve() function is used to resolve a service name returned by
DNSServiceBrowse() to host IP address, port number, and TXT record. The
DNSServiceResolve() function returns results asynchronously. A DNSServiceResolve() call
to resolve service name can be ended by calling DNSServiceRefDeallocate(). The callback
argument points to a function of type DNSServiceResolveReply as listed above. The callback
function is invoked on finding a result or when the async resolve call fails. The sdRef
argument to DNSServiceResolve() points to an uninitialized DNSServiceRef. If the call to
DNSServiceResolve() succeeds, sdRef is initialized and kDNSServiceErr_NoError is
returned.

The flags argument to DNSServiceResolve() is currently unused and reserved for future use.
The interfaceIndex argument indicates the interface on which to resolve the service. If the
DNSServiceResolve() call is the result of an earlier DNSServiceBrowse() operation, pass the
interfaceIndex to perform a resolve on all interfaces. See the section “Constants for specifying
an interface index” in <dns_sd.h> for more details. The name parameter is the service
instance name to be resolved, as returned from a DNSServiceBrowse() call. The regtype holds
the service type and the domain parameter indicates the domain in which the service instance
was found. The context parameter points to a value that is passed to the callback function.

The sdRef argument passed to the callback function is initialized by DNSServiceResolve()
call. The flags parameter in the callback function is currently unused and reserved for future
use. The errorCode parameter is kDNSServiceErr_NoError on success. Otherwise, it will hold
the error defined in <dns_sd.h> and other parameters are undefined when errorCode is
nonzero. The fullname parameter in the callback holds the full service domain name in the
format <servicename>.<protocol>.<domain>. The full service domain name is escaped to
follow standard DNS rules. The hosttarget parameter holds the target hostname of the machine
providing the service. The port parameter indicates the port in network byte order on which
the service accepts connections. The txtLen and txtRecord parameters hold the length and the
TXT record of the service’s primary TXT record. The context parameter points to the value that
was passed as context to the DNSServiceResolve() call.
The `DNSServiceResolve` function returns `kDNSServiceErr_NoError` on success. Otherwise, an error code defined in `<dns_sd.h>` is returned to indicate an error has occurred. When an error is returned by `DNSServiceResolve`, the callback function is not invoked and the `DNSServiceRef` argument is not initialized.

**Attributes**  See attributes(5) for description of the following attributes:

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</table>

**See Also** `DNSServiceBrowse(3DNS_SD), DNSServiceRefDeallocate(3DNS_SD), attributes(5)`
endhostent(3XNET)

Name  
endhostent, gethostbyaddr, gethostbyname, gethostent, sethostent – network host database functions

Synopsis  
cc [ flag ... ] file ... -lxnet [ library ... ]
#include <netdb.h>
extern int h_errno;

void endhostent(void)
struct hostent *gethostbyaddr(const void *addr, socklen_t len, int type);
struct hostent *gethostbyname(const char *name);
struct hostent *gethostent(void)
void sethostent(int stayopen);

Description  
The gethostent() function reads the next entry of the database, opening a connection to the database if necessary.

The gethostbyaddr() function searches the database and finds an entry which matches the address family specified by the type argument and which matches the address pointed to by the addr argument, opening a connection to the database if necessary. The addr argument is a pointer to the binary-format (that is, not null-terminated) address in network byte order, whose length is specified by the len argument. The datatype of the address depends on the address family. For an address of type AF_INET, this is an in_addr structure, defined in <netinet/in.h>. For an address of type AF_INET6, there is an in6_addr structure defined in <netinet/in.h>.

The gethostbyname() function searches the database and finds an entry which matches the host name specified by the name argument, opening a connection to the database if necessary. If name is an alias for a valid host name, the function returns information about the host name to which the alias refers, and name is included in the list of aliases returned.

The sethostent() function opens a connection to the network host database, and sets the position of the next entry to the first entry. If the stayopen argument is non-zero, the connection to the host database will not be closed after each call to gethostent() (either directly, or indirectly through one of the other gethost*( ) functions).

The endhostent() function closes the connection to the database.

Usage  
The gethostent(), gethostbyaddr(), and gethostbyname() functions may return pointers to static data, which may be overwritten by subsequent calls to any of these functions.

These functions are generally used with the Internet address family.
Return Values
On successful completion, gethostbyaddr(), gethostbyname() and gethostent() return a pointer to a hostent structure if the requested entry was found, and a null pointer if the end of the database was reached or the requested entry was not found. Otherwise, a null pointer is returned.

On unsuccessful completion, gethostbyaddr() and gethostbyname() functions set h_errno to indicate the error.

Errors
No errors are defined for endhostent(), gethostent() and sethostent().

The gethostbyaddr() and gethostbyname() functions will fail in the following cases, setting h_errno to the value shown in the list below. Any changes to errno are unspecified.

HOST_NOT_FOUND No such host is known.
NO_DATA The server recognised the request and the name but no address is available. Another type of request to the name server for the domain might return an answer.
NO_RECOVERY An unexpected server failure occurred which can not be recovered.
TRY_AGAIN A temporary and possibly transient error occurred, such as a failure of a server to respond.

Attributes
See attributes(5) for descriptions of the following attributes:

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<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also endservent(3XNET), htonl(3XNET), inet_addr(3XNET), attributes(5), standards(5)
endnetent(3XNET)

Name  endnetent, getnetbyaddr, getnetbyname, getnetent, setnetent – network database functions

Synopsis  cc [ flag ... ] file ... -lxnet [ library ... ]
#include <netdb.h>

void endnetent(void);
struct netent *getnetbyaddr(in_addr_t net, int type);
struct netent *getnetbyname(const char *name);
struct netent *getnetent(void)
void setnetent(int stayopen);

Description  The getnetbyaddr(), getnetbyname() and getnetent(), functions each return a pointer to a
netent structure, the members of which contain the fields of an entry in the network database.

The getnetent() function reads the next entry of the database, opening a connection to the
database if necessary.

The getnetbyaddr() function searches the database from the beginning, and finds the first
entry for which the address family specified by type matches the n_addrtype member and the
network number net matches the n_net member, opening a connection to the database if
necessary. The net argument is the network number in host byte order.

The getnetbyname() function searches the database from the beginning and finds the first
entry for which the network name specified by name matches the n_name member, opening a
connection to the database if necessary.

The setnetent() function opens and rewinds the database. If the stayopen argument is
non-zero, the connection to the net database will not be closed after each call to getnetent() 
(either directly, or indirectly through one of the other getnet*( ) functions).

The endnetent() function closes the database.

Usage  The getnetbyaddr(), getnetbyname() and getnetent(), functions may return pointers to
static data, which may be overwritten by subsequent calls to any of these functions.

These functions are generally used with the Internet address family.

Return Values  On successful completion, getnetbyaddr(), getnetbyname() and getnetent(), return a
pointer to a netent structure if the requested entry was found, and a null pointer if the end of
the database was reached or the requested entry was not found. Otherwise, a null pointer is
returned.

Errors  No errors are defined.

Attributes  See attributes(5) for descriptions of the following attributes:
<table>
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<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  attributes(5), standards(5)
Name  endprotoent, getprotobyname, getprotobynumber, getprotoent, setprotoent – network protocol database functions

Synopsis  cc [ flag ... ] file ... -lxnet [ library ... ]
#include <netdb.h>

void endprotoent(void);
struct protoent *getprotobyname(const char *name);
struct protoent *getprotobynumber(int proto);
struct protoent *getprotoent(void);
void setprotoent(int stayopen);

Description  The getprotobyname(), getprotobynumber() and getprotoent(), functions each return a pointer to a protoent structure, the members of which contain the fields of an entry in the network protocol database.

The getprotoent() function reads the next entry of the database, opening a connection to the database if necessary.

The getprotobyname() function searches the database from the beginning and finds the first entry for which the protocol name specified by name matches the p_name member, opening a connection to the database if necessary.

The getprotobynumber() function searches the database from the beginning and finds the first entry for which the protocol number specified by number matches the p_proto member, opening a connection to the database if necessary.

The setprotoent() function opens a connection to the database, and sets the next entry to the first entry. If the stayopen argument is non-zero, the connection to the network protocol database will not be closed after each call to getprotoent() (either directly, or indirectly through one of the other getproto*( ) functions).

The endprotoent() function closes the connection to the database.

Usage  The getprotobyname(), getprotobynumber() and getprotoent() functions may return pointers to static data, which may be overwritten by subsequent calls to any of these functions.

These functions are generally used with the Internet address family.

Return Values  On successful completion, getprotobyname(), getprotobynumber() and getprotoent() functions return a pointer to a protoent structure if the requested entry was found, and a null pointer if the end of the database was reached or the requested entry was not found. Otherwise, a null pointer is returned.
Errors  No errors are defined.

Attributes  See attributes(5) for descriptions of the following attributes:

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</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  attributes(5), standards(5)
Name  endservent, getservbyname, getservbyport, getservent, setservent – network services database functions

Synopsis  
cc [ flag ... ] file ... -lxnet [ library ... ]
#include <netdb.h>

void endservent(void)
struct servent *getservbyname(const char *name, const char *proto);
struct servent *getservbyport(int port, const char *proto);
struct servent *getservent(void)
void setservent(int stayopen);

Description  The getservbyname(), getservbyport() and getservent() functions each return a pointer to a servent structure, the members of which contain the fields of an entry in the network services database.

The getservent() function reads the next entry of the database, opening a connection to the database if necessary.

The getservbyname() function searches the database from the beginning and finds the first entry for which the service name specified by name matches the s_name member and the protocol name specified by proto matches the s_proto member, opening a connection to the database if necessary. If proto is a null pointer, any value of the s_proto member will be matched.

The getservbyport() function searches the database from the beginning and finds the first entry for which the port specified by port matches the s_port member and the protocol name specified by proto matches the s_proto member, opening a connection to the database if necessary. If proto is a null pointer, any value of the s_proto member will be matched. The port argument must be in network byte order.

The setservent() function opens a connection to the database, and sets the next entry to the first entry. If the stayopen argument is non-zero, the net database will not be closed after each call to the getservent() function, either directly, or indirectly through one of the other getserv*() functions.

The endservent() function closes the database.

Usage  The port argument of getservbyport() need not be compatible with the port values of all address families.

The getservent(), getservbyname() and getservbyport() functions may return pointers to static data, which may be overwritten by subsequent calls to any of these functions.

These functions are generally used with the Internet address family.
Return Values On successful completion, `getservbyname()`, `getservbyport()` and `getservent()` return a pointer to a `servent` structure if the requested entry was found, and a null pointer if the end of the database was reached or the requested entry was not found. Otherwise, a null pointer is returned.

Errors No errors are defined.

Attributes See `attributes(5)` for descriptions of the following attributes:

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<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</tbody>
</table>

See Also `endhostent(3XNET), endprotoent(3XNET), htonl(3XNET), inet_addr(3XNET), attributes(5), standards(5)`
ethers(3SOCKET)

Name  ethers, ether_ntoa, ether_aton, ether_ntohost, ether_hostton, ether_line – Ethernet address
       mapping operations

Synopsis  cc [ flag ... ] file ... -lssocket -lnsl [ library ... ]
#include <sys/types.h>
#include <sys/ethernet.h>

    char *ether_ntoa(const struct ether_addr *e);
    struct ether_addr *ether_aton(const char *s);
    int ether_ntohost(char *hostname, const struct ether_addr *e);
    int ether_hostton(const char *hostname, struct ether_addr *e);
    int ether_line(const char *l, struct ether_addr *e, char *hostname);

Description  These routines are useful for mapping 48 bit Ethernet numbers to their ASCII representations
              or their corresponding host names, and vice versa.

              The function ether_ntoa() converts a 48 bit Ethernet number pointed to by e to its standard
              ASCII representation; it returns a pointer to the ASCII string. The representation is of the
              form x:x:x:x:x:x where x is a hexadecimal number between 0 and ff. The function
              ether_aton() converts an ASCII string in the standard representation back to a 48 bit
              Ethernet number; the function returns NULL if the string cannot be scanned successfully.

              The function ether_ntohost() maps an Ethernet number (pointed to by e) to its associated
              hostname. The string pointed to by hostname must be long enough to hold the hostname and
              a NULL character. The function returns zero upon success and non-zero upon failure.
              Inversely, the function ether_hostton() maps a hostname string to its corresponding
              Ethernet number; the function modifies the Ethernet number pointed to by e. The function
              also returns zero upon success and non-zero upon failure. In order to do the mapping, both
              these functions may lookup one or more of the following sources: the ethers file, and the NIS
              maps ethersbyname and ethersbyaddr. The sources and their lookup order are specified in
              the /etc/nsswitch.conf file. See nsswitch.conf(4) for details.

              The function ether_line() scans a line, pointed to by l, and sets the hostname and the
              Ethernet number, pointed to by e. The string pointed to by hostname must be long enough to
              hold the hostname and a NULL character. The function returns zero upon success and
              non-zero upon failure. The format of the scanned line is described by ethers(4).

Files  /etc/ethers  Ethernet address to hostname database or domain

       /etc/nsswitch.conf  configuration file for the name service switch

Attributes  See attributes(5) for descriptions of the following attributes:

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<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>
See Also ethers(4), nsswitch.conf(4), attributes(5)
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` member of the structure is not null, the entire list of structures is freed. The `freeaddrinfo()` function supports the freeing of arbitrary sublists of an `addrinfo` list originally returned by `getaddrinfo()`.

The `getaddrinfo()` function translates the name of a service location (for example, a host name) and/or a 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 null pointers or pointers to null-terminated strings. One or both of these two arguments are supplied by the application as a non-null pointer.

The format of a valid name depends on the address family or families. If a specific family is not given and the name could be interpreted as valid within multiple supported families, the implementation attempts to resolve the name in all supported families and, in absence of errors, one or more results are returned.

If the `nodename` argument is not null, it can be a descriptive name or 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 Internet standard dot notation as specified in `inet_addr(3XNET)` are valid.

If the specified address family is `AF_INET6` or `AF_UNSPEC`, standard IPv6 text forms described in `inet_ntop(3XNET)` are valid.

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 string 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 hints argument is not null, it refers to a structure containing input values that can direct the operation by providing options and by limiting the returned information to a specific socket type, address family and/or protocol. In this hints structure every member other than ai_flags, ai_family, ai_socktype, and ai_protocol is set to 0 or a null pointer. A value of AF_UNSPEC for ai_family means that the caller accepts any address family. A value of 0 for ai_socktype means that the caller accepts any socket type. A value of 0 for ai_protocol means that the caller accepts any protocol. If hints is a null pointer, the behavior is as if it referred to a structure containing the value 0 for the ai_flags, ai_socktype, and ai_protocol members, and AF_UNSPEC for the ai_family member.

The ai_flags member to which the hints parameter points is set to 0 or be the bitwise-inclusive OR of one or more of the values AI_PASSIVE, AI_CANONNAME, AI_NUMERICHOST, and AI_NUMERICSERV.

If the AI_PASSIVE flag is specified, the returned address information is suitable for use in binding a socket for accepting incoming connections for the specified service. In this case, if the nodename argument is null, then the IP address portion of the socket address structure is set to INADDR_ANY for an IPv4 address or IN6ADDR_ANY_INIT for an IPv6 address. If the AI_PASSIVE flag is not specified, the returned address information is suitable for a call to connect(3XNET) (for a connection-mode protocol) or for a call to connect(), sendto(3XNET), or sendmsg(3XNET) (for a connectionless protocol). In this case, if the nodename argument is null, then the IP address portion of the socket address structure is set to the loopback address.

If the AI_CANONNAME flag is specified and the nodename argument is not null, the function attempts to determine the canonical name corresponding to nodename (for example, if nodename is an alias or shorthand notation for a complete name).

If the AI_NUMERICHOST flag is specified, then a non-null nodename string supplied is a numeric host address string. Otherwise, an EAI_NONAME error is returned. This flag prevents any type of name resolution service (for example, the DNS) from being invoked.

If the AI_NUMERICSERV flag is specified, then a non-null servname string supplied is a numeric port string. Otherwise, an EAI_NONAME error is returned. This flag prevents any type of name resolution service (for example, NIS) from being invoked.

If the AI_V4MAPPED flag is specified along with an ai_family of AF_INET6, then getaddrinfo() returns IPv4-mapped IPv6 addresses on finding no matching IPv6 addresses (ai_addrlen is 16). The AI_V4MAPPED flag is ignored unless ai_family equals AF_INET6. If the AI_ALL flag is used with the AI_V4MAPPED flag, then getaddrinfo() returns all matching IPv6 and IPv4 addresses. The AI_ALL flag without the AI_V4MAPPED flag is ignored.

The ai_socktype member to which argument hints points specifies the socket type for the service, as defined in socket(3XNET). If a specific socket type is not given (for example, a value of 0) and the service name could be interpreted as valid with multiple supported socket types, the implementation attempts to resolve the service name for all supported socket types.
and, in the absence of errors, all possible results are returned. A non-zero socket type value limits the returned information to values with the specified socket type.

If the ai_family member to which hints points has the value AF_UNSPEC, addresses are returned for use with any address family that can be used with the specified nodename and/or servname. Otherwise, addresses are returned for use only with the specified address family. If ai_family is not AF_UNSPEC and ai_protocol is not 0, then addresses are returned for use only with the specified address family and protocol; the value of ai_protocol is interpreted as in a call to the socket() function with the corresponding values of ai_family and ai_protocol.

Return Values
A 0 return value for getaddrinfo() indicates successful completion; a non-zero return value indicates failure. The possible values for the failures are listed in the ERRORS section.

Upon successful return of getaddrinfo(), the location to which res points refers to a linked list of addrinfo structures, each of which specifies a socket address and information for use in creating a socket with which to use that socket address. The list includes at least one addrinfo structure. The ai_next member of each structure contains a pointer to the next structure on the list, or a null pointer if it is the last structure on the list. Each structure on the list includes values for use with a call to the socket function, and a socket address for use with the connect function or, if the AI_PASSIVE flag was specified, for use with the bind function. The ai_family, ai_socktype, and ai_protocol members are usable as the arguments to the socket() function to create a socket suitable for use with the returned address. The ai_addr and ai_addrlen members are usable as the arguments to the connect() or bind() functions with such a socket, according to the AI_PASSIVE flag.

If nodename is not null, and if requested by the AI_CANONNAME flag, the ai_canonname member of the first returned addrinfo structure points to a null-terminated string containing the canonical name corresponding to the input nodename. If the canonical name is not available, then ai_canonname refers to the nodename argument or a string with the same contents. The contents of the ai_flags member of the returned structures are undefined.

All members in socket address structures returned by getaddrinfo() that are not filled in through an explicit argument (for example, sin6_flowinfo) are set to 0, making it easier to compare socket address structures.

Errors
The getaddrinfo() function will fail if:

- **EAI_AGAIN** The name could not be resolved at this time. Future attempts might succeed.
- **EAI_BADFLAGS** The ai_flags member of the addrinfo structure had an invalid value.
- **EAI_FAIL** A non-recoverable error occurred when attempting to resolve the name.
- **EAI_FAMILY** The address family was not recognized.
- **EAI_MEMORY** There was a memory allocation failure when trying to allocate storage for the return value.
EAI_NONAME  he name does not resolve for the supplied parameters. Neither nodename nor servname were supplied. At least one of these must be supplied.

EAI_SERVICE  The service passed was not recognized for the specified socket type.

EAI_SOCKTYPE  The intended socket type was not recognized.

EAI_SYSTEM  A system error occurred. The error code can be found in errno.

EAI_OVERFLOW  An argument buffer overflowed.

Usage  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.

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.

Attributes  See attributes(5) for descriptions of the following attributes:

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<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  connect(3XNET), gai_strerror(3XNET), gethostbyname(3XNET), getnameinfo(3XNET), getservbyname(3XNET), inet_addr(3XNET), inet_ntop(3XNET), socket(3XNET), attributes(5), standards(5)
gai_strerror(3XNET)

Name  gai_strerror – address and name information error description

Synopsis  cc [ flag ... ] file ... -lxnet [ library ... ]
#include <netdb.h>

const char *gai_strerror(int ecode);

Description  The gai_strerror() function returns a text string describing an error value for the
getaddrinfo(3XNET) and getnameinfo(3XNET) functions listed in the <netdb.h> header.

When the ecode argument is one of the following values listed in the <netdb.h> header:
EAI_AGAIN
EAI_BADFLAGS
EAI_FAIL
EAI_FAMILY
EAI_MEMORY
EAI_NONAME
EAI_SERVICE
EAI_SOCKTYPE
EAI_SYSTEM

the function return value points to a string describing the error. If the argument is not one of
those values, the function returns a pointer to a string whose contents indicate an unknown
error.

Return Values  Upon successful completion, gai_strerror() returns a pointer to a string describing the
error value.

Errors  No errors are defined.

Attributes  See attributes(5) for descriptions of the following attributes:

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<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  getaddrinfo(3XNET), getnameinfo(3XNET), attributes(5), standards(5)
The `getaddrinfo()` function performs the node name to address translation. The `nodename` and `servname` arguments are pointers to null-terminated strings or NULL. One or both of these arguments must be a non-null pointer. In the normal client scenario, both the `nodename` and `servname` are specified. In the normal server scenario, only the `servname` is specified.

A non-null `nodename` string can be a node name or a numeric host address string. The `nodename` can also be an IPv6 zone-id in the form:

```
<address>%<zone-id>
```

The address is the literal IPv6 link-local address or host name of the destination. The zone-id is the interface ID of the IPv6 link used to send the packet. The zone-id can either be a numeric value, indicating a literal zone value, or an interface name such as `hme0`.

A non-null `servname` string can be either a service name or a decimal port number.

The caller can optionally pass an `addrinfo` structure, pointed to by the `hints` argument, to provide hints concerning the type of socket that the caller supports.

The `addrinfo` structure is defined as:

```c
struct addrinfo {
    int ai_flags;  /* AI_PASSIVE, AI_CANONNAME,
                    AI_NUMERICHOST, AI_NUMERICSERV
                    AI_V4MAPPED, AI_ALL,
                    AI_ADDRCONFIG */
    int ai_family;  /* PF_xxx */
    int ai_socktype; /* SOCK_xxx */
    int ai_protocol; /* IPPROTO_xxx */
    socklen_t ai_addrlen; /* length of ai_addr */
};
```
In this \textit{hints} structure, all members other than \texttt{ai\_flags}, \texttt{ai\_family}, \texttt{ai\_socktype}, and \texttt{ai\_protocol} must be 0 or a null pointer. A value of \texttt{PF\_UNSPEC} for \texttt{ai\_family} indicates that the caller will accept any protocol family. A value of 0 for \texttt{ai\_socktype} indicates that the caller will accept any socket type. A value of 0 for \texttt{ai\_protocol} indicates that the caller will accept any protocol. For example, if the caller handles only TCP and not UDP, then the \texttt{ai\_socktype} member of the \textit{hints} structure should be set to \texttt{SOCK\_STREAM} when \texttt{getaddrinfo()} is called. If the caller handles only IPv4 and not IPv6, then the \texttt{ai\_family} member of the \textit{hints} structure should be set to \texttt{PF\_INET} when \texttt{getaddrinfo()} is called. If the third argument to \texttt{getaddrinfo()} is a null pointer, it is as if the caller had filled in an \texttt{addrinfo} structure initialized to 0 with \texttt{ai\_family} set to \texttt{PF\_UNSPEC}.

Upon success, a pointer to a linked list of one or more \texttt{addrinfo} structures is returned through the final argument. The caller can process each \texttt{addrinfo} structure in this list by following the \texttt{ai\_next} pointer, until a null pointer is encountered. In each returned \texttt{addrinfo} structure the three members \texttt{ai\_family}, \texttt{ai\_socktype}, and \texttt{ai\_protocol} are the corresponding arguments for a call to the \texttt{socket(3SOCKET)} function. In each \texttt{addrinfo} structure the \texttt{ai\_addr} member points to a filled-in socket address structure whose length is specified by the \texttt{ai\_addrlen} member.

If the \texttt{AI\_PASSIVE} bit is set in the \texttt{ai\_flags} member of the \textit{hints} structure, the caller plans to use the returned socket address structure in a call to \texttt{bind(3SOCKET)}. In this case, if the \texttt{nodename} argument is a null pointer, the IP address portion of the socket address structure will be set to \texttt{INADDR\_ANY} for an IPv4 address or \texttt{IN6ADDR\_ANY\_INIT} for an IPv6 address.

If the \texttt{AI\_PASSIVE} bit is not set in the \texttt{ai\_flags} member of the \textit{hints} structure, then the returned socket address structure will be ready for a call to \texttt{connect(3SOCKET)} (for a connection-oriented protocol) or either \texttt{connect(3SOCKET)}, \texttt{sendto(3SOCKET)}, or \texttt{sendmsg(3SOCKET)} (for a connectionless protocol). If the \texttt{nodename} argument is a null pointer, the IP address portion of the socket address structure will be set to the loopback address.

If the \texttt{AI\_CANONNAME} bit is set in the \texttt{ai\_flags} member of the \textit{hints} structure, then upon successful return the \texttt{ai\_canonname} member of the first \texttt{addrinfo} structure in the linked list will point to a null-terminated string containing the canonical name of the specified \texttt{nodename}. A numeric host address string is not a name, and thus does not have a canonical name form; no address to host name translation is performed.

If the \texttt{AI\_NUMERICHOST} bit is set in the \texttt{ai\_flags} member of the \textit{hints} structure, then a non-null \texttt{nodename} string must be a numeric host address string. Otherwise an error of \texttt{EAI\_NONAME} is returned. This flag prevents any type of name resolution service (such as DNS) from being called.
If the \texttt{AI\_NUMERIC\_SERV} flag is specified, then a non-null servername string supplied will be a numeric port string. Otherwise, an \texttt{[EAI\_NONAME]} error is returned. This flag prevents any type of name resolution service (for example, NIS) from being invoked.

If the \texttt{AI\_V4MAPPED} flag is specified along with an \texttt{ai\_family} of \texttt{AF\_INET6}, then \texttt{getaddrinfo()} returns IPv4-mapped IPv6 addresses on finding no matching IPv6 addresses (\texttt{ai\_addrlen} shall be 16). For example, if no AAAA records are found when using DNS, a query is made for A records. Any found records are returned as IPv4-mapped IPv6 addresses.

The \texttt{AI\_V4MAPPED} flag is ignored unless \texttt{ai\_family} equals \texttt{AF\_INET6}.

If the \texttt{AI\_ALL} flag is used with the \texttt{AI\_V4MAPPED} flag, then \texttt{getaddrinfo()} returns all matching IPv6 and IPv4 addresses. For example, when using the DNS, queries are made for both AAAA records and A records, and \texttt{getaddrinfo()} returns the combined results of both queries. Any IPv4 addresses found are returned as IPv4-mapped IPv6 addresses.

The \texttt{AI\_ALL} flag without the \texttt{AI\_V4MAPPED} flag is ignored.

When \texttt{ai\_family} is not specified (\texttt{AF\_UNSPEC}), \texttt{AI\_V4MAPPED} and \texttt{AI\_ALL} flags are used only if \texttt{AF\_INET6} is supported.

If the \texttt{AI\_ADDR\_CONFIG} flag is specified, IPv4 addresses are returned only if an IPv4 address is configured on the local system, and IPv6 addresses are returned only if an IPv6 address is configured on the local system. For this case, the loopback address is not considered to be as valid as a configured address. For example, when using the DNS, a query for AAAA records should occur only if the node has at least one IPv6 address configured (other than IPv6 loopback) and a query for A records should occur only if the node has at least one IPv4 address configured (other than the IPv4 loopback).

All of the information returned by \texttt{getaddrinfo()} is dynamically allocated: the \texttt{addrinfo} structures as well as the socket address structures and canonical node name strings pointed to by the \texttt{addrinfo} structures. The \texttt{freeaddrinfo()} function is called to return this information to the system. For \texttt{freeaddrinfo()}, the \texttt{addrinfo} structure pointed to by the \texttt{ai} argument is freed, along with any dynamic storage pointed to by the structure. This operation is repeated until a null \texttt{ai\_next} pointer is encountered.

To aid applications in printing error messages based on the \texttt{EAI\_\_*} codes returned by \texttt{getaddrinfo()}, the \texttt{gai\__strerror()} is defined. The argument is one of the \texttt{EAI\_\_*} values defined below and the return value points to a string describing the error. If the argument is not one of the \texttt{EAI\_\_*} values, the function still returns a pointer to a string whose contents indicate an unknown error.

The \texttt{getnameinfo()} function looks up an IP address and port number provided by the caller in the name service database and system-specific database, and returns text strings for both in buffers provided by the caller. The function indicates successful completion by a 0 return value; a non-zero return value indicates failure.
The first argument, sa, 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 salen argument gives the length of the sockaddr_in or sockaddr_in6 structure.

The function returns the node name associated with the IP address in the buffer pointed to by the host argument.

The function can also return the IPv6 zone-id in the form:

<address>%<zone-id>

The caller provides the size of this buffer with the hostlen argument. The service name associated with the port number is returned in the buffer pointed to by serv, and the servlen argument gives the length of this buffer. The caller specifies not to return either string by providing a 0 value for the hostlen or servlen arguments. Otherwise, the caller must provide buffers large enough to hold the node name and the service name, including the terminating null characters.

To aid the application in allocating buffers for these two returned strings, the following constants are defined in <netdb.h>:

#define NI_MAXHOST 1025
#define NI_MAXSERV 32

The final argument is a flag that changes the default actions of this function. By default, the fully-qualified domain name (FQDN) for the host is looked up in the name service database and returned. If the flag bit NI_NOFQDN is set, only the node name portion of the FQDN is returned for localhosts.

If the flag bit NI_NUMERICHOST is set, or if the host's name cannot be located in the name service, the numeric form of the host's address is returned instead of its name, for example, by calling inet_ntop() (see inet(3SOCKET)) instead of getipnodebyname(3SOCKET). If the flag bit NI_NAMEREQD is set, an error is returned if the host's name cannot be located in the name service database.

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. The two NI_NUMERIC* flags are required to support the -n flag that many commands provide.

A fifth flag bit, NI_DGRAM, specifies that the service is a datagram service, and causes getservbyport(3SOCKET) to be called with a second argument of udp instead of the default tcp. This is required for the few ports (for example, 512-514) that have different services for UDP and TCP.

These NI_* flags are defined in <netdb.h> along with the AI_* flags already defined for getaddrinfo().
Return Values  For getaddrinfo(), if the query is successful, a pointer to a linked list of one or more addrinfo structures is returned by the fourth argument and the function returns 0. The order of the addresses returned in the fourth argument is discussed in the ADDRESS ORDERING section. If the query fails, a non-zero error code will be returned. For getnameinfo(), if successful, the strings hostname and service are copied into host and serv, respectively. If unsuccessful, zero values for either hostlen or servlen will suppress the associated lookup; in this case no data is copied into the applicable buffer. If gai_strerror() is successful, a pointer to a string containing an error message appropriate for the EAI_* errors is returned. If errcode is not one of the EAI_* values, a pointer to a string indicating an unknown error is returned.

Address Ordering  AF_INET6 addresses returned by the fourth argument of getaddrinfo() are ordered according to the algorithm described in RFC 3484, Default Address Selection for Internet Protocol version 6 (IPv6). The addresses are ordered using a list of pair-wise comparison rules which are applied in order. If a rule determines that one address is better than another, the remaining rules are irrelevant to the comparison of those two addresses. If two addresses are equivalent according to one rule, the remaining rules act as a tie-breaker. The address ordering list of pair-wise comparison rules follow below:

<table>
<thead>
<tr>
<th>Avoid unusable destinations.</th>
<th>Prefer a destination that is reachable through the IP routing table.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefer matching scope.</td>
<td>Prefer a destination whose scope is equal to the scope of its source address. See inet(7P) for the definition of scope used by this rule.</td>
</tr>
<tr>
<td>Avoid link-local source.</td>
<td>Avoid selecting a link-local source address when the destination address is not a link-local address.</td>
</tr>
<tr>
<td>Avoid deprecated addresses.</td>
<td>Prefer a destination that is not deprecated (IFF_DEPRECATED).</td>
</tr>
<tr>
<td>Prefer matching label. This rule uses labels that are obtained through the IPv6 default address selection policy table. See ipaddrsel(1M) for a description of the default contents of the table and how the table is configured.</td>
<td>Prefer a destination whose label is equal to the label of its source address.</td>
</tr>
<tr>
<td>Prefer higher precedence. This rule uses precedence values that are obtained through the IPv6 default address selection policy table. See ipaddrsel(1M) for a description of the default contents of the table and how the table is configured.</td>
<td>Prefer the destination whose precedence is higher than the other destination.</td>
</tr>
<tr>
<td>Prefer native transport.</td>
<td>Prefer a destination if the interface that is used for sending packets to that destination is not an IP over IP tunnel.</td>
</tr>
<tr>
<td>Prefer smaller scope. See inet(7P) for the definition of this rule.</td>
<td>Prefer the destination whose scope is smaller than the other destination.</td>
</tr>
</tbody>
</table>
Use longest matching prefix. When the two destinations belong to the same address family, prefer the destination that has the longer matching prefix with its source address.

**Errors**

The following names are the error values returned by `getaddrinfo()` and are defined in `<netdb.h>`:

- **EAI_ADDRFAMILY**: Address family for nodename is not supported.
- **EAI_AGAIN**: Temporary failure in name resolution has occurred.
- **EAI_BADFLAGS**: Invalid value specified for `ai_flags`.
- **EAI_FAIL**: Non-recoverable failure in name resolution has occurred.
- **EAI_FAMILY**: The `ai_family` is not supported.
- **EAI_MEMORY**: Memory allocation failure has occurred.
- **EAI_NODATA**: No address is associated with `nodename`.
- **EAI_NONAME**: Neither `nodename` nor `servname` is provided or known.
- **EAI_SERVICE**: The `servname` is not supported for `ai_socktype`.
- **EAI_SOCKTYPE**: The `ai_socktype` is not supported.
- **EAI_OVERFLOW**: Argument buffer has overflowed.
- **EAI_SYSTEM**: System error was returned in `errno`.

**Files**

- `/etc/inet/hosts`: Local database that associates names of nodes with IP addresses
- `/etc/netconfig`: Network configuration database
- `/etc/nsswitch.conf`: Configuration file for the name service switch

**Attributes**

See `attributes(5)` for description of the following attributes:

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<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**

`ipaddrsel(1M)`, `gethostbyname(3NSL)`, `getipnodebyname(3SOCKET)`, `htonl(3SOCKET)`, `inet(3SOCKET)`, `netdb.h(3HEAD)`, `socket(3SOCKET)`, `hosts(4)`, `nsswitch.conf(4)`, `attributes(5)`, `standards(5)`, `inet6(7P)`

Notes  IPv4-mapped addresses are not recommended.
gethostbyname(3NSL)

Name  
gethostbyname, gethostbyname_r, gethostbyaddr, gethostbyaddr_r, gethostent, gethostent_r, 
sethostent, endhostent — get network host entry

Synopsis  
cc [ flag... ] file... -lnsl [ library... ]
#include <netdb.h>

struct hostent *gethostbyname(const char *name);
struct hostent *gethostbyname_r(const char *name, 
   struct hostent *result, char *buffer, int buflen, 
   int *h_errno);

struct hostent *gethostbyaddr(const char *addr, int len, 
   int type);
struct hostent *gethostbyaddr_r(const char *addr, int length, 
   int type, struct hostent *result, char *buffer, 
   int buflen, int *h_errno);

struct hostent *gethostent(void);
struct hostent *gethostent_r(struct hostent *result, 
   char *buffer, int buflen, int *h_errno);
int sethostent(int stayopen);
int endhostent(void);

Description  
These functions are used to obtain entries describing hosts. An entry can come from any of the 
sources for hosts specified in the /etc/nsswitch.conf file. See nsswitch.conf(4). These 
functions have been superseded by getipnodebyname(3SOCKET), 
getipnodebyaddr(3SOCKET), and getaddrinfo(3SOCKET), which provide greater 
portability to applications when multithreading is performed or technologies such as IPv6 are 
used. For example, the functions described in the following cannot be used with applications 
targeted to work with IPv6.

The gethostbyname() function searches for information for a host with the hostname 
specified by the character-string parameter name.

The gethostbyaddr() function searches for information for a host with a given host address. 
The parameter type specifies the family of the address. This should be one of the address 
families defined in <sys/socket.h>. See the NOTES section for more information. Also see the 
EXAMPLES section for information on how to convert an Internet IP address notation that is 
separated by periods (.) into an addr parameter. The parameter len specifies the length of the 
buffer indicated by addr.

All addresses are returned in network order. In order to interpret the addresses, 
byteorder(3SOCKET) must be used for byte order conversion.

The sethostent(), gethostent(), and endhostent() functions are used to enumerate host 
entries from the database.
The `sethostent()` function sets or resets the enumeration to the beginning of the set of host entries. This function should be called before the first call to `gethostent()`. Calls to `gethostbyname()` and `gethostbyaddr()` leave the enumeration position in an indeterminate state. If the `stayopen` flag is non-zero, the system can keep allocated resources such as open file descriptors until a subsequent call to `endhostent()`.

Successive calls to the `gethostent()` function return either successive entries or `NULL`, indicating the end of the enumeration.

The `endhostent()` function can be called to indicate that the caller expects to do no further host entry retrieval operations; the system can then deallocate resources it was using. It is still allowed, but possibly less efficient, for the process to call more host retrieval functions after calling `endhostent()`.

The `gethostbyname()`, `gethostbyaddr()`, and `gethostent()` functions use static storage that is reused in each call, making these functions unsafe for use in multithreaded applications.

The `gethostbyname_r()`, `gethostbyaddr_r()`, and `gethostent_r()` functions provide reentrant interfaces for these operations.

Each reentrant interface performs the same operation as its non-reentrant counterpart, named by removing the `_r` suffix. The reentrant interfaces, however, use buffers supplied by the caller to store returned results and the interfaces are safe for use in both single-threaded and multithreaded applications.

Each reentrant interface takes the same parameters as its non-reentrant counterpart, as well as the following additional parameters. The parameter `result` must be a pointer to a `struct hostent` structure allocated by the caller. On successful completion, the function returns the host entry in this structure. The parameter `buffer` must be a pointer to a buffer supplied by the caller. This buffer is used as storage space for the host data. All of the pointers within the returned `struct hostent` point to data stored within this buffer. See the `RETURN VALUES` section for more information. The buffer must be large enough to hold all of the data associated with the host entry. The parameter `buflen` should give the size in bytes of the buffer indicated by `buffer`. The parameter `h_errno` should be a pointer to an integer. An integer error status value is stored there on certain error conditions. See the `ERRORS` section for more information.

For enumeration in multithreaded applications, the position within the enumeration is a process-wide property shared by all threads. The `sethostent()` function can be used in a multithreaded application but resets the enumeration position for all threads. If multiple threads interleave calls to `gethostent_r()`, the threads will enumerate disjoint subsets of the host database.

Like their non-reentrant counterparts, `gethostbyname_r()` and `gethostbyaddr_r()` leave the enumeration position in an indeterminate state.
Return Values  Host entries are represented by the \texttt{struct hostent} structure defined in \texttt{<netdb.h>}: 

\begin{verbatim}
struct hostent {
    char  *h_name;  /* canonical name of host */
    char **h_aliases;  /* alias list */
    int    h_addrtype;  /* host address type */
    int    h_length;    /* length of address */
    char **h_addr_list; /* list of addresses */
};
\end{verbatim}

See the \texttt{EXAMPLES} section for information about how to retrieve a "." separated Internet IP address string from the \texttt{h_addr_list} field of \texttt{struct hostent}.

The \texttt{gethostbyname()}, \texttt{gethostbyname\_r()}, \texttt{gethostbyaddr()}, and \texttt{gethostbyaddr\_r()} functions each return a pointer to a \texttt{struct hostent} if they successfully locate the requested entry; otherwise they return \texttt{NULL}.

The \texttt{gethostent()} and \texttt{gethostent\_r()} functions each return a pointer to a \texttt{struct hostent} if they successfully enumerate an entry; otherwise they return \texttt{NULL}, indicating the end of the enumeration.

The \texttt{gethostbyname()}, \texttt{gethostbyaddr()}, and \texttt{gethostent()} functions use static storage, so returned data must be copied before a subsequent call to any of these functions if the data is to be saved.

When the pointer returned by the reentrant functions \texttt{gethostbyname\_r()}, \texttt{gethostbyaddr\_r()}, and \texttt{gethostent\_r()} is not \texttt{NULL}, it is always equal to the \texttt{result} pointer that was supplied by the caller.

The \texttt{sethostent()} and \texttt{endhostent()} functions return \texttt{0} on success.

Errors  The reentrant functions \texttt{gethostbyname\_r()}, \texttt{gethostbyaddr\_r()}, and \texttt{gethostent\_r()} will return \texttt{NULL} and set \texttt{errno} to \texttt{ERANGE} if the length of the buffer supplied by caller is not large enough to store the result. See \texttt{Intro(2)} for the proper usage and interpretation of \texttt{errno} in multithreaded applications.

The reentrant functions \texttt{gethostbyname\_r()} and \texttt{gethostbyaddr\_r()} set the integer pointed to by \texttt{h_errno} to one of these values in case of error.

On failures, the non-reentrant functions \texttt{gethostbyname()} and \texttt{gethostbyaddr()} set a global integer \texttt{h_errno} to indicate one of these error codes (defined in \texttt{<netdb.h>}): \texttt{HOST\_NOT\_FOUND}, \texttt{TRY\_AGAIN}, \texttt{NO\_RECOVERY}, \texttt{NO\_DATA}, and \texttt{NO\_ADDRESS}.

If a resolver is provided with a malformed address, or if any other error occurs before \texttt{gethostbyname()} is resolved, then \texttt{gethostbyname()} returns an internal error with a value of \texttt{-1}.

The \texttt{gethostbyname()} function will set \texttt{h_errno} to \texttt{NETDB\_INTERNAL} when it returns a \texttt{NULL} value.
**Examples**

**Example 1.** Using `gethostbyaddr()`

Here is a sample program that gets the canonical name, aliases, and `"."` separated Internet IP addresses for a given `"."` separated IP address:

```c
#include <stdio.h>
#include <stdlib.h>
#include <string.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>
#include <netdb.h>

int main(int argc, const char **argv)
{
    in_addr_t addr;
    struct hostent *hp;
    char **p;
    if (argc != 2) {
        (void) printf("usage: %s IP-address\n", argv[0]);
        exit (1);
    }
    if ((int)(addr = inet_addr(argv[1])) == -1) {
        (void) printf("IP-address must be of the form a.b.c.d\n");
        exit (2);
    }
    hp = gethostbyaddr((char *)&addr, 4, AF_INET);
    if (hp == NULL) {
        (void) printf("host information for %s not found\n", argv[1]);
        exit (3);
    }
    for (p = hp->h_addr_list; *p != 0; p++) {
        struct in_addr in;
        char **q;
        (void) memcpy(&in.s_addr, *p, sizeof (in.s_addr));
        (void) printf("%s %s
", inet_ntoa(in), hp->h_name);
        for (q = hp->h_aliases; *q != 0; q++)
            (void) printf("%s
", *q);
        (void) putchar(\n');
    }
    exit (0);
}
```

Note that the preceding sample program is unsafe for use in multithreaded applications.

**Files**

- `/etc/hosts` hosts file that associates the names of hosts with their Internet Protocol (IP) addresses
- `/etc/netconfig` network configuration database
- `/etc/nsswitch.conf` configuration file for the name service switch
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>See Reentrant Interfaces in the DESCRIPTION section.</td>
</tr>
</tbody>
</table>

See Also  Intro(2), Intro(3), byteorder(3SOCKET), inet(3SOCKET), netdb.h(3HEAD), netdir(3NSL), hosts(4), netconfig(4), nss(4), nsswitch.conf(4), attributes(5)

Warnings  The reentrant interfaces gethostbyname_r(), gethostbyaddr_r(), and gethostent_r() are included in this release on an uncommitted basis only and are subject to change or removal in future minor releases.

Notes  To ensure that they all return consistent results, gethostbyname(), gethostbyname_r(), and netdir_getbyname() are implemented in terms of the same internal library function. This function obtains the system-wide source lookup policy based on the inet family entries in netconfig(4) and the hosts: entry in nsswitch.conf(4). Similarly, gethostbyaddr(), gethostbyaddr_r(), and netdir_getbyaddr() are implemented in terms of the same internal library function. If the inet family entries in netconfig(4) have a "-" in the last column for nametoaddr libraries, then the entry for hosts in nsswitch.conf will be used; nametoaddr libraries in that column will be used, and nsswitch.conf will not be consulted.

There is no analogue of gethostent() and gethostent_r() in the netdir functions, so these enumeration functions go straight to the hosts entry in nsswitch.conf. Thus enumeration can return results from a different source than that used by gethostbyname(), gethostbyname_r(), gethostbyaddr(), and gethostbyaddr_r().

All the functions that return a struct hostent must always return the canonical name in the h_name field. This name, by definition, is the well-known and official hostname shared between all aliases and all addresses. The underlying source that satisfies the request determines the mapping of the input name or address into the set of names and addresses in hostent. Different sources might do that in different ways. If there is more than one alias and more than one address in hostent, no pairing is implied between them.

The system attempts to put those addresses that are on the same subnet as the caller before addresses that are on different subnets. However, if address sorting is disabled by setting SORT_ADDRS to FALSE in the /etc/default/nss file, the system does not put the local subnet addresses first. See nss(4) for more information.

When compiling multithreaded applications, see Intro(3), MULTITHREADED APPLICATIONS, for information about the use of the _REENTRANT flag.

Use of the enumeration interfaces gethostent() and gethostent_r() is discouraged; enumeration might not be supported for all database sources. The semantics of enumeration are discussed further in nsswitch.conf(4).
The current implementations of these functions only return or accept addresses for the Internet address family (type AF_INET).

The form for an address of type AF_INET is a struct in_addr defined in <netinet/in.h>. The functions described in inet(3SOCKET), and illustrated in the EXAMPLES section, are helpful in constructing and manipulating addresses in this form.

When the caller provides the IP address (the addr argument of gethostbyaddr() and gethostbyaddr_r()), the addr argument should be aligned on a word boundary or the code must be changed to memcpy(3C) the argument to an aligned area; otherwise an error such as a SIGBUS may result.
#include <unistd.h>

int gethostname(char *name, size_t namelen);

The gethostname() function returns the standard hostname for the current machine. The namelen argument specifies the size of the array pointed to by the name argument. The returned name is null-terminated, except that if namelen is an insufficient length to hold the host name, then the returned name is truncated and it is unspecified whether the returned name is null-terminated.

Host names are limited to 255 bytes.

Return Values
On successful completion, 0 is returned. Otherwise, -1 is returned.

Errors
No errors are defined.

Attributes
See attributes(5) for descriptions of the following attributes:

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<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also
uname(1), gethostid(3C), attributes(5), standards(5)
getifaddrs, freeifaddrs – get interface addresses

Synopsis

```
cc [ flag... ] file ... -lssocket -lnsl [ library ... ]
#include <sys/types.h>
#include <sys/socket.h>
#include <ifaddrs.h>

int getifaddrs(struct ifaddrs **ifap);
void freeifaddrs(struct ifaddrs *ifp);
```

Description

The `getifaddrs()` function stores a reference to a linked list of network interface addresses on the local machine in the memory referenced by `ifap`. The list consists of `ifaddrs` structures, as defined in the include file `<ifaddrs.h>`. Each element of the list describes one network interface address. The caller can process each `ifaddrs` structure in this list by following the `ifa_next` pointer, until a null pointer is encountered.

```c
struct ifaddrs {
    struct ifaddrs *ifa_next; /* next structure in linked list*/
    char *ifa_name; /* Interface name */
    uint64_t ifa_flags; /* Interface flags (if_tcp(7P)) */
    struct sockaddr *ifa_addr; /* Interface address */
    struct sockaddr *ifa_netmask; /* Interface netmask */
    union {
        struct sockaddr *ifa_dstaddr; /* Interface broadcast address */
        struct sockaddr *ifa_broadaddr; /* P2P interface destination */
    } ifa_ifu;
    void *ifa_data; /* Address specific data (unused) */
};
```

The `ifa_name` member contains the interface name.

The `ifa_flags` member contains the interface flags.

The `ifa_addr` member references the address of the interface. (The `sa_family` member of the `ifa_addr` member should be consulted to determine the format of the `ifa_addr` address.)

The `ifa_netmask` member references the netmask associated with `ifa_addr`, if one is set, otherwise it is NULL.

The `ifa_broadaddr` member, which should only be referenced for non-P2P interfaces, references the broadcast address associated with `ifa_addr`, if one exists, otherwise it is NULL.
The `ifa_dstaddr` member references the destination address on a P2P interface, if one exists, otherwise it is `NULL`.

The `ifa_data` member is currently unused.

The data returned by `getifaddrs()` is dynamically allocated and should be freed using `freeifaddrs()` when no longer needed.

**Return Values**
The `getifaddrs()` function returns the value 0 if successful; otherwise -1 is returned and `errno` is set to indicate the error.

**Errors**
The `getifaddrs()` function may fail and set `errno` for any of the errors specified for `ioctl(2)`, `socket(3SOCKET)`, and `malloc(3C)`.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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</tbody>
</table>

**See Also**
`ipadm(1M), ifconfig(1M), ioctl(2), malloc(3C), socket(3SOCKET), if_tcp(7P), attributes(5)`
The `getipnodebyname()` function searches the ipnodes database from the beginning. The function finds the first h_name member that matches the hostname specified by `name`. The function takes an `af` argument that specifies the address family. The address family can be `AF_INET` for IPv4 addresses or `AF_INET6` for IPv6 addresses. The `flags` argument determines what results are returned based on the value of `flags`. If the `flags` argument is set to 0 (zero), the default operation of the function is specified as follows:

- If the `af` argument is `AF_INET`, a query is made for an IPv4 address. If successful, IPv4 addresses are returned and the h_length member of the hostent structure is 4. Otherwise, the function returns a NULL pointer.
- If the `af` argument is `AF_INET6`, a query is made for an IPv6 address. If successful, IPv6 addresses are returned and the h_length member of the hostent structure is 16. Otherwise, the function returns a NULL pointer.

The `flags` argument changes the default actions of the function. Set the `flags` argument with a logical OR operation on any of combination of the following values:

- `AI_V4MAPPED`
- `AI_ALL`
- `AI_ADDRCONFIG`

The special flags value, `AI_DEFAULT`, should handle most applications. Porting simple applications to use IPv6 replaces the call...
hptr = gethostbyname(name);

with

hptr = getipnodebyname(name, AF_INET6, AI_DEFAULT, &error_num);

The flags value 0 (zero) implies a strict interpretation of the af argument:

- If flags is 0 and af is AF_INET, the caller wants only IPv4 addresses. A query is made for A records. If successful, IPv4 addresses are returned and the h_length member of the hostent structure is 4. Otherwise, the function returns a NULL pointer.
- If flags is 0 and af is AF_INET6, the caller wants only IPv6 addresses. A query is made for AAAA records. If successful, IPv6 addresses are returned and the h_length member of the hostent structure is 16. Otherwise, the function returns a NULL pointer.

Logically OR other constants into the flags argument to modify the behavior of the getipnodebyname() function.

- If the AI_V4MAPPED flag is specified with af set to AF_INET6, the caller can accept IPv4-mapped IPv6 addresses. If no AAAA records are found, a query is made for A records. Any A records found are returned as IPv4-mapped IPv6 addresses and the h_length is 16. The AI_V4MAPPED flag is ignored unless af equals AF_INET6.
- The AI_ALL flag is used in conjunction with the AI_V4MAPPED flag, exclusively with the IPv6 address family. When AI_ALL is logically ORed with AI_V4MAPPED flag, the caller wants all addresses: IPv6 and IPv4-mapped IPv6 addresses. A query is first made for AAAA records and, if successful, IPv6 addresses are returned. Another query is then made for A records. Any A records found are returned as IPv4-mapped IPv6 addresses and the h_length is 16. Only when both queries fail does the function return a NULL pointer. The AI_ALL flag is ignored unless af is set to AF_INET6.
- The AI_ADDRCONFIG flag specifies that a query for AAAA records should occur only when the node is configured with at least one IPv6 source address. A query for A records should occur only when the node is configured with at least one IPv4 source address. For example, if a node is configured with no IPv6 source addresses, af equals AF_INET6, and the node name queried has both AAAA and A records, then:
  - A NULL pointer is returned when only the AI_ADDRCONFIG value is specified.
  - The A records are returned as IPv4-mapped IPv6 addresses when the AI_ADDRCONFIG and AI_V4MAPPED values are specified.

The special flags value, AI_DEFAULT, is defined as

#define AI_DEFAULT (AI_V4MAPPED | AI_ADDRCONFIG)

The getipnodebyname() function allows the name argument to be a node name or a literal address string: a dotted-decimal IPv4 address or an IPv6 hex address. Applications do not have to call inet_pton(3SOCKET) to handle literal address strings.
Four scenarios arise based on the type of literal address string and the value of the *af* argument. The two simple cases occur when *name* is a dotted-decimal IPv4 address and *af* equals AF_INET and when *name* is an IPv6 hex address and *af* equals AF_INET6. The members of the returned *hostent* structure are:

- **h_name**: Pointer to a copy of the *name* argument
- **h_aliases**: NULL pointer.
- **h_addrtype**: Copy of the *af* argument.
- **h_length**: 4 for AF_INET or 16 for AF_INET6.
- **h_addr_list**: Array of pointers to 4-byte or 16-byte binary addresses. The array is terminated by a NULL pointer.

**Return Values**

Upon successful completion, *getipnodebyname()* and *getipnodebyaddr()* return a *hostent* structure. Otherwise they return NULL.

The *hostent* structure does not change from the existing definition when used with *gethostbyname*(3NSL). For example, host entries are represented by the struct *hostent* structure defined in `<netdb.h>`:

```
struct hostent {
    char  *h_name;  /* canonical name of host */
    char **h_aliases; /* alias list */
    int   h_addrtype; /* host address type */
    int   h_length;   /* length of address */
    char **h_addr_list; /* list of addresses */
};
```

An error occurs when *name* is an IPv6 hex address and *af* equals AF_INET. The return value of the function is a NULL pointer and *error_num* equals HOST_NOT_FOUND.

The *getipnodebyaddr()* function has the same arguments as the existing *gethostbyaddr*(3NSL) function, but adds an error number. As with *getipnodebyname()* and *getipnodebyaddr()*, it is thread-safe. The *error_num* value is returned to the caller with the appropriate error code to support thread-safe error code returns. The following error conditions can be returned for *error_num*:

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>HOST_NOT_FOUND</td>
<td>Host is unknown.</td>
</tr>
<tr>
<td>NO_DATA</td>
<td>No address is available for the <em>name</em> specified in the server request. This error is not a soft error. Another type of <em>name</em> server request might be successful.</td>
</tr>
<tr>
<td>NO_RECOVERY</td>
<td>An unexpected server failure occurred, which is a non-recoverable error.</td>
</tr>
<tr>
<td>TRY_AGAIN</td>
<td>This error is a soft error that indicates that the local server did not receive a response from an authoritative server. A retry at some later time may be successful.</td>
</tr>
</tbody>
</table>
One possible source of confusion is the handling of IPv4-mapped IPv6 addresses and IPv4-compatible IPv6 addresses, but the following logic should apply:

1. If \texttt{af} is \texttt{AF_INET6}, and if \texttt{len} equals 16, and if the IPv6 address is an IPv4-mapped IPv6 address or an IPv4-compatible IPv6 address, then skip over the first 12 bytes of the IPv6 address, set \texttt{af} to \texttt{AF_INET}, and set \texttt{len} to 4.
2. If \texttt{af} is \texttt{AF_INET}, lookup the \texttt{name} for the given IPv4 address.
3. If \texttt{af} is \texttt{AF_INET6}, lookup the \texttt{name} for the given IPv6 address.
4. If the function is returning success, then the single address that is returned in the hostent structure is a copy of the first argument to the function with the same address family that was passed as an argument to this function.

All four steps listed are performed in order.

This structure, and the information pointed to by this structure, are dynamically allocated by \texttt{getipnodebyname()} and \texttt{getipnodebyaddr()}. The \texttt{freehostent()} function frees this memory.

**Examples**

**EXAMPLE 1** Getting the Canonical Name, Aliases, and Internet IP Addresses for a Given Hostname

The following is a sample program that retrieves the canonical name, aliases, and all Internet IP addresses, both version 6 and version 4, for a given hostname.

```c
#include <stdio.h>
#include <string.h>
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>
#include <netdb.h>

main(int argc, const char **argv)
{
    char abuf[INET6_ADDRSTRLEN];
    int error_num;
    struct hostent *hp;
    char **p;

    if (argc != 2) {
        (void) printf("usage: %s hostname\n", argv[0]);
        exit (1);
    }

    /* argv[1] can be a pointer to a hostname or literal IP address */
    hp = getipnodebyname(argv[1], AF_INET6, AI_ALL | AI_ADDRCONFIG |
EXAMPLE 1  Getting the Canonical Name, Aliases, and Internet IP Addresses for a Given Hostname
(Continued)

    AI_V4MAPPED, &error_num);
    if (hp == NULL) {
        if (error_num == TRY_AGAIN) {
            printf("%s: unknown host or invalid literal address ", argv[1]);
        } else {
            printf("%s: unknown host or invalid literal address\n", argv[1]);
        }
        exit (1);
    }
    for (p = hp->h_addr_list; *p != 0; p++) {
        struct in6_addr in6;
        char **q;

        bcopy(*p, (caddr_t)&in6, hp->h_length);
        (void) printf("%s\t%s
", inet_ntop(AF_INET6, (void *)&in6, abuf, sizeof(abuf)), hp->h_name);
        for (q = hp->h_aliases; *q != 0; q++)
            (void) printf( "\n");
        (void) putchar( '\n');
    }
    freehostent(hp);
    exit (0);
}

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  getaddrinfo(3SOCKET), gethostbyname(3NSL), htonl(3SOCKET), inet(3SOCKET),
          netdb.h(3HEAD), hosts(4), nsswitch.conf(4), attributes(5)

Notes  No enumeration functions are provided for IPv6. Existing enumeration functions such as
        sethostent(3NSL) do not work in combination with the getipnodebyname() and
        getipnodebyaddr() functions.

        All the functions that return a struct hostent must always return the canonical in the
        h_name field. This name, by definition, is the well-known and official hostname shared
        between all aliases and all addresses. The underlying source that satisfies the request
determines the mapping of the input name or address into the set of names and addresses in hostent. Different sources might make such as determination in different ways. If more than one alias and more than one address in hostent exist, no pairing is implied between the alias and address.

The current implementations of these functions return or accept only addresses for the Internet address family (type AF_INET) or the Internet address family Version 6 (type AF_INET6).

IPv4-mapped addresses are not recommended. The getaddrinfo(3SOCKET) function is preferred over getipnodebyaddr() because it allows applications to lookup IPv4 and IPv6 addresses without relying on IPv4-mapped addresses.

The form for an address of type AF_INET is a struct in_addr defined in <netinet/in.h>. The form for an address of type AF_INET6 is a struct in6_addr, also defined in <netinet/in.h>. The functions described in inet_ntop(3SOCKET) and inet_pton(3SOCKET) that are illustrated in the EXAMPLES section are helpful in constructing and manipulating addresses in either of these forms.
Name  getipsecalgbyname, getipsecalgbynum, freeipsecalgent – query algorithm mapping entries

Synopsis  cc [ flag... ] file... -lnsl [ library... ]
#include <netdb.h>

struct ipsecalgent *getipsecalgbyname  
    (const char *alg_name, int protocol_num, int *errnop);

struct ipsecalgent *getipsecalgbynum(int alg_num, 
    int protocol_num, int *errnop);

void freeipsecalgent(struct ipsecalgent *ptr);

Description  Use the getipsecalgbyname(), getipsecalgbynum(), freeipsecalgent() functions to obtain the IPsec algorithm mappings that are defined by ipsecalgs(1M). The IPsec algorithms and associated protocol name spaces are defined by RFC 2407.

getipsecalgbyname() and getipsecalgbynum() return a structure that describes the algorithm entry found. This structure is described in the RETURN VALUES section below.

freeipsecalgent() must be used by the caller to free the structures returned by getipsecalgbyname() and getipsecalgbynum() when they are no longer needed.

Both getipsecalgbyname() and getipsecalgbynum() take as parameter the protocol identifier in which the algorithm is defined. See getipsecprotobyname(3NSL) and getipsecprotobyname(3NSL).

The following protocol numbers are pre-defined:

IPSEC_PROTO_ESP  Defines the encryption algorithms (transforms) that can be used by IPsec to provide data confidentiality.

IPSEC_PROTO_AH  Defines the authentication algorithms (transforms) that can be used by IPsec to provide authentication.

getipsecalgbyname() looks up the algorithm by its name, while getipsecalgbynum() looks up the algorithm by its assigned number.

Parameters  errnop  A pointer to an integer used to return an error status value on certain error conditions. See ERRORS.

Return Values  The getipsecalgbyname() and getipsecalgbynum() functions return a pointer to the structure ipsecalgent_t, defined in <netdb.h>. If the requested algorithm cannot be found, these functions return NULL.

The structure ipsecalgent_t is defined as follows:

typedef struct ipsecalgent {
    char **a_names;  /* algorithm names */
    int a_proto_num;  /* protocol number */
    int a_alg_num;  /* algorithm number */

    ...
};
char *a_mech_name; /* mechanism name */
int *a_block_sizes; /* supported block sizes */
int *a_key_sizes; /* supported key sizes */
int a_key_increment; /* key size increment */
int *a_mech_params; /* mechanism specific parameters */
int a_alg_flags; /* algorithm flags */
}

ipsecalgent_t;

If a_key_increment is non-zero, a_key_sizes[0] contains the default key size for the algorithm. a_key_sizes[1] and a_key_sizes[2] specify the smallest and biggest key sizes supported by the algorithm, and a_key_increment specifies the valid key size increments in that range.

If a_key_increment is zero, the array a_key_sizes contains the set of key sizes, in bits, supported by the algorithm. The last key length in the array is followed by an element of value 0. The first element of this array is used as the default key size for the algorithm.

a_name is an array of algorithm names, terminated by an element containing a NULL pointer. a_name[0] is the primary name for the algorithm.

a_proto_num is the protocol identifier of this algorithm. a_alg_num is the algorithm number. a_mech_name contains the mechanism name associated with the algorithm.

a_block_sizes is an array containing the supported block lengths or MAC lengths, in bytes, supported by the algorithm. The last valid value in the array is followed by an element containing the value 0.

a_block_sizes is an array containing the supported block lengths or MAC lengths, in bytes, supported by the algorithm. The last valid value in the array is followed by an element containing the value 0.

Errors When the specified algorithm cannot be returned to the caller, getipsecalgbyname() and getipsecalgbynum() return a value of NULL and set the integer pointed to by the errnop parameter to one of the following values:

- ENOMEM Not enough memory
- ENOENT Specified algorithm not found
- EINVAL Specified protocol number not found

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library (32 bit)</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>-----------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td></td>
<td>SUNWcsdx (64 bit)</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also cryptoadm(1M), ipsecalgs(1M), getipsecprotobynam(3NSL), getipsecprotobynam(3NSL), attributes(5)

getipsecprotobyname(3NSL)

Name  getipsecprotobyname, getipsecprotobynum – query IPsec protocols entries

Synopsis  cc -flag ... file ... lnsl [ -library ... ]
          #include <netdb.h>

          int getipsecprotobyname(const char *proto_name
          char *getipsecprotobynum(int proto_num

Description  Use the getipsecprotobyname() and getipsecprotobynum() functions to obtain the IPsec algorithm mappings that are defined by ipsecalgs(1M). You can also use the getipsecprotobyname() and getipsecprotobynum() functions in conjunction with getipsecalgbname(3NSL) and getipsecalgbnum(3NSL) to obtain information about the supported IPsec algorithms. The IPsec algorithms and associated protocol name spaces are defined by RFC 2407.

getipsecprotobyname() takes as argument the name of an IPsec protocol and returns its assigned protocol number. The character string returned by the getipsecprotobyname() function must be freed by the called when it is no longer needed.

getipsecprotobynum() takes as argument a protocol number and returns the corresponding protocol name.

The following protocol numbers are pre-defined:

<table>
<thead>
<tr>
<th>Protocol Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPSEC_PROTO_ESP</td>
<td>Defines the encryption algorithms (transforms)</td>
</tr>
<tr>
<td></td>
<td>that can be used by IPsec to provide data</td>
</tr>
<tr>
<td></td>
<td>confidentiality.</td>
</tr>
<tr>
<td>IPSEC_PROTO_AH</td>
<td>Defines the authentication algorithms (transforms)</td>
</tr>
<tr>
<td></td>
<td>that can be used by IPsec to provide authentication.</td>
</tr>
</tbody>
</table>

Parameters  proto_name  A pointer to the name of an IPsec protocol.
           proto_num  A pointer to a protocol number. conditions.

Return Values  The getipsecprotobyname() function returns a protocol number upon success, or –1 if the protocol specified does not exist.

The getipsecprotobynum() function returns a protocol name upon success, or the NULL value if the protocol number specified does not exist.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library (32 bit)</td>
</tr>
<tr>
<td></td>
<td>SUNWcslx (64 bit)</td>
</tr>
<tr>
<td>MT Level</td>
<td>MT Safe</td>
</tr>
<tr>
<td>ATTRIBUTE TYPE</td>
<td>ATTRIBUTE VALUE</td>
</tr>
<tr>
<td>---------------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**  
ipsealgs(1M), getipsecalgbyname(3NSL), getipsecalgbyname(3NSL), attributes(5)

getnameinfo (3XNET)

Name
getnameinfo – get name information

Synopsis
cc [ flag ... ] file ... -lxnet [ library ... ]
#include <sys/socket.h>
#include <netdb.h>

int getnameinfo(const struct sockaddr *restrict sa, socklen_t salen,
    char *restrict node, socklen_t nodelen, char *restrict service,
    socklen_t servicelen, unsigned flags);

Description
The getnameinfo() function translates a socket address to a node name and service location,
all of which are defined as in getaddrinfo (3XNET).

The sa argument points to a socket address structure to be translated. If the socket address
structure contains an IPv4-mapped IPv6 address or an IPv4-compatible IPv6 address, the
implementation extracts the embedded IPv4 address and lookup the node name for that IPv4
address.

If the node argument is non-NULL and the nodelen argument is non-zero, then the node
argument points to a buffer able to contain up to nodelen characters that receives the node
name as a null-terminated string. If the node argument is NULL or the nodelen argument is
zero, the node name is not returned. If the node’s name cannot be located, the numeric form of
the node’s address is returned instead of its name.

If the service argument is non-NULL and the servicelen argument is non-zero, then the service
argument points to a buffer able to contain up to servicelen bytes that receives the service name
as a null-terminated string. If the service argument is NULL or the servicelen argument is zero,
the service name is not returned. If the service’s name cannot be located, the numeric form of
the service address (for example, its port number) is returned instead of its name.

The flags argument is a flag that changes the default actions of the function. By default the
fully-qualified domain name (FQDN) for the host is returned, but:

- 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, under all circumstances.
- 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, under all circumstances.
- If the flag bit NI_DGRAM is set, this indicates that the service is a datagram service
  (SOCK_DGRAM). The default behavior assumes that the service is a stream service
  (SOCK_STREAM).
**Return Values**
A 0 return value for `getnameinfo()` indicates successful completion; a non-zero return value indicates failure. The possible values for the failures are listed in the ERRORS section.

Upon successful completion, `getnameinfo()` returns the node and service names, if requested, in the buffers provided. The returned names are always null-terminated strings.

**Errors**
The `getnameinfo()` function will fail if:

- **EAI_AGAIN**: The name could not be resolved at this time. Future attempts might succeed.
- **EAI_BADFLAGS**: The `flags` argument had an invalid value.
- **EAI_FAIL**: A non-recoverable error occurred.
- **EAI_FAMILY**: The address family was not recognized or the address length was invalid for the specified family.
- **EAI_MEMORY**: There was a memory allocation failure.
- **EAI_NONAME**: The name does not resolve for the supplied parameters. `NI_NAMEREQD` is set and the host’s name cannot be located, or both `nodename` and `servname` were NULL.
- **EAI_SYSTEM**: A system error occurred. The error code can be found in `errno`.

**Usage**
If the returned values are to be used as part of any further name resolution (for example, passed to `getaddrinfo()`), applications should provide buffers large enough to store any result possible on the system.

Given the IPv4-mapped IPv6 address “::ffff:1.2.3.4”, the implementation performs a lookup as if the socket address structure contains the IPv4 address “1.2.3.4”.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**
gai_strerror(3XNET), getaddrinfo(3XNET), getservbyname(3XNET), socket(3XNET), attributes(5), standards(5)

**Notes**
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 is returned.
The two \texttt{NI\_NUMERIC}xxx flags are required to support the \texttt{-n} flag that many commands provide.

The \texttt{NI\_DGRAM} flag is required for the few \texttt{AF\_INET} and \texttt{AF\_INET6} port numbers (for example, [512,514]) that represent different services for UDP and TCP.
**Name**  
getnetbyname, getnetbyname_r, getnetbyaddr, getnetbyaddr_r, getnetent, getnetent_r,  
setnetent, endnetent – get network entry

**Synopsis**  
cc [ flag ... ] file ... -lssocket -lnsl [ library ... ]  
#include <netdb.h>  

struct netent *getnetbyname(const char *name);  
struct netent *getnetbyname_r(const char *name, struct netent *result,  
  char *buffer, int buflen);  
struct netent *getnetbyaddr(long net, int type);  
struct netent *getnetbyaddr_r(long net, int type, struct netent *result,  
  char *buffer, int buflen);  
struct netent *getnetent(void);  
struct netent *getnetent_r(struct netent *result, char *buffer,  
  int buflen);  
int setnetent(int stayopen);  
int endnetent(void);

**Description**  
These functions are used to obtain entries for networks. An entry may come from any of the  
sources for networks specified in the /etc/nsswitch.conf file. See nsswitch.conf(4).

getnetbyname() searches for a network entry with the network name specified by the  
character string parameter name.

getnetbyaddr() searches for a network entry with the network address specified by net. The  
parameter type specifies the family of the address. This should be one of the address families  
defined in <sys/socket.h>. See the NOTES section below for more information.

Network numbers and local address parts are returned as machine format integer values, that  
is, in host byte order. See also inet(3SOCKET).

The netent.n_net member in the netent structure pointed to by the return value of the  
above functions is calculated by inet_network(). The inet_network() function returns a  
value in host byte order that is aligned based upon the input string. For example:

<table>
<thead>
<tr>
<th>Text</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;10&quot;</td>
<td>0x0000000a</td>
</tr>
<tr>
<td>&quot;10.0&quot;</td>
<td>0x00000a00</td>
</tr>
<tr>
<td>&quot;10.0.1&quot;</td>
<td>0a000a0001</td>
</tr>
<tr>
<td>&quot;10.0.1.28&quot;</td>
<td>0x0a000180</td>
</tr>
</tbody>
</table>
Commonly, the alignment of the returned value is used as a crude approximate of pre-CIDR (Classless Inter-Domain Routing) subnet mask. For example:

```c
in_addr_t addr, mask;
addr = inet_network(net_name);
mask= ~(in_addr_t)0;
if ((addr & IN_CLASSA_NET) == 0)
    addr <<= 8, mask <<= 8;
if ((addr & IN_CLASSA_NET) == 0)
    addr <<= 8, mask <<= 8;
if ((addr & IN_CLASSA_NET) == 0)
    addr <<= 8, mask <<= 8;
```


The functions setnetent(), getnetent(), and endnetent() are used to enumerate network entries from the database.

setnetent() sets (or resets) the enumeration to the beginning of the set of network entries. This function should be called before the first call to getnetent(). Calls to getnetbyname() and getnetbyaddr() leave the enumeration position in an indeterminate state. If the stayopen flag is non-zero, the system may keep allocated resources such as open file descriptors until a subsequent call to endnetent().

Successive calls to getnetent() return either successive entries or NULL, indicating the end of the enumeration.

endnetent() may be called to indicate that the caller expects to do no further network entry retrieval operations; the system may then deallocate resources it was using. It is still allowed, but possibly less efficient, for the process to call more network entry retrieval functions after calling endnetent().

Reentrant Interfaces

The functions getnetbyname(), getnetbyaddr(), and getnetent() use static storage that is reused in each call, making these routines unsafe for use in multi-threaded applications.

The functions getnetbyname_r(), getnetbyaddr_r(), and getnetent_r() provide reentrant interfaces for these operations.

Each reentrant interface performs the same operation as its non-reentrant counterpart, named by removing the "_r" suffix. The reentrant interfaces, however, use buffers supplied by the caller to store returned results, and are safe for use in both single-threaded and multi-threaded applications.

Each reentrant interface takes the same parameters as its non-reentrant counterpart, as well as the following additional parameters. The parameter result must be a pointer to a struct netent structure allocated by the caller. On successful completion, the function returns the
network entry in this structure. The parameter `buffer` must be a pointer to a buffer supplied by the caller. This buffer is used as storage space for the network entry data. All of the pointers within the returned `struct netent` `result` point to data stored within this buffer. See `RETURN VALUES`. The buffer must be large enough to hold all of the data associated with the network entry. The parameter `buflen` should give the size in bytes of the buffer indicated by `buffer`.

For enumeration in multi-threaded applications, the position within the enumeration is a process-wide property shared by all threads. `setnetent()` may be used in a multi-threaded application but resets the enumeration position for all threads. If multiple threads interleave calls to `getnetent_r()`, the threads will enumerate disjointed subsets of the network database.

Like their non-reentrant counterparts, `getnetbyname_r()` and `getnetbyaddr_r()` leave the enumeration position in an indeterminate state.

### Return Values

Network entries are represented by the `struct netent` structure defined in `<netdb.h>`.

The functions `getnetbyname()`, `getnetbyname_r()`, `getnetbyaddr()`, and `getnetbyaddr_r()` each return a pointer to a `struct netent` if they successfully locate the requested entry; otherwise they return `NULL`.

The functions `getnetent()` and `getnetent_r()` each return a pointer to a `struct netent` if they successfully enumerate an entry; otherwise they return `NULL`, indicating the end of the enumeration.

The functions `getnetbyname()`, `getnetbyaddr()`, and `getnetent()` use static storage, so returned data must be copied before a subsequent call to any of these functions if the data is to be saved.

When the pointer returned by the reentrant functions `getnetbyname_r()`, `getnetbyaddr_r()`, and `getnetent_r()` is non-`NULL`, it is always equal to the `result` pointer that was supplied by the caller.

The functions `setnetent()` and `endnetent()` return `0` on success.

### Errors

The reentrant functions `getnetbyname_r()`, `getnetbyaddr_r` and `getnetent_r()` will return `NULL` and set `errno` to `ERANGE` if the length of the buffer supplied by caller is not large enough to store the result. See `Intro(2)` for the proper usage and interpretation of `errno` in multi-threaded applications.

### Files

- `/etc/networks` network name database
- `/etc/nsswitch.conf` configuration file for the name service switch

### Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>
See Also

Intro(2), Intro(3), byteorder(3SOCKET), inet(3SOCKET), netdb.h(3HEAD), networks(4), nsswitch.conf(4), attributes(5)


Warnings

The reentrant interfaces getnetbyname_r(), getnetbyaddr_r(), and getnetent_r() are included in this release on an uncommitted basis only, and are subject to change or removal in future minor releases.

Notes

The current implementation of these functions only return or accept network numbers for the Internet address family (type AF_INET). The functions described in inet(3SOCKET) may be helpful in constructing and manipulating addresses and network numbers in this form.

When compiling multi-threaded applications, see Intro(3), Notes On Multithread Applications, for information about the use of the _REENTRANT flag.

Use of the enumeration interfaces getnetent() and getnetent_r() is discouraged; enumeration may not be supported for all database sources. The semantics of enumeration are discussed further in nsswitch.conf(4).
**Name**
getnetconfig, setnetconfig, endnetconfig, getnetconfigent, freenetconfigent, nc_perror, nc_sperror – get network configuration database entry

**Synopsis**

```
#include <netconfig.h>

struct netconfig *getnetconfig(void *handlep);
void *setnetconfig(void);
int endnetconfig(void *handlep);
struct netconfig *getnetconfigent(const char *netid);
void freenetconfigent(struct netconfig *netconfigp);
void nc_perror(const char *msg);
char *nc_sperror(void);
```

**Description**
The library routines described on this page are part of the Network Selection component. They provide the application access to the system network configuration database, /etc/netconfig. In addition to the routines for accessing the netconfig database, Network Selection includes the environment variable NETPATH (see `environ(5)`) and the NETPATH access routines described in `getnetpath(3NSL)`.

`getnetconfig()` returns a pointer to the current entry in the netconfig database, formatted as a struct netconfig. Successive calls will return successive netconfig entries in the netconfig database. `getnetconfig()` can be used to search the entire netconfig file. `getnetconfig()` returns NULL at the end of the file. `handlep` is the handle obtained through `setnetconfig()`.

A call to `setnetconfig()` has the effect of “binding” to or “rewinding” the netconfig database. `setnetconfig()` must be called before the first call to `getnetconfig()` and may be called at any other time. `setnetconfig()` need not be called before a call to `getnetconfigent()`. `setnetconfig()` returns a unique handle to be used by `getnetconfig()`.

`endnetconfig()` should be called when processing is complete to release resources for reuse. `handlep` is the handle obtained through `setnetconfig()`. Programmers should be aware, however, that the last call to `endnetconfig()` frees all memory allocated by `getnetconfig()` for the struct netconfig data structure. `endnetconfig()` may not be called before `setnetconfig()`.

`getnetconfigent()` returns a pointer to the struct netconfig structure corresponding to `netid`. It returns NULL if `netid` is invalid (that is, does not name an entry in the netconfig database).

`freenetconfigent()` frees the netconfig structure pointed to by `netconfigp` (previously returned by `getnetconfigent()`).
nc_perror() prints a message to the standard error indicating why any of the above routines failed. The message is prepended with the string msg and a colon. A NEWLINE is appended at the end of the message.

nc_sperror() is similar to nc_perror() but instead of sending the message to the standard error, will return a pointer to a string that contains the error message.

nc_perror() and nc_sperror() can also be used with the NETPATH access routines defined in getnetpath(3NSL).

Return Values  setnetconfig() returns a unique handle to be used by getnetconfig(). In the case of an error, setnetconfig() returns NULL and nc_perror() or nc_sperror() can be used to print the reason for failure.

getnetconfig() returns a pointer to the current entry in the netconfig() database, formatted as a struct netconfig. getnetconfig() returns NULL at the end of the file, or upon failure.

endnetconfig() returns 0 on success and -1 on failure (for example, if setnetconfig() was not called previously).

On success, getnetconfigent() returns a pointer to the struct netconfig structure corresponding to netid; otherwise it returns NULL.

nc_sperror() returns a pointer to a buffer which contains the error message string. This buffer is overwritten on each call. In multithreaded applications, this buffer is implemented as thread-specific data.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  getnetpath(3NSL), netconfig(4), attributes(5), environ(5)
Name  getnetpath, setnetpath, endnetpath – get /etc/netconfig entry corresponding to NETPATH component

Synopsis  
```c
#include <netconfig.h>

struct netconfig *getnetpath(void *handlep);
void *setnetpath(void);
int endnetpath(void *handlep);
```

Description  
The routines described on this page are part of the Network Selection component. They provide the application access to the system network configuration database, /etc/netconfig, as it is "filtered" by the NETPATH environment variable. See environ(5). See getnetconfig(3NSL) for other routines that also access the network configuration database directly. The NETPATH variable is a list of colon-separated network identifiers.

getnetpath() returns a pointer to the netconfig database entry corresponding to the first valid NETPATH component. The netconfig entry is formatted as a struct netconfig. On each subsequent call, getnetpath() returns a pointer to the netconfig entry that corresponds to the next valid NETPATH component. getnetpath() can thus be used to search the netconfig database for all networks included in the NETPATH variable. When NETPATH has been exhausted, getnetpath() returns NULL.

A call to setnetpath() "binds" to or "rewinds" NETPATH. setnetpath() must be called before the first call to getnetpath() and may be called at any other time. It returns a handle that is used by getnetpath().

gemetpath() silently ignores invalid NETPATH components. A NETPATH component is invalid if there is no corresponding entry in the netconfig database.

If the NETPATH variable is unset, getnetpath() behaves as if NETPATH were set to the sequence of ”default” or ”visible” networks in the netconfig database, in the order in which they are listed.

endnetpath() may be called to ”unbind” from NETPATH when processing is complete, releasing resources for reuse. Programmers should be aware, however, that endnetpath() frees all memory allocated by getnetpath() for the struct netconfig data structure.

dnetpath() returns 0 on success and -1 on failure (for example, if setnetpath() was not called previously).

Return Values  setnetpath() returns a handle that is used by getnetpath(). In case of an error, setnetpath() returns NULL. nc_perror() or nc_serror() can be used to print out the reason for failure. See getnetconfig(3NSL).

When first called, getnetpath() returns a pointer to the netconfig database entry corresponding to the first valid NETPATH component. When NETPATH has been exhausted, getnetpath() returns NULL.
endnetpath() returns 0 on success and -1 on failure (for example, if setnetpath() was not called previously).

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also** getnetconfig(3NSL), netconfig(4), attributes(5), environ(5)
getpeername(3SOCKET)

Name
getpeername – get name of connected peer

Synopsis
cc [ flag ... ] file ... -lsocket -lnsl [ library ... ]
#include <sys/socket.h>

int getpeername(int s, struct sockaddr *name, socklen_t *namelen);

Description
getpeername() returns the name of the peer connected to socket s. The
int pointed to by the namelen parameter should be initialized to indicate
the amount of space pointed to by name. On return it contains the actual size
of the name returned (in bytes), prior to any truncation. The name is
truncated if the buffer provided is too small.

Return Values
If successful, getpeername() returns 0; otherwise it returns -1 and sets
errno to indicate the error.

Errors
The call succeeds unless:
EBADF The argument s is not a valid descriptor.
ENOMEM There was insufficient user memory for the operation to complete.
ENOSR There were insufficient STREAMS resources available for the operation
to complete.
ENOTCONN The socket is not connected.
ENOTSOCK The argument s is not a socket.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also
accept(3SOCKET), bind(3SOCKET), getsockname(3SOCKET), socket(3SOCKET),
attributes(5), socket.h(3HEAD)
Name  getpeername – get the name of the peer socket

Synopsis  cc [ flag ... ] file ... -lxnet [ library ... ]
#include <sys/socket.h>

int getpeername(int socket, struct sockaddr *restrict address,
                socklen_t *restrict address_len);

Description The getpeername() function retrieves the peer address of the specified socket, stores this address in the sockaddr structure pointed to by the address argument, and stores the length of this address in the object pointed to by the address_len argument.

If the actual length of the address is greater than the length of the supplied sockaddr structure, the stored address will be truncated.

If the protocol permits connections by unbound clients, and the peer is not bound, then the value stored in the object pointed to by address is unspecified.

Return Values Upon successful completion, 0 is returned. Otherwise, −1 is returned and errno is set to indicate the error.

Errors The getpeername() function will fail if:

EBADF The socket argument is not a valid file descriptor.
EFAULT The address or address_len parameter cannot be accessed or written.
EINVAL The socket has been shut down.
ENOTCONN The socket is not connected or otherwise has not had the peer prespecified.
ENOTSOCK The socket argument does not refer to a socket.
EOPNOTSUPP The operation is not supported for the socket protocol.

The getpeername() function may fail if:

ENOBFS Insufficient resources were available in the system to complete the call.
ENOSR There were insufficient STREAMS resources available for the operation to complete.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>
See Also: accept(3XNET), bind(3XNET), getsockname(3XNET), socket(3XNET), attributes(5), standards(5)
getprotobyname(3SOCKET)

Name  getprotobyname, getprotobyname_r, getprotobynumber, getprotobynumber_r, getprotoent, getprotoent_r, setprotoent, endprotoent – get protocol entry

Synopsis  cc [ flag ... ] file ... -lssocket -lnsl [ library ... ]
    #include <netdb.h>

    struct protoent *getprotobyname(const char *name);
    struct protoent *getprotobyname_r(const char *name,
        struct protoent *result, char *buffer,
        int buflen);
    struct protoent *getprotobynumber(int proto);
    struct protoent *getprotobynumber_r(int proto, struct protoent *result,
        char *buffer, int buflen);
    struct protoent *getprotoent(void);
    struct protoent_r(struct protoent *result, char *buffer,
        int buflen);
    int setprotoent(int stayopen);
    int endprotoent(void);

Description  These functions return a protocol entry. Two types of interfaces are supported: reentrant (getprotobyname_r(), getprotobynumber_r(), and getprotoent_r()) and non-reentrant (getprotobyname(), getprotobynumber(), and getprotoent()). The reentrant functions can be used in single-threaded applications and are safe for multithreaded applications, making them the preferred interfaces.

    The reentrant routines require additional parameters which are used to return results data. result is a pointer to a struct protoent structure and will be where the returned results will be stored. buffer is used as storage space for elements of the returned results. buflen is the size of buffer and should be large enough to contain all returned data. buflen must be at least 1024 bytes.

    getprotobyname_r(), getprotobynumber_r(), and getprotoent_r() each return a protocol entry.

    The entry may come from one of the following sources: the protocols file (see protocols(4)), and the NIS maps “protocols.byname” and “protocols.bynumber”. The sources and their lookup order are specified in the /etc/nsswitch.conf file (see nsswitch.conf(4) for details). Some name services such as NIS will return only one name for a host, whereas others such as DNS will return all aliases.

    The getprotobyname_r() and getprotobynumber_r() functions sequentially search from the beginning of the file until a matching protocol name or protocol number is found, or until an EOF is encountered.
getprotobyname() and getprotobynumber() have the same functionality as getprotobyname_r() and getprotobynumber_r() except that a static buffer is used to store returned results. These functions are Unsafe in a multithreaded application.

getprotoent_r() enumerates protocol entries: successive calls to getprotoent_r() will return either successive protocol entries or NULL. Enumeration might not be supported by some sources. If multiple threads call getprotoent_r(), each will retrieve a subset of the protocol database.

getprotoent() has the same functionality as getprotoent_r() except that a static buffer is used to store returned results. This routine is unsafe in a multithreaded application.

setprotoent() "rewinds" to the beginning of the enumeration of protocol entries. If the stayopen flag is non-zero, resources such as open file descriptors are not deallocated after each call to getprotobynumber_r() and getprotobyname_r. Calls to getprotobyname_r(), getprotobynumber_r(), and getprotobynumber() functions might leave the enumeration in an indeterminate state, so setprotoent() should be called before the first call to getprotoent_r() or getprotoent(). The setprotoent() function has process-wide scope, and "rewinds" the protocol entries for all threads calling getprotoent_r() as well as main-thread calls to getprotoent().

The endprotoent() function can be called to indicate that protocol processing is complete; the system may then close any open protocols file, dealtlocate storage, and so forth. It is legitimate, but possibly less efficient, to call more protocol functions after endprotoent().

The internal representation of a protocol entry is a protoent structure defined in <netdb.h> with the following members:

```c
char *p_name;
char **p_aliases;
int p_proto;
```

**Return Values**

The getprotobyname_r(), getprotobyname(), getprotobynumber_r(), and getprotobynumber() functions return a pointer to a struct protoent if they successfully locate the requested entry; otherwise they return NULL.

The getprotoent_r() and getprotoent() functions return a pointer to a struct protoent if they successfully enumerate an entry; otherwise they return NULL, indicating the end of the enumeration.

**Errors**

The getprotobyname_r(), getprotobynumber_r(), and getprotoent_r() functions will fail if:

- ERANGE The length of the buffer supplied by the caller is not large enough to store the result.
Files

/etc/protocols
/etc/nsswitch.conf

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>See NOTES below.</td>
</tr>
</tbody>
</table>

See Also

Intro(3), nsswitch.conf(4), protocols(4), attributes(5), netdb.h(3HEAD)

Notes

Although getprotobyname_r(), getprotobynumber_r(), and getprotoent_r() are not mentioned by POSIX 1003.1:2001, they were added to complete the functionality provided by similar thread-safe functions.

When compiling multithreaded applications, see Intro(3), Notes On Multithread Applications, for information about the use of the _REENTRANT flag.

The getprotobyname_r(), getprotobynumber_r(), and getprotoent_r() functions are reentrant and multithread safe. The reentrant interfaces can be used in single-threaded as well as multithreaded applications and are therefore the preferred interfaces.

The getprotobyname(), getprotobynumaddr(), and getprotoent() functions use static storage, so returned data must be copied if it is to be saved. Because of their use of static storage for returned data, these functions are not safe for multithreaded applications.

The setprotoent() and endprotoent() functions have process-wide scope, and are therefore not safe in multi-threaded applications.

Use of getprotoent_r() and getprotoent() is discouraged; enumeration is well-defined for the protocols file and is supported (albeit inefficiently) for NIS, but in general may not be well-defined. The semantics of enumeration are discussed in nsswitch.conf(4).

Bugs

Only the Internet protocols are currently understood.
getpublickey(), getsecretkey(), publickey – retrieve public or secret key

**Synopsis**

```c
#include <rpc/rpc.h>
#include <rpc/key_prot.h>

int getpublickey(const char netname[MAXNETNAMELEN],
    char publickey[HEXKEYBYTES+1]);

int getsecretkey(const char netname[MAXNETNAMELEN],
    char secretkey[HEXKEYBYTES+1], const char *passwd);
```

**Description**

The `getpublickey()` and `getsecretkey()` functions get public and secret keys for `netname`. The key may come from one of the following sources:

- `/etc/publickey` file. See `publickey(4)`.
- NIS map “publickey.byname”. The sources and their lookup order are specified in the `/etc/nsswitch.conf` file. See `nsswitch.conf(4)`.

`getsecretkey()` has an extra argument, `passwd`, which is used to decrypt the encrypted secret key stored in the database.

**Return Values**

Both routines return 1 if they are successful in finding the key. Otherwise, the routines return 0. The keys are returned as null-terminated, hexadecimal strings. If the password supplied to `getsecretkey()` fails to decrypt the secret key, the routine will return 1 but the `secretkey [0]` will be set to NULL.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**

`secure_rpc(3NSL), nsswitch.conf(4), publickey(4), attributes(5)`
These functions are used to obtain entries for RPC (Remote Procedure Call) services. An entry may come from any of the sources for rpc specified in the /etc/nsswitch.conf file (see nsswitch.conf(4)).

getrpcbyname() searches for an entry with the RPC service name specified by the parameter name.

getrpcbynumber() searches for an entry with the RPC program number number.

The functions setrpcent(), getrpcent(), and endrpcent() are used to enumerate RPC entries from the database.

setrpcent() sets (or resets) the enumeration to the beginning of the set of RPC entries. This function should be called before the first call to getrpcent(). Calls to getrpcbyname() and getrpcbynumber() leave the enumeration position in an indeterminate state. If the stayopen flag is non-zero, the system may keep allocated resources such as open file descriptors until a subsequent call to endrpcent().

Successful calls to getrpcent() return either successive entries or NULL, indicating the end of the enumeration.

endrpcent() may be called to indicate that the caller expects to do no further RPC entry retrieval operations; the system may then deallocate resources it was using. It is still allowed, but possibly less efficient, for the process to call more RPC entry retrieval functions after calling endrpcent().
getrpcbyname(3NSL)

Reentrant Interfaces

The functions getrpcbyname(), getrpcbynumber(), and getrpcent() use static storage that is re-used in each call, making these routines unsafe for use in multithreaded applications.

The functions getrpcbyname_r(), getrpcbynumber_r(), and getrpcent_r() provide reentrant interfaces for these operations.

Each reentrant interface performs the same operation as its non-reentrant counterpart, named by removing the “_r” suffix. The reentrant interfaces, however, use buffers supplied by the caller to store returned results, and are safe for use in both single-threaded and multithreaded applications.

Each reentrant interface takes the same parameters as its non-reentrant counterpart, as well as the following additional parameters. The parameter result must be a pointer to a struct rpcent structure allocated by the caller. On successful completion, the function returns the RPC entry in this structure. The parameter buffer must be a pointer to a buffer supplied by the caller. This buffer is used as storage space for the RPC entry data. All of the pointers within the returned struct rpcent result point to data stored within this buffer (see RETURN VALUES). The buffer must be large enough to hold all of the data associated with the RPC entry. The parameter buflen should give the size in bytes of the buffer indicated by buffer.

For enumeration in multithreaded applications, the position within the enumeration is a process-wide property shared by all threads. setrpcent() may be used in a multithreaded application but resets the enumeration position for all threads. If multiple threads interleave calls to getrpcent_r(), the threads will enumerate disjoint subsets of the RPC entry database.

Like their non-reentrant counterparts, getrpcbyname_r() and getrpcbynumber_r() leave the enumeration position in an indeterminate state.

Return Values

RPC entries are represented by the struct rpcent structure defined in <rpc/rpcent.h>:

```c
struct rpcent {
    char *r_name;    /* name of this rpc service */
    char **r_aliases; /* zero-terminated list of alternate names */
    int r_number;    /* rpc program number */
};
```

The functions getrpcbyname(), getrpcbyname_r(), getrpcbynumber(), and getrpcbynumber_r() each return a pointer to a struct rpcent if they successfully locate the requested entry; otherwise they return NULL.

The functions getrpcent() and getrpcent_r() each return a pointer to a struct rpcent if they successfully enumerate an entry; otherwise they return NULL, indicating the end of the enumeration.

The functions getrpcbyname(), getrpcbynumber(), and getrpcent() use static storage, so returned data must be copied before a subsequent call to any of these functions if the data is to be saved.
When the pointer returned by the reentrant functions `getrpcbyname_r()`, `getrpcbyname_r()`, and `getrpcent_r()` is non-NULL, it is always equal to the result pointer that was supplied by the caller.

**Errors** The reentrant functions `getrpcbyname_r()`, `getrpcbyname_r()`, and `getrpcent_r()` will return NULL and set `errno` to `ERANGE` if the length of the buffer supplied by caller is not large enough to store the result. See `Intro(2)` for the proper usage and interpretation of `errno` in multithreaded applications.

**Files** `/etc/rpc

/etc/nsswitch.conf

Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>See &quot;Reentrant Interfaces&quot; in DESCRIPTION.</td>
</tr>
</tbody>
</table>

**See Also** `rpcinfo(1M), rpc(3NSL), nsswitch.conf(4), rpc(4), attributes(5)`

**Warnings** The reentrant interfaces `getrpcbyname_r()`, `getrpcbyname_r()`, and `getrpcent_r()` are included in this release on an uncommitted basis only, and are subject to change or removal in future minor releases.

**Notes** When compiling multithreaded applications, see `Intro(3), Notes On Multi threaded Applications`, for information about the use of the `_REENTRANT` flag.

Use of the enumeration interfaces `getrpcent()` and `getrpcent_r()` is discouraged; enumeration may not be supported for all database sources. The semantics of enumeration are discussed further in `nsswitch.conf(4)`.
# Name
getservbyname, getservbyname_r, getservbyport, getservbyport_r, getservent, getservent_r, setservent, endservent – get service entry

## Synopsis
cc [ flag ...] file ... -lsocket -lnsl [ library ... ]
#include <netdb.h>

struct servent *getservbyname(const char *name, const char *proto);
struct servent *getservbyname_r(const char *name, const char *proto,
    struct servent *result, char *buffer, int buflen);
struct servent *getservbyport(int port, const char *proto);
struct servent *getservbyport_r(int port, const char *proto,
    struct servent *result, char *buffer, int buflen);
struct servent *getservent(void);
struct servent *getservent_r(struct servent *result, char *buffer,
    int buflen);
int setservent(int stayopen);
int endservent(void);

## Description
These functions are used to obtain entries for Internet services. An entry may come from any of the sources for services specified in the /etc/nsswitch.conf file. See nsswitch.conf(4).

The getservbyname() and getservbyport() functions sequentially search from the beginning of the file until a matching protocol name or port number is found, or until end-of-file is encountered. If a protocol name is also supplied (non-null), searches must also match the protocol.

The getservbyname() function searches for an entry with the Internet service name specified by the name parameter.

The getservbyport() function searches for an entry with the Internet port number port.

All addresses are returned in network order. In order to interpret the addresses, byteorder(3SOCKET) must be used for byte order conversion. The string proto is used by both getservbyname() and getservbyport() to restrict the search to entries with the specified protocol. If proto is NULL, entries with any protocol can be returned.

The functions setservent(), getservent() and endservent() are used to enumerate entries from the services database.

The setservent() function sets (or resets) the enumeration to the beginning of the set of service entries. This function should be called before the first call to getservent(). Calls to the functions getservbyname() and getservbyport() leave the enumeration position in an indeterminate state. If the stayopen flag is non-zero, the system may keep allocated resources such as open file descriptors until a subsequent call to endservent().
The `getservent()` function reads the next line of the file, opening the file if necessary. `getservent()` opens and rewinds the file. If the `stayopen` flag is non-zero, the net database will not be closed after each call to `getservent()` (either directly, or indirectly through one of the other "getserv" calls).

Successive calls to `getservent()` return either successive entries or NULL, indicating the end of the enumeration.

The `endservent()` function closes the file. The `endservent()` function can be called to indicate that the caller expects to do no further service entry retrieval operations; the system can then deallocate resources it was using. It is still allowed, but possibly less efficient, for the process to call more service entry retrieval functions after calling `endservent()`.

The functions `getservbyname()`, `getservbyport()`, and `getservent()` use static storage that is re-used in each call, making these functions unsafe for use in multithreaded applications.

The functions `getservbyname_r()`, `getservbyport_r()`, and `getservent_r()` provide reentrant interfaces for these operations.

Each reentrant interface performs the same operation as its non-reentrant counterpart, named by removing the "_r" suffix. The reentrant interfaces, however, use buffers supplied by the caller to store returned results, and are safe for use in both single-threaded and multithreaded applications.

Each reentrant interface takes the same parameters as its non-reentrant counterpart, as well as the following additional parameters. The parameter `result` must be a pointer to a `struct servent` structure allocated by the caller. On successful completion, the function returns the service entry in this structure. The parameter `buffer` must be a pointer to a buffer supplied by the caller. This buffer is used as storage space for the service entry data. All of the pointers within the returned `struct servent` `result` point to data stored within this buffer. See the RETURN VALUES section of this manual page. The buffer must be large enough to hold all of the data associated with the service entry. The parameter `buflen` should give the size in bytes of the buffer indicated by `buffer`.

For enumeration in multithreaded applications, the position within the enumeration is a process-wide property shared by all threads. The `setservent()` function can be used in a multithreaded application but resets the enumeration position for all threads. If multiple threads interleave calls to `getservent_r()`, the threads will enumerate disjoint subsets of the service database.

Like their non-reentrant counterparts, `getservbyname_r()` and `getservbyport_r()` leave the enumeration position in an indeterminate state.

**Return Values** Service entries are represented by the `struct servent` structure defined in `<netdb.h>`:

```c
struct servent {
    char *s_name;    /* official name of service */
    char **s_aliases; /* alias list */
```

---

**Reentrant Interfaces**

The functions `getservbyname_r()`, `getservbyport_r()`, and `getservent_r()` provide reentrant interfaces for these operations.

Each reentrant interface performs the same operation as its non-reentrant counterpart, named by removing the "_r" suffix. The reentrant interfaces, however, use buffers supplied by the caller to store returned results, and are safe for use in both single-threaded and multithreaded applications.

Each reentrant interface takes the same parameters as its non-reentrant counterpart, as well as the following additional parameters. The parameter `result` must be a pointer to a `struct servent` structure allocated by the caller. On successful completion, the function returns the service entry in this structure. The parameter `buffer` must be a pointer to a buffer supplied by the caller. This buffer is used as storage space for the service entry data. All of the pointers within the returned `struct servent` `result` point to data stored within this buffer. See the RETURN VALUES section of this manual page. The buffer must be large enough to hold all of the data associated with the service entry. The parameter `buflen` should give the size in bytes of the buffer indicated by `buffer`.

For enumeration in multithreaded applications, the position within the enumeration is a process-wide property shared by all threads. The `setservent()` function can be used in a multithreaded application but resets the enumeration position for all threads. If multiple threads interleave calls to `getservent_r()`, the threads will enumerate disjoint subsets of the service database.

Like their non-reentrant counterparts, `getservbyname_r()` and `getservbyport_r()` leave the enumeration position in an indeterminate state.

**Return Values** Service entries are represented by the `struct servent` structure defined in `<netdb.h>`:
The members of this structure are:

- **s_name**: The official name of the service.
- **s_aliases**: A zero terminated list of alternate names for the service.
- **s_port**: The port number at which the service resides. Port numbers are returned in network byte order.
- **s_proto**: The name of the protocol to use when contacting the service.

The functions `getservbyname()`, `getservbyname_r()`, `getservbyport()`, and `getservbyport_r()` each return a pointer to a `struct servent` if they successfully locate the requested entry; otherwise they return `NULL`.

The functions `getservent()` and `getservent_r()` each return a pointer to a `struct servent` if they successfully enumerate an entry; otherwise they return `NULL`, indicating the end of the enumeration.

The functions `getservbyname()`, `getservbyport()`, and `getservent()` use static storage, so returned data must be copied before a subsequent call to any of these functions if the data is to be saved.

When the pointer returned by the reentrant functions `getservbyname_r()`, `getservbyport_r()`, and `getservent_r()` is non-null, it is always equal to the `result` pointer that was supplied by the caller.

**Errors**
The reentrant functions `getservbyname_r()`, `getservbyport_r()`, and `getservent_r()` return `NULL` and set `errno` to `ERANGE` if the length of the buffer supplied by caller is not large enough to store the result. See `Intro(2)` for the proper usage and interpretation of `errno` in multithreaded applications.

**Files**

- `/etc/services` Internet network services
- `/etc/netconfig` network configuration file
- `/etc/nsswitch.conf` configuration file for the name-service switch

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>See &quot;Reentrant Interfaces&quot; in DESCRIPTION.</td>
</tr>
</tbody>
</table>
There are reentrant interfaces `getservbyname_r()`, `getservbyport_r()`, and `getservent_r()` included in this release on an uncommitted basis only, and are subject to change or removal in future minor releases.

The functions that return `struct servent` return the least significant 16-bits of the `s_port` field in network byte order. `getservbyport()` and `getservbyport_r()` also expect the input parameter `port` in the network byte order. See `htons(3SOCKET)` for more details on converting between host and network byte orders.

To ensure that they all return consistent results, `getservbyname()`, `getservbyname_r()`, and `netdir_getbyname()` are implemented in terms of the same internal library function. This function obtains the system-wide source lookup policy based on the `inet` family entries in `netconfig(4)` and the `services:` entry in `nsswitch.conf(4)`. Similarly, `getservbyport()`, `getservbyport_r()`, and `netdir_getbyaddr()` are implemented in terms of the same internal library function. If the `inet` family entries in `netconfig(4)` have a “-” in the last column for nametoaddr libraries, then the entry for services in `nsswitch.conf` will be used; otherwise the nametoaddr libraries in that column will be used, and `nsswitch.conf` will not be consulted.

There is no analogue of `getservent()` and `getservent_r()` in the `netdir` functions, so these enumeration functions go straight to the `services` entry in `nsswitch.conf`. Thus enumeration may return results from a different source than that used by `getservbyname()`, `getservbyname_r()`, `getservbyport()`, and `getservbyport_r()`.

When compiling multithreaded applications, see `Intro(3), Notes On Multithread Applications`, for information about the use of the `_REENTRANT` flag.

Use of the enumeration interfaces `getservent()` and `getservent_r()` is discouraged; enumeration may not be supported for all database sources. The semantics of enumeration are discussed further in `nsswitch.conf(4)`.
**Name**  
getsockname – get socket name

**Synopsis**  
cc [ flag ... ] file ... -lsocket -lmsl [ library ... ]  
#include <sys/socket.h>

    int getsockname(int s, struct sockaddr *name, socklen_t *namelen);

**Description**  
getsockname() returns the current name for socket s. The namelen parameter should be initialized to indicate the amount of space pointed to by name. On return it contains the actual size in bytes of the name returned.

**Return Values**  
If successful, getsockname() returns 0; otherwise it returns −1 and sets errno to indicate the error.

**Errors**  
The call succeeds unless:

- **EBADF** The argument s is not a valid file descriptor.
- **ENOMEM** There was insufficient memory available for the operation to complete.
- **ENOSR** There were insufficient STREAMS resources available for the operation to complete.
- **ENOTSOCK** The argument s is not a socket.

**Attributes**  
See attributes(5) for descriptions of the following attributes:

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<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  
bind(3SOCKET), getpeername(3SOCKET), socket(3SOCKET), attributes(5)
getsockname – get the socket name

Synopsis

cc [ flag ... ] file ... -lxnet [ library ... ]
#include <sys/socket.h>

int getsockname(int socket, struct sockaddr *restrict address,
    socklen_t *restrict address_len);

Description

The getsockname() function retrieves the locally-bound name of the specified socket, stores this address in the sockaddr structure pointed to by the address argument, and stores the length of this address in the object pointed to by the address_len argument.

If the actual length of the address is greater than the length of the supplied sockaddr structure, the stored address will be truncated.

If the socket has not been bound to a local name, the value stored in the object pointed to by address is unspecified.

Return Values

Upon successful completion, 0 is returned, the address argument points to the address of the socket, and the address_len argument points to the length of the address. Otherwise, −1 is returned and errno is set to indicate the error.

Errors

The getsockname() function will fail:

EBADF      The socket argument is not a valid file descriptor.
EFAULT     The address or address_len parameter cannot be accessed or written.
ENOTSOCK   The socket argument does not refer to a socket.
EOPNOTSUPP The operation is not supported for this socket’s protocol.

The getsockname() function may fail if:

EINVAL     The socket has been shut down.
ENOBUFS     Insufficient resources were available in the system to complete the call.
ENOSR      There were insufficient STREAMS resources available for the operation to complete.

Attributes

See attributes(5) for descriptions of the following attributes:

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<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>
See Also  accept(3XNET), bind(3XNET), getpeername(3XNET), socket(3XNET) attributes(5), standards(5)
getsockopt(3SOCKET)

Name
getsockopt, setsockopt – get and set options on sockets

Synopsis
cc [ flag ... ] file ... -lsocket -lnsl [ library ... ]
#include <sys/socket.h>

int getsockopt(int s, int level, int optname, void *optval,
    socklen_t *optlen);

int setsockopt(int s, int level, int optname, const void *optval,
    socklen_t optlen);

Description
The getsockopt() and setsockopt() functions manipulate options associated with a socket.
Options may exist at multiple protocol levels; they are always present at the uppermost “socket” level.

The level argument specifies the protocol level at which the option resides. To manipulate options at the socket level, specify the level argument as SOL_SOCKET. To manipulate options at the protocol level, supply the appropriate protocol number for the protocol controlling the option. For example, to indicate that an option will be interpreted by the TCP, set level to the protocol number of TCP, as defined in the <netinet/in.h> header, or as determined by using getprotobynumber(3SOCKET). Some socket protocol families may also define additional levels, such as SOL_ROUTE. Only socket-level options are described here.

The parameters optval and optlen are used to access option values for setsockopt(). For getsockopt(), they identify a buffer in which the value(s) for the requested option(s) are to be returned. For getsockopt(), optlen is a value-result parameter, initially containing the size of the buffer pointed to by optval, and modified on return to indicate the actual size of the value returned. Use a 0 optval if no option value is to be supplied or returned.

The optname and any specified options are passed uninterpreted to the appropriate protocol module for interpretation. The include file <sys/socket.h> contains definitions for the socket-level options described below. Options at other protocol levels vary in format and name.

Most socket-level options take an int for optval. For setsockopt(), the optval parameter should be non-zero to enable a boolean option, or zero if the option is to be disabled.
SO_LINGER uses a struct linger parameter that specifies the desired state of the option and the linger interval. struct linger is defined in <sys/socket.h>. struct linger contains the following members:

- l_onoff on = 1/off = 0
- l linger linger time, in seconds

The following options are recognized at the socket level. Except as noted, each may be examined with getsockopt() and set with setsockopt().

SO_DEBUG enable/disable recording of debugging information
SO_REUSEADDR enable/disable local address reuse
SO_REUSEPORT enable/disable local port reuse for PF_INET/PF_INET6 socket
SO_KEEPALIVE enable/disable keep connections alive
SO_DONTROUTE enable/disable routing bypass for outgoing messages
SO_LINGER linger on close if data is present
SO_BROADCAST enable/disable permission to transmit broadcast messages
SO_OOBINLINE enable/disable reception of out-of-band data in band
SO_SNDBUF set buffer size for output
SO_RCVBUF set buffer size for input
SO_DGRAM_ERRIND application wants delayed error
SO_TIMESTAMP enable/disable reception of timestamp with datagrams
SO_EXCLBIND enable/disable exclusive binding of the socket
SO_TYPE get the type of the socket (get only)
SO_ERROR get and clear error on the socket (get only)
SO_MAC_EXEMPT get or set mandatory access control on the socket. This option is available only when the system is configured with Trusted Extensions.
SO_ALLZONES bypass zone boundaries (privileged).
SO_DOMAIN get the domain used in the socket (get only)
SO_PROTOTYPE for socket in domains PF_INET and PF_INET6, get the underlying protocol number used in the socket. For socket in domain PF_ROUTE, get the address family used in the socket.
SO_PASSIVE_CONNECT modify connect(3SOCKET) to wait for connection request from a peer instead of initiating a connection request to it. It is applicable to TCP/SCTP PF_INET/PF_INET6 socket.

The SO_DEBUG option enables debugging in the underlying protocol modules. The SO_REUSEADDR/SO_REUSEPORT options indicate that the rules used in validating addresses and ports supplied in a bind(3SOCKET) call should allow reuse of local addresses or ports. The SO_KEEPALIVE option enables the periodic transmission of messages on a connected socket. If the connected party fails to respond to these messages, the connection is considered broken and threads using the socket are notified using a SIGPIPE signal. The SO_DONTROUTE option indicates that outgoing messages should bypass the standard routing facilities. Instead, messages are directed to the appropriate network interface according to the network portion of the destination address.
The SO_LINGER option controls the action taken when unsent messages are queued on a socket and a close(2) is performed. If the socket promises reliable delivery of data and SO_LINGER is set, the system will block the thread on the close() attempt until it is able to transmit the data or until it decides it is unable to deliver the information (a timeout period, termed the linger interval, is specified in the setsockopt() call when SO_LINGER is requested). If SO_LINGER is disabled and a close() is issued, the system will process the close() in a manner that allows the thread to continue as quickly as possible.

The option SO_BROADCAST requests permission to send broadcast datagrams on the socket. With protocols that support out-of-band data, the SO_OOBINLINE option requests that out-of-band data be placed in the normal data input queue as received; it will then be accessible with recv() or read() calls without the MSG_OOB flag.

The SO_SNDBUF and SO_RCVBUF options adjust the normal buffer sizes allocated for output and input buffers, respectively. The buffer size may be increased for high-volume connections or may be decreased to limit the possible backlog of incoming data. The maximum buffer size for UDP/TCP is determined by the value of the ipadm variable max_buf for that particular protocol. Use the ipadm(1M) utility to determine the current default values. See the Solaris Tunable Parameters Reference Manual for information on setting the values of max_buf for either TCP, UDP or both. At present, lowering SO_RCVBUF on a TCP connection after it has been established has no effect.

By default, delayed errors (such as ICMP port unreachable packets) are returned only for connected datagram sockets. The SO_DGRAM_ERRIND option makes it possible to receive errors for datagram sockets that are not connected. When this option is set, certain delayed errors received after completion of a sendto() or sendmsg() operation will cause a subsequent sendto() or sendmsg() operation using the same destination address (to parameter) to fail with the appropriate error. See send(3SOCKET).

If the SO_TIMESTAMP option is enabled on a SO_DGRAM or a SO_RAW socket, the recvmsg(3XNET) call will return a timestamp in the native data format, corresponding to when the datagram was received.

The SO_EXCLBIND option is used to enable or disable the exclusive binding of a socket. It overrides the use of the SO_REUSEADDR option to reuse an address on bind(3SOCKET). The actual semantics of the SO_EXCLBIND option depend on the underlying protocol. See tcp(7P) or udp(7P) for more information.

The SO_TYPE and SO_ERROR options are used only with getsockopt(). The SO_TYPE option returns the type of the socket, for example, SOCK_STREAM. It is useful for servers that inherit sockets on startup. The SO_ERROR option returns any pending error on the socket and clears the error status. It may be used to check for asynchronous errors on connected datagram sockets or for other asynchronous errors.
The `SO_MAC_EXEMPT` option is used to toggle socket behavior with unlabeled peers. A socket that has this option enabled can communicate with an unlabeled peer if it is in the global zone or has a label that dominates the default label of the peer. Otherwise, the socket must have a label that is equal to the default label of the unlabeled peer. Calling `setsockopt()` with this option returns an `EACCES` error if the process lacks the `NET_MAC_AWARE` privilege or if the socket is bound. The `SO_MAC_EXEMPT` option is available only when the system is configured with Trusted Extensions.

The `SO_ALLZONES` option can be used to bypass zone boundaries between shared-IP zones. Normally, the system prevents a socket from being bound to an address that is not assigned to the current zone. It also prevents a socket that is bound to a wildcard address from receiving traffic for other zones. However, some daemons which run in the global zone might need to send and receive traffic using addresses that belong to other shared-IP zones. If set before a socket is bound, `SO_ALLZONES` causes the socket to ignore zone boundaries between shared-IP zones and permits the socket to be bound to any address assigned to the shared-IP zones. If the socket is bound to a wildcard address, it receives traffic intended for all shared-IP zones and behaves as if an equivalent socket were bound in each active shared-IP zone. Applications that use the `SO_ALLZONES` option to initiate connections or send datagram traffic should specify the source address for outbound traffic by binding to a specific address. There is no effect from setting this option in an exclusive-IP zone. Setting this option requires the `sys_net_config` privilege. See `zones(5)`.

The `SO_PASSIVE_CONNECT` option can be used to modify `connect()` semantics for TCP and SCTP socket. After this option is set, calling `connect()` on the socket will not initiate a connection setup sequence. Instead, the transport end point is in listen state waiting for a connection request from the remote peer specified in `connect()`. After the expected connection is established, `connect()` returns.

**Return Values**  If successful, `getsockopt()` and `setsockopt()` return 0. Otherwise, the functions return −1 and set `errno` to indicate the error.

**Errors**  The `getsockopt()` and `setsockopt()` calls succeed unless:

- **EBADF**  The argument `s` is not a valid file descriptor.
- **EACCES**  Permission denied.
- **EADDRINUSE**  Address already joined for `IP_ADD_MEMBERSHIP`.
- **EADDRNOTAVAIL**  Bad interface address for `IP_ADD_MEMBERSHIP` and `IP_DROP_MEMBERSHIP`.
- **EHOSTUNREACH**  Invalid address for `IP_MULTICAST_IF`.
- **EINVAL**  Invalid length for `IP_OPTIONS`.
- **ENOTMADDR**  Not a multicast address for `IP_ADD_MEMBERSHIP` and `IP_DROP_MEMBERSHIP`.

Networking Library Functions
The specified option is invalid at the specified socket level, or the socket has been shut down.

**ENOBUFS**  
SO_SNDBUF or SO_RCVBUF exceeds a system limit.

**ENOENT**  
Address not joined for IP_DROP_MEMBERSHIP.

**ENOMEM**  
There was insufficient memory available for the operation to complete.

**ENOPROTOOPT**  
The option is unknown at the level indicated.

**ENOSR**  
There were insufficient STREAMS resources available for the operation to complete.

**ENOTSOCK**  
The argument s is not a socket.

**EPERM**  
No permissions.

**Attributes**  
See attributes(5) for descriptions of the following attributes:

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<thead>
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<tr>
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<td>Safe</td>
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</tbody>
</table>

**See Also**  
ipadm(1M), close(2), ioctl(2), read(2), bind(3SOCKET), connect(3SOCKET), getprotobyname(3SOCKET), recv(3SOCKET), recvmsg(3XNET), send(3SOCKET), socket(3SOCKET), socket.h(3HEAD), attributes(5), zones(5), tcp(7P), udp(7P)

*Solaris Tunable Parameters Reference Manual*
The `getsockopt()` function retrieves the value for the option specified by the `option_name` argument for the socket specified by the `socket` argument. If the size of the option value is greater than `option_len`, the value stored in the object pointed to by the `option_value` argument will be silently truncated. Otherwise, the object pointed to by the `option_len` argument will be modified to indicate the actual length of the value.

The `level` argument specifies the protocol level at which the option resides. To retrieve options at the socket level, specify the `level` argument as `SOL_SOCKET`. To retrieve options at other levels, supply the appropriate protocol number for the protocol controlling the option. For example, to indicate that an option will be interpreted by the TCP (Transport Control Protocol), set `level` to the protocol number of TCP, as defined in the `<netinet/in.h>` header, or as determined by using `getprotobyname(3XNET)` function.

The socket in use might require the process to have appropriate privileges to use the `getsockopt()` function.

The `option_name` argument specifies a single option to be retrieved. It can be one of the following values defined in `<sys/socket.h>`:

- **SO_DEBUG**: Reports whether debugging information is being recorded. This option stores an `int` value. This is a boolean option.
- **SO_ACCEPTCONN**: Reports whether socket listening is enabled. This option stores an `int` value.
- **SO_BROADCAST**: Reports whether transmission of broadcast messages is supported, if this is supported by the protocol. This option stores an `int` value. This is a boolean option.
- **SO_REUSEADDR**: Reports whether the rules used in validating addresses supplied to `bind(3XNET)` should allow reuse of local addresses, if this is supported by the protocol. This option stores an `int` value. This is a boolean option.
- **SO_KEEPALIVE**: Reports whether connections are kept active with periodic transmission of messages, if this is supported by the protocol. If the connected socket fails to respond to these messages, the connection is broken and threads writing to that socket are notified with a `SIGPIPE` signal. This option stores an `int` value. This is a boolean option.
SO_LINGER  Reports whether the socket lingers on close(2) if data is present. If SO_LINGER is set, the system blocks the process during close(2) until it can transmit the data or until the end of the interval indicated by the linger member, whichever comes first. If SO_LINGER is not specified, and close(2) is issued, the system handles the call in a way that allows the process to continue as quickly as possible. This option stores a linger structure.

SO_OOBINLINE  Reports whether the socket leaves received out-of-band data (data marked urgent) in line. This option stores an int value. This is a boolean option.

SO_SNDBUF  Reports send buffer size information. This option stores an int value.

SO_RCVBUF  Reports receive buffer size information. This option stores an int value.

SO_ERROR  Reports information about error status and clears it. This option stores an int value.

SO_TYPE  Reports the socket type. This option stores an int value.

SO_DONTROUTE  Reports whether outgoing messages bypass the standard routing facilities. The destination must be on a directly-connected network, and messages are directed to the appropriate network interface according to the destination address. The effect, if any, of this option depends on what protocol is in use. This option stores an int value. This is a boolean option.

SO_MAC_EXEMPT  Gets the mandatory access control status of the socket. A socket that has this option enabled can communicate with an unlabeled peer if the socket is in the global zone or has a label that dominates the default label of the peer. Otherwise, the socket must have a label that is equal to the default label of the unlabeled peer. SO_MAC_EXEMPT is a boolean option that is available only when the system is configured with Trusted Extensions.

SO_ALLZONES  Bypasses zone boundaries (privileged). This option stores an int value. This is a boolean option.

The SO_ALLZONES option can be used to bypass zone boundaries between shared-IP zones. Normally, the system prevents a socket from being bound to an address that is not assigned to the current zone. It also prevents a socket that is bound to a wildcard address from receiving traffic for other zones. However, some daemons which run in the global zone might need to send and receive traffic using addresses that belong to other shared-IP zones. If set before a socket is bound, SO_ALLZONES causes the socket to ignore zone boundaries between shared-IP zones and permits the socket to be bound to any address assigned to the shared-IP zones. If the socket is bound to a wildcard address, it receives traffic.
intended for all shared-IP zones and behaves as if an equivalent socket were bound in each active shared-IP zone. Applications that use the SO_ALLZONES option to initiate connections or send datagram traffic should specify the source address for outbound traffic by binding to a specific address. There is no effect from setting this option in an exclusive-IP zone. Setting this option requires the sys_net_config privilege. See zones(5).

SO_DOMAIN get the domain used in the socket (get only)
SO_PROTOTYPE for socket in domains AF_INET and AF_INET6, get the underlying protocol number used in the socket. For socket in domain AF_ROUTE, get the address family used in the socket.

For boolean options, a zero value indicates that the option is disabled and a non-zero value indicates that the option is enabled.

Options at other protocol levels vary in format and name.

The socket in use may require the process to have appropriate privileges to use the getsockopt() function.

Return Values Upon successful completion, getsockopt() returns 0. Otherwise, −1 is returned and errno is set to indicate the error.

Errors The getsockopt() function will fail if:

EBADF The socket argument is not a valid file descriptor.
EFAULT The option_value or option_len parameter cannot be accessed or written.
EINVAL The specified option is invalid at the specified socket level.
ENOPROTOOPT The option is not supported by the protocol.
ENOTSOCK The socket argument does not refer to a socket.

The getsockopt() function may fail if:

EACCES The calling process does not have the appropriate privileges.
EINVAL The socket has been shut down.
ENOBFS Insufficient resources are available in the system to complete the call.
ENOSR There were insufficient STREAMS resources available for the operation to complete.

Attributes See attributes(5) for descriptions of the following attributes:
getsockopt(3XNET)

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<td>Standard</td>
<td>See standards(5).</td>
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</tbody>
</table>

See Also  close(2), bind(3XNET), endprotoent(3XNET), setsockopt(3XNET), socket(3XNET), attributes, standards(5)
getsourcefilter, setsourcefilter, getipv4sourcefilter, setipv4sourcefilter – retrieve and set a socket's multicast filter

**Synopsis**

cc [ flag... ] file... -lssocket [ library... ]
#include <netinet/in.h>

int getsourcefilter(int s, uint32_t interface, struct sockaddr *group, socklen_t grouplen, uint32_t *fmode, uint_t *numsrc, struct sockaddr_storage *slist);

int setsourcefilter(int s, uint32_t interface, struct sockaddr *group, socklen_t grouplen, uint32_t fmode, uint_t numsrc, struct sockaddr_storage *slist);

int getipv4sourcefilter(int s, struct in_addr interface, struct in_addr group, uint32_t *fmode, uint32_t *numsrc, struct in_addr *slist);

int setipv4sourcefilter(int s, struct in_addr interface, struct in_addr group, uint32_t fmode, uint32_t numsrc, struct in_addr *slist);

**Description**

These functions allow applications to retrieve and modify the 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 MODE_INCLUDE or MODE_EXCLUDE, and a list of source addresses which are filtered. If a group is simply joined with no source address restrictions, the filter mode is MODE_EXCLUDE and the source list is empty.

The getsourcesfilter() and setsourcefilter() functions are protocol-independent. They can be used on either PF_INET or PF_INET6 sockets. The getipv4sourcefilter() and setipv4sourcefilter() functions are IPv4-specific. They must be used only on PF_INET sockets.

For the protocol-independent functions, the first four arguments identify the socket, interface, multicast group tuple values. The argument s is an open socket of type SOCK_DGRAM or SOCK_RAW. The `interface` argument is the interface index. The interface name can be mapped to the index using `if_nametoindex(3SOCKET)`. The `group` points to either a sockaddr_in containing an IPv4 multicast address if the socket is PF_INET or a sockaddr_in6 containing an IPv6 multicast address if the socket is PF_INET6. The `grouplen` is the size of the structure pointed to by `group`.

For the IPv4-specific functions, the first three arguments identify the same socket, interface, multicast group tuple values. The argument s is an open socket of type SOCK_DGRAM or SOCK_RAW and protocol family PF_INET. The `interface` argument is the IPv4 address assigned to the local interface. The `group` argument is the IPv4 multicast address.

The getsourcesfilter() and getipv4sourcefilter() functions retrieve the current filter for the given tuple consisting of socket, interface, and multicast group values. On successful return, `fmode` contains either MODE_INCLUDE or MODE_EXCLUDE, indicating the filter mode.
input, the \texttt{numsrc} argument holds the number of addresses that can fit in the \texttt{slist} array. On return, \texttt{slist} contains as many addresses as fit, while \texttt{numsrc} contains the total number of source addresses in the filter. It is possible that \texttt{numsrc} can contain a number larger than the number of addresses in the \texttt{slist} array. An application might determine the required buffer size by calling \texttt{getsourcefilter()} with \texttt{numsrc} containing 0 and \texttt{slist} a NULL pointer. On return, \texttt{numsrc} contains the number of elements that the \texttt{slist} buffer must be able to hold. Alternatively, the maximum number of source addresses allowed by this implementation is defined in \texttt{<netinet/in.h>}:

\begin{verbatim}
#define MAX_SRC_FILTER_SIZE 64
\end{verbatim}

The \texttt{setsourcefilter()} and \texttt{setipv4sourcefilter} functions replace the current filter with the filter specified in the arguments \texttt{fmode}, \texttt{numsrc}, and \texttt{slist}. The \texttt{fmode} argument must be set to either \texttt{MODE\_INCLUDE} or \texttt{MODE\_EXCLUDE}. The \texttt{numsrc} argument is the number of addresses in the \texttt{slist} array. The \texttt{slist} argument points to the array of source addresses to be included or excluded, depending on the \texttt{fmode} value.

\begin{description}
\item[Return Values] If successful, all four functions return 0. Otherwise, they return -1 and set \texttt{errno} to indicate the error.
\item[Errors] These functions will fail if:
\begin{description}
\item[EBADF] The \texttt{s} argument is not a valid descriptor.
\item[EAFNOSUPPORT] The address family of the passed-in \texttt{sockaddr} is not \texttt{AF\_INET} or \texttt{AF\_INET6}.
\item[ENOPROTOOPT] The socket \texttt{s} is not of type \texttt{SOCK\_DGRAM} or \texttt{SOCK\_RAW}.
\item[ENOPROTOOPT] The address family of the group parameter does not match the protocol family of the socket.
\item[ENOSR] Insufficient STREAMS resources available for the operation to complete.
\item[ENXIO] The \texttt{interface} argument, either an index or an IPv4 address, does not identify a valid interface.
\end{description}
\item[Errors] The \texttt{getsourcefilter()} and \texttt{getipv4sourcefilter()} functions will fail if:
\begin{description}
\item[EADDRNOTAVAIL] The tuple consisting of socket, interface, and multicast group values does not exist; \texttt{group} is not being listened to on \texttt{interface} by \texttt{socket}.
\end{description}
\item[Errors] The functions \texttt{setsourcefilter()} and \texttt{setipv4sourcefilter()} can fail in the following additional case:
\begin{description}
\item[ENOBUFFS] The source filter list is larger than that allowed by the implementation.
\end{description}
\item[Attributes] See \texttt{attributes(5)} for descriptions of the following attributes:
### getsourcefilter(3SOCKET)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  
*if_nametoindex(3SOCKET), socket(3SOCKET), attributes(5)*

RFC 3678
The parameter descriptions for `gss_accept_sec_context()` follow:

### `minor_status`

The status code returned by the underlying mechanism.

### `context_handle`

The context handle to return to the initiator. This should be set to `GSS_C_NO_CONTEXT` before the loop begins.

### `acceptor_cred_handle`

The handle for the credentials acquired by the acceptor, typically through `gss_acquire_cred()`. It may be initialized to `GSS_C_NO_CREDENTIAL` to indicate a default credential to use. If no default credential is defined, the function returns `GSS_C_NO_CRED`.

### `input_token_buffer`

Token received from the context initiative.

### `input_chan_bindings`

Optional application-specified bindings. Allows application to securely bind channel identification information to the security context. Set to `GSS_C_NO_CHANNEL_BINDINGS` if you do not want to use channel bindings.

### `src_name`

The authenticated name of the context initiator. After use, this name should be deallocated by passing it to `gss_release_name()`. See `gss_release_name(3GSS)`. If not required, specify NULL.

### `mech_type`

The security mechanism used. Set to NULL if it does not matter which mechanism is used.

### `output_token`

The token to send to the acceptor. Initialize it to `GSS_C_NO_BUFFER` before the function is called (or its length field set to zero). If the length is zero, no token need be sent.

### `ret_flags`

Contains various independent flags, each of which indicates that the context supports a specific service option. If not needed, specify NULL. Test the returned bit-mask `ret_flags`
value against its symbolic name to determine if the given option is supported by the context. `ret_flags` may contain one of the following values:

**GSS_C_DELEG_FLAG**

If true, delegated credentials are available by means of the `delegated_cred_handle` parameter. If false, no credentials were delegated.

**GSS_C_MUTUAL_FLAG**

If true, a remote peer asked for mutual authentication. If false, no remote peer asked for mutual authentication.

**GSS_C_REPLAY_FLAG**

If true, replay of protected messages will be detected. If false, replayed messages will not be detected.

**GSS_C_SEQUENCE_FLAG**

If true, out of sequence protected messages will be detected. If false, they will not be detected.

**GSS_C_CONF_FLAG**

If true, confidentiality service may be invoked by calling the `gss_wrap()` routine. If false, no confidentiality service is available by means of `gss_wrap()`. `gss_wrap()` will provide message encapsulation, data-origin authentication and integrity services only.

**GSS_C_INTEG_FLAG**

If true, integrity service may be invoked by calling either the `gss_get_mic(3GSS)` or the `gss_wrap(3GSS)` routine. If false, per-message integrity service is not available.

**GSS_C_ANON_FLAG**

If true, the initiator does not wish to be authenticated. The `src_name` parameter, if requested, contains an anonymous internal name. If false, the initiator has been authenticated normally.

**GSS_C_PROT_READY_FLAG**

If true, the protection services specified by the states of `GSS_C_CONF_FLAG` and `GSS_C_INTEG_FLAG` are available if the accompanying major status return value is either `GSS_S_COMPLETE` or `GSS_S_CONTINUE_NEEDED`. If false, the protection services are available only if the accompanying major status return value is `GSS_S_COMPLETE`.

**GSS_C_TRANS_FLAG**

If true, the resultant security context may be transferred to other processes by means of a call to `gss_export_sec_context(3GSS)`. If false, the security context cannot be transferred.

`time_rec`

The number of sections for which the context will remain value. Specify NULL if not required.
The credential value for credentials received from the context's initiator. It is valid only if the initiator has requested that the acceptor act as a proxy: that is, if the ret_flag argument resolves to GSS_C_DELEG_FLAG.

The gss_accept_sec_context() function allows a remotely initiated security context between the application and a remote peer to be established. The routine may return an output_token, which should be transferred to the peer application, where the peer application will present it to gss_init_sec_context(). See gss_init_sec_context(3GSS). If no token need be sent, gss_accept_sec_context() will indicate this by setting the length field of the output_token argument to zero. To complete the context establishment, one or more reply tokens may be required from the peer application; if so, gss_accept_sec_context() will return a status flag of GSS_S_CONTINUE_NEEDED, in which case it should be called again when the reply token is received from the peer application, passing the token to gss_accept_sec_context() by means of the input_token parameters.

Portable applications should be constructed to use the token length and return status to determine whether to send or to wait for a token.

Whenever gss_accept_sec_context() returns a major status that includes the value GSS_S_CONTINUE_NEEDED, the context is not fully established, and the following restrictions apply to the output parameters:

- The value returned by means of the time_rec parameter is undefined.
- Unless the accompanying ret_flags parameter contains the bit GSS_C_PROT_READY_FLAG, which indicates that per-message services may be applied in advance of a successful completion status, the value returned by the mech_type parameter may be undefined until gss_accept_sec_context() returns a major status value of GSS_S_COMPLETE.

The values of the GSS_C_DELEG_FLAG, GSS_C_MUTUAL_FLAG, GSS_C_REPLAY_FLAG, GSS_C_SEQUENCE_FLAG, GSS_C_CONF_FLAG, GSS_C_INTEG_FLAG and GSS_C_ANON_FLAG bits returned by means of the ret_flags parameter are values that would be valid if context establishment were to succeed.

The values of the GSS_C_PROT_READY_FLAG and GSS_C_TRANS_FLAG bits within ret_flags indicate the actual state at the time gss_accept_sec_context() returns, whether or not the context is fully established. However, applications should not rely on this behavior, as GSS_C_PROT_READY_FLAG was not defined in Version 1 of the GSS-API. Instead, applications should be prepared to use per-message services after a successful context establishment, based upon the GSS_C_INTEG_FLAG and GSS_C_CONF_FLAG values.

All other bits within the ret_flags argument are set to zero.

While gss_accept_sec_context() returns GSS_S_CONTINUE_NEEDED, the values returned by means of the the ret_flags argument indicate the services available from the established context. If the initial call of gss_accept_sec_context() fails, no context object is created, and
the value of the `context_handle` parameter is set to `GSS_C_NO_CONTEXT`. In the event of a failure on a subsequent call, the security context and the `context_handle` parameter are left untouched for the application to delete using `gss_delete_sec_context(3GSS)`. During context establishment, the informational status bits `GSS_S_OLD_TOKEN` and `GSS_S_DUPLICATE_TOKEN` indicate fatal errors; GSS-API mechanisms always return them in association with a routine error of `GSS_S_FAILURE`. This pairing requirement did not exist in version 1 of the GSS-API specification, so applications that wish to run over version 1 implementations must special-case these codes.

**Errors** `gss_accept_sec_context()` may return the following status codes:

- **GSS_S_COMPLETE**
  Successful completion.

- **GSS_S_CONTINUE_NEEDED**
  A token from the peer application is required to complete the context, and that `gss_accept_sec_context()` must be called again with that token.

- **GSS_S_DEFECTIVE_TOKEN**
  Consistency checks performed on the `input_token` failed.

- **GSS_S_DEFECTIVE_CREDENTIAL**
  Consistency checks performed on the credential failed.

- **GSS_S_NO_CRED**
  The supplied credentials were not valid for context acceptance, or the credential handle did not reference any credentials.

- **GSS_S_CREDENTIALS_EXPIRED**
  The referenced credentials have expired.

- **GSS_S_BAD_BINDINGS**
  The `input_token` contains different channel bindings than those specified by means of the `input_chan_bindings` parameter.

- **GSS_S_NO_CONTEXT**
  The supplied context handle did not refer to a valid context.

- **GSS_S_BAD_SIG**
  The `input_token` contains an invalid MIC.

- **GSS_S_OLD_TOKEN**
  The `input_token` was too old. This is a fatal error while establishing context.

- **GSS_S_DUPLICATE_TOKEN**
  The `input_token` is valid, but it is duplicate of a token already processed. This is a fatal error while establishing context.

- **GSS_S_BAD_MECH**
  The token received specified a mechanism that is not supported by the implementation or the provided credential.

- **GSS_S_FAILURE**
  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.
EXAMPLE 1  Invoking gss_accept_sec_context() Within a Loop

A typical portable caller should always invoke gss_accept_sec_context() within a loop:

gss_ctx_id_t context_hdl = GSS_C_NO_CONTEXT;

do {
    receive_token_from_peer(input_token);
    maj_stat = gss_accept_sec_context(&min_stat,
                                       &context_hdl,
                                       cred_hdl,
                                       input_token,
                                       input_bindings,
                                       &client_name,
                                       &mech_type,
                                       output_token,
                                       &ret_flags,
                                       &time_rec,
                                       &deleg_cred);
    if (GSS_ERROR(maj_stat)) {
        report_error(maj_stat, min_stat);
    };
    if (output_token->length != 0) {
        send_token_to_peer(output_token);
        gss_release_buffer(&min_stat, output_token);
    };
    if (GSS_ERROR(maj_stat)) {
        if (context_hdl != GSS_C_NO_CONTEXT)
            gss_delete_sec_context(&min_stat,
                                    &context_hdl,
                                    GSS_C_NO_BUFFER);
        break;
    };
} while (maj_stat & GSS_S_CONTINUE_NEEDED);

/* Check client_name authorization */
...
(void) gss_release_name(&min_stat, &client_name);

/* Use and/or store delegated credential */
...
(void) gss_release_cred(&min_stat, &deleg_cred);

Attributes  See attributes(5) for descriptions of the following attributes:
<table>
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<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**

- `gss_delete_sec_context(3GSS)`, `gss_export_sec_context(3GSS)`, `gss_get_mic(3GSS)`, `gss_init_sec_context(3GSS)`, `gss_release_cred(3GSS)`, `gss_release_name(3GSS)`, `gss_store_cred(3GSS)`, `gss_wrap(3GSS)`, `attributes(5)`

*Developer's Guide to Oracle Solaris 11 Security*
gss_acquire_cred(3GSS)

Name  gss_acquire_cred – acquire a handle for a pre-existing credential by name

Synopsis  cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_acquire_cred(OM_uint32 *minor_status,
    const gss_name_t desired_name, OM_uint32 time_req,
    const gss_OID_set desired_mech, gss_cred_usage_t cred_usage,
    gss_cred_id_t *output_cred_handle, gss_OID_set *actual_mechs,
    OM_uint32 *time_rec);

Description  The gss_acquire_cred() function allows an application to acquire a handle for a pre-existing credential by name. This routine is not intended as a function to login to the network; a function for login to the network would involve creating new credentials rather than merely acquiring a handle to existing credentials.

If desired_name is GSS_C_NO_NAME, the call is interpreted as a request for a credential handle that will invoke default behavior when passed to gss_init_sec_context(3GSS) (if cred_usage is GSS_C_INITIATE or GSS_C_BOTH) or gss_accept_sec_context(3GSS) (if cred_usage is GSS_C_ACCEPT or GSS_C_BOTH).

Normally gss_acquire_cred() returns a credential that is valid only for the mechanisms requested by the desired_mechs argument. However, if multiple mechanisms can share a single credential element, the function returns all the mechanisms for which the credential is valid in the actual_mechs argument.

gss_acquire_cred() is intended to be used primarily by context acceptors, since the GSS-API routines obtain initiator credentials through the system login process. Accordingly, you may not acquire GSS_C_INITIATE or GSS_C_BOTH credentials by means of gss_acquire_cred() for any name other than GSS_C_NO_NAME. Alternatively, you may acquire GSS_C_INITIATE or GSS_C_BOTH credentials for a name produced when gss_inquire_cred(3GSS) is applied to a valid credential, or when gss_inquire_context(3GSS) is applied to an active context.

If credential acquisition is time-consuming for a mechanism, the mechanism may choose to delay the actual acquisition until the credential is required, for example, by gss_init_sec_context(3GSS) or by gss_accept_sec_context(3GSS). Such mechanism-specific implementations are, however, invisible to the calling application; thus a call of gss_inquire_cred(3GSS) immediately following the call of gss_acquire_cred() will return valid credential data and incur the overhead of a deferred credential acquisition.

Parameters  The parameter descriptions for gss_acquire_cred() follow:

desired_name  The name of the principal for which a credential should be acquired.

time_req  The number of seconds that credentials remain valid. Specify GSS_C_INDEFINITE to request that the credentials have the maximum permitted lifetime.
desired_mechs  The set of underlying security mechanisms that may be used. GSS_C_NO_OID_SET may be used to obtain a default.

cred_usage A flag that indicates how this credential should be used. If the flag is GSS_C_ACCEPT, then credentials will be used only to accept security credentials. GSS_C_INITIATE indicates that credentials will be used only to initiate security credentials. If the flag is GSS_C_BOTH, then credentials may be used either to initiate or accept security contexts.

output_cred_handle The returned credential handle. Resources associated with this credential handle must be released by the application after use with a call to gss_release_cred(3GSS)

actual_mechs The set of mechanisms for which the credential is valid. Storage associated with the returned OID-set must be released by the application after use with a call to gss_release_oid_set(3GSS). Specify NULL if not required.

time_rec Actual number of seconds for which the returned credentials will remain valid. Specify NULL if not required.

minor_status Mechanism specific status code.

Errors gss_acquire_cred() may return the following status code:

GSS_S_COMPLETE Successful completion.
GSS_S_BAD_MECH An unavailable mechanism has been requested.
GSS_S_BAD_NAMETYPE The type contained within the desired_name parameter is not supported.
GSS_S_BAD_NAME The value supplied for desired_name parameter is ill formed.
GSS_S_CREDENTIALS_EXPIRED The credentials could not be acquired because they have expired.
GSS_S_NO_CRED No credentials were found for the specified name.
GSS_S_FAILURE The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes See attributes(5) for descriptions of the following attributes:
**gss_acquire_cred(3GSS)**

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
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<tr>
<td>MT-Level</td>
<td>Safe</td>
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</tbody>
</table>

**See Also**  
gss_accept_sec_context(3GSS), gss_init_sec_context(3GSS),  
gss_inquire_context(3GSS), gss_inquire_cred(3GSS), gss_release_cred(3GSS),  
gss_release_oid_set(3GSS), attributes(5)

*Developer’s Guide to Oracle Solaris 11 Security*
Name: gss_add_cred – add a credential-element to a credential

Synopsis:

```c
#include <gssapi/gssapi.h>

OM_uint32 gss_add_cred(OM_uint32 *minor_status,
                      const gss_cred_id_t input_cred_handle,
                      const gss_name_t desired_name,
                      const gss_OID desired_mech,
                      gss_cred_usage_t cred_usage,
                      OM_uint32 initiator_time_req,
                      OM_uint32 acceptor_time_req,
                      gss_cred_id_t *output_cred_handle,
                      gss_OID_set *actual_mechs,
                      OM_uint32 *initiator_time_rec,
                      OM_uint32 *acceptor_time_rec);
```

Parameters: The parameter descriptions for gss_add_cred() follow:

- `minor_status`: Mechanism specific status code.
- `input_cred_handle`: Credential to which the credential-element is added. If GSS_C_NO_CREDENTIAL is specified, the function composes the new credential based on default behavior. While the credential-handle is not modified by gss_add_cred(), the underlying credential is modified if output_credential_handle is NULL.
- `desired_name`: Name of the principal for which a credential should be acquired.
- `desired_mech`: Underlying security mechanism with which the credential can be used. GSS_C_NULL_OID can be used to obtain a default.
- `cred_usage`: Flag that indicates how a credential is used to initiate or accept security credentials. If the flag is GSS_C_ACCEPT, the credentials are used only to accept security credentials. If the flag is GSS_C_INITIATE, the credentials are used only to initiate security credentials. If the flag is GSS_C_BOTH, the credentials can be used to either initiate or accept security contexts.
- `initiator_time_req`: Number of seconds that the credential may remain valid for initiating security contexts. This argument is ignored if the composed credentials are of the GSS_C_ACCEPT type. Specify GSS_C_INDEFINITE to request that the credentials have the maximum permitted initiator lifetime.
- `acceptor_time_req`: Number of seconds that the credential may remain valid for accepting security contexts. This argument is ignored if the composed credentials are of the GSS_C_INITIATE type. Specify GSS_C_INDEFINITE to request that the credentials have the maximum permitted initiator lifetime.
output_cred_handle  Returned credential handle that contains the new credential-element and all the credential-elements from input_cred_handle. If a valid pointer to a gss_cred_id_t is supplied for this parameter, gss_add_cred() creates a new credential handle that contains all credential-elements from input_cred_handle and the newly acquired credential-element. If NULL is specified for this parameter, the newly acquired credential-element is added to the credential identified by input_cred_handle.

The resources associated with any credential handle returned by means of this parameter must be released by the application after use by a call to gss_release_cred(3GSS).

actual_mechs  Complete set of mechanisms for which the new credential is valid. Storage for the returned OID-set must be freed by the application after use by a call to gss_release_oid_set(3GSS). Specify NULL if this parameter is not required.

initiator_time_rec  Actual number of seconds for which the returned credentials remain valid for initiating contexts using the specified mechanism. If a mechanism does not support expiration of credentials, the value GSS_C_INDEFINITE is returned. Specify NULL if this parameter is not required.

acceptor_time_rec  Actual number of seconds for which the returned credentials remain valid for accepting security contexts using the specified mechanism. If a mechanism does not support expiration of credentials, the value GSS_C_INDEFINITE is returned. Specify NULL if this parameter is not required.

Description  The gss_add_cred() function adds a credential-element to a credential. The credential-element is identified by the name of the principal to which it refers. This function is not intended as a function to login to the network. A function for login to the network would involve creating new mechanism-specific authentication data, rather than acquiring a handle to existing data.

If the value of desired_name is GSS_C_NO_NAME, the call is interpreted as a request to add a credential-element to invoke default behavior when passed to gss_init_sec_context(3GSS) if the value of cred_usage is GSS_C_INITIATE or GSS_C_BOTH. The call is also interpreted as a request to add a credential-element to the invoke default behavior when passed to gss_accept_sec_context(3GSS) if the value of cred_usage is GSS_C_ACCEPT or GSS_C_BOTH.

The gss_add_cred() function is expected to be used primarily by context acceptors. The GSS-API provides mechanism-specific ways to obtain GSS-API initiator credentials through
the system login process. Consequently, the GSS-API does not support acquiring
GSS_C_INITIATE or GSS_C_BOTH credentials by means of gss_acquire_cred(3GSS) for any
name other than the following:
■ GSS_C_NO_NAME
■ Name produced by gss_inquire_cred(3GSS) applied to a valid credential
■ Name produced by gss_inquire_context(3GSS) applied to an active context

If credential acquisition is time consuming for a mechanism, the mechanism can choose to
delay the actual acquisition until the credential is required by gss_init_sec_context(3GSS),
for example, or by gss_accept_sec_context(3GSS). Such mechanism-specific
implementation decisions are invisible to the calling application. A call to
gss_inquire_cred(3GSS) immediately following the call gss_add_cred() returns valid
credential data as well as incurring the overhead of deferred credential acquisition.

The gss_add_cred() function can be used either to compose a new credential that contains all
credential-elements of the original in addition to the newly-acquired credential-element. The
function can also be used to add the new credential-element to an existing credential. If the
value of the output_cred_handle parameter is NULL, the new credential-element is added to the
credential identified by input_cred_handle. If a valid pointer is specified for the
output_cred_handle parameter, a new credential handle is created.

If the value of input_cred_handle is GSS_C_NO_CREDENTIAL, the gss_add_cred() function
composes a credential and sets the output_cred_handle parameter based on the default
behavior. The call has the same effect as a call first made by the application to
gss_acquire_cred(3GSS) to specify the same usage and to pass GSS_C_NO_NAME as the
desired_name parameter. Such an application call obtains an explicit credential handle that
incorporates the default behaviors, then passes the credential handle to gss_add_cred(), and
finally calls gss_release_cred(3GSS) on the first credential handle.

If the value of the input_cred_handle parameter is GSS_C_NO_CREDENTIAL, a non-NULL value
must be supplied for the output_cred_handle parameter.

Return Values

The gss_add_cred() function can return the following status codes:

- **GSS_S_COMPLETE**
  - Successful completion.

- **GSS_S_BAD_MECH**
  - An unavailable mechanism has been requested.

- **GSS_S_BAD_NAMETYPE**
  - The type contained within the desired_name parameter is not supported.

- **GSS_S_BAD_NAME**
  - The value supplied for desired_name parameter is ill
    formed.

- **GSS_S_DUPLICATE_ELEMENT**
  - The credential already contains an element for the
    requested mechanism that has overlapping usage and
    validity period.
GSS_S_CREDENTIALS_EXPIRED  The credentials could not be added because they have expired.
GSS_S_NO_CRED       No credentials were found for the specified name.
GSS_S_FAILURE       The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  gss_add_cred(3GSS), gss_acquire_cred(3GSS),
gss_init_sec_context(3GSS), gss_inquire_context(3GSS), gss_inquire_cred(3GSS),
gss_release_cred(3GSS), gss_release_oid_set(3GSS), libgss(3LIB), attributes(5)

Developer’s Guide to Oracle Solaris 11 Security
gss_add_oid_set_member(3GSS)

**Name**
gss_add_oid_set_member – add an object identifier to an object identifier set

**Synopsis**
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_add_oid_set_member(OM_uint32 * minor_status,
    const gss_OID member_oid, gss_OID_set * oid_set);

**Parameters**
The parameter descriptions for gss_add_oid_set_member() follow:

- **minor_status**: A mechanism specific status code.
- **member_oid**: Object identifier to be copied into the set.
- **oid_set**: Set in which the object identifier should be inserted.

**Description**
The gss_add_oid_set_member() function adds an object identifier to an object identifier set. You should use this function in conjunction with gss_create_empty_oid_set(3GSS) when constructing a set of mechanism OIDs for input to gss_acquire_cred(3GSS). The oid_set parameter must refer to an OID-set created by GSS-API, that is, a set returned by gss_create_empty_oid_set(3GSS).

The GSS-API creates a copy of the member_oid and inserts this copy into the set, expanding the storage allocated to the OID-set elements array, if necessary. New members are always added to the end of the OID set's elements. If the member_oid is already present, the oid_set should remain unchanged.

**Errors**
The gss_add oid_set_member() function can return the following status codes:

- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_FAILURE**: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

**Attributes**
See attributes(5) for descriptions of the following attributes:

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</table>

**See Also**
gss_acquire_cred(3GSS), gss_create_empty_oid_set(3GSS), attributes(5)

*Developer's Guide to Oracle Solaris 11 Security*
Name  gss_canonicalize_name – convert an internal name to a mechanism name

Synopsis  cc [flag...] file... -lgss [library...]  
#include <gssapi/gssapi.h>  

OM_uint32 gss_canonicalize_name(OM_uint32 *minor_status,  
    const gss_name_t input_name, const gss_OID mech_type,  
    gss_name_t *output_name);  

Description  The gss_canonicalize_name() function generates a canonical mechanism name from an arbitrary internal name. The mechanism name is the name that would be returned to a context acceptor on successful authentication of a context where the initiator used the input_name in a successful call to gss_acquire_cred(3GSS), specifying an OID set containing mech_type as its only member, followed by a call to gss_init_sec_context(3GSS), specifying mech_type as the authentication mechanism.

Parameters  The parameter descriptions for gss_canonicalize_name() follow:

  minor_status  Mechanism-specific status code.

  input_name  The name for which a canonical form is desired.

  mech_type  The authentication mechanism for which the canonical form of the name is desired. The desired mechanism must be specified explicitly; no default is provided.

  output_name  The resultant canonical name. Storage associated with this name must be freed by the application after use with a call to gss_release_name(3GSS).

Errors  The gss_canonicalize_name() function may return the status codes:

  GSS_S_COMPLETE  Successful completion.

  GSS_S_BAD_MECH  The identified mechanism is not supported.

  GSS_S_BAD_NAMETYPE  The provided internal name contains no elements that could be processed by the specified mechanism.

  GSS_S_BAD_NAME  The provided internal name was ill-formed.

  GSS_S_FAILURE  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

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</table>
See Also  gss_acquire_cred(3GSS), gss_init_sec_context(3GSS), gss_release_name(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
The `gss_compare_name()` function allows an application to compare two internal-form names to determine whether they refer to the same entity.

If either name presented to `gss_compare_name()` denotes an anonymous principal, the routines indicate that the two names do not refer to the same identity.

The parameter descriptions for `gss_compare_name()` follow:

- **minor_status**: Mechanism-specific status code.
- **name1**: Internal-form name.
- **name2**: Internal-form name.
- **name_equal**: If non-zero, the names refer to same entity. If 0, the names refer to different entities. Strictly, the names are not known to refer to the same identity.

The `gss_compare_name()` function may return the following status codes:

- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_BAD_NAMETYPE**: The two names were of incomparable types.
- **GSS_S_BAD_NAME**: One or both of `name1` or `name2` was ill-formed.
- **GSS_S_FAILURE**: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

See `attributes(5)` for descriptions of the following attributes:

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</table>

See Also `attributes(5)`

*Developer’s Guide to Oracle Solaris 11 Security*
Name  gss_context_time – determine how long a context will remain valid

Synopsis  cc [ flag... ] file... -lgss [ library... ]
          #include <gssapi/gssapi.h>

OM_uint32 gss_context_time(OM_uint32 *minor_status,
                             gss_ctx_id_t *context_handle, OM_uint32 *time_rec);

Description  The gss_context_time() function determines the number of seconds for which
              the specified context will remain valid.

Parameters  The parameter descriptions for gss_context_time() are as follows:

         minor_status  A mechanism-specific status code.
         context_handle  A read-only value. Identifies the context to be interrogated.
         time_rec  Modifies the number of seconds that the context remains valid. If the
                    context has already expired, returns zero.

Errors  The gss_context_time() function returns one of the following status codes:

         GSS_S_COMPLETE  Successful completion.
         GSS_S_CONTEXT_EXPIRED  The context has already expired.
         GSS_S_NO_CONTEXT  The context_handle parameter did not identify a valid context.
         GSS_S_FAILURE  The underlying mechanism detected an error for which no
                        specific GSS status code is defined. The mechanism-specific
                        status code reported by means of the minor_status parameter
                        details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  gss_init_sec_context(3GSS), gss_accept_sec_context(3GSS),
          gss_delete_sec_context(3GSS), gss_process_context_token(3GSS),
          gss_inquire_context(3GSS), gss_wrap_size_limit(3GSS),
          gss_export_sec_context(3GSS), gss_import_sec_context(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
gss_create_empty_oid_set(3GSS)

**Name**
gss_create_empty_oid_set – create an object-identifier set containing no object identifiers

**Synopsis**
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

```c
OM_uint32 gss_create_empty_oid_set(OM_uint32 *minor_status,
   gss_OID_set *oid_set);
```

**Description**
The `gss_create_empty_oid_set()` function creates an object-identifier set containing no object identifiers to which members may be subsequently added using the `gss_add_oid_set_member(3GSS)` function. These functions can be used to construct sets of mechanism object identifiers for input to `gss_acquire_cred(3GSS)`.

**Parameters**
The parameter descriptions for `gss_create_empty_oid_set()` follow:

- `minor_status`   Mechanism-specific status code
- `oid_set`        Empty object identifier set. The function will allocate the `gss_OID_set_desc` object, which the application must free after use with a call to `gss_release_oid_set(3GSS)`.

**Errors**
The `gss_create_empty_oid_set()` function may return the following status codes:

- **GSS_S_COMPLETE**  Successful completion
- **GSS_S_FAILURE**   The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

**Attributes**
See attributes(5) for descriptions of the following attributes:

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**See Also**
gss_acquire_cred(3GSS), gss_add_oid_set_member(3GSS), gss_release_oid_set(3GSS), attributes(5)

*Developer’s Guide to Oracle Solaris 11 Security*
Name  gss_delete_sec_context – delete a GSS-API security context

Synopsis  cc [ flag... ] file... -lgss [ library... ]

#include <gssapi/gssapi.h>

OM_uint32 gss_delete_sec_context(OM_uint32 *minor_status,
    gss_ctx_id_t *context_handle, gss_buffer_t output_token);

Description  Use the gss_delete_sec_context() function to delete a security context. The
  gss_delete_sec_context() function will delete the local data structures associated with
  the specified security context. You may not obtain further security services that use the context
  specified by context_handle.

In addition to deleting established security contexts, gss_delete_sec_context() will delete
any half-built security contexts that result from incomplete sequences of calls to
  gss_init_sec_context(3GSS) and gss_accept_sec_context(3GSS).

The Solaris implementation of the GSS-API retains the output_token parameter for
compatibility with version 1 of the GSS-API. Both peer applications should invoke
  gss_delete_sec_context(), passing the value GSS_C_NO_BUFFER to the output_token
parameter; this indicates that no token is required. If the application passes a valid buffer to
  gss_delete_sec_context(), it will return a zero-length token, indicating that no token
should be transferred by the application.

Parameters  The parameter descriptions for gss_delete_sec_context() follow:

  minor_status  A mechanism specific status code.
  context_handle  Context handle identifying specific context to delete. After deleting the
                  context, the GSS-API will set context_handle to GSS_C_NO_CONTEXT.
  output_token  A token to be sent to remote applications that instructs them to delete the
                context.

Errors  gss_delete_sec_context() may return the following status codes:

  GSS_S_COMPLETE  Successful completion.
  GSS_S_NO_CONTEXT  No valid context was supplied.
  GSS_S_FAILURE  The underlying mechanism detected an error for which no specific
                 GSS status code is defined. The mechanism-specific status code
                 reported by means of the minor_status parameter details the error
                 condition.

Attributes  See attributes(5) for descriptions of the following attributes:
**gss_delete_sec_context(3GSS)**

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**See Also**  
gss_accept_sec_context(3GSS), gss_init_sec_context(3GSS), attributes(5)

*Developer's Guide to Oracle Solaris 11 Security*
gss_display_name(3GSS)

Name  gss_display_name – convert internal-form name to text

Synopsis  cc [flag...] file... -lgss [library...]
          #include <gssapi/gssapi.h>

          OM_uint32 gss_display_name(OM_uint32 * minor_status,
                           const gss_name_t input_name, gss_buffer_t output_name_buffer,
                           gss_OID * output_name_type);

Description  The gss_display_name() function allows an application to obtain a textual representation of an opaque internal-form name for display purposes.

If input_name denotes an anonymous principal, the GSS-API returns the gss_OID value GSS_C_NT_ANONYMOUS as the output_name_type, and a textual name that is syntactically distinct from all valid supported printable names in output_name_buffer.

If input_name was created by a call to gss_import_name(3GSS), specifying GSS_C_NO_OID as the name-type, the GSS-API returns GSS_C_NO_OID by means of the output_name_type parameter.

Parameters  The parameter descriptions for gss_display_name() follow:

    minor_status        Mechanism-specific status code.
    input_name          Name in internal form.
    output_name_buffer  Buffer to receive textual name string. The application must free storage associated with this name after use with a call to gss_release_buffer(3GSS).
    output_name_type    The type of the returned name. The returned gss_OID will be a pointer into static storage and should be treated as read-only by the caller. In particular, the application should not attempt to free it. Specify NULL if this parameter is not required.

Errors  The gss_display_name() function may return the following status codes:

    GSS_S_COMPLETE       Successful completion.
    GSS_S_BAD_NAME       The input_name was ill-formed.
    GSS_S_FAILURE        The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

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gss_display_name(3GSS)

See Also  gss_import_name(3GSS), gss_release_buffer(3GSS), attributes(5)

*Developer's Guide to Oracle Solaris 11 Security*
The `gss_display_status()` function enables an application to obtain a textual representation of a GSS-API status code for display to the user or for logging purposes. Because some status values may indicate multiple conditions, applications may need to call `gss_display_status()` multiple times, with each call generating a single text string.

The `message_context` parameter is used by `gss_acquire_cred()` to store state information on error messages that are extracted from a given `status_value`. The `message_context` parameter must be initialized to 0 by the application prior to the first call, and `gss_display_status()` will return a non-zero value in this parameter if there are further messages to extract.

The `message_context` parameter contains all state information required by `gss_display_status()` to extract further messages from the `status_value`. If a non-zero value is returned in this parameter, the application is not required to call `gss_display_status()` again unless subsequent messages are desired.

The parameter descriptions for `gss_display_status()` follow:

- **minor_status**: Status code returned by the underlying mechanism.
- **status_value**: Status value to be converted.
- **status_type**: If the value is `GSS_C_GSS_CODE`, `status_value` is a GSS-API status code. If the value is `GSS_C_MECH_CODE`, then `status_value` is a mechanism status code.
- **mech_type**: Underlying mechanism that is used to interpret a minor status value. Supply `GSS_C_NO_OID` to obtain the system default.
- **message_context**: Should be initialized to zero prior to the first call. On return from `gss_display_status()`, a non-zero `status_value` parameter indicates that additional messages may be extracted from the status code by means of subsequent calls to `gss_display_status()`, passing the same `status_value`, `status_type`, `mech_type`, and `message_context` parameters.
- **status_string**: Textual representation of the `status_value`. Storage associated with this parameter must be freed by the application after use with a call to `gss_release_buffer(3GSS)`.
Errors  The `gss_display_status()` function may return the following status codes:

- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_BAD_MECH**: Indicates that translation in accordance with an unsupported mechanism type was requested.
- **GSS_S_BAD_STATUS**: The status value was not recognized, or the status type was neither `GSS_C_GSS_CODE` nor `GSS_C_MECH_CODE`.
- **GSS_S_FAILURE**: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

Attributes  See `attributes(5)` for descriptions of the following attributes:

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See Also  `gss_acquire_cred(3GSS), gss_release_buffer(3GSS), attributes(5)`

*Developer’s Guide to Oracle Solaris 11 Security*
Name  
gss_duplicate_name – create a copy of an internal name

Synopsis  
cc [flag...] file... -lgss [library...]  
#include <gssapi/gssapi.h>

OM_uint32 gss_duplicate_name(OM_uint32 *minor_status,  
  const gss_name_t src_name, gss_name_t *dest_name);

Description  
The gss_duplicate_name() function creates an exact duplicate of the existing internal name src_name. The new dest_name will be independent of the src_name. The src_name and dest_name must both be released, and the release of one does not affect the validity of the other.

Parameters  
The parameter descriptions for gss_duplicate_name() follow:

- minor_status: A mechanism-specific status code.
- src_name: Internal name to be duplicated.
- dest_name: The resultant copy of src_name. Storage associated with this name must be freed by the application after use with a call to gss_release_name(3GSS).

Errors  
The gss_duplicate_name() function may return the following status codes:

- GSS_S_COMPLETE: Successful completion.
- GSS_S_BAD_NAME: The src_name parameter was ill-formed.
- GSS_S_FAILURE: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  
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See Also  
gss_release_name(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
Name  gss_export_name – convert a mechanism name to export form

Synopsis  cc [flag...] file... -lgss [library ...]
#include <gssapi/gssapi.h>

OM_uint32 gss_export_name(OM_uint32 *minor_status,  
    const gss_name_t input_name, gss_buffer_t exported_name);

Description  The gss_export_name() function allows a GSS-API internal name to be converted into a mechanism-specific name. The function produces a canonical contiguous string representation of a mechanism name, suitable for direct comparison, with memory(3C), or for use in authorization functions, matching entries in an access-control list. The input_name parameter must specify a valid mechanism name, that is, an internal name generated by gss_accept_sec_context(3GSS) or by gss_canonicalize_name(3GSS).

Parameters  The parameter descriptions for gss_export_name() follow:

  minor_status  A mechanism-specific status code.
  input_name  The mechanism name to be exported.
  exported_name  The canonical contiguous string form of input_name. Storage associated with this string must freed by the application after use with gss_release_buffer(3GSS).

Errors  The gss_export_name() function may return the following status codes:

  GSS_S_COMPLETE  Successful completion.
  GSS_S_NAME_NOT_MN  The provided internal name was not a mechanism name.
  GSS_S_FAILURE  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  gss_accept_sec_context(3GSS), gss_canonicalize_name(3GSS), gss_release_buffer(3GSS), memory(3C), attributes(5)

Developer’s Guide to Oracle Solaris 11 Security
**Name**
gss_export_sec_context – transfer a security context to another process

**Synopsis**
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_export_sec_context(OM_uint32 *minor_status,
gss_ctx_id_t *context_handle, gss_buffer_t interprocess_token);

**Description**
The gss_export_sec_context() function generates an interprocess token for transfer to another process within an end system. gss_export_sec_context() and gss_import_sec_context() allow a security context to be transferred between processes on a single machine.

The gss_export_sec_context() function supports the sharing of work between multiple processes. This routine is typically used by the context-acceptor, in an application where a single process receives incoming connection requests and accepts security contexts over them, then passes the established context to one or more other processes for message exchange. gss_export_sec_context() deactivates the security context for the calling process and creates an interprocess token which, when passed to gss_import_sec_context() in another process, reactivates the context in the second process. Only a single instantiation of a given context can be active at any one time; a subsequent attempt by a context exporter to access the exported security context will fail.

The interprocess token may contain security-sensitive information, for example cryptographic keys. While mechanisms are encouraged to either avoid placing such sensitive information within interprocess tokens or to encrypt the token before returning it to the application, in a typical object-library GSS-API implementation, this might not be possible. Thus, the application must take care to protect the interprocess token and ensure that any process to which the token is transferred is trustworthy. If creation of the interprocess token is successful, the GSS-API deallocates all process-wide resources associated with the security context and sets the context_handle to GSS_C_NO_CONTEXT. In the event of an error that makes it impossible to complete the export of the security context, the function does not return an interprocess token and leaves the security context referenced by the context_handle parameter untouched.

Sun’s implementation of gss_export_sec_context() does not encrypt the interprocess token. The interprocess token is serialized before it is transferred to another process.

**Parameters**
The parameter descriptions for gss_export_sec_context() are as follows:

- **minor_status**
  A mechanism-specific status code.

- **context_handle**
  Context handle identifying the context to transfer.

- **interprocess_token**
  Token to be transferred to target process. Storage associated with this token must be freed by the application after use with a call to gss_release_buffer(3GSS).
Errors  gss_export_sec_context() returns one of the following status codes:

GSS_S_COMPLETE  Successful completion.
GSS_S_CONTEXT_EXPIRED  The context has expired.
GSS_S_NO_CONTEXT  The context was invalid.
GSS_S_UNAVAILABLE  The operation is not supported.
GSS_S_FAILURE  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  gss_accept_sec_context(3GSS), gss_import_sec_context(3GSS), gss_init_sec_context(3GSS), gss_release_buffer(3GSS), attributes(5)

Developer’s Guide to Oracle Solaris 11 Security
### gss_get_mic(3GSS)

**Name**
gss_get_mic – calculate a cryptographic message

**Synopsis**
```c
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_get_mic(OM_uint32 *minor_status,
    const gss_ctx_id_t context_handle, gss_qop_t qop_req,
    const gss_buffer_t message_buffer, gss_buffer_t msg_token);
```

**Description**
The `gss_get_mic()` function generates a cryptographic MIC for the supplied message, and places the MIC in a token for transfer to the peer application. The `qop_req` parameter allows a choice between several cryptographic algorithms, if supported by the chosen mechanism.

Since some application-level protocols may wish to use tokens emitted by `gss_wrap(3GSS)` to provide secure framing, the GSS-API allows MICs to be derived from zero-length messages.

**Parameters**
The parameter descriptions for `gss_get_mic()` follow:

- **minor_status**: The status code returned by the underlying mechanism.
- **context_handle**: Identifies the context on which the message will be sent.
- **qop_req**: Specifies the requested quality of protection. Callers are encouraged, on portability grounds, to accept the default quality of protection offered by the chosen mechanism, which may be requested by specifying `GSS_C_QOP_DEFAULT` for this parameter. If an unsupported protection strength is requested, `gss_get_mic()` will return a `major_status` of `GSS_S_BAD_QOP`.
- **message_buffer**: The message to be protected.
- **msg_token**: The buffer to receive the token. Storage associated with this message must be freed by the application after use with a call to `gss_release_buffer(3GSS)`.

**Errors**
`gss_get_mic()` may return the following status codes:

- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_CONTEXT_EXPIRED**: The context has already expired.
- **GSS_S_NO_CONTEXT**: The `context_handle` parameter did not identify a valid context.
- **GSS_S_BAD_QOP**: The specified QOP is not supported by the mechanism.
- **GSS_S_FAILURE**: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.
Attributes See attributes(5) for descriptions of the following attributes:

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See Also gss_release_buffer(3GSS), gss_wrap(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
**Name**
gss_import_name – convert a contiguous string name to GSS_API internal format

**Synopsis**
```c
cc [flag ...] file... -lgss [library ...]
#include <gssapi/gssapi.h>

OM_uint32 gss_import_name(OM_uint32 * minor_status,
    const gss_buffer_t input_name_buffer, const gss_OID input_name_type,
    gss_name_t *output_name);
```

**Description**
The `gss_import_name()` function converts a contiguous string name to internal form. In general, the internal name returned by means of the `output_name` parameter will not be a mechanism name; the exception to this is if the `input_name_type` indicates that the contiguous string provided by means of the `input_name_buffer` parameter is of type `GSS_C_NT_EXPORT_NAME`, in which case, the returned internal name will be a mechanism name for the mechanism that exported the name.

**Parameters**
The parameter descriptions for `gss_import_name()` follow:

- **minor_status**
  Status code returned by the underlying mechanism.

- **input_name_buffer**
  The `gss_buffer_desc` structure containing the name to be imported.

- **input_name_type**
  A `gss_OID` that specifies the format that the `input_name_buffer` is in.

- **output_name**
  The `gss_name_t` structure to receive the returned name in internal form. Storage associated with this name must be freed by the application after use with a call to `gss_release_name()`.

**Errors**
The `gss_import_name()` function may return the following status codes:

- **GSS_S_COMPLETE**
  The `gss_import_name()` function completed successfully.

- **GSS_S_BAD_NAMETYPE**
  The `input_name_type` was unrecognized.

- **GSS_S_BAD_NAME**
  The `input_name` parameter could not be interpreted as a name of the specified type.

- **GSS_S_BAD_MECH**
  The `input_name_type` was `GSS_C_NT_EXPORT_NAME`, but the mechanism contained within the `input_name` is not supported.

- **GSS_S_FAILURE**
  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>
gss_import_name(3GSS)

See Also gss_release_buffer(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
The `gss_import_sec_context()` function allows a process to import a security context established by another process. A given interprocess token can be imported only once. See `gss_export_sec_context(3GSS)`.

The parameter descriptions for `gss_import_sec_context()` are as follows:

- **minor_status**: A mechanism-specific status code.
- **interprocess_token**: Token received from exporting process.
- **context_handle**: Context handle of newly reactivated context. Resources associated with this context handle must be released by the application after use with a call to `gss_delete_sec_context(3GSS)`.

`gss_import_sec_context()` returns one of the following status codes:

- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_NO_CONTEXT**: The token did not contain a valid context reference.
- **GSS_S_DESTRUCTIVE_TOKEN**: The token was invalid.
- **GSS_S_UNAVAILABLE**: The operation is unavailable.
- **GSS_S_UNAUTHORIZED**: Local policy prevents the import of this context by the current process.
- **GSS_S_FAILURE**: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

### Attributes

See [attributes](5) for descriptions of the following attributes:

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</table>

### See Also

- `gss_accept_sec_context(3GSS), gss_context_time(3GSS), gss_delete_sec_context(3GSS), gss_export_sec_context(3GSS), gss_init_sec_context(3GSS), gss_inquire_context(3GSS), gss_process_context_token(3GSS), gss_wrap_size_limit(3GSS), attributes(5)`
gss_import_sec_context(3GSS)

*Developer's Guide to Oracle Solaris 11 Security*
The `gss_indicate_mechs()` function enables an application to determine available underlying security mechanisms.

The parameter descriptions for `gss_indicate_mechs()` follow:

- **minor_status**: A mechanism-specific status code.
- **mech_set**: Set of supported mechanisms. The returned `gss_OID_set` value will be a dynamically-allocated OID set that should be released by the caller after use with a call to `gss_release_oid_set(3GSS)`.

The `gss_indicate_mechs()` function may return the following status codes:

- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_FAILURE**: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

See also `gss_release_oid_set(3GSS), attributes(5)`

*Developer’s Guide to Oracle Solaris 11 Security*
gss_init_sec_context(3GSS)

Name  gss_init_sec_context – initiate a GSS-API security context with a peer application

Synopsis  cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_init_sec_context(OM_uint32 *minor_status,
  const gss_cred_id_t *initiator_cred_handle,
  gss_ctx_id_t *context_handle, const gss_name_t *target_name,
  const gss_OID mech_type, OM_uint32 req_flags,
  OM_uint32 time_req, const gss_channel_bindings_t *input_chan_bindings,
  const gss_buffer_t *input_token, gss_OID *actual_mech_type,
  gss_buffer_t *output_token, OM_uint32 *ret_flags,
  OM_uint32 *time_rec);

Parameters  The parameter descriptions for gss_init_sec_context() follow:

  minor_status
      A mechanism specific status code.

  initiator_cred_handle
      The handle for the credentials claimed. Supply GSS_C_NO_CREDENTIAL to act as a default
      initiator principal. If no default initiator is defined, the function returns GSS_S_NO_CRED.

  context_handle
      The context handle for a new context. Supply the value GSS_C_NO_CONTEXT for the first call,
      and use the value returned in any continuation calls. The resources associated with
      context_handle must be released by the application after use by a call to
      gss_delete_sec_context(3GSS).

  target_name
      The name of the context acceptor.

  mech_type
      The object ID of the desired mechanism. To obtain a specific default, supply the value
      GSS_C_NO_OID.

  req_flags
      Contains independent flags, each of which will request that the context support a specific
      service option. A symbolic name is provided for each flag. Logically-OR the symbolic name
      to the corresponding required flag to form the bit-mask value. req_flags may contain one of
      the following values:

      GSS_C_DELEG_FLAG
      If true, delegate credentials to a remote peer. Do not delegate the credentials if the value
      is false.

      GSS_C_MUTUAL_FLAG
      If true, request that the peer authenticate itself. If false, authenticate to the remote peer
      only.
GSS_C_REPLAY_FLAG
If true, enable replay detection for messages protected with gss_wrap(3GSS) or gss_get_mic(3GSS). Do not attempt to detect replayed messages if false.

GSS_C_SEQUENCE_FLAG
If true, enable detection of out-of-sequence protected messages. Do not attempt to detect out-of-sequence messages if false.

GSS_C_CONF_FLAG
If true, request that confidential service be made available by means of gss_wrap(3GSS). If false, no per-message confidential service is required.

GSS_C_INTEG_FLAG
If true, request that integrity service be made available by means of gss_wrap(3GSS) or gss_get_mic(3GSS). If false, no per-message integrity service is required.

GSS_C_ANON_FLAG
If true, do not reveal the initiator's identify to the acceptor. If false, authenticate normally.

time_req
The number of seconds for which the context will remain valid. Supply a zero value to time_req to request a default validity period.

input_chan_bindings
Optional application-specified bindings. Allows application to securely bind channel identification information to the security context. Set to GSS_C_NO_CHANNEL_BINDINGS if you do not want to use channel bindings.

input_token
Token received from the peer application. On the initial call, supply GSS_C_NO_BUFFER or a pointer to a buffer containing the value GSS_C_EMPTY_BUFFER.

actual_mech_type
The actual mechanism used. The OID returned by means of this parameter will be pointer to static storage that should be treated as read-only. The application should not attempt to free it. To obtain a specific default, supply the value GSS_C_NO_OID. Specify NULL if the parameter is not required.

output_token
The token to send to the peer application. If the length field of the returned buffer is zero, no token need be sent to the peer application. After use storage associated with this buffer must be freed by the application by a call to gss_release_buffer(3GSS).

ret_flags
Contains various independent flags, each of which indicates that the context supports a specific service option. If not needed, specify NULL. Test the returned bit-mask ret_flags value against its symbolic name to determine if the given option is supported by the context. ret_flags may contain one of the following values:
GSS_C_DELEG_FLAG
If true, credentials were delegated to the remote peer. If false, no credentials were

del gated.

GSS_C_MUTUAL_FLAG
If true, the remote peer authenticated itself. If false, the remote peer did not authenticate
itself.

GSS_C_REPLAY_FLAG
If true, replay of protected messages will be detected. If false, replayed messages will not
be detected.

GSS_C_SEQUENCE_FLAG
If true, out of sequence protected messages will be detected. If false, they will not be
dected.

GSS_C_CONF_FLAG
If true, confidential service may be invoked by calling the gss_wrap() routine. If false,
no confidentiality service is available by means of gss_wrap(3GSS). gss_wrap() will
provide message encapsulation, data-origin authentication and integrity services only.

GSS_C_INTEG_FLAG
If true, integrity service may be invoked by calling either the gss_wrap(3GSS) or
gss_get_mic(3GSS) routine. If false, per-message integrity service is not available.

GSS_C_ANON_FLAG
If true, the initiator’s identity has not been revealed; it will not be revealed if any emitted
token is passed to the acceptor. If false, the initiator has been or will be authenticated
ormally.

GSS_C_PROT_READY_FLAG
If true, the protection services specified by the states of GSS_C_CONF_FLAG and
GSS_C_INTEG_FLAG are available if the accompanying major status return value is either
GSS_SCOMPLETE or GSS_S_CONTINUE_NEEDED. If false, the protection services are
available only if the accompanying major status return value is GSS_SCOMPLETE.

GSS_C_TRANS_FLAG
If true, the resultant security context may be transferred to other processes by means of a
call to gss_export_sec_context(3GSS). If false, the security context cannot be
ised.

time_rec
The number of seconds for which the context will remain valid. Specify NULL if the
parameter is not required.

Description The gss_init_sec_context() function initiates the establishment of a security context
between the application and a remote peer. Initially, the input_token parameter should be
specified either as GSS_C_NO_BUFFER, or as a pointer to a gss_buffer_desc object with a
length field that contains a zero value. The routine may return a output_token, which should
The value returned by means of the `time_rec` parameter is undefined. Unless the accompanying `ret_flags` parameter contains the bit `GSS_C_PROT_READY_FLAG`, which indicates that per-message services may be applied in advance of a successful completion status, the value returned by means of the `actual_mech_type` parameter is undefined until the routine returns a major status value of `GSS_S_COMPLETE`.

The values of the `GSS_C_DELEG_FLAG`, `GSS_C_MUTUAL_FLAG`, `GSS_C_REPLAY_FLAG`, `GSS_C_SEQUENCE_FLAG`, `GSS_C_CONF_FLAG`, `GSS_C_INTEG_FLAG` and `GSS_C_ANON_FLAG` bits returned by the `ret_flags` parameter contain values that will be valid if context establishment succeeds. For example, if the application requests a service such as delegation or anonymous authentication by means of the `req_flags` argument, and the service is unavailable from the underlying mechanism, `gss_init_sec_context()` generates a token that will not provide the service, and it indicate by means of the `ret_flags` argument that the service will not be supported. The application may choose to abort context establishment by calling `gss_delete_sec_context(3GSS)` if it cannot continue without the service, or if the service was merely desired but not mandatory, it may transmit the token and continue context establishment.

The values of the `GSS_C_PROT_READY_FLAG` and `GSS_C_TRANS_FLAG` bits within `ret_flags` indicate the actual state at the time `gss_init_sec_context()` returns, whether or not the context is fully established.

The GSS-API sets the `GSS_C_PROT_READY_FLAG` in the final `ret_flags` returned to a caller, for example, when accompanied by a `GSS_S_COMPLETE` status code. However, applications should not rely on this behavior, as the flag was not defined in Version 1 of the GSS-API. Instead, applications should determine what per-message services are available after a successful context establishment according to the `GSS_C_INTEG_FLAG` and `GSS_C_CONF_FLAG` values.

All other bits within the `ret_flags` argument are set to zero.

If the initial call of `gss_init_sec_context()` fails, the GSS-API does not create a context object; it leaves the value of the `context_handle` parameter set to `GSS_C_NO_CONTEXT` to indicate...
In the event of failure on a subsequent call, the GSS-API leaves the security context untouched for the application to delete using `gss_delete_sec_context(3GSS)`.

During context establishment, the informational status bits `GSS_S_OLD_TOKEN` and `GSS_S_DUPLICATE_TOKEN` indicate fatal errors, and GSS-API mechanisms should always return them in association with a status code of `GSS_S_FAILURE`. This pairing requirement was not part of Version 1 of the GSS-API specification, so applications that wish to run on Version 1 implementations must special-case these codes.

**Errors** `gss_init_sec_context()` may return the following status codes:

- **GSS_S_COMPLETE**
  Successful completion.

- **GSS_S_CONTINUE_NEEDED**
  A token from the peer application is required to complete the context, and `gss_init_sec_context()` must be called again with that token.

- **GSS_S_DEFECTIVE_TOKEN**
  Consistency checks performed on the `input_token` failed.

- **GSS_S_DEFECTIVE_CREDENTIAL**
  Consistency checks performed on the credential failed.

- **GSS_S_NO_CRED**
  The supplied credentials are not valid for context acceptance, or the credential handle does not reference any credentials.

- **GSS_S_CREDENTIALS_EXPIRED**
  The referenced credentials have expired.

- **GSS_S_BAD_BINDINGS**
  The `input_token` contains different channel bindings than those specified by means of the `input_chan_bindings` parameter.

- **GSS_S_BAD_SIG**
  The `input_token` contains an invalid MIC or a MIC that cannot be verified.

- **GSS_S_OLD_TOKEN**
  The `input_token` is too old. This is a fatal error while establishing context.

- **GSS_S_DUPLICATE_TOKEN**
  The `input_token` is valid, but it is a duplicate of a token already processed. This is a fatal error while establishing context.

- **GSS_S_NO_CONTEXT**
  The supplied context handle does not refer to a valid context.

- **GSS_S_BAD_NAMETYPE**
  The provided `target_name` parameter contains an invalid or unsupported `name` type.
GSS_S_BAD_NAME
   The supplied target_name parameter is ill-formed.

GSS_S_BAD_MECH
   The token received specifies a mechanism that is not supported by the implementation or the provided credential.

GSS_S_FAILURE
   The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

**Examples**

**EXAMPLE**

Invoking `gss_init_sec_context()` Within a Loop

A typical portable caller should always invoke `gss_init_sec_context()` within a loop:

```c
int context_established = 0;
gss_ctx_id_t context_hdl = GSS_C_NO_CONTEXT;
...
input_token->length = 0;

while (!context_established) {
   maj_stat = gss_init_sec_context(&min_stat,
      cred_hdl,
      &context_hdl,
      target_name,
      desired_mech,
      desired_services,
      desired_time,
      input_bindings,
      input_token,
      &actual_mech,
      output_token,
      &actual_services,
      &actual_time);

   if (GSS_ERROR(maj_stat)) {
      report_error(maj_stat, min_stat);
   };

   if (output_token->length != 0) {
      send_token_to_peer(output_token);
      gss_release_buffer(&min_stat, output_token)
   };
   if (GSS_ERROR(maj_stat)) {

      if (context_hdl != GSS_C_NO_CONTEXT)
      gss_delete_sec_context(&min_stat,
         &context_hdl,
         GSS_C_NO_BUFFER);
```
EXAMPLE 1 Invoking gss_init_sec_context() Within a Loop  (Continued)

break;
};
if (maj_stat & GSS_S_CONTINUE_NEEDED) {
    receive_token_from_peer(input_token);
} else {
    context_established = 1;
};

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
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<tr>
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</table>

See Also  gss_delete_sec_context(3GSS), gss_export_sec_context(3GSS), gss_get_mic(3GSS),
gss_wrap(3GSS), attributes(5)

Developer’s Guide to Oracle Solaris 11 Security
Name  
gss_inquire_context – obtain information about a security context

Synopsis  
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_inquire_context(OM_uint32 *minor_status,
const gss_ctx_id_t context_handle, gss_name_t *src_name,
gss_name_t *targ_name, OM_uint32 *lifetime_rec,
gss_OID *mech_type, OM_uint32 *ctx_flags,
int *locally_initiated, int *open);

Description  
The gss_inquire_context() function obtains information about a security context. The
caller must already have obtained a handle that refers to the context, although the context
need not be fully established.

Parameters  
The parameter descriptions for gss_inquire_context() are as follows:

- **minor_status**: A mechanism-specific status code.
- **context_handle**: A handle that refers to the security context.
- **src_name**: The name of the context initiator. If the context was established using
  anonymous authentication, and if the application invoking
  gss_inquire_context() is the context acceptor, an anonymous name is
  returned. Storage associated with this name must be freed by the
  application after use with a call to gss_release_name(). Specify NULL if
  the parameter is not required.
- **targ_name**: The name of the context acceptor. Storage associated with this name
  must be freed by the application after use with a call to
  gss_release_name(). If the context acceptor did not authenticate itself,
  and if the initiator did not specify a target name in its call to
  gss_init_sec_context(), the value GSS_C_NO_NAME is returned. Specify
  NULL if the parameter is not required.
- **lifetime_rec**: The number of seconds for which the context will remain valid. If the
  context has expired, this parameter will be set to zero. Specify NULL if the
  parameter is not required.
- **mech_type**: The security mechanism providing the context. The returned OID is a
  pointer to static storage that should be treated as read-only by the
  application; in particular, the application should not attempt to free it.
  Specify NULL if the parameter is not required.
- **ctx_flags**: Contains various independent flags, each of which indicates that the
  context supports (or is expected to support, if ctx_open is false) a specific
  service option. If not needed, specify NULL. Symbolic names are provided
  for each flag, and the symbolic names corresponding to the required flags
should be logically ANDed with the ret_flags value to test whether a given option is supported by the context. The flags are:

GSS_C_DELEG_FLAG If true, credentials were delegated from the initiator to the acceptor. If false, no credentials were delegated.

GSS_C_MUTUAL_FLAG If true, the acceptor was authenticated to the initiator. If false, the acceptor did not authenticate itself.

GSS_C_REPLAY_FLAG If true, the replay of protected messages will be detected. If false, replayed messages will not be detected.

GSS_C_SEQUENCE_FLAG If true, out-of-sequence protected messages will be detected. If false, out-of-sequence messages will not be detected.

GSS_C_CONF_FLAG If true, confidential service may be invoked by calling the gss_wrap(3GSS) routine. If false, no confidential service is available through gss_wrap(). gss_wrap() provides message encapsulation, data-origin authentication, and integrity services only.

GSS_C_INTEG_FLAG If true, integrity service can be invoked by calling either the gss_get_mic() or the gss_wrap() routine. If false, per-message integrity service is unavailable.

GSS_C_ANON_FLAG If true, the initiator's identity is not revealed to the acceptor. The src_name parameter, if requested, contains an anonymous internal name. If false, the initiator has been authenticated normally.

GSS_C_PROT_READY_FLAG If true, the protection services, as specified by the states of the GSS_C_CONF_FLAG and GSS_C_INTEG_FLAG, are available for use. If false, they are available only if the context is fully established, that is, if the open parameter is non-zero.

GSS_C_TRANS_FLAG If true, resultant security context can be transferred to other processes through a call to gss_export_sec_context(). If
false, the security context is not transferable.

*locally_initiated* Non-zero if the invoking application is the context initiator. Specify `NULL` if the parameter is not required.

*open* Non-zero if the context is fully established; zero if a context-establishment token is expected from the peer application. Specify `NULL` if the parameter is not required.

**Errors** `gss_inquire_context()` returns one of the following status codes:

- **GSS_S_COMPLETE** Successful completion.
- **GSS_S_NO_CONTEXT** The referenced context could not be accessed.
- **GSS_S_FAILURE** The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

**Attributes** See attributes(5) for descriptions of the following attributes:

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**See Also**

- `gss_accept_sec_context(3GSS), gss_context_time(3GSS), gss_delete_sec_context(3GSS), gss_export_sec_context(3GSS), gss_import_sec_context(3GSS), gss_init_sec_context(3GSS), gss_process_context_token(3GSS), gss_wrap(3GSS), gss_wrap_size_limit(3GSS), attributes(5)`

*Developer's Guide to Oracle Solaris 11 Security*
gss_inquire_cred(3GSS)

Name  gss_inquire_cred – obtain information about a credential

Synopsis  
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_inquire_cred(OM_uint32 *minor_status,
    const gss_cred_id_t cred_handle, gss_name_t *name,
    OM_uint32 *lifetime, gss_cred_usage_t *cred_usage,
    gss_OID_set *mechanisms);

Parameters  The parameter descriptions for gss_inquire_cred() follow:

  minor_status  Mechanism specific status code.

  cred_handle  Handle that refers to the target credential. Specify GSS_C_NO_CREDENTIAL to
  inquire about the default initiator principal.

  name  Name of the identity asserted by the credential. Any storage associated with
  this name should be freed by the application after use by a call to
  gss_release_name(3GSS).

  lifetime  Number of seconds for which the credential remains valid. If the credential
  has expired, this parameter will be set to zero. Specify NULL if the parameter
  is not required.

  cred_usage  Flag that indicates how a credential is used. The cred_usage parameter may
  contain one of the following values: GSS_C_INITIATE, GSS_C_ACCEPT, or
  GSS_C_BOTH. Specify NULL if this parameter is not required.

  mechanisms  Set of mechanisms supported by the credential. Storage for the returned
  OID-set must be freed by the application after use by a call to
  gss_release_oid_set(3GSS). Specify NULL if this parameter is not
  required.

Description  Use the gss_inquire_cred() function to obtain information about a credential.

Return Values  The gss_inquire_cred() function can return the following status codes:

  GSS_S_COMPLETE  Successful completion.

  GSS_S_NO_CRED  The referenced credentials could not be accessed.

  GSS_S_DEFECTIVE_CREDENTIAL  The referenced credentials were invalid.

  GSS_S_CREDENTIALS_EXPIRED  The referenced credentials have expired. If the lifetime
  parameter was not passed as NULL, it will be set to 0.

  GSS_S_FAILURE  The underlying mechanism detected an error for which
  no specific GSS status code is defined. The
  mechanism-specific status code reported by means of the
  minor_status parameter details the error condition.
### Attributes

See attributes(5) for descriptions of the following attributes:

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### See Also

gss_release_name(3GSS), gss_release_oid_set(3GSS), libgss(3LIB), attributes(5)

*Developer’s Guide to Oracle Solaris 11 Security*
gss_inquire_cred_by_mech(3GSS)

Name
gss_inquire_cred_by_mech – obtain per-mechanism information about a credential

Synopsis
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_inquire_cred_by_mech(OM_uint32 * minor_status,
const gss_cred_id_t cred_handle, const gss_OID mech_type,
gss_name_t * name, OM_uint32 * initiator_lifetime,
OM_uint32 * acceptor_lifetime, gss_cred_usage_t * cred_usage);

Parameters

acceptor_lifetime The number of seconds that the credential is capable of accepting
security contexts under the specified mechanism. If the credential can
no longer be used to accept contexts, or if the credential usage for this
mechanism is GSS_C_INITIATE, this parameter will be set to 0. Specify
NULL if this parameter is not required.

cred_handle A handle that refers to the target credential. Specify
GSS_C_NO_CREDENTIAL to inquire about the default initiator principal.

cred_usage How the credential may be used with the specified mechanism. The
cred_usage parameter may contain one of the following values:
GSS_C_INITIATE, GSS_C_ACCEPT, or GSS_C_BOTH. Specify NULL if this
parameter is not required.

initiator_lifetime The number of seconds that the credential is capable of initiating
security contexts under the specified mechanism. If the credential can
no longer be used to initiate contexts, or if the credential usage for this
mechanism is GSS_C_ACCEPT, this parameter will be set to 0. Specify
NULL if this parameter is not required.

mech_type The mechanism for which the information should be returned.

minor_status A mechanism specific status code.

name The name whose identity the credential asserts. Any storage associated
with this name must be freed by the application after use by a call to
gss_release_name(3GSS).

Description
The gss_inquire_cred_by_mech() function obtains per-mechanism information about a
credential.

Errors
The gss_inquire_cred_by_mech() function can return the following status codes:

GSS_S_COMPLETE Successful completion.

GSS_S_CREDENTIALS_EXPIRED The credentials cannot be added because they have expired.

GSS_S_DEFECTIVE_CREDENTIAL The referenced credentials are invalid.
The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

The referenced credentials cannot be accessed.

The gss_inquire_cred_by_mech() function is not available for the specified mechanism type.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also gss_release_name(3GSS), attributes(5)

Developer’s Guide to Oracle Solaris 11 Security
gss_inquire_mechs_for_name(3GSS)

Name  gss_inquire_mechs_for_name – list mechanisms that support the specified name-type

Synopsis  cc [flag ...] file... -lgss [library ...]
#include <gssapi/gssapi.h>

OM_uint32 gss_inquire_mechs_for_name(OM_uint32 *minor_status,
const gss_name_t input_name, gss_OID_set *mech_types);

Description  The gss_inquire_mechs_for_name() function returns the set of mechanisms supported by the GSS-API that may be able to process the specified name. Each mechanism returned will recognize at least one element within the internal name.

Some implementations of the GSS-API may perform this test by checking nametype information contained within the passed name and registration information provided by individual mechanisms. This means that the mech_types set returned by the function may indicate that a particular mechanism will understand the name, when in fact the mechanism would refuse to accept the name as input to gss_canonicalize_name(3GSS), gss_init_sec_context(3GSS), gss_acquire_cred(3GSS), or gss_add_cred(3GSS), due to some property of the name itself rather than the name-type. Therefore, this function should be used only as a pre-filter for a call to a subsequent mechanism-specific function.

Parameters  The parameter descriptions for gss_inquire_mechs_for_name() follow in alphabetical order:

- minor_status  Mechanism-specific status code.
- input_name  The name to which the inquiry relates.
- mech_types  Set of mechanisms that may support the specified name. The returned OID set must be freed by the caller after use with a call to gss_release_oid_set(3GSS).

Errors  The gss_inquire_mechs_for_name() function may return the following status codes:

- GSS_S_COMPLETE  Successful completion.
- GSS_S_BAD_NAME  The input_name parameter was ill-formed.
- GSS_S_BAD_NAMETYPE  The input_name parameter contained an invalid or unsupported type of name.
- GSS_S_FAILURE  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:
gss_inquire_mechs_for_name(3GSS)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<tr>
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</table>

See Also  
gss_acquire_cred(3GSS), gss_add_cred(3GSS), gss_canonicalize_name(3GSS),  
gss_init_sec_context(3GSS), gss_release_oid_set(3GSS), attributes(5)

*Developer's Guide to Oracle Solaris 11 Security*
Name  gss_inquire_names_for_mech – list the name-types supported by the specified mechanism

Synopsis  cc [flag...] file... -lgss [library...]  
#include <gssapi/gssapi.h>

OM_uint32 gss_inquire_names_for_mech(OM_uint32 *minor_status,  
const gss_OID mechanism, gss_OID_set *name_types);

Description  The gss_inquire_names_for_mech() function returns the set of name-types supported by  
the specified mechanism.

Parameters  The parameter descriptions for gss_inquire_names_for_mech() follow:

  minor_status  A mechanism-specific status code.

  mechanism  The mechanism to be interrogated.

  name_types  Set of name-types supported by the specified mechanism. The returned OID  
set must be freed by the application after use with a call to  
gss_release_oid_set(3GSS).

Errors  The gss_inquire_names_for_mech() function may return the following values:

  GSS_S_COMPLETE  Successful completion.

  GSS_S_FAILURE  The underlying mechanism detected an error for which no specific GSS  
status code is defined. The mechanism-specific status code reported by  
means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

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</table>

See Also  gss_release_oid_set(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
**Name**  
gss_oid_to_str – convert an OID to a string

**Synopsis**  
cc [ flag... ] file... -lgss [ library... ]  
#include <gssapi/gssapi.h>  
gss_oid_to_str(OM_uint32 *minor_status, const gss_OID oid,  
gss_buffer_t oid_str);

**Parameters**  
- *minor_status*  
  Status code returned by underlying mechanism.
- *oid*  
  GSS-API OID structure to convert.
- *oid_str*  
  String to receive converted OID.

**Description**  
The gss_oid_to_str() function converts a GSS-API OID structure to a string. You can use the function to convert the name of a mechanism from an OID to a simple string. This function is a convenience function, as is its complementary function, gss_str_to_oid(3GSS).

If an OID must be created, use gss_create_empty_oid_set(3GSS) and gss_add_oid_set_member(3GSS) to create it. OIDs created in this way must be released with gss_release_oid_set(3GSS). However, it is strongly suggested that applications use the default GSS-API mechanism instead of creating an OID for a specific mechanism.

**Errors**  
The gss_oid_to_str() function returns one of the following status codes:

- **GSS_S_CALL_INACCESSIBLE_READ**  
  A required input parameter could not be read.

- **GSS_S_CALL_INACCESSIBLE_WRITE**  
  A required output parameter could not be written.

- **GSS_S_COMPLETE**  
  Successful completion.

- **GSS_S_FAILURE**  
  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the *minor_status* parameter details the error condition.

**Attributes**  
See attributes(5) for descriptions of the following attributes:

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**See Also**  
gss_add_oid_set_member(3GSS), gss_create_empty_oid_set(3GSS), gss_release_oid_set(3GSS), gss_str_to_oid(3GSS), attributes(5)

*Developer's Guide to Oracle Solaris 11 Security*
**Warnings**  This function is included for compatibility only with programs using earlier versions of the GSS-API and should not be used for new programs. Other implementations of the GSS-API might not support this function, so portable programs should not rely on it. Sun might not continue to support this function.
# gss_process_context_token

## Synopsis

```c
#include <gssapi/gssapi.h>

OM_uint32 gss_process_context_token(OM_uint32 *minor_status,
                                   const gss_ctx_id_t context_handle,
                                   const gss_buffer_t token_buffer);
```

## Description

The `gss_process_context_token()` function provides a way to pass an asynchronous token to the security service. Most context-level tokens are emitted and processed synchronously by `gss_init_sec_context()` and `gss_accept_sec_context()`, and the application is informed as to whether further tokens are expected by the `GSS_C_CONTINUE_NEEDED` major status bit. Occasionally, a mechanism might need to emit a context-level token at a point when the peer entity is not expecting a token. For example, the initiator's final call to `gss_init_sec_context()` may emit a token and return a status of `GSS_S_COMPLETE`, but the acceptor's call to `gss_accept_sec_context()` might fail. The acceptor's mechanism might want to send a token containing an error indication to the initiator, but the initiator is not expecting a token at this point, believing that the context is fully established.

`gss_process_context_token()` provides a way to pass such a token to the mechanism at any time.

This function is provided for compatibility with the GSS-API version 1. Because `gss_delete_sec_context()` no longer returns a valid `output_token` to be sent to `gss_process_context_token()`, applications using a newer version of the GSS-API do not need to rely on this function.

## Parameters

The parameter descriptions for `gss_process_context_token()` are as follows:

- `minor_status`: A mechanism-specific status code.
- `context_handle`: Context handle of context on which token is to be processed.
- `token_buffer`: Token to process.

## Errors

`gss_process_context_token()` returns one of the following status codes:

- `GSS_S_COMPLETE`: Successful completion.
- `GSS_S_DEFECTIVE_TOKEN`: Indicates that consistency checks performed on the token failed.
- `GSS_S_NO_CONTEXT`: The `context_handle` did not refer to a valid context.
- `GSS_S_FAILURE`: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  gss_accept_sec_context(3GSS), gss_delete_sec_context(3GSS), gss_init_sec_context(3GSS), attributes(5)

*Developer's Guide to Oracle Solaris 11 Security*
The `gss_release_buffer()` function frees buffer storage allocated by a GSS-API function. The `gss_release_buffer()` function also zeros the length field in the descriptor to which the buffer parameter refers, while the GSS-API function sets the pointer field in the descriptor to NULL. Any buffer object returned by a GSS-API function may be passed to `gss_release_buffer()`, even if no storage is associated with the buffer.

The parameter descriptions for `gss_release_buffer()` follow:

- **minor_status**: Mechanism-specific status code.
- **buffer**: The storage associated with the buffer will be deleted. The `gss_buffer_desc()` object will not be freed; however, its length field will be zeroed.

The `gss_release_buffer()` function may return the following status codes:

- **GSS_S_COMPLETE**: Successful completion
- **GSS_S_FAILURE**: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

See attributes(5) for descriptions of the following attributes:

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<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also attributes(5)

*Developer's Guide to Oracle Solaris 11 Security*
**gss_release_cred**

**Name**
gss_release_cred – discard a credential handle

**Synopsis**
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_release_cred(OM_uint32 *minor_status,
gss_cred_id_t *cred_handle);

**Description**
The gss_release_cred() function informs the GSS-API that the specified credential handle is no longer required by the application and frees the associated resources. The cred_handle parameter is set to GSS_C_NO_CREDENTIAL when this call completes successfully.

**Parameters**
The parameter descriptions for gss_release_cred() follow:

- minor_status: A mechanism specific status code.
- cred_handle: An opaque handle that identifies the credential to be released. If GSS_C_NO_CREDENTIAL is specified, the gss_release_cred() function will complete successfully, but it will do nothing.

**Errors**
gss_release_cred() may return the following status codes:

- GSS_S_COMPLETE: Successful completion.
- GSS_S_NO_CRED: The referenced credentials cannot be accessed.
- GSS_S_FAILURE: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**
attributes(5)

*Developer’s Guide to Oracle Solaris 11 Security*
Name  gss_release_name – discard an internal-form name  

Synopsis  cc [flag...] file... -lgss [library...]
#include <gssapi/gssapi.h

OM_uint32 gss_release_name(OM_uint32 *minor_status, gss_name_t *name);

Description  The gss_release_name() function frees GSS-API-allocated storage associated with an internal-form name. The name is set to GSS_C_NO_NAME on successful completion of this call.

Parameters  The parameter descriptions for gss_release_name() follow:

minor_status  A mechanism-specific status code.

name  The name to be deleted.

Errors  The gss_release_name() function may return the following status codes:

GSS_S_COMPLETE  Successful completion.

GSS_S_BAD_NAME  The name parameter did not contain a valid name.

GSS_S_FAILURE  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  attributes(5)

Developer's Guide to Oracle Solaris 11 Security
gss_release_oid

Name
gss_release_oid – release an object identifier

Synopsis
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>
gss_release_oid(OM_uint32 * minor_status, const gss_OID * oid);

Description
The gss_release_oid() function deletes an OID. Such an OID might have been created with

gss_str_to_oid().

Since creating and deleting individual OIDs is discouraged, it is preferable to use
gss_release_oid_set() if it is necessary to deallocate a set of OIDs.

Parameters
The parameter descriptions for gss_release_oid() are as follows:

minor_status A mechanism-specific status code.
oid The object identifier of the mechanism to be deleted.

Errors
gss_release_oid() returns one of the following status codes:

GSS_S_COMPLETE Successful completion.

GSS_S_FAILURE The underlying mechanism detected an error for which no specific GSS
status code is defined. The mechanism-specific status code reported by
means of the minor_status parameter details the error condition.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also
gss_release_oid_set(3GSS), gss_str_to_oid(3GSS), attributes(5)

Developer’s Guide to Oracle Solaris 11 Security

Warnings
This function is included for compatibility only with programs using earlier versions of the
GSS-API and should not be used for new programs. Other implementations of the GSS-API
might not support this function, so portable programs should not rely on it. Sun might not
continue to support this function.
gss_release_oid_set(3GSS)

**Name**
gss_release_oid_set – free storage associated with a GSS-API-generated gss_OID_set object

**Synopsis**
cc [flag...] file... -lgss [library...]
#include <gssapi/gssapi.h>

OM_uint32 gss_release_oid_set(OM_uint32 *minor_status, gss_OID_set *set);

**Description**
The gss_release_oid_set() function frees storage associated with a GSS-API-generated gss_OID_set object. The set parameter must refer to an OID-set that was returned from a GSS-API function. The gss_release_oid_set() function will free the storage associated with each individual member OID, the OID set’s elements array, and gss_OID_set_desc.

gss_OID_set is set to GSS_C_NO_OID_SET on successful completion of this function.

**Parameters**
The parameter descriptions for gss_release_oid_set() follow:

- **minor_status** — A mechanism-specific status code
- **set** — Storage associated with the gss_OID_set will be deleted

**Errors**
The gss_release_oid_set() function may return the following status codes:

- **GSS_S_COMPLETE** — Successful completion
- **GSS_S_FAILURE** — The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

**Attributes**
See attributes(5) for descriptions of the following attributes:

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<td>Safe</td>
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</tbody>
</table>

**See Also**
attributes(5)

*Developer’s Guide to Oracle Solaris 11 Security*
# gss_store_cred

## Synopsis

```c
#include <gssapi/gssapi.h>

OM_uint32 gss_store_cred(OM_uint32 *minor_status,
                          const gss_cred_id_t input_cred,
                          const gss_cred_usage_t cred_usage,
                          const gss_OID desired_mech,
                          OM_uint32 overwrite_cred,
                          OM_uint32 default_cred,
                          gss_OID_set *elements_stored,
                          gss_cred_usage_t *cred_usage_stored);
```

## Parameters

The parameter descriptions for `gss_store_cred()` follow:

- **input_cred**
  - The credential to be stored.

- **cred_usage**
  - This parameter specifies whether to store an initiator, an acceptor, or both usage components of a credential.

- **desired_mech**
  - The mechanism-specific component of a credential to be stored. If `GSS_C_NULL_OID` is specified, the `gss_store_cred()` function attempts to store all the elements of the given `input_cred`.

  The `gss_store_cred()` function is not atomic when storing multiple elements of a credential. All delegated credentials, however, contain a single element.

- **overwrite_cred**
  - A boolean that indicates whether to overwrite existing credentials in the current store for the same principal as that of the `input_cred`. A non-zero value indicates that credentials are overwritten. A zero value indicates that credentials are not overwritten.

- **default_cred**
  - A boolean that indicates whether to set the principal name of the `input_cred` parameter as the default of the current credential store. A non-zero value indicates that the principal name is set as the default. A zero value indicates that the principal name is not set as the default. The default principal of a credential store matches `GSS_C_NO_NAME` as the `desired_name` input parameter for `gss_store_cred(3GSS)`.

- **elements_stored**
  - The set of mechanism OIDs for which `input_cred` elements have been stored.

- **cred_usage_stored**
  - The stored `input_cred` usage elements: initiator, acceptor, or both.

- **minor_status**
  - Minor status code that is specific to one of the following: the mechanism identified by the `desired_mech` parameter, or the element of a single mechanism in the `input_cred`. In all other cases, `minor_status` has an undefined value on return.
The **gss_store_cred()** function stores a credential in the current GSS-API credential store for the calling process. Input credentials can be re-acquired through **gss_add_cred(3GSS)** and **gss_acquire_cred(3GSS)**.

The **gss_store_cred()** function is specifically intended to make delegated credentials available to a user’s login session.

The **gss_accept_sec_context()** function can return a delegated GSS-API credential to its caller. The function does not store delegated credentials to be acquired through **gss_add_cred(3GSS)**. Delegated credentials can be used only by a receiving process unless they are made available for acquisition by calling the **gss_store_cred()** function.

The Solaris Operating System supports a single GSS-API credential store per user. The current GSS-API credential store of a process is determined by its effective UID.

In general, acceptor applications should switch the current credential store by changing the effective UID before storing a delegated credential.

The **gss_store_cred()** can return the following status codes:

- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_CREDENTIALS_EXPIRED**: The credentials could not be stored because they have expired.
- **GSS_S_CALL_INACCESSIBLE_READ**: No input credentials were given.
- **GSS_S_UNAVAILABLE**: The credential store is unavailable.
- **GSS_S_DUPLICATE_ELEMENT**: The credentials could not be stored because the `overwrite_cred` input parameter was set to `false` (0) and the `input_cred` parameter conflicts with a credential in the current credential store.
- **GSS_S_FAILURE**: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

### Attributes

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<tbody>
<tr>
<td>Interface Stability</td>
<td>Uncommitted</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>
See Also  
gss_accept_sec_context(3GSS), gss_acquire_cred(3GSS), gss_add_cred(3GSS),  
gss_init_sec_context(3GSS), gss_inquire_cred(3GSS), gss_release_cred(3GSS),  
gss_release_oid_set(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
The `gss_str_to_oid()` function converts a string to a GSS-API OID structure. You can use the function to convert a simple string to an OID to. This function is a convenience function, as is its complementary function, `gss_oid_to_str(3GSS)`.

OIDs created with `gss_str_to_oid()` must be deallocated through `gss_release_oid(3GSS)`, if available. If an OID must be created, use `gss_create_empty_oid_set(3GSS)` and `gss_add_oid_set_member(3GSS)` to create it. OIDs created in this way must be released with `gss_release_oid_set(3GSS)`. However, it is strongly suggested that applications use the default GSS-API mechanism instead of creating an OID for a specific mechanism.

The parameter descriptions for `gss_str_to_oid()` are as follows:

- **minor_status**: Status code returned by underlying mechanism.
- **oid**: GSS-API OID structure to receive converted string.
- **oid_str**: String to convert.

`gss_str_to_oid()` returns one of the following status codes:

- `GSS_S_CALL_INACCESSIBLE_READ`: A required input parameter could not be read.
- `GSS_S_CALL_INACCESSIBLE_WRITE`: A required output parameter could not be written.
- `GSS_S_COMPLETE`: Successful completion.
- `GSS_S_FAILURE`: The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

See attributes(5) for descriptions of the following attributes:

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See Also `gss_add_oid_set_member(3GSS), gss_create_empty_oid_set(3GSS), gss_oid_to_str(3GSS), gss_release_oid_set(3GSS), attributes(5)`
**Warnings**  This function is included for compatibility only with programs using earlier versions of the GSS-API and should not be used for new programs. Other implementations of the GSS-API might not support this function, so portable programs should not rely on it. Sun might not continue to support this function.
The `gss_test_oid_set_member()` function interrogates an object identifier set to determine if a specified object identifier is a member. This function should be used with OID sets returned by `gss_indicate_mechs(3GSS)`, `gss_acquire_cred(3GSS)`, and `gss_inquire_cred(3GSS)`, but it will also work with user-generated sets.

The parameter descriptions for `gss_test_oid_set_member()` follow:

- **minor_status** A mechanism-specific status code
- **member** An object identifier whose presence is to be tested
- **set** An object identifier set.
- **present** The value of `present` is non-zero if the specified OID is a member of the set; if not, the value of `present` is zero.

The `gss_test_oid_set_member()` function may return the following status codes:

- **GSS_S_COMPLETE** Successful completion
- **GSS_S_FAILURE** The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the `minor_status` parameter details the error condition.

See attributes(5) for descriptions of the following attributes:

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</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also `gss_acquire_cred(3GSS)`, `gss_indicate_mechs(3GSS)`, `gss_inquire_cred(3GSS)`, attributes(5)

*Developer's Guide to Oracle Solaris 11 Security*
gss_unwrap (3GSS)

Name
gss_unwrap – verify a message with attached cryptographic message

Synopsis
c { flag... } file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_unwrap(OM_uint32 *minor_status,
const gss_ctx_id_t context_handle,
const gss_buffer_t input_message_buffer,
gss_buffer_t output_message_buffer, int *conf_state,
gss_qop_t *qop_state);

Description
The gss_unwrap() function converts a message previously protected by gss_wrap(3GSS)
back to a usable form, verifying the embedded MIC. The conf_state parameter indicates
whether the message was encrypted; the qop_state parameter indicates the strength of
protection that was used to provide the confidentiality and integrity services.

Since some application-level protocols may wish to use tokens emitted by gss_wrap(3GSS) to
provide secure framing, the GSS-API supports the wrapping and unwrapping of zero-length
messages.

Parameters
The parameter descriptions for gss_unwrap() follow:

minor_status
The status code returned by the underlying mechanism.

context_handle
Identifies the context on which the message arrived.

input_message_buffer
The message to be protected.

output_message_buffer
The buffer to receive the unwrapped message. Storage associated
with this buffer must be freed by the application after use with a
call to gss_release_buffer(3GSS).

conf_state
If the value of conf_state is non-zero, then confidentiality and
integrity protection were used. If the value is zero, only integrity
service was used. Specify NULL if this parameter is not required.

qop_state
Specifies the quality of protection provided. Specify NULL if this
parameter is not required.

Errors
gss_unwrap() may return the following status codes:

GSS_S_COMPLETE
Successful completion.

GSS_S_DEFECTIVE_TOKEN
The token failed consistency checks.

GSS_S_BAD_SIG
The MIC was incorrect.

GSS_S_DUPLICATE_TOKEN
The token was valid, and contained a correct MIC for the
message, but it had already been processed.

GSS_S_OLD_TOKEN
The token was valid, and contained a correct MIC for the
message, but it is too old to check for duplication.
GSS_S_UNSEQ_TOKEN  The token was valid, and contained a correct MIC for the message, but has been verified out of sequence; a later token has already been received.

GSS_S_GAP_TOKEN  The token was valid, and contained a correct MIC for the message, but has been verified out of sequence; an earlier expected token has not yet been received.

GSS_SCONTEXT_EXPIRED  The context has already expired.

GSS_S_NO_CONTEXT  The context_handle parameter did not identify a valid context.

GSS_S_FAILURE  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  gss_release_buffer(3GSS), gss_wrap(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
# gss_verify_mic

## Synopsis
```
cc [ flag... ] file... -lgss [ library... ]
#include <gssapi/gssapi.h>

OM_uint32 gss_verify_mic(OM_uint32 *minor_status,
    const gss_ctx_id_t context_handle, const gss_buffer_t message_buffer,
    const gss_buffer_t token_buffer, gss_qop_t *qop_state);
```

## Description
The `gss_verify_mic()` function verifies that a cryptographic MIC, contained in the token parameter, fits the supplied message. The `qop_state` parameter allows a message recipient to determine the strength of protection that was applied to the message.

Since some application-level protocols may wish to use tokens emitted by `gss_wrap(3GSS)` to provide secure framing, the GSS-API supports the calculation and verification of MICs over zero-length messages.

## Parameters
The parameter descriptions for `gss_verify_mic()` follow:
- `minor_status`: The status code returned by the underlying mechanism.
- `context_handle`: Identifies the context on which the message arrived.
- `message_buffer`: The message to be verified.
- `token_buffer`: The token associated with the message.
- `qop_state`: Specifies the quality of protection gained from the MIC. Specify NULL if this parameter is not required.

## Errors
`gss_verify_mic()` may return the following status codes:
- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_DEFECTIVE_TOKEN**: The token failed consistency checks.
- **GSS_S_BAD_SIG**: The MIC was incorrect.
- **GSS_S_DUPLICATE_TOKEN**: The token was valid and contained a correct MIC for the message, but it had already been processed.
- **GSS_S_OLD_TOKEN**: The token was valid and contained a correct MIC for the message, but it is too old to check for duplication.
- **GSS_S_UNSEQ_TOKEN**: The token was valid and contained a correct MIC for the message, but it has been verified out of sequence; a later token has already been received.
- **GSS_S_GAP_TOKEN**: The token was valid and contained a correct MIC for the message, but it has been verified out of sequence; an earlier expected token has not yet been received.
- **GSS_S_CONTEXT_EXPIRED**: The context has already expired.
GSS_S_NO_CONTEXT
The context_handle parameter did not identify a valid context.

GSS_S_FAILURE
The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also

gss_wrap(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
The `gss_wrap()` function attaches a cryptographic MIC and optionally encrypts the specified `input_message`. The `output_message` contains both the MIC and the message. The `qop_req` parameter allows a choice between several cryptographic algorithms, if supported by the chosen mechanism.

Since some application-level protocols may wish to use tokens emitted by `gss_wrap()` to provide secure framing, the GSS-API supports the wrapping of zero-length messages.

**Parameters**

The parameter descriptions for `gss_wrap()` follow:

- `minor_status`: The status code returned by the underlying mechanism.
- `context_handle`: Identifies the context on which the message will be sent.
- `conf_req_flag`: If the value of `conf_req_flag` is non-zero, both confidentiality and integrity services are requested. If the value is zero, then only integrity service is requested.
- `qop_req`: Specifies the required quality of protection. A mechanism-specific default may be requested by setting `qop_req` to `GSS_C_QOP_DEFAULT`. If an unsupported protection strength is requested, `gss_wrap()` will return a `major_status` of `GSS_S_BAD_QOP`.
- `input_message_buffer`: The message to be protected.
- `conf_state`: If the value of `conf_state` is non-zero, confidentiality, data origin authentication, and integrity services have been applied. If the value is zero, then integrity services have been applied. Specify NULL if this parameter is not required.
- `output_message_buffer`: The buffer to receive the protected message. Storage associated with this message must be freed by the application after use with a call to `gss_release_buffer(3GSS)`.

**Errors**

`gss_wrap()` may return the following status codes:

- `GSS_S_COMPLETE`: Successful completion.
- `GSS_S_CONTEXT_EXPIRED`: The context has already expired.
GSS_S_NO_CONTEXT  The context_handle parameter did not identify a valid context.
GSS_S_BAD_QOP    The specified QOP is not supported by the mechanism.
GSS_S_FAILURE    The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  gss_release_buffer(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
The `gss_wrap_size_limit()` function allows an application to determine the maximum message size that, if presented to `gss_wrap()` with the same `conf_req_flag` and `qop_req` parameters, results in an output token containing no more than `req_output_size` bytes. This call is intended for use by applications that communicate over protocols that impose a maximum message size. It enables the application to fragment messages prior to applying protection. The GSS-API detects invalid QOP values when `gss_wrap_size_limit()` is called. This routine guarantees only a maximum message size, not the availability of specific QOP values for message protection.

Successful completion of `gss_wrap_size_limit()` does not guarantee that `gss_wrap()` will be able to protect a message of length `max_input_size` bytes, since this ability might depend on the availability of system resources at the time that `gss_wrap()` is called.

The parameter descriptions for `gss_wrap_size_limit()` are as follows:

- **minor_status**: A mechanism-specific status code.
- **context_handle**: A handle that refers to the security over which the messages will be sent.
- **conf_req_flag**: Indicates whether `gss_wrap()` will be asked to apply confidential protection in addition to integrity protection. See `gss_wrap(3GSS)` for more details.
- **qop_req**: Indicates the level of protection that `gss_wrap()` will be asked to provide. See `gss_wrap(3GSS)` for more details.
- **req_output_size**: The desired maximum size for tokens emitted by `gss_wrap()`.
- **max_input_size**: The maximum input message size that can be presented to `gss_wrap()` to guarantee that the emitted token will be no larger than `req_output_size` bytes.

`gss_wrap_size_limit()` returns one of the following status codes:

- **GSS_S_COMPLETE**: Successful completion.
- **GSS_S_NO_CONTEXT**: The referenced context could not be accessed.
- **GSS_S_CONTEXT_EXPIRED**: The context has expired.
GSS_S_BAD_QOP  The specified QOP is not supported by the mechanism.
GSS_S_FAILURE  The underlying mechanism detected an error for which no specific GSS status code is defined. The mechanism-specific status code reported by means of the minor_status parameter details the error condition.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  gss_wrap(3GSS), attributes(5)

Developer's Guide to Oracle Solaris 11 Security
htonl(3XNET)

Name  htonl, htons, ntohl, ntohs – convert values between host and network byte order

Synopsis  cc [ flag ... ] file ... -lxnet [ library ... ]
           #include <arpa/inet.h>

           uint32_t htonl(uint32_t hostlong);
           uint16_t htons(uint16_t hostshort);
           uint32_t ntohl(uint32_t netlong);
           uint16_t ntohs(uint16_t netshort);

Description  These functions convert 16-bit and 32-bit quantities between network byte order and host byte order.

The uint32_t and uint16_t types are made available by inclusion of <inttypes.h>.

Usage  These functions are most often used in conjunction with Internet addresses and ports as returned by gethostent(3XNET) and getservent(3XNET).

On some architectures these functions are defined as macros that expand to the value of their argument.

Return Values  The htonl() and htons() functions return the argument value converted from host to network byte order.

The ntohl() and ntohs() functions return the argument value converted from network to host byte order.

Errors  No errors are defined.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5)</td>
</tr>
</tbody>
</table>

See Also  endhostent(3XNET),endservent(3XNET),attributes(5),standards(5)
Name  icmp6_filter – Variable allocation datatype

Synopsis  
void ICMP6_FILTER_SETPASSALL (struct icmp6_filter *);
void ICMP6_FILTER_SETBLOCKALL (struct icmp6_filter *);
void ICMP6_FILTER_SETPASS (int, struct icmp6_filter *);
void ICMP6_FILTER_SETBLOCK (int, struct icmp6_filter *);
int ICMP6_FILTER_WILLPASS (int, const struct icmp6_filter *);
int ICMP6_FILTER_WILLBLOCK (int, const struct icmp6_filter *);

Description  
The icmp6_filter structure is similar to the fd_set datatype used with the select() function in the sockets API. The icmp6_filter structure is an opaque datatype and the application should not care how it is implemented. The application allocates a variable of this type, then passes a pointer to it. Next it passes a pointer to a variable of this type to getsockopt() and setsockopt() and operates on a variable of this type using the six macros defined below.

The SETPASSALL and SETBLOCKALL functions enable you to specify that all ICMPv6 messages are passed to the application or that all ICMPv6 messages are blocked from being passed.

The SETPASS and SETBLOCKALL functions enable you to specify that messages of a given ICMPv6 type should be passed to the application or not passed to the application (blocked).

The WILLPASS and WILLBLOCK return true or false depending whether the specified message type is passed to the application or blocked from being passed to the application by the filter pointed to by the second argument.

The pointer argument to all six icmp6_filter macros is a pointer to a filter that is modified by the first four macros and is examined by ICMP6_FILTER_SETBLOCK and ICMP6_FILTER_WILLBLOCK. The first argument, (an integer), to the ICMP6_FILTER_BLOCKALL, ICMP6_FILTER_SETPASS, ICMP6_FILTER_SETBLOCK, and ICMP6_FILTER_WILLBLOCK macros is an ICMPv6 message type, between 0 and 255.

The current filter is fetched and stored using getsockopt() and setsockopt() with a level of IPPROTO_ICMPV6 and an option name of ICMP6_FILTER.

Attributes  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>
This API defines two functions that map between an Internet Protocol network interface name and index, a third function that returns all the interface names and indexes, and a fourth function to return the dynamic memory allocated by the previous function.

Network interfaces are normally known by names such as eri0, sl1, ppp2, and the like. The *ifname* argument must point to a buffer of at least IF_NAMESIZE bytes into which the interface name corresponding to the specified index is returned. IF_NAMESIZE is defined in <net/if.h> and its value includes a terminating null byte at the end of the interface name.

The *if_nametoindex()* function returns the interface index corresponding to the interface name pointed to by the *ifname* pointer. If the specified interface name does not exist, the return value is 0, and *errno* is set to ENXIO. If there was a system error, such as running out of memory, the return value is 0 and *errno* is set to the proper value, for example, ENOMEM.

The *if_indextoname()* function maps an interface index into its corresponding name. This pointer is also the return value of the function. If there is no interface corresponding to the specified index, NULL is returned, and *errno* is set to ENXIO, if there was a system error, such as running out of memory, *if_indextoname()* returns NULL and *errno* would be set to the proper value, for example, ENOMEM.

The *if_nameindex()* function returns an array of *if_nameindex* structures, one structure per interface. The *if_nameindex* structure holds the information about a single interface and is defined when the <net/if.h> header is included:
struct if_nameindex
    unsigned int if_index; /* 1, 2, ... */
    char *if_name; /* "net0", "net1", ... */
};

While any IPMP IP interfaces are returned by if_nameindex(), the underlying IP interfaces that comprise each IPMP group are not returned.

The end of the array of structures is indicated by a structure with an if_index of 0 and an if_name of NULL. The function returns a null pointer upon an error and sets errno to the appropriate value. 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 the if_freenamexindex() function.

if_freenamexindex() The if_freenamexindex() function frees the dynamic memory that was allocated by if_nameindex(). The argument to this function must be a pointer that was returned by if_nameindex().

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also ifconfig(1M), if_nametoindex(3XNET), attributes(5), if(7P)
if_nametoindex, if_indextoname, if_nameindex, if_freenameindex – functions to map Internet Protocol network interface names and interface indexes

Synopsis

cc [ flag... ] file... -lxnet [ library... ]
#include <net/if.h>

unsigned int if_nametoindex(const char *ifname);
char *if_indextoname(unsigned int ifindex, char *ifname);
struct if_nameindex *if_nameindex(void);
void if_freenameindex(struct if_nameindex *ptr);

Parameters

These functions support the following parameters:

- **ifname** interface name
- **ifindex** interface index
- **ptr** pointer returned by if_nameindex()

Description

This API defines two functions that map between an Internet Protocol network interface name and index, a third function that returns all the interface names and indexes, and a fourth function to return the dynamic memory allocated by the previous function.

Network interfaces are normally known by names such as et0, sl1, ppp2, and the like. The ifname argument must point to a buffer of at least IF_NAMESIZE bytes into which the interface name corresponding to the specified index is returned. IF_NAMESIZE is defined in <net/if.h> and its value includes a terminating null byte at the end of the interface name.

- **if_nametoindex()**
The if_nametoindex() function returns the interface index corresponding to the interface name pointed to by the ifname pointer. If the specified interface name does not exist, the return value is 0, and errno is set to ENXIO. If there was a system error, such as running out of memory, the return value is 0 and errno is set to the proper value, for example, ENOMEM.

- **if_indextoname()**
The if_indextoname() function maps an interface index into its corresponding name. This pointer is also the return value of the function. If there is no interface corresponding to the specified index, NULL is returned, and errno is set to ENXIO, if there was a system error, such as running out of memory, if_indextoname() returns NULL and errno would be set to the proper value, for example, ENOMEM.

- **if_nameindex()**
The if_nameindex() function returns an array of if_nameindex structures, one structure per interface. The if_nameindex structure holds the information about a single interface and is defined when the <net/if.h> header is included:
struct if_nameindex {
    unsigned int if_index; /* 1, 2, ... */
    char *if_name; /* null terminated name: "eri0", ... */
};

The end of the array of structures is indicated by a structure with an
if_index of 0 and an if_name of NULL. The function returns a null
pointer upon an error and sets errno to the appropriate value. 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 the if_frenenameindex() function.

if_frenenameindex() The if_frenenameindex() function frees the dynamic memory that
was allocated by if_nameindex(). The argument to this function
must be a pointer that was returned by if_nameindex().

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library (32-bit)</td>
</tr>
<tr>
<td></td>
<td>SUNWcslx (64-bit)</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also ifconfig(1M), if_nametoindex(3SOCKET), attributes(5), standards(5), if(7P)
**Inet(3SOCKET)**

**Name**
inet, inet6, inet_ntop, inet_pton, inet_aton, inet_network, inet_makeaddr, inet_lnaof, inet_netof, inet_ntoa – Internet address manipulation

**Synopsis**
cc [ flag... ] file... -lsocket -lssl [ library... ]
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

const char *inet_ntop(int af, const void *addr, char *cp,
   socklen_t size);

int inet_pton(int af, const char *cp, void *addr);

int inet_aton(const char *cp, struct in_addr *addr);
in_addr_t inet_addr(const char *cp);
in_addr_t inet_network(const char *cp);

struct in_addr inet_makeaddr(const int net, in_addr_t lna);
in_addr_t inet_lnaof(struct in_addr in);
in_addr_t inet_netof(struct in_addr in);
char *inet_ntoa(struct in_addr in);

**Description**
The `inet_ntop()` and `inet_pton()` functions can manipulate both IPv4 and IPv6 addresses. The `inet_aton()`, `inet_addr()`, `inet_network()`, `inet_makeaddr()`, `inet_lnaof()`, `inet_netof()`, and `inet_ntoa()` functions can only manipulate IPv4 addresses.

The `inet_ntop()` function converts a numeric address into a string suitable for presentation. The `af` argument specifies the family of the address which can be AF_INET or AF_INET6. The `addr` argument points to a buffer that holds an IPv4 address if the `af` argument is AF_INET. The `addr` argument points to a buffer that holds an IPv6 address if the `af` argument is AF_INET6. The address must be in network byte order. The `cp` argument points to a buffer where the function stores the resulting string. The application must specify a non-NULL `cp` argument. The `size` argument specifies the size of this buffer. For IPv6 addresses, the buffer must be at least 46-octets. For IPv4 addresses, the buffer must be at least 16-octets. 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>`:

```c
#define INET_ADDRSTRLEN 16
#define INET6_ADDRSTRLEN 46
```

The `inet_pton()` function converts the standard text presentation form of an address into its numeric binary form. The `af` argument specifies the family of the address. Currently, the AF_INET and AF_INET6 address families are supported. The `cp` argument points to the string being passed in. The `addr` argument points to a buffer where the function stores the numeric address. The calling application must ensure that the buffer referred to by `addr` is large enough to hold the numeric address, at least 4 bytes for AF_INET or 16 bytes for AF_INET6.
The `inet_aton()`, `inet_addr()` and `inet_network()` functions interpret character strings that represent numbers expressed in the IPv4 standard '.' notation, returning numbers suitable for use as IPv4 addresses and IPv4 network numbers, respectively. The `inet_makeaddr()` function uses an IPv4 network number and a local network address to construct an IPv4 address. The `inet_ntof()` and `inet_ntof()` functions break apart IPv4 host addresses, then return the network number and local network address, respectively.

The `inet_ntoa()` function returns a pointer to a string in the base 256 notation d.d.d.d. See the following section on IPv4 addresses.

Internet addresses are returned in network order, bytes ordered from left to right. Network numbers and local address parts are returned as machine format integer values.

### IPv6 Addresses

There are three conventional forms for representing IPv6 addresses as strings:

1. The preferred form is x::x::x::x::x::x, where the 'x' s are the hexadecimal values of the eight 16-bit pieces of the address. For example:
   
   `1080:0:0:8:800:200C:417A`

   It is not necessary to write the leading zeros in an individual field. There must be at least one numeral in every field, except when the special syntax described in the following is used.

2. It is common for addresses to contain long strings of zero bits in some methods used to allocate certain IPv6 address styles. A special syntax is available to compress the zeros. The use of `::` indicates multiple groups of 16 bits of zeros. The `::` may only appear once in an address. The `:` can also be used to compress the leading and trailing zeros in an address. For example:
   
   `1080::8:800:200C:417A`

3. The alternative form x:x:x:x:d.d.d.d is sometimes more convenient when dealing with a mixed environment of IPv4 and IPv6 nodes. The 'x' s in this form represent the hexadecimal values of the six high-order 16-bit pieces of the address. The d's represent the decimal values of the four low-order 8-bit pieces of the standard IPv4 address. For example:
   
   `::FFFF:129.144.52.38`
   `::129.144.52.38`

The `::FFFF:d.d.d.d` and `::d.d.d.d` pieces are the general forms of an IPv4-mapped IPv6 address and an IPv4-compatible IPv6 address.

The IPv4 portion must be in the d.d.d.d form. The following forms are invalid:

   `::FFFF:d.d.d`
   `::FFFF:d.d`
   `::d.d.d`
   `::d.d`
The ::FFFF:d form is a valid but unconventional representation of the IPv4–compatible IPv6 address ::255.255.0.d.

The ::d form corresponds to the general IPv6 address 0:0:0:0:0:0:0:d.

IPv4 Addresses

Values specified using ’.’ notation take one of the following forms:

d.d.d.d

d.d.d

d.d

d

When four parts are specified, each part is interpreted as a byte of data and assigned from left to right to the four bytes of an IPv4 address.

When a three-part address is specified, the last part is interpreted as a 16-bit quantity and placed in the rightmost two bytes of the network address. The three part address format is convenient for specifying Class B network addresses such as 128.net.host.

When a two-part address is supplied, the last part is interpreted as a 24-bit quantity and placed in the rightmost three bytes of the network address. The two part address format is convenient for specifying Class A network addresses such as net.host.

When only one part is given, the value is stored directly in the network address without any byte rearrangement.

With the exception of inet_pton(), numbers supplied as parts in ’.’ notation may be decimal, octal, or hexadecimal, as specified in C language. For example, a leading 0x or 0X implies hexadecimal. A leading 0 implies octal. Otherwise, the number is interpreted as decimal.

For IPv4 addresses, inet_pton() accepts only a string in standard IPv4 dot notation:

d.d.d.d

Each number has one to three digits with a decimal value between 0 and 255.

The inet_addr() function has been obsoleted by inet_aton().

Return Values

The inet_aton() function returns nonzero if the address is valid, 0 if the address is invalid.

The inet_ntop() function returns a pointer to the buffer that contains a string if the conversion succeeds. Otherwise, NULL is returned. Upon failure, errno is set to EAFNOSUPPORT if the af argument is invalid or ENOSPC if the size of the result buffer is inadequate.

The inet_pton() function returns 1 if the conversion succeeds, 0 if the input is not a valid IPv4 dotted-decimal string or a valid IPv6 address string. The function returns −1 with errno set to EAFNOSUPPORT if the af argument is unknown.

The value INADDR_NONE, which is equivalent to (in_addr_t)(-1), is returned by inet_addr() and inet_network() for malformed requests.
The functions `inet_netof()` and `inet_lnaof()` break apart IPv4 host addresses, returning the network number and local network address part, respectively.

The function `inet_ntoa()` returns a pointer to a string in the base 256 notation d.d.d.d, described in the section on IPv4 addresses.

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
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</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>See below.</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

The `inet_ntop()`, `inet_nton()`, `inet_aton()`, `inet_addr()`, and `inet_network()` functions are Committed. The `inet_lnaof()`, `inet_makeaddr()`, `inet_netof()`, and `inet_network()` functions are Committed (Obsolete).

**See Also**  gethostbyname(3NSL), getipnodebyname(3SOCKET), getnetbyname(3SOCKET), inet.h(3HEAD), hosts(4), networks(4), attributes(5)

**Notes**  The return value from `inet_ntoa()` points to a buffer which is overwritten on each call. This buffer is implemented as thread-specific data in multithreaded applications.

IPv4-mapped addresses are not recommended.

**Bugs**  The problem of host byte ordering versus network byte ordering is confusing. A simple way to specify Class C network addresses in a manner similar to that for Class B and Class A is needed.
inet6_opt, inet6_opt_init, inet6_opt_append, inet6_opt_finish, inet6_opt_set_val, inet6_opt_next, inet6_opt_find, inet6_opt_get_val – Option manipulation mechanism

cc [ flag ... ] file ... -lsocket [library...]
#include <netinet/in.h>

int inet6_opt_init(void *extbuf, socklen_t extlen);
int inet6_opt_append(void *extbuf, socklen_t extlen,
                      int offset, uint8_t type, socklen_t len, uint_t align,
                      void **databufp);
int inet6_opt_finish(void *extbuf, socklen_t extlen,
                     int offset);
int inet6_opt_set_val(void *databuf, int offset,
                      void *val, socklen_t vallen);
int inet6_opt_next(void *extbuf, socklen_t extlen,
                   int offset, uint8_t *typep, socklen_t *lenp,
                   void **databufp);
int inet6_opt_find(void *extbuf, socklen_t extlen, int offset,
                   uint8_t *type, socklen_t *lenp, void **databufp);
int inet6_opt_get_val(void *databuf, int offset,
                      void *val, socklen_t *vallen);

**Description**
The `inet6_opt` functions enable users to manipulate options without having to know the structure of the option header.

The `inet6_opt_init()` function returns the number of bytes needed for the empty extension header, that is, without any options. If `extbuf` is not NULL, it also initializes the extension header to the correct length field. If the `extlen` value is not a positive non-zero multiple of 8, the function fails and returns −1.

The `inet6_opt_append()` function returns the updated total length while adding an option with length `len` and alignment `align`. If `extbuf` is not NULL, then, in addition to returning the length, the function inserts any needed Pad option, initializes the option setting the type and length fields, and returns a pointer to the location for the option content in `databufp`. If the option does not fit in the extension header buffer, the function returns −1. The type is the 8-bit option type. The `len` is the length of the option data, excluding the option type and option length fields. Once `inet6_opt_append()` is called, the application can use the `databuf` directly, or `inet6_opt_set_val()` can be used to specify the content of the option. The option type must have a value from 2 to 255, inclusive. The values 0 and 1 are reserved for the Pad1 and PadN options, respectively. The option data length must have a value between 0 and 255, inclusive, and it is the length of the option data that follows. The align parameter must have a value of 1, 2, 4, or 8. The align value cannot exceed the value of `len`.

The `inet6_opt_finish()` function returns the updated total length the takes into account the final padding of the extension header to make it a multiple of 8 bytes. If `extbuf` is not NULL, the
The `inet6_opt_set_val()` function inserts data items of various sizes in the data portion of the option. The `val` parameter should point to the data to be inserted. The `offset` specifies the data portion of the option in which the value should be inserted. The first byte after the option type and length is accessed by specifying an `offset` of zero.

The `inet6_opt_next()` function parses the received option extension headers which return the next option. The `extbuf` and `extlen` parameters specify the extension header. The `offset` should be zero for the first option or the length returned by a previous call to either `inet6_opt_next()` or `inet6_opt_find()`. The `offset` specifies where to continue scanning the extension buffer. The subsequent option is returned by updating `typep`, `lenp`, and `databufp`. The `typep` argument stores the option type. The `lenp` argument stores the length of the option data, excluding the option type and option length fields. The `databufp` argument points to the data field of the option.

The `inet6_opt_find()` function is similar to the `inet6_opt_next()` function. Unlike `inet6_opt_next()`, the `inet6_opt_find()` function enables the caller to specify the option type to be searched for, rather than returning the next option in the extension header.

The `inet6_opt_get_val()` function extracts data items of various sizes in the portion of the option. The `val` argument should point to the destination for the extracted data. The `offset` specifies at which point in the option’s data portion the value should be extracted. The first byte following the option type and length is accessed by specifying an `offset` of zero.

### Return Values

- **inet6_opt_init()** function returns the number of bytes needed for the empty extension header. If the `extlen` value is not a positive non-zero multiple of 8, the function fails and returns −1.

- **inet6_opt_append()** function returns the updated total length.

- **inet6_opt_finish()** function returns the updated total length.

- **inet6_opt_set_val()** function returns the `offset` for the subsequent field.

- **inet6_opt_next()** function returns the updated "previous" length computed by advancing past the option that was returned. When there are no additional options or if the option extension header is malformed, the return value is −1.

- **inet6_opt_find()** function returns the updated "previous" total length. If an option of the specified type is not located, the return value is −1. If the option extension header is malformed, the return value is −1.

- **inet6_opt_get_val()** function returns the `offset` for the next field (that is, `offset + vallen`) which can be used when extracting option content with multiple fields.
**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
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<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

**See Also**  RFC 3542 – Advanced Sockets Application Programming Interface (API) for IPv6, The Internet Society. May 2003
#include <netinet/in.h>

socklen_t inet6_rth_space(int type, int segments);

void *inet6_rth_init(void *bp, socklen_t bp_len, int type, int segments);

int inet6_rth_add(void *bp, const struct, in6_addr *addr);

int inet6_rth_reverse(const void *in, void *out);

int inet6_rth_segments(const void *bp);

struct in6_addr *inet6_rth_getaddr(const void *bp, int index);

The inet6_rth functions enable users to manipulate routing headers without having knowledge of their structure.

The inet6_rth_init() function 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. The bp_len argument is used only to verify that the buffer is large enough. The ip6r_sgleft field is set to zero and inet6_rth_add() increments it. The caller allocates the buffer and its size can be determined by calling inet6_rth_space().

The inet6_rth_add() function adds the IPv6 address pointed to by addr to the end of the routing header that is being constructed.

The inet6_rth_reverse() function takes a routing header extension header pointed to by the first argument and writes a new routing header that sends datagrams along the reverse of the route. The function reverses the order of the addresses and sets the sgleft member in the new routing header to the number of segments. Both arguments can point to the same buffer (that is, the reversal can occur in place).

The inet6_rth_segments() function returns the number of segments (addresses) contained in the routing header described by bp.

The inet6_rth_getaddr() function returns a pointer to the IPv6 address specified by index, which must have a value between 0 and one less than the value returned by inet6_rth_segments() in the routing header described by bp. Applications should first call inet6_rth_segments() to obtain the number of segments in the routing header.

The inet6_rth_space() function returns the size, but the function does not allocate the space required for the ancillary data routing header.

Routing Headers

To receive a routing header, the application must enable the IPV6_RECV_RTHDR socket option:

```c
int on = 1;
setsockopt (fd, IPPROTO_IPV6, IPV6_RECV_RTHDR, &on, sizeof(on));
```
Each received routing header is returned as one ancillary data object described by a cmsghdr structure with cmsg_type set to IPV6_RTHDR.

To send a routing header, the application specifies it either as ancillary data in a call to sendmsg() or by using setsockopt(). For the sending side, this API assumes the number of occurrences of the routing header as described in RFC-2460. Applications can specify no more than one outgoing routing header.

The application can remove any sticky routing header by calling setsockopt() for IPV6_RTHDR with a zero option length.

When using ancillary data, a routing header is passed between the application and the kernel as follows: The cmsg_level member has a value of IPPROTO_IPV6 and the cmsg_type member has a value of IPV6_RTHDR. The contents of the cmsg_data member is implementation-dependent and should not be accessed directly by the application, but should be accessed using the inet6_rth functions.

The following constant is defined as a result of including the <netinet/in.h>:

```
#define IPV6_RTHDR_TYPE_0 0 /* IPv6 Routing header type 0 */
```

Source routing in IPv6 is accomplished by specifying a routing header as an extension header. There are a number of different routing headers, but IPv6 currently defines only the Type 0 header. See RFC-2460. The Type 0 header supports up to 127 intermediate nodes, limited by the length field in the extension header. With this maximum number of intermediate nodes, a source, and a destination, there are 128 hops.

### Return Values

The `inet6_rth_init()` function returns a pointer to the buffer (bp) upon success.

For the `inet6_rth_add()` function, the segleft member of the routing header is updated to account for the new address in the routing header. The function returns 0 upon success and −1 upon failure.

The `inet6_rth_reverse()` function returns 0 upon success or −1 upon an error.

The `inet6_rth_segments()` function returns 0 or greater upon success and −1 upon an error.

The `inet6_rth_getaddr()` function returns NULL upon an error.

The `inet6_rth_space()` function returns the size of the buffer needed for the routing header.

### Attributes

See attributes(5) for descriptions of the following attributes:

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</tbody>
</table>
See Also  RFC 3542 – Advanced Sockets Application Programming Interface (API) for IPv6, The Internet Society. May 2003
inet_addr(3XNET)

Name
inet_addr, inet_network, inet_makeaddr, inet_lnaof, inet_netof, inet_ntoa – Internet address manipulation

Synopsis
cc [ flag ... ] file ... -lxnet [ library ... ]
#include <arpa/inet.h>

in_addr_t inet_addr(const char *cp);
in_addr_t inet_lnaof(struct in_addr in);
struct in_addr inet_makeaddr(in_addr_t net, in_addr_t lna);
in_addr_t inet_netof(struct in_addr in);
in_addr_t inet_network(const char *cp);
char *inet_ntoa(struct in_addr in);

Description
The inet_addr() function converts the string pointed to by cp, in the Internet standard dot notation, to an integer value suitable for use as an Internet address.

The inet_lnaof() function takes an Internet host address specified by in and extracts the local network address part, in host byte order.

The inet_makeaddr() function takes the Internet network number specified by net and the local network address specified by lna, both in host byte order, and constructs an Internet address from them.

The inet_netof() function takes an Internet host address specified by in and extracts the network number part, in host byte order.

The inet_network() function converts the string pointed to by cp, in the Internet standard dot notation, to an integer value suitable for use as an Internet network number.

The inet_ntoa() function converts the Internet host address specified by in to a string in the Internet standard dot notation.

All Internet addresses are returned in network order (bytes ordered from left to right).

Values specified using dot notation take one of the following forms:

a.b.c.d  When four parts are specified, each is interpreted as a byte of data and assigned, from left to right, to the four bytes of an Internet address.

a.b.c  When a three-part address is specified, the last part is interpreted as a 16-bit quantity and placed in the rightmost two 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 supplied, the last part is interpreted as a 24-bit quantity and placed in the rightmost three bytes of the network address. This makes the two-part address format convenient for specifying Class A network addresses as net.host.

When only one part is given, the value is stored directly in the network address without any byte rearrangement.

All numbers supplied as parts in dot notation may be decimal, octal, or hexadecimal, that is, a leading 0x or 0X implies hexadecimal, as specified in the ISO C standard; otherwise, a leading 0 implies octal; otherwise, the number is interpreted as decimal.

Usage
The return value of inet_ntoa() may point to static data that may be overwritten by subsequent calls to inet_ntoa().

Return Values
Upon successful completion, inet_addr() returns the Internet address. Otherwise, it returns (in_addr_t)(-1).

Upon successful completion, inet_network() returns the converted Internet network number. Otherwise, it returns (in_addr_t)(-1).

The inet_makeaddr() function returns the constructed Internet address.

The inet_lnaof() function returns the local network address part.

The inet_netof() function returns the network number.

The inet_ntoa() function returns a pointer to the network address in Internet-standard dot notation.

Errors
No errors are defined.

Attributes
See attributes(5) for descriptions of the following attributes:

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<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also endhostent(3XNET), endnetent(3XNET), attributes(5), standards(5)
inet_cidr_ntop, inet_cidr_pton – network translation routines

Synopsis

cc [ flag... ] file... -lresolv -lsocket -lnsl [ library...]
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

char *inet_cidr_ntop(int af, const void *src, int bits, char *dst, size_t size);
int inet_cidr_pton(int af, const char *src, void *dst, int *bits);

Description

These routines are used for converting addresses to and from network and presentation forms with CIDR (Classless Inter-Domain Routing) representation, embedded net mask.

The inet_cidr_ntop() function converts an address from network to presentation format.

The af parameter describes the type of address that is being passed in src. Currently only AF_INET is supported.

The src parameter is an address in network byte order, its length is determined from af.

The bits parameter specifies the number of bits in the netmask unless it is -1 in which case the CIDR representation is omitted.

The dst parameter is a caller supplied buffer of at least size bytes.

The inet_cidr_ntop() function returns dst on success or NULL. Check errno for reason.

The inet_cidr_pton() function converts and address from presentation format, with optional CIDR representation, to network format. The resulting address is zero filled if there were insufficient bits in src.

The af parameter describes the type of address that is being passed in via src and determines the size of dst.

The src parameter is an address in presentation format.

The bits parameter returns the number of bits in the netmask or -1 if a CIDR representation was not supplied.

The inet_cidr_pton() function returns 0 on success or -1 on error. Check errno for reason. ENOENT indicates an invalid netmask.

Attributes

See attributes(5) for descriptions of the following attributes:
### See Also

[Intro(2), attributes(5)]
inet_ntop, inet_pton – convert IPv4 and IPv6 addresses between binary and text form

**Synopsis**
```
cc [ flag ... ] file ... -lxnet [ library ... ]
#include <arpa/inet.h>
```

```c
const char *inet_ntop(int af, const void *restrict src, char *restrict dst, socklen_t size);
int inet_pton(int af, const char *restrict src, dst);
```

**Description**
The `inet_ntop()` function converts a numeric address into a text string suitable for presentation. The `af` argument specifies the family of the address. This can be `AF_INET` or `AF_INET6`. The `src` argument points to a buffer holding an IPv4 address if the `af` argument is `AF_INET`, or an IPv6 address if the `af` argument is `AF_INET6`. The `dst` argument points to a buffer where the function stores the resulting text string; it cannot be `NULL`. The `size` argument specifies the size of this buffer, which must be large enough to hold the text string (`INET_ADDRSTRLEN` characters for IPv4, `INET6_ADDRSTRLEN` characters for IPv6).

The `inet_pton()` function converts an address in its standard text presentation form into its numeric binary form. The `af` argument specifies the family of the address. The `AF_INET` and `AF_INET6` address families are supported. The `src` argument points to the string being passed in. The `dst` argument points to a buffer into which the function stores the numeric address; this must be large enough to hold the numeric address (32 bits for `AF_INET`, 128 bits for `AF_INET6`).

If the `af` argument of `inet_pton()` is `AF_INET`, the `src` string is in the standard IPv4 dotted-decimal form:

```
  dddddddddd
```

where "dddd" is a one to three digit decimal number between 0 and 255 (see `inet_addr(3XNET)`). The `inet_pton()` function does not accept other formats (such as the octal numbers, hexadecimal numbers, and fewer than four numbers that `inet_addr()` accepts).

If the `af` argument of `inet_pton()` is `AF_INET6`, the `src` string is 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 must 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") can be represented simply as "::".

3. A third form that is sometimes more convenient when dealing with a mixed environment of IPv4 and IPv6 nodes is "x:x:x:x:x:x:d.d.d.d", where the '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).
A more extensive description of the standard representations of IPv6 addresses can be found in RFC 2373.

**Return Values**  The `inet_ntop()` function returns a pointer to the buffer containing the text string if the conversion succeeds. Otherwise it returns `NULL` and sets `errno` to indicate the error.

The `inet_pton()` function returns 1 if the conversion succeeds, with the address pointed to by `dst` in network byte order. It returns 0 if the input is not a valid IPv4 dotted-decimal string or a valid IPv6 address string. It returns −1 and sets `errno` to `EAFNOSUPPORT` if the `af` argument is unknown.

**Errors**  The `inet_ntop()` and `inet_pton()` functions will fail if:

- `EAFNOSUPPORT`  The `af` argument is invalid.
- `ENOSPC`  The size of the `inet_ntop()` result buffer is inadequate.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

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<td>See <code>standards(5)</code>.</td>
</tr>
</tbody>
</table>

**See Also**  `inet_addr(3XNET), attributes(5)`
The Lightweight Directory Access Protocol ("LDAP") package (SUNWldap) includes various command line LDAP clients and a LDAP client library to provide programmatic access to the LDAP protocol. This man page gives an overview of the LDAP client library functions.

An application might use the LDAP client library functions as follows. The application would initialize a LDAP session with a LDAP server by calling `ldap_init(3LDAP)`. Next, it authenticates to the LDAP server by calling `ldap_sasl_bind(3LDAP)` and friends. It may perform some LDAP operations and obtain results by calling `ldap_search(3LDAP)` and friends. To parse the results returned from these functions, it calls `ldap_parse_result(3LDAP), ldap_next_entry(3LDAP), and ldap_first_entry(3LDAP)` and others. It closes the LDAP session by calling `ldap_unbind(3LDAP).

LDAP operations can be either synchronous or asynchronous. By convention, the names of the synchronous functions end with "_s." For example, a synchronous binding to the LDAP server can be performed by calling `ldap_sasl_bind_s(3LDAP)`. Complete an asynchronous binding with `ldap_sasl_bind(3LDAP)`. All synchronous functions return the actual outcome of the operation, either LDAP_SUCCESS or an error code. Asynchronous routines provide an invocation identifier which can be used to obtain the result of a specific operation by passing it to the `ldap_result(3LDAP)` function.

Initializing a LDAP session

Initializing a LDAP session involves calling the `ldap_init(3LDAP)` function. However, the call does not actually open a connection to the LDAP server. It merely initializes a LDAP structure that represents the session. The connection is opened when the first operation is attempted. Unlike `ldap_init()`, `ldap_open(3LDAP)` attempts to open a connection with the LDAP server. However, the use of `ldap_open()` is deprecated.

Authenticating to a LDAP server

The `ldap_sasl_bind(3LDAP)` and `ldap_sasl_bind_s(3LDAP)` functions provide general and extensible authentication for an LDAP client to a LDAP server. Both use the Simple Authentication Security Layer (SASL). Simplified routines `ldap_simple_bind(3LDAP)` and `ldap_simple_bind_s(3LDAP)` use cleartext passwords to bind to the LDAP server. Use of `ldap_bind(3LDAP)` and `ldap_bind_s(3LDAP)` is deprecated.

Searching a LDAP directory

Search for an entry in a LDAP directory by calling the `ldap_search_ext(3LDAP)` or the `ldap_search_ext_s(3LDAP)` functions. These functions support LDAPv3 server controls, client controls and variable size and time limits as arguments for each search operation. `ldap_search(3LDAP)` and `ldap_search_s(3LDAP)` are identical functions but do not support the controls and limits as arguments to the call.
Adding or Deleting an entry

Use `ldap_add_ext(3LDAP)` and `ldap_delete_ext(3LDAP)` to add or delete entries in a LDAP directory server. The synchronous counterparts to these functions are `ldap_add_ext_s(3LDAP)` and `ldap_delete_ext_s(3LDAP)`. The `ldap_add(3LDAP)`, `ldap_add_s(3LDAP)`, `ldap_delete(3LDAP)`, and `ldap_delete_s(3LDAP)` provide identical functionality to add and to delete entries, but they do not support LDAP v3 server and client controls.

Modifying Entries

Use `ldap_modify_ext(3LDAP)` and `ldap_modify_ext_s(3LDAP)` to modify an existing entry in a LDAP server that supports for LDAPv3 server and client controls. Similarly, use `ldap_rename(3LDAP)` and `ldap_rename_s(3LDAP)` to change the name of an LDAP entry. The `ldap_modrdn(3LDAP)`, `ldap_modrdn_s(3LDAP)`, `ldap_modrdn2(3LDAP)`, and `ldap_modrdn2_s(3LDAP)` interfaces are deprecated.

Obtaining Results

Use `ldap_result(3LDAP)` to obtain the results of a previous asynchronous operation. For all LDAP operations other than search, only one message is returned. For the search operation, a list of result messages can be returned.

Handling Errors and Parsing Results

Use the `ldap_parse_result(3LDAP)`, `ldap_parse_sasl_bind_result(3LDAP)`, and the `ldap_parse_extended_result(3LDAP)` functions to extract required information from results and to handle the returned errors. To covert a numeric error code into a null-terminated character string message describing the error, use `ldap_err2string(3LDAP)`. The `ldap_result2error(3LDAP)` and `ldap_perror(3LDAP)` functions are deprecated. To step through the list of messages in a result returned by `ldap_result()`, use `ldap_first_message(3LDAP)` and `ldap_next_message(3LDAP)`. `ldap_count_messages(3LDAP)` returns the number of messages contained in the list.

You can use `ldap_first_entry(3LDAP)` and `ldap_next_entry(3LDAP)` to step through and obtain a list of entries from a list of messages returned by a search result. `ldap_count_entries(3LDAP)` returns the number of entries contained in a list of messages. Call either `ldap_first_attribute(3LDAP)` and `ldap_next_attribute(3LDAP)` to step through a list of attributes associated with an entry. Retrieve the values of a given attribute by calling `ldap_get_values(3LDAP)` and `ldap_get_values_len(3LDAP)`. Count the number of values returned by using `ldap_count_values(3LDAP)` and `ldap_count_values_len(3LDAP)`.

Use the `ldap_get_lang_values(3LDAP)` and `ldap_get_lang_values_len(3LDAP)` to return an attribute's values that matches a specified language subtype. The `ldap_get_lang_values()` function returns an array of an attribute's string values that matches a specified language subtype. To retrieve the binary data from an attribute, call the `ldap_get_lang_values_len()` function instead.

Uniform Resource Locators (URLS)

You can use the `ldap_url(3LDAP)` function to test a URL to verify that it is an LDAP URL, to parse LDAP URLs into their component pieces, to initiate searches directly using an LDAP URL, and to retrieve the URL associated with a DNS domain name or a distinguished name.
### User Friendly Naming

The `ldap_ufn(3LDAP)` functions implement a user friendly naming scheme by means of LDAP. This scheme allows you to look up entries using fuzzy, untyped names like "mark smith, umich, us".

### Caching

The `ldap_memcache(3LDAP)` functions provide an in-memory client side cache to store search requests. Caching improves performance and reduces network bandwidth when a client makes repeated requests.

### Utility Functions

There are also various utility functions. You can use the `ldap_sort(3LDAP)` functions are used to sort the entries and values returned by means of the ldap search functions. The `ldap_friendly(3LDAP)` functions will map from short two letter country codes or other strings to longer “friendlier” names. Use the `ldap_charset(3LDAP)` functions to translate to and from the T.61 character set that is used for many character strings in the LDAP protocol.

### Generating Filters

Make calls to `ldap_init_getfilter(3LDAP)` and `ldap_search(3LDAP)` to generate filters to be used in `ldap_search(3LDAP)` and `ldap_search_s(3LDAP)`. `ldap_init_getfilter()` reads `ldapfilter.conf(4)`, the LDAP configuration file, while `ldap_init_getfilter_buf()` reads the configuration information from `buf` of length ` buflen`. `ldap_getfilter_free(3LDAP)` frees memory that has been allocated by means of `ldap_init_getfilter()`.

### BER Library

The LDAP package includes a set of lightweight Basic Encoding Rules ("BER") functions. The LDAP library functions use the BER functions to encode and decode LDAP protocol elements through the slightly simplified BER defined by LDAP. They are not normally used directly by an LDAP application program will not normally use the BER functions directly. Instead, these functions provide a `printf()` and `scanf()`-like interface, as well as lower-level access.

### List Of Interfaces

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<tr>
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<td>Initialize a session with a LDAP server without opening a connection to a server.</td>
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<td><code>ldap_result(3LDAP)</code></td>
<td>Obtain the result from a previous asynchronous operation.</td>
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<tr>
<td><code>ldap_add_ext(3LDAP)</code></td>
<td>Asynchronously add an entry with support for LDAPv3 controls.</td>
</tr>
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<td><code>ldap_add_ext_s(3LDAP)</code></td>
<td>Synchronously add an entry with support for LDAPv3 controls.</td>
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<tr>
<td><code>ldap_bind(3LDAP)</code></td>
<td>Deprecated. Use <code>ldap_sasl_bind(3LDAP)</code> or <code>ldap_simple_bind(3LDAP)</code>.</td>
</tr>
<tr>
<td>Function</td>
<td>Description</td>
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<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>ldap_sasl_bind(3LDAP)</td>
<td>Asynchronously bind to the directory using SASL authentication</td>
</tr>
<tr>
<td>ldap_sasl_bind_s(3LDAP)</td>
<td>Synchronously bind to the directory using SASL authentication</td>
</tr>
<tr>
<td>ldap_bind_s(3LDAP)</td>
<td>Deprecated. Use ldap_sasl_bind_s(3LDAP) or ldap_simple_bind_s(3LDAP).</td>
</tr>
<tr>
<td>ldap_simple_bind(3LDAP)</td>
<td>Asynchronously bind to the directory using simple authentication.</td>
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</tr>
<tr>
<td>ldap_unbind(3LDAP)</td>
<td>Synchronously unbind from the LDAP server, close the connection, and dispose the session handle.</td>
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<tr>
<td>ldap_unbind_ext(3LDAP)</td>
<td>Synchronously unbind from the LDAP server and close the connection. ldap_unbind_ext() allows you to explicitly include both server and client controls in the unbind request.</td>
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<tr>
<td>ldap_set_rebind_proc(3LDAP)</td>
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<td>ldap_memcache_update(3LDAP)</td>
<td>Checks the cache for items that have expired and removes them.</td>
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<td>ldap_compare(3LDAP)</td>
<td>Asynchronous compare with a directory entry.</td>
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<td>Synchronous compare with a directory entry.</td>
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<tr>
<td>ldap_compare_ext(3LDAP)</td>
<td>Asynchronous compare with a directory entry, with support for LDAPv3 controls.</td>
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</tbody>
</table>
ldap_compare_ext_s(3LDAP)  Synchronous compare with a directory entry, with support for LDAPv3 controls.
ldap_control_free(3LDAP)     Dispose of an LDAP control.
ldap_controls_free(3LDAP)    Dispose of an array of LDAP controls.
ldap_delete(3LDAP)           Asynchronously delete an entry.
ldap_delete_s(3LDAP)         Synchronously delete an entry.
ldap_delete_ext(3LDAP)       Asynchronously delete an entry, with support for LDAPv3 controls.
ldap_delete_ext_s(3LDAP)     Synchronously delete an entry, with support for LDAPv3 controls.
ldap_init_templates(3LDAP)   Read a sequence of templates from a LDAP template configuration file.
ldap_init_templates_buf(3LDAP) Read a sequence of templates from a buffer.
ldap_free_templates(3LDAP)   Dispose of the templates allocated.
ldap_first_reference(3LDAP)  Step through a list of continuation references from a search result.
ldap_next_reference(3LDAP)   Step through a list of continuation references from a search result.
ldap_count_references(3LDAP) Count the number of messages in a search result.
ldap_first_message(3LDAP)    Step through a list of messages in a search result.
ldap_count_messages(3LDAP)   Count the messages in a list of messages in a search result.
ldap_next_message(3LDAP)     Step through a list of messages in a search result.
ldap_msgtype(3LDAP)          Return the type of LDAP message.
ldap_first_disptmpl(3LDAP)   Get first display template in a list.
ldap_next_disptmpl(3LDAP)    Get next display template in a list.
ldap_oc2template(3LDAP)      Return template appropriate for the objectclass.
ldap_name2template(3LDAP)    Return named template
ldap_tmplattrs(3LDAP)        Return attributes needed by the template.
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<td>Return first row of displayable items in a template.</td>
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<td><code>ldap_next_tmplrow(3LDAP)</code></td>
<td>Return next row of displayable items in a template.</td>
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<td><code>ldap_first_tmplcol(3LDAP)</code></td>
<td>Return first column of displayable items in a template.</td>
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<td><code>ldap_next_tmplcol(3LDAP)</code></td>
<td>Return next column of displayable items in a template.</td>
</tr>
<tr>
<td><code>ldap_entry2text(3LDAP)</code></td>
<td>Display an entry as text by using a display template.</td>
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<tr>
<td><code>ldap_entry2text_search(3LDAP)</code></td>
<td>Search for and display an entry as text by using a display template.</td>
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<tr>
<td><code>ldap_vals2text(3LDAP)</code></td>
<td>Display values as text.</td>
</tr>
<tr>
<td><code>ldap_entry2html(3LDAP)</code></td>
<td>Display an entry as HTML (HyperText Markup Language) by using a display template.</td>
</tr>
<tr>
<td><code>ldap_entry2html_search(3LDAP)</code></td>
<td>Search for and display an entry as HTML by using a display template.</td>
</tr>
<tr>
<td><code>ldap_vals2html(3LDAP)</code></td>
<td>Display values as HTML.</td>
</tr>
<tr>
<td><code>ldap_perror(3LDAP)</code></td>
<td>Deprecated. Use <code>ldap_parse_result(3LDAP)</code></td>
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<tr>
<td><code>ldap_result2error(3LDAP)</code></td>
<td>Deprecated. Use <code>ldap_parse_result(3LDAP)</code></td>
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<tr>
<td><code>ldap_err2string(3LDAP)</code></td>
<td>Convert LDAP error indication to a string.</td>
</tr>
<tr>
<td><code>ldap_first_attribute(3LDAP)</code></td>
<td>Return first attribute name in an entry.</td>
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<td><code>ldap_next_attribute(3LDAP)</code></td>
<td>Return next attribute name in an entry.</td>
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<tr>
<td><code>ldap_first_entry(3LDAP)</code></td>
<td>Return first entry in a chain of search results.</td>
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<tr>
<td><code>ldap_next_entry(3LDAP)</code></td>
<td>Return next entry in a chain of search results.</td>
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<tr>
<td><code>ldap_count_entries(3LDAP)</code></td>
<td>Return number of entries in a search result.</td>
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<td><code>ldap_friendly_name(3LDAP)</code></td>
<td>Map from unfriendly to friendly names.</td>
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<tr>
<td><code>ldap_free_friendlymap(3LDAP)</code></td>
<td>Free resources used by <code>ldap_friendly(3LDAP)</code>.</td>
</tr>
<tr>
<td><code>ldap_get_dn(3LDAP)</code></td>
<td>Extract the DN from an entry.</td>
</tr>
<tr>
<td><code>ldap_explode_dn(3LDAP)</code></td>
<td>Convert a DN into its component parts.</td>
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### LDAP Functions

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<tr>
<th>Function Name</th>
<th>Description</th>
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<td>ldap_explode_dns(3LDAP)</td>
<td>Convert a DNS-style DN into its component parts (experimental).</td>
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<tr>
<td>ldap_is_dns_dn(3LDAP)</td>
<td>Check to see if a DN is a DNS-style DN (experimental).</td>
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<tr>
<td>ldap_dns_to_dn(3LDAP)</td>
<td>Convert a DNS domain name into an X.500 distinguished name.</td>
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<td>ldap_dn2ufn(3LDAP)</td>
<td>Convert a DN into user friendly form.</td>
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<tr>
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<td>Return an attribute's values.</td>
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<tr>
<td>ldap_get_values_len(3LDAP)</td>
<td>Return an attribute's values with lengths.</td>
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<tr>
<td>ldap_value_free(3LDAP)</td>
<td>Free memory allocated by ldap_get_values(3LDAP).</td>
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<td>Free memory allocated by ldap_get_values_len(3LDAP).</td>
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<tr>
<td>ldap_count_values(3LDAP)</td>
<td>Return number of values.</td>
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<td>Return number of values.</td>
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<td>Initialize getfilter functions from a file.</td>
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<td>Initialize getfilter functions from a buffer.</td>
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<tr>
<td>ldap_getfilter_free(3LDAP)</td>
<td>Free resources allocated by ldap_init_getfilter(3LDAP).</td>
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<td>ldap_getfirstfilter(3LDAP)</td>
<td>Return first search filter.</td>
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<td>ldap_getnextfilter(3LDAP)</td>
<td>Return next search filter.</td>
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<tr>
<td>ldap_build_filter(3LDAP)</td>
<td>Construct an LDAP search filter from a pattern.</td>
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<td>Set prefix and suffix for search filters.</td>
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<td>Asynchronously modify an entry.</td>
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<td>ldap_modify_s(3LDAP)</td>
<td>Synchronously modify an entry.</td>
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<td>ldap_modify_ext(3LDAP)</td>
<td>Asynchronously modify an entry, return value, and place message.</td>
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<td>ldap_modify_ext_s(3LDAP)</td>
<td>Synchronously modify an entry, return value, and place message.</td>
</tr>
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<td>ldap_mods_free(3LDAP)</td>
<td>Free array of pointers to mod structures used by ldap_modify(3LDAP).</td>
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<td><code>ldap_modrdn2(3LDAP)</code></td>
<td>Deprecated. Use <code>ldap_rename(3LDAP)</code> instead.</td>
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<tr>
<td><code>ldap_modrdn2_s(3LDAP)</code></td>
<td>Deprecated. Use <code>ldap_rename_s(3LDAP)</code> instead.</td>
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<td><code>ldap_modrdn(3LDAP)</code></td>
<td>Deprecated. Use <code>ldap_rename(3LDAP)</code> instead.</td>
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<td><code>ldap_modrdn_s(3LDAP)</code></td>
<td>Deprecated. Use <code>ldap_rename_s(3LDAP)</code> instead.</td>
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<td>Synchronously search the directory.</td>
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<td><code>ldap_search_ext(3LDAP)</code></td>
<td>Asynchronously search the directory with support for LDAPv3 controls.</td>
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<td><code>ldap_search_ext_s(3LDAP)</code></td>
<td>Synchronously search the directory with support for LDAPv3 controls.</td>
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<td>Set prefix used by <code>ldap_ufn(3LDAP)</code> functions.</td>
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<td>ldap_url_search_s(3LDAP)</td>
<td>Synchronously search by using an LDAP URL.</td>
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<td>ldap_init_searchprefs(3LDAP)</td>
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<td>Translate from the T.61 character set to another character set.</td>
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<td>ldap_translate_to_t61(3LDAP)</td>
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<td>ldap_enable_translation(3LDAP)</td>
<td>Enable or disable character translation for an LDAP entry result.</td>
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</table>
ldap_version(3LDAP) Get version information about the LDAP SDK for C.
ldap_get_lang_values(3LDAP) Return an attribute's value that matches a specified language subtype.
ldap_get_lang_values_len(3LDAP) Return an attribute's value that matches a specified language subtype along with lengths.
ldap_get_entry_controls(3LDAP) Get the LDAP controls included with a directory entry in a set of search results.
ldap_get_option(3LDAP) Get session preferences in an LDAP structure.
ldap_set_option(3LDAP) Set session preferences in an LDAP structure.
ldap_memfree(3LDAP) Free memory allocated by LDAP API functions.

Attributes See attributes(5) for a description of the following attributes:

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<th>ATTRIBUTE VALUE</th>
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<td>system/library</td>
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<tr>
<td>Interface Stability</td>
<td>Committed</td>
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See Also attributes(5)
**Name**
ldap_abandon – abandon an LDAP operation in progress

**Synopsis**
```
cc [ flag... ] file... -lldap [ library... ]
#include <ber.h>
#include <ldap.h>

int ldap_abandon(LDAP *ld, intmsgid);
```

**Description**
The `ldap_abandon()` function is used to abandon or cancel an LDAP operation in progress. The `msgid` passed should be the message id of an outstanding LDAP operation, as returned by `ldap_search(3LDAP)`, `ldap_modify(3LDAP)`, etc.

`ldap_abandon()` checks to see if the result of the operation has already come in. If it has, it deletes it from the queue of pending messages. If not, it sends an LDAP abandon operation to the LDAP server.

The caller can expect that the result of an abandoned operation will not be returned from a future call to `ldap_result(3LDAP)`.

**Errors**
`ldap_abandon()` returns 0 if successful or −1 otherwise and setting `ld_errno` appropriately. See `ldap_error(3LDAP)` for details.

**Attributes**
See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**
`ldap(3LDAP), ldap_result(3LDAP), ldap_error(3LDAP), attributes(5)`
The `ldap_add_s()` function is used to perform an LDAP add operation. It takes `dn`, the DN of the entry to add, and `attrs`, a null-terminated array of the entry's attributes. The LDAPMod structure is used to represent attributes, with the `mod_type` and `mod_values` fields being used as described under `ldap_modify(3LDAP)`, and the `ldap_op` field being used only if you need to specify the LDAP_MOD_BVALUES option. Otherwise, it should be set to zero.

Note that all entries except that specified by the last component in the given DN must already exist. `ldap_add_s()` returns an LDAP error code indicating success or failure of the operation. See `ldap_error(3LDAP)` for more details.

The `ldap_add()` function works just like `ldap_add_s()`, but it is asynchronous. It returns the message id of the request it initiated. The result of this operation can be obtained by calling `ldap_result(3LDAP).

The `ldap_add_ext()` function initiates an asynchronous add operation and returns LDAP_SUCCESS if the request was successfully sent to the server, or else it returns a LDAP error code if not (see `ldap_error(3LDAP)`). If successful, `ldap_add_ext()` places the message id of '*msgidp'. A subsequent call to `ldap_result()`, can be used to obtain the result of the add request.

The `ldap_add_ext_s()` function initiates a synchronous add operation and returns the result of the operation itself.

The `ldap_add()` returns −1 in case of error initiating the request, and will set the `ld_errno` field in the `ld` parameter to indicate the error. `ldap_add_s()` will return an LDAP error code directly.

**Errors**

See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
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<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
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<tr>
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<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
ldap_add(3LDAP)

See Also  ldap(3LDAP), ldap_error(3LDAP), ldap_modify(3LDAP), attributes(5)
ldap_ber_free – free a BerElement structure from memory

Synopsis

\texttt{cc flag... file... -lldap \[library ...\]}
#include <ldap.h>

\texttt{void ldap_ber_free(BerElement *ber, int freebuf);} 

Description
You can make a call to the \texttt{ldap_ber_free()} function to free BerElement structures allocated by \texttt{ldap_first_attribute()} and by \texttt{ldap_next_attribute()} function calls. When freeing structures allocated by these functions, specify 0 for the \texttt{freebuf} argument. The \texttt{ldap_first_attribute()} and by \texttt{ldap_next_attribute()} functions do not allocate the extra buffer in the BerElement structure.

For example, to retrieve attributes from a search result entry, you need to call the \texttt{ldap_first_attribute()} function. A call to this function allocates a BerElement structure, which is used to help track the current attribute. When you are done working with the attributes, this structure should be freed from memory, if it still exists.

This function is deprecated. Use the \texttt{ber_free()} function instead.

Attributes
See \texttt{attributes(5)} for descriptions of the following attributes:

\begin{center}
\begin{tabular}{|l|l|}
\hline
\textbf{ATTRIBUTE TYPE} & \textbf{ATTRIBUTE VALUE} \\
\hline
Availability & system/library \\
Interface Stability & Committed \\
\hline
\end{tabular}
\end{center}

See Also \texttt{ber_free(3LDAP), ldap_first_attribute(3LDAP), ldap_next_attribute(3LDAP), attributes(5)}
ldap_bind(3LDAP)

Name
ldap_bind, ldap_bind_s, ldap_sasl_bind, ldap_sasl_bind_s, ldap_simple_bind,
ldap_simple_bind_s, ldap_unbind, ldap_unbind_s, ldap_unbind_ext, ldap_set_rebind_proc,
ldap_sasl_interactive_bind_s - LDAP bind functions

Synopsis
cc [ flag... ] file... -lldap [ library... ]
#include <ber.h>
#include <ldap.h>

int ldap_bind(LDAP *ld, char *who, char *cred, int method);
int ldap_bind_s(LDAP *ld, char *who, char *cred, int method);
int ldap_simple_bind(LDAP *ld, char *who, char *passwd);
int ldap_simple_bind_s(LDAP *ld, char *who, char *passwd);
int ldap_unbind(LDAP *ld);
int ldap_unbind_s(LDAP *ld);
int ldap_unbind_ext(LDAP *ld, LDAPControl **serverctrls,
LDAPControl **clientctrls);
void ldap_set_rebind_proc(LDAP *ld, int (*rebindproc));
int ldap_sasl_bind(LDAP *ld, char *dn, char *mechanism,
struct berval **serverctrls, LDAPControl **clientctrls,
int *msgidp);
int ldap_sasl_bind_s(LDAP *ld, char *dn, char *mechanism,
struct berval **cred, LDAPControl **serverctrls,
LDAPControl **clientctrls);
int ldap_sasl_interactive_bind_s(LDAP *ld, char *dn,
char *saslMechanism, LDAPControl **ctrl,
LDAPControl **cctrl, unsigned flags,
LDAP_SASL_INTERACT_PROC *callback, void *defaults);

Description
These functions provide various interfaces to the LDAP bind operation. After a connection is
made to an LDAP server, the ldap_bind() function returns the message ID of the request
initiated. The ldap_bind_s() function returns an LDAP error code.

Simple Authentication
The simplest form of the bind call is ldap_simple_bind_s(). The function takes the DN
(Distinguished Name) of the dn parameter and the userPassword associated with the entry in
passwd to return an LDAP error code. See ldap_error(3LDAP).

The ldap_simple_bind() call is asynchronous. The function takes the same parameters as
ldap_simple_bind_s() but initiates the bind operation and returns the message ID of the
request sent. The result of the operation can be obtained by a subsequent call to
ldap_result(3LDAP).
The `ldap_bind()` and `ldap_bind_s()` functions are used to select the authentication method at runtime. Both functions take an extra method parameter to set the authentication method. For simple authentication, the method parameter is set to LDAP_AUTH_SIMPLE. The `ldap_bind()` function returns the message id of the request initiated. The `ldap_bind_s()` function returns an LDAP error code.

### SASL Authentication

The `ldap_sasl_bind()` and `ldap_sasl_bind_s()` functions are used for general and extensible authentication over LDAP through the use of the Simple Authentication Security Layer. The routines both take the DN to bind as the authentication method. A dotted-string representation of an OID identifies the method, and the `berval` structure holds the credentials. The special constant value LDAP_SASL_SIMPLE (""”) can be passed to request simple authentication. Otherwise, the `ldap_simple_bind()` function or the `ldap_simple_bind_s()` function can be used.

The `ldap_sasl_interactive_bind_s()` helper function takes its data and performs the necessary `ldap_sasl_bind()` and associated SASL library authentication sequencing with the LDAP server that uses the provided connection (ld).

Upon a successful bind, the `ldap_sasl_bind()` function will, if negotiated by the SASL interface, install the necessary internal libldap plumbing to enable SASL integrity and privacy (over the wire encryption) with the LDAP server.

The LDAP_SASL_INTERACTIVE option flag is passed to the libldap API through the flags argument of the API. The flag tells the API to use the SASL interactive mode and to have the API request SASL authentication data through the LDAP_SASL_INTERACTIVE_PROC callback as needed. The callback provided is in the form:

```c
typedef int (LDAP_SASL_INTERACT_PROC)
    (LDAP *ld, unsigned flags, void* defaults, void *interact);
```

The user-provided SASL callback is passed to the current LDAP connection pointer, the current flags field, an optional pointer to user-defined data, and the list of `sasl_interact_t` authentication values requested by `libsasl(3LIB)` to complete authentication.

The user-defined callback collects and returns the authentication information in the `sasl_interact_t` array according to `libsasl` rules. The authentication information can include user IDs, passwords, realms, or other information defined by SASL. The SASL library uses this date during sequencing to complete authentication.

The `ldap_unbind()` call is used to unbind from a directory, to terminate the current association, and to free the resources contained in the `ld` structure. Once the function is called, the connection to the LDAP server is closed and the `ld` structure is invalid. The `ldap_unbind_s()` and `ldap_unbind()` calls are identical and synchronous in nature.

The `ldap_unbind_ext()` function is used to unbind from a directory, to terminate the current association, and to free the resources contained in the LDAP structure. Unlike `ldap_unbind()` and `ldap_unbind_s()`, both server and client controls can be explicitly included with
\texttt{ldap_unbind_ext()} requests. No server response is made to an unbind request and responses should not be expected from server controls included with unbind requests.

The \texttt{ldap_set_rebind_proc()} call is used to set a function called back to obtain bind credentials. The credentials are used when a new server is contacted after an LDAP referral. If \texttt{ldap_set_rebind_proc()} is never called, or if it is called with a NULL \texttt{rebindproc} parameter, an unauthenticated simple LDAP bind is always done when chasing referrals.

The \texttt{rebindproc()} function is declared as shown below:

\begin{verbatim}
int rebindproc(LDAP *ld, char **whop, char **credp,
              int *methodp, int freeit);
\end{verbatim}

The LDAP library first calls the \texttt{rebindproc()} to obtain the referral bind credentials. The \texttt{freeit} parameter is zero. The \texttt{whop}, \texttt{credp}, and \texttt{methodp} parameters should be set as appropriate. If \texttt{rebindproc()} returns LDAP\_SUCCESS, referral processing continues. The \texttt{rebindproc()} is called a second time with a non-zero \texttt{freeit} value to give the application a chance to free any memory allocated in the previous call.

If anything but LDAP\_SUCCESS is returned by the first call to \texttt{rebindproc()}, referral processing is stopped and the error code is returned for the original LDAP operation.

\textbf{Return Values} Make a call to \texttt{ldap_result(3LDAP)} to obtain the result of a bind operation.

\textbf{Errors} Asynchronous functions will return −1 in case of error. See \texttt{ldap_error(3LDAP)} for more information on error codes returned. If no credentials are returned, the result parameter is set to NULL.

\textbf{Attributes} See \texttt{attributes(5)} for descriptions of the following attributes:

\begin{tabular}{|c|c|}
\hline
\textbf{ATTRIBUTE TYPE} & \textbf{ATTRIBUTE VALUE} \\
\hline
Interface Stability & Committed \\
MT-Level & Safe \\
\hline
\end{tabular}

\textbf{See Also} \texttt{ldap(3LDAP)}, \texttt{ldap_error(3LDAP)}, \texttt{ldap_open(3LDAP)}, \texttt{ldap_result(3LDAP)}, \texttt{libsasl(3LIB)}, \texttt{attributes(5)}
**Name**
ldap_charset, ldap_set_string_translators, ldap_t61_to_8859, ldap_8859_to_t61, ldap_translate_from_t61, ldap_translate_to_t61, ldap_enable_translation – LDAP character set translation functions

**Synopsis**
cc [ flag... ] file... -lldap [ library... ]  
#include <ber.h>
#include <ldap.h>

```c
void ldap_set_string_translators(LDAP *ld,
   BERTranslateProc encode_proc, BERTranslateProc decodeproc);

typedef int(*BERTranslateProc)(char **bufp, unsigned long *buflenp,
   int free_input);

int ldap_t61_to_8859(char **bufp, unsigned long *buflenp,
   int free_input);

int ldap_8859_to_t61(char **bufp, unsigned long *buflenp,
   int free_input);

int ldap_translate_from_t61(LDAP *ld, char **bufp,
   unsigned long *lenp, int free_input);

int ldap_translate_to_t61(LDAP *ld, char **bufp, unsigned long *lenp,
   int free_input);

void ldap_enable_translation(LDAP *ld, LDAPMessage *entry, int enable);
```

**Description**

These functions are used to used to enable translation of character strings used in the LDAP library to and from the T.61 character set used in the LDAP protocol. These functions are only available if the LDAP and LBER libraries are compiled with STR_TRANSLATION defined. It is also possible to turn on character translation by default so that all LDAP library callers will experience translation; see the LDAP Make-common source file for details.

`ldap_set_string_translators()` sets the translation functions that will be used by the LDAP library. They are not actually used until the `ld_lberoptions` field of the LDAP structure is set to include the LBER_TRANSLATE_STRINGS option.

`ldap_t61_to_8859()` and `ldap_8859_to_t61()` are translation functions for converting between T.61 characters and ISO-8859 characters. The specific 8859 character set used is determined at compile time.

`ldap_translate_from_t61()` is used to translate a string of characters from the T.61 character set to a different character set. The actual translation is done using the `decode_proc` that was passed to a previous call to `ldap_set_string_translators()`. On entry, `*bufp` should point to the start of the T.61 characters to be translated and `*lenp` should contain the number of bytes to translate. If `free_input` is non-zero, the input buffer will be freed if translation is a success. If the translation is a success, LDAP_SUCCESS will be returned, `*bufp` will point to a newly malloc’d buffer that contains the translated characters, and `*lenp` will contain the length of the result. If translation fails, an LDAP error code will be returned.
ldap_translate_to_t61() is used to translate a string of characters to the T.61 character set from a different character set. The actual translation is done using the encode_proc that was passed to a previous call to ldap_set_string_translators(). This function is called just like ldap_translate_from_t61().

ldap_enable_translation() is used to turn on or off string translation for the LDAP entry (typically obtained by calling ldap_first_entry() or ldap_next_entry() after a successful LDAP search operation). If enable is zero, translation is disabled; if non-zero, translation is enabled. This function is useful if you need to ensure that a particular attribute is not translated when it is extracted using ldap_get_values() or ldap_get_values_len(). For example, you would not want to translate a binary attributes such as jpegPhoto.

Attributes See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also ldap(3LDAP), attributes(5)
ldap_compare(3LDAP)

Name
ldap_compare, ldap_compare_s, ldap_compare_ext, ldap_compare_ext_s – LDAP compare operation

Synopsis
cc [ flag... ] file... -lldap [ library... ]
#include <lber.h>
#include <ldap.h>

int ldap_compare(LDAP *ld, char *dn, char *attr, char *value);
int ldap_compare_s(LDAP *ld, char *dn, char *attr, char *value);
int ldap_compare_ext(LDAP *ld, char *dn, char *attr,
    struct berval *bvalue, LDAPControl **serverctrls,
    LDAPControl **clientctrls, int *msgidp);
int ldap_compare_ext_s(LDAP *ld, char *dn, char *attr,
    struct berval *bvalue, LDAPControl **serverctrls,
    LDAPControl **clientctrls);

Description
The ldap_compare_s() function is used to perform an LDAP compare operation synchronously. It takes dn, the DN of the entry upon which to perform the compare, and attr and value, the attribute type and value to compare to those found in the entry. It returns an LDAP error code, which will be LDAP_COMPARE_TRUE if the entry contains the attribute value and LDAP_COMPARE_FALSE if it does not. Otherwise, some error code is returned.

The ldap_compare() function is used to perform an LDAP compare operation asynchronously. It takes the same parameters as ldap_compare_s(), but returns the message id of the request it initiated. The result of the compare can be obtained by a subsequent call to ldap_result(3LDAP).

The ldap_compare_ext() function initiates an asynchronous compare operation and returns LDAP_SUCCESS if the request was successfully sent to the server, or else it returns a LDAP error code if not (see ldap_error(3LDAP)). If successful, ldap_compare_ext() places the message id of the request in *msgidp. A subsequent call to ldap_result(), can be used to obtain the result of the add request.

The ldap_compare_ext_s() function initiates a synchronous compare operation and as such returns the result of the operation itself.

Errors
ldap_compare_s() returns an LDAP error code which can be interpreted by calling one of ldap_perror(3LDAP) and friends. ldap_compare() returns −1 if something went wrong initiating the request. It returns the non-negative message id of the request if it was successful.

Attributes
See attributes(5) for a description of the following attributes:

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<tr>
<th>ATTRIBUTE TYPE</th>
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</table>
ldap_compare(3LDAP)

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ldap(3LDAP), ldap_error(3LDAP), attributes(5)

Bugs  There is no way to compare binary values using ldap_compare().
ldap_control_free, ldap_controls_free – LDAP control disposal

Synopsis

cc [ flag... ] file... -lldap [ library... ]
#include <lber.h>
#include <ldap.h>

void ldap_control_free(LDAPControl *ctrl);
void ldap_controls_free(LDAPControl *ctrls);

Description

ldap_controls_free() and ldap_control_free() are routines which can be used to dispose
of a single control or an array of controls allocated by other LDAP APIs.

Return Values

None.

Errors

No errors are defined for these functions.

Attributes

See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

ldap_error(3LDAP), ldap_result(3LDAP), attributes(5)
ldap_delete(3LDAP)

**Name**
ldap_delete, ldap_delete_s, ldap_delete_ext, ldap_delete_ext_s – LDAP delete operation

**Synopsis**
```
c[ flag... 1 file... -lldap[ library... ]
#include <lber.h>
#include <ldap.h>

int ldap_delete(LDAP *ld, char *dn);
int ldap_delete_s(LDAP *ld, char *dn);
int ldap_delete_ext(LDAP *ld, char *dn, LDAPControl **serverctrls,
                     LDAPControl **clientctrls, int *msgidp);
int ldap_delete_ext_s(LDAP *ld, char *dn, LDAPControl **serverctrls,
                     LDAPControl **clientctrls);
```

**Description**
The `ldap_delete_s()` function is used to perform an LDAP delete operation synchronously. It takes `dn`, the DN of the entry to be deleted. It returns an LDAP error code, indicating the success or failure of the operation.

The `ldap_delete()` function is used to perform an LDAP delete operation asynchronously. It takes the same parameters as `ldap_delete_s()`, but returns the message id of the request it initiated. The result of the delete can be obtained by a subsequent call to `ldap_result(3LDAP)`.

The `ldap_delete_ext()` function initiates an asynchronous delete operation and returns LDAP_SUCCESS if the request was successfully sent to the server, or else it returns a LDAP error code if not (see `ldap_error(3LDAP)`). If successful, `ldap_delete_ext()` places the message id of the request in `msgidp`. A subsequent call to `ldap_result()`, can be used to obtain the result of the add request.

The `ldap_delete_ext_s()` function initiates a synchronous delete operation and as such returns the result of the operation itself.

**Errors**
'ldap_delete_s()' returns an LDAP error code which can be interpreted by calling one of `ldap_error(3LDAP)` functions. `ldap_delete()` returns −1 if something went wrong initiating the request. It returns the non-negative message id of the request if things were successful.

**Attributes**
See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
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<tr>
<td>Availability</td>
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<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
See Also  ldap(3LDAP), ldap_error(3LDAP), attributes(5)
ldap_disptmpl(3LDAP)

Name
ldap_disptmpl, ldap_init_templates, ldap_init_templates_buf, ldap_free_templates, ldap_first_disptmpl, ldap_next_disptmpl, ldap_oc2template, ldap_name2template, ldap_tmplattrs, ldap_first_tmplrow, ldap_next_tmplrow, ldap_first_tmplcol, ldap_next_tmplcol – LDAP display template functions

Synopsis
cc [ flag... ] file... -lldap [ library... ]
#include <ber.h>
#include <ldap.h>

int ldap_init_templates(char *file, struct ldap_disptmpl **tmpllist);
int ldap_init_templates_buf(char *buf, unsigned long len,
   struct ldap_disptmpl **tmpllist);
void ldap_freeTemplates(struct ldap_disptmpl *tmpllist);
struct ldap_disptmpl *ldap_first_disptmpl
   (struct ldap_disptmpl *tmpllist);
struct ldap_disptmpl *ldap_next_disptmpl
   (struct ldap_disptmpl *tmpllist, struct ldap_disptmpl *tmpl);
struct ldap_disptmpl *ldap_oc2template (char **oclist,
   struct ldap_disptmpl *tmpllist);
struct ldap_disptmpl *ldap_name2template (char *name,
   struct ldap_disptmpl *tmpllist);
char **ldap_tmplattrs(struct ldap_disptmpl *tmpl, char **includeattrs,
   int exclude, unsigned long syntaxmask);
struct ldap_tmplitem *ldap_first_tmplrow(struct ldap_disptmpl *tmpl);
struct ldap_tmplitem *ldap_next_tmplrow(struct ldap_disptmpl *tmpl,
   struct ldap_tmplitem *row);
struct ldap_tmplitem *ldap_first_tmplcol(struct ldap_disptmpl *tmpl,
   struct ldap_tmplitem *row, struct ldap_tmplitem *col);
struct ldap_tmplitem *ldap_next_tmplcol(struct ldap_disptmpl *tmpl,
   struct ldap_tmplitem *row, struct ldap_tmplitem *col);

Description
These functions provide a standard way to access LDAP entry display templates. Entry display templates provide a standard way for LDAP applications to display directory entries. The general idea is that it is possible to map the list of object class values present in an entry to an appropriate display template. Display templates are defined in a configuration file. See ldaptemplates.conf(4). Each display template contains a pre-determined list of items, where each item generally corresponds to an attribute to be displayed. The items contain information and flags that the caller can use to display the attribute and values in a reasonable fashion. Each item has a syntaxid, which are described in the SYNTAX IDS section below. The ldap_entry2text(3LDAP) functions use the display template functions and produce text output.
ldap_init_templates() reads a sequence of templates from a valid LDAP template configuration file (see ldaptemplates.conf(4)). Upon success, 0 is returned, and tmpllistp is set to point to a list of templates. Each member of the list is an ldap_disptmpl structure (defined below in the DISPTMPL Structure Elements section).

ldap_init_templates_buf() reads a sequence of templates from buf (whose size is buflen). buf should point to the data in the format defined for an LDAP template configuration file (see ldaptemplates.conf(4)). Upon success, 0 is returned, and tmpllistp is set to point to a list of templates.

The LDAP_SET_DISPTMPL_APPDATA() macro is used to set the value of the dt_appdata field in an ldap_disptmpl structure. This field is reserved for the calling application to use; it is not used internally.

The LDAP_GET_DISPTMPL_APPDATA() macro is used to retrieve the value in the dt_appdata field.

The LDAP_IS_DISPTMPL_OPTION_SET() macro is used to test a ldap_disptmpl structure for the existence of a template option. The options currently defined are:
- LDAP_DTMPL_OPT_ADDABLE (it is appropriate to allow entries of this type to be added),
- LDAP_DTMPL_OPT_ALLOWMODRDN (it is appropriate to offer the "modify rdn" operation),
- LDAP_DTMPL_OPT_ALTVIEW (this template is merely an alternate view of another template, typically used for templates pointed to be an LDAP_SYNC_LINKACTION item).

ldap_free_templates() disposes of the templates allocated by ldap_init_templates().

ldap_first_disptmpl() returns the first template in the list tmplist. The tmplist is typically obtained by calling ldap_init_templates().

ldap_next_disptmpl() returns the template after tmpl in the template list tmplist. A NULL pointer is returned if tmpl is the last template in the list.

ldap_oc2template() searches tmplist for the best template to use to display an entry that has a specific set of objectClass values. oclist should be a null-terminated array of strings that contains the values of the objectClass attribute of the entry. A pointer to the first template where all of the object classes listed in one of the template's dt_oclist elements are contained in oclist is returned. A NULL pointer is returned if no appropriate template is found.

ldap_tmplatattrs() returns a null-terminated array that contains the names of attributes that need to be retrieved if the template tmpl is to be used to display an entry. The attribute list should be freed using ldap_value_free(). The includeattrs parameter contains a null-terminated array of attributes that should always be included (it may be NULL if no extra attributes are required). If syntaxmask is non-zero, it is used to restrict the attribute set returned. If exclude is zero, only attributes where the logical AND of the template item syntax id and the syntaxmask is non-zero are included. If exclude is non-zero, attributes where the logical AND of the template item syntax id and the syntaxmask is non-zero are excluded.

ldap_first_tmplrow() returns a pointer to the first row of items in template tmpl.
ldap_next_tmplrow() returns a pointer to the row that follows row in template tmpl.

ldap_first_tmplcol() returns a pointer to the first item (in the first column) of row row within template tmpl. A pointer to an ldap_tmplitem structure (defined below in the TMPLITEM Structure Elements section) is returned.

The LDAP_SET_TMPLITEM_APPDATA() macro is used to set the value of the ti_appdata field in a ldap_tmplitem structure. This field is reserved for the calling application to use; it is not used internally.

The LDAP_GET_TMPLITEM_APPDATA() macro is used to retrieve the value of the ti_appdata field.

The LDAP_IS_TMPLITEM_OPTION_SET() macro is used to test a ldap_tmplitem structure for the existence of an item option. The options currently defined are:
LDAP_DITEM_OPT_READONLY (this attribute should not be modified),
LDAP_DITEM_OPT_SORTVALUES (it makes sense to sort the values),
LDAP_DITEM_OPT_SINGLEVALUED (this attribute can only hold a single value),
LDAP_DITEM_OPT_VALUEREQUIRED (this attribute must contain at least one value),
LDAP_DITEM_OPT_HIDEIFEMPTY (do not show this item if there are no values), and
LDAP_DITEM_OPT_HIDEIFFALSE (for boolean attributes only: hide this item if the value is FALSE).

ldap_next_tmplcol() returns a pointer to the item (column) that follows column col within row row of template tmpl.

The ldap_disptmpl structure is defined as:

```c
struct ldap_disptmpl {
    char *dt_name;
    char *dt_pluralname;
    char *dt_iconname;
    unsigned long dt_options;
    char *dt_authattrname;
    char *dt_defrdnattrname;
    char *dt_defaddlocation;
    struct ldap_oclist *dt_oclist;
    struct ldap_addeflist *dt_addeflist;
    struct ldap_tmplitem *dt_items;
    void *dt_appdata;
    struct ldap_disptmpl *dt_next;
};
```

The dt_name member is the singular name of the template. The dt_pluralname is the plural name. The dt_iconname member will contain the name of an icon or other graphical element that can be used to depict entries that correspond to this display template. The dt_options contains options which may be tested using the LDAP_IS_TMPLITEM_OPTION_SET() macro.
The `dt_authattrname` contains the name of the DN-syntax attribute whose value(s) should be used to authenticate to make changes to an entry. If `dt_authattrname` is `NULL`, then authenticating as the entry itself is appropriate. The `dt_defrdnattrname` is the name of the attribute that is normally used to name entries of this type, for example, “cn” for person entries. The `dt_defadlocation` is the distinguished name of an entry below which new entries of this type are typically created (its value is site-dependent).

`dt_oclist` is a pointer to a linked list of object class arrays, defined as:

```c
struct ldap_oclist {
    char **oc_objclasses;
    struct ldap_oclist *oc_next;
};
```

These are used by the `ldap_oc2template()` function.

`dt_adddeflist` is a pointer to a linked list of rules for defaulting the values of attributes when new entries are created. The `ldap_adddeflist` structure is defined as:

```c
struct ldap_adddeflist {
    int ad_source;
    char *ad_attrname;
    char *ad_value;
    struct ldap_adddeflist *ad_next;
};
```

The `ad_attrname` member contains the name of the attribute whose value this rule sets. If `ad_source` is `LDAP_ADSRC_CONSTANTVALUE` then the `ad_value` member contains the (constant) value to use. If `ad_source` is `LDAP_ADSRC_ADDERSDN` then `ad_value` is ignored and the distinguished name of the person who is adding the new entry is used as the default value for `ad_attrname`.

The `ldap_tmplitem` structure is defined as:

```c
struct ldap_tmplitem {
    unsigned long ti_syntaxid;
    unsigned long ti_options;
    char *ti_attrname;
    char *ti_label;
    char ***ti_args;
    struct ldap_tmplitem *ti_next_in_row;
    struct ldap_tmplitem *ti_next_in_col;
    void *ti_appdata;
};
```

Syntax IDs Syntax ids are found in the `ldap_tmplitem` structure element `ti_syntaxid`, and they can be used to determine how to display the values for the attribute associated with an item. The `LDAP_GET_SYN_TYPE()` macro can be used to return a general type from a syntax id. The five general types currently defined are: `LDAP_SYN_TYPE_TEXT` (for attributes that are most
appropriately shown as text), LDAP_SYN_TYPE_IMAGE (for JPEG or FAX format images), LDAP_SYN_TYPE_BOOLEAN (for boolean attributes), LDAP_SYN_TYPE_BUTTON (for attributes whose values are to be retrieved and display only upon request, for example, in response to the press of a button, a JPEG image is retrieved, decoded, and displayed), and LDAP_SYN_TYPE_ACTION (for special purpose actions such as “search for the entries where this entry is listed in the seeAlso attribute”).

The LDAP_GET_SYN_OPTIONS macro can be used to retrieve an unsigned long bitmap that defines options. The only currently defined option is LDAP_SYN_OPT_DEFER, which (if set) implies that the values for the attribute should not be retrieved until requested.

There are sixteen distinct syntax ids currently defined. These generally correspond to one or more X.500 syntaxes.

LDAP_SYN_CASEIGNORESTR is used for text attributes which are simple strings whose case is ignored for comparison purposes.

LDAP_SYN_MULTILINESTR is used for text attributes which consist of multiple lines, for example, postalAddress, homePostalAddress, multilineDescription, or any attributes of syntax caseIgnoreList.

LDAP_SYN_RFC822ADDR is used for case ignore string attributes that are RFC-822 conformant mail addresses, for example, mail.

LDAP_SYN_DN is used for attributes with a Distinguished Name syntax, for example, seeAlso.

LDAP_SYN_BOOLEAN is used for attributes with a boolean syntax.

LDAP_SYN_JPEGIMAGE is used for attributes with a jpeg syntax, for example, jpegPhoto.

LDAP_SYN_JPEGBUTTON is used to provide a button (or equivalent interface element) that can be used to retrieve, decode, and display an attribute of jpeg syntax.

LDAP_SYN_FAXIMAGE is used for attributes with a photo syntax, for example, Photo. These are actually Group 3 Fax (T.4) format images.

LDAP_SYN_FAXBUTTON is used to provide a button (or equivalent interface element) that can be used to retrieve, decode, and display an attribute of photo syntax.

LDAP_SYN_AUDIOBUTTON is used to provide a button (or equivalent interface element) that can be used to retrieve and play an attribute of audio syntax. Audio values are in the “mu law” format, also known as “au” format.

LDAP_SYN_TIME is used for attributes with the UTCTime syntax, for example, lastModifiedTime. The value(s) should be displayed in complete date and time fashion.

LDAP_SYN_DATE is used for attributes with the UTCTime syntax, for example, lastModifiedTime. Only the date portion of the value(s) should be displayed.
LDAP_SYN_LABELEDURL is used for labeledURL attributes.

LDAP_SYN_SEARCHACTION is used to define a search that is used to retrieve related information. If ti_attrname is not NULL, it is assumed to be a boolean attribute which will cause no search to be performed if its value is FALSE. The ti_args structure member will have four strings in it: ti_args[0] should be the name of an attribute whose values are used to help construct a search filter or “-dn” is the distinguished name of the entry being displayed should be used, ti_args[1] should be a filter pattern where any occurrences of “%v” are replaced with the value derived from ti_args[0], ti_args[2] should be the name of an additional attribute to retrieve when performing the search, and ti_args[3] should be a human-consumable name for that attribute. The ti_args[2] attribute is typically displayed along with a list of distinguished names when multiple entries are returned by the search.

LDAP_SYN_LINKACTION is used to define a link to another template by name. ti_args[0] will contain the name of the display template to use. The ldap_name2template() function can be used to obtain a pointer to the correct ldap_disptmpl structure.

LDAP_SYN_ADDONACTION and LDAP_SYN_VERIFYACTION are reserved as actions but currently undefined.

Errors The init template functions return LDAP_TMPL_ERR_VERSION if buf points to data that is newer than can be handled, LDAP_TMPL_ERR_MEM if there is a memory allocation problem, LDAP_TMPL_ERR_SYNTAX if there is a problem with the format of the templates buffer or file. LDAP_TMPL_ERR_FILE is returned by ldap_init_templates if the file cannot be read. Other functions generally return NULL upon error.

Attributes See attributes(5) for a description of the following attributes:

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<tr>
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<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also ldap(3LDAP), ldap_entry2text(3LDAP), ldaptemplates.conf(4), attributes(5)
ldap_entry2text(3LDAP)

Name
ldap_entry2text, ldap_entry2text_search, ldap_entry2html, ldap_entry2html_search,
ldap_vals2html, ldap_vals2text – LDAP entry display functions

Synopsis
#include <ber.h>
#include <ldap.h>

int ldap_entry2text(LDAP *ld, char *buf, LDAPMessage *entry,
struct ldap_disptmpl *tmpl, char **defattrs, char ***defvals,
int (*writeproc)(), void *writeparm, char *eol, int rdncount,
unsigned long opts);

int ldap_entry2text_search(LDAP *ld, char *dn, char *base,
LDAPMessage *entry, struct ldap_disptmpl *tmpllist,
char **defattrs, char ***defvals, int (*writeproc)(),
void *writeparm, char *eol, int rdncount,
unsigned long opts);

int ldap_vals2text(LDAP *ld, char *buf, char **vals, char *label,
int labelwidth, unsigned long syntaxid, int (*writeproc)(),
void *writeparm, char *eol, int rdncount);

int ldap_entry2html(LDAP *ld, char *buf, LDAPMessage *entry,
struct ldap_disptmpl *tmpl, char **defattrs, char ***defvals,
int (*writeproc)(), void *writeparm, char *eol, int rdncount,
unsigned long opts, char *urlprefix, char *base);

int ldap_entry2html_search(LDAP *ld, char *dn, LDAPMessage *entry,
struct ldap_disptmpl *tmpllist, char **defattrs, char ***defvals,
int (*writeproc)(), void *writeparm, char *eol, int rdncount,
unsigned long opts, char *urlprefix);

int ldap_vals2html(LDAP *ld, char *buf, char **vals,
char *label, int labelwidth, unsigned long syntaxid,
int (*writeproc)(), void *writeparm, char *eol, int rdncount,
char *urlprefix);

#define LDAP_DISP_OPT_AUTOLABELWIDTH 0x00000001
#define LDAP_DISP_OPT_HTMLBODYONLY 0x00000002
#define LDAP_DTMPL_BUFSIZ 2048

Description
These functions use the LDAP display template functions (see ldap_disptmpl(3LDAP) and
ldap_templates.conf(4)) to produce a plain text or an HyperText Markup Language
(HTML) display of an entry or a set of values. Typical plain text output produced for an entry
might look like:

"Barbara J Jensen, Information Technology Division"
Also Known As:
Babs Jensen
Barbara Jensen
Barbara J Jensen
E-Mail Address:  
bjensen@terminator.rs.itd.umich.edu  
Work Address:  
535 W. William  
Ann Arbor, MI 48103  
Title:  
Mythical Manager, Research Systems  
...  

The exact output produced will depend on the display template configuration. HTML output is similar to the plain text output, but more richly formatted.

`ldap_entry2text()` produces a text representation of `entry` and writes the text by calling the `writeproc` function. All of the attributes values to be displayed must be present in `entry`; no interaction with the LDAP server will be performed within `ldap_entry2text`. `ld` is the LDAP pointer obtained by a previous call to `ldap_open`. `writeproc` should be declared as:

```c
int writeproc( writeparm, p, len )
  void  *writeparm;
  char  *p;
  int   len;
```

where `p` is a pointer to text to be written and `len` is the length of the text. `p` is guaranteed to be zero-terminated. Lines of text are terminated with the string `eol`. `buf` is a pointer to a buffer of size LDAP_DTMPL_BUFSIZE or larger. If `buf` is `NULL` then a buffer is allocated and freed internally. `tmpl` is a pointer to the display template to be used (usually obtained by calling `ldap_oc2template`). If `tmpl` is `NULL`, no template is used and a generic display is produced. `defattrs` is a NULL-terminated array of LDAP attribute names which you wish to provide default values for (only used if `entry` contains no values for the attribute). An array of NULL-terminated arrays of default values corresponding to the attributes should be passed in `defvals`. The `rdncount` parameter is used to limit the number of Distinguished Name (DN) components that are actually displayed for DN attributes. If `rdncount` is zero, all components are shown. `opts` is used to specify output options. The only values currently allowed are zero (default output), LDAP_DISP_OPT_AUTOLABELWIDTH which causes the width for labels to be determined based on the longest label in `tmpl`, and LDAP_DISP_OPT_HTMLBODYONLY. The LDAP_DISP_OPT_HTMLBODYONLY option instructs the library not to include `<HTML>`, `<HEAD>`, `<TITLE>`, and `<BODY>` tags. In other words, an HTML fragment is generated, and the caller is responsible for prepending and appending the appropriate HTML tags to construct a correct HTML document.

`ldap_entry2text_search()` is similar to `ldap_entry2text`, and all of the like-named parameters have the same meaning except as noted below. If `base` is not `NULL`, it is the search base to use when executing search actions. If it is `NULL`, search action template items are ignored. If `entry` is not `NULL`, it should contain the `objectClass` attribute values for the entry to be displayed. If `entry` is `NULL`, `dn` must not be `NULL`, and `ldap_entry2text_search` will retrieve the `objectClass` values itself by calling `ldap_search_s`. `ldap_entry2text_search` will determine the appropriate display template to use by calling `ldap_oc2template`, and will call


ldap_search_s to retrieve any attribute values to be displayed. The tmplist parameter is a pointer to the entire list of templates available (usually obtained by calling ldap_init_templates or ldap_init_templates_buf). If tmplist is NULL, ldap_entry2text_search will attempt to read a load templates from the default template configuration file /etc/ldap/ldaptemplates.conf.

ldap_vals2text produces a text representation of a single set of LDAP attribute values. The ld, buf, writeproc, writeparm, col, and rdncount parameters are the same as the like-named parameters for ldap_entry2text. vals is a NULL-terminated list of values, usually obtained by a call to ldap_get_values. label is a string shown next to the values (usually a friendly form of an LDAP attribute name). labelwidth specifies the label margin, which is the number of blank spaces displayed to the left of the values. If zero is passed, a default label width is used. syntaxid is a display template attribute syntax identifier (see ldap_disptmpl(3LDAP) for a list of the pre-defined LDAP SYN_... values).

ldap_entry2html produces an HTML representation of entry. It behaves exactly like ldap_entry2text(3LDAP), except for the formatted output and the addition of two parameters. urlprefix is the starting text to use when constructing an LDAP URL. The default is the string ldap:// The second additional parameter, base, the search base to use when executing search actions. If it is NULL, search action template items are ignored.

ldap_entry2html_search behaves exactly like ldap_entry2text_search(3LDAP), except HTML output is produced and one additional parameter is required. urlprefix is the starting text to use when constructing an LDAP URL. The default is the string ldap://

ldap_vals2html behaves exactly like ldap_vals2text, except HTML output is sent and one additional parameter is required. urlprefix is the starting text to use when constructing an LDAP URL. The default is the string ldap://

Errors These functions all return an LDAP error code. LDAP_SUCCESS is returned if no error occurs. See ldap_error(3LDAP) for details. The ld_errno field of the ld parameter is also set to indicate the error.

Files /etc/ldap/ldaptemplates.conf

Attributes See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
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<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also ldap(3LDAP), ldap_disptmpl(3LDAP), ldaptemplates.conf(4), attributes(5)
ldap_error, ldap_err2string, ldap_perror, ldap_result2error – LDAP protocol error handling functions

Synopsis

cc [ flag... ] file... -lldap[ library... ]
#include <lber.h>
#include <ldap.h>

char *ldap_err2string(int err);
void ldap_perror(LDAP *ld, const char *s);
int ldap_result2error(LDAP *ld, LDAPMessage *res, int freeit);

Description

These functions interpret the error codes that are returned by the LDAP API routines. The ldap_perror() and ldap_result2error() functions are deprecated for all new development. Use ldap_err2string() instead.

You can also use ldap_parse_sasl_bind_result(3LDAP), ldap_parse_extended_result(3LDAP), and ldap_parse_result(3LDAP) to provide error handling and interpret error codes returned by LDAP API functions.

The ldap_err2string() function takes err, a numeric LDAP error code, returned either by ldap_parse_result(3LDAP) or another LDAP API call. It returns an informative, null-terminated, character string that describes the error.

The ldap_result2error() function takes res, a result produced by ldap_result(3LDAP) or other synchronous LDAP calls, and returns the corresponding error code. If the freeit parameter is non-zero, it indicates that the res parameter should be freed by a call to ldap_result(3LDAP) after the error code has been extracted.

Similar to the way perror(3C) works, the ldap_perror() function can be called to print an indication of the error to standard error.

Errors

The possible values for an LDAP error code are:

- LDAP_SUCCESS: The request was successful.
- LDAP_OPERATIONS_ERROR: An operations error occurred.
- LDAP_PROTOCOL_ERROR: A protocol violation was detected.
- LDAP_TIMELIMIT_EXCEEDED: An LDAP time limit was exceeded.
- LDAP_SIZELIMIT_EXCEEDED: An LDAP size limit was exceeded.
- LDAP_COMPARE_FALSE: A compare operation returned false.
- LDAP_COMPARE_TRUE: A compare operation returned true.
- LDAP_STRONG_AUTH_NOT_SUPPORTED: The LDAP server does not support strong authentication.
- LDAP_STRONG_AUTH_REQUIRED: Strong authentication is required for the operation.
<table>
<thead>
<tr>
<th>LDAP Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDAP_PARTIAL_RESULTS</td>
<td>Only partial results are returned.</td>
</tr>
<tr>
<td>LDAP_NO_SUCH_ATTRIBUTE</td>
<td>The attribute type specified does not exist in the entry.</td>
</tr>
<tr>
<td>LDAP_UNDEFINED_TYPE</td>
<td>The attribute type specified is invalid.</td>
</tr>
<tr>
<td>LDAP_INAPPROPRIATE_MATCHING</td>
<td>The filter type is not supported for the specified attribute.</td>
</tr>
<tr>
<td>LDAP_CONSTRAINT_VIOLATION</td>
<td>An attribute value specified violates some constraint. For example, a postalAddress has too many lines, or a line that is too long.</td>
</tr>
<tr>
<td>LDAP_TYPE_OR_VALUE_EXISTS</td>
<td>An attribute type or attribute value specified already exists in the entry.</td>
</tr>
<tr>
<td>LDAP_INVALID_SYNTAX</td>
<td>An invalid attribute value was specified.</td>
</tr>
<tr>
<td>LDAP_NO_SUCH_OBJECT</td>
<td>The specified object does not exist in the directory.</td>
</tr>
<tr>
<td>LDAP_ALIAS_PROBLEM</td>
<td>An alias in the directory points to a nonexistent entry.</td>
</tr>
<tr>
<td>LDAP_INVALID_DN_SYNTAX</td>
<td>A syntactically invalid DN was specified.</td>
</tr>
<tr>
<td>LDAP_IS_LEAF</td>
<td>The object specified is a leaf.</td>
</tr>
<tr>
<td>LDAP_ALIAS_DEREF_PROBLEM</td>
<td>A problem was encountered when dereferencing an alias.</td>
</tr>
<tr>
<td>LDAP_INAPPROPRIATE_AUTH</td>
<td>Inappropriate authentication was specified. For example, LDAP_AUTH_SIMPLE was specified and the entry does not have a userPassword attribute.</td>
</tr>
<tr>
<td>LDAP_INVALID_CREDENTIALS</td>
<td>Invalid credentials were presented, for example, the wrong password.</td>
</tr>
<tr>
<td>LDAP_INSUFFICIENT_ACCESS</td>
<td>The user has insufficient access to perform the operation.</td>
</tr>
<tr>
<td>LDAP_BUSY</td>
<td>The DSA is busy.</td>
</tr>
<tr>
<td>LDAP_UNAVAILABLE</td>
<td>The DSA is unavailable.</td>
</tr>
<tr>
<td>LDAP_UNWILLING_TO_PERFORM</td>
<td>The DSA is unwilling to perform the operation.</td>
</tr>
<tr>
<td>LDAP_LOOP_DETECT</td>
<td>A loop was detected.</td>
</tr>
<tr>
<td>LDAP_NAMING_VIOLATION</td>
<td>A naming violation occurred.</td>
</tr>
<tr>
<td>LDAP_OBJECT_CLASS_VIOLATION</td>
<td>An object class violation occurred. For example, a must attribute was missing from the entry.</td>
</tr>
<tr>
<td>Constant</td>
<td>Description</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>LDAP_NOT_ALLOWED_ON_NONLEAF</td>
<td>The operation is not allowed on a nonleaf object.</td>
</tr>
<tr>
<td>LDAP_NOT_ALLOWED_ON_RDN</td>
<td>The operation is not allowed on an RDN.</td>
</tr>
<tr>
<td>LDAP_ALREADY_EXISTS</td>
<td>The entry already exists.</td>
</tr>
<tr>
<td>LDAP_NO_OBJECT_CLASS_MODS</td>
<td>Object class modifications are not allowed.</td>
</tr>
<tr>
<td>LDAP_OTHER</td>
<td>An unknown error occurred.</td>
</tr>
<tr>
<td>LDAP_SERVER_DOWN</td>
<td>The LDAP library cannot contact the LDAP server.</td>
</tr>
<tr>
<td>LDAP_LOCAL_ERROR</td>
<td>Some local error occurred. This is usually the result of a failed malloc(3C)</td>
</tr>
<tr>
<td></td>
<td>call or a failure to fflush(3C) the stdio stream to files, even when the LDAP</td>
</tr>
<tr>
<td></td>
<td>requests were processed successfully by the remote server.</td>
</tr>
<tr>
<td>LDAP_ENCODING_ERROR</td>
<td>An error was encountered encoding parameters to send to the LDAP server.</td>
</tr>
<tr>
<td>LDAP_DECODING_ERROR</td>
<td>An error was encountered decoding a result from the LDAP server.</td>
</tr>
<tr>
<td>LDAP_TIMEOUT</td>
<td>A time limit was exceeded while waiting for a result.</td>
</tr>
<tr>
<td>LDAP_AUTH_UNKNOWN</td>
<td>The authentication method specified to ldap_bind(3LDAP) is not known.</td>
</tr>
<tr>
<td>LDAP_FILTER_ERROR</td>
<td>An invalid filter was supplied to ldap_search(3LDAP), for example, unbalanced</td>
</tr>
<tr>
<td></td>
<td>parentheses.</td>
</tr>
<tr>
<td>LDAP_PARAM_ERROR</td>
<td>An LDAP function was called with a bad parameter, for example, a NULL ld pointer, and the like.</td>
</tr>
<tr>
<td>LDAP_NO_MEMORY</td>
<td>A memory allocation call failed in an LDAP library function, for example, malloc(3C).</td>
</tr>
<tr>
<td>LDAP_CONNECT_ERROR</td>
<td>The LDAP client has either lost its connection to an LDAP server or it cannot establish a connection.</td>
</tr>
<tr>
<td>LDAP_NOT_SUPPORTED</td>
<td>The requested functionality is not supported., for example, when an LDAPv2 client requests some LDAPv3 functionality.</td>
</tr>
<tr>
<td>LDAP_CONTROL_NOT_FOUND</td>
<td>An LDAP client requested a control not found in the list of supported controls sent by the server.</td>
</tr>
<tr>
<td>LDAP_NO_RESULTS_RETURNED</td>
<td>The LDAP server sent no results.</td>
</tr>
<tr>
<td>LDAP_MORE_RESULTS_TO_RETURN</td>
<td>More results are chained in the message chain.</td>
</tr>
</tbody>
</table>
LDAP_CLIENT_LOOP
A loop has been detected, for example, when following referrals.

LDAP_REFERRAL_LIMIT_EXCEEDED
The referral exceeds the hop limit. The hop limit determines the number of servers that the client can hop through to retrieve data.

Attributes
See attributes(5) for a description of the following attributes:

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See Also
fflush(3C), ldap(3LDAP), ldap_bind(3LDAP), ldap_result(3LDAP),
ldap_parse_extended_result(3LDAP), ldap_parse_result(3LDAP),
ldap_parse_sasl_bind_result(3LDAP), ldap_search(3LDAP), malloc(3C), perror(3C),
attributes(5)
ldap_first_attribute, ldap_next_attribute – step through LDAP entry attributes

Synopsis

cc [ flag...] file... -lldap[ library...]
#include <ber.h>
#include <ldap.h>

char *ldap_first_attribute(LDAP *ld, LDAPMessage *entry, BerElement **berptr);
char *ldap_next_attribute(LDAP *ld, LDAPMessage *entry, BerElement *ber);

Description

The ldap_first_attribute() function gets the value of the first attribute in an entry.

The ldap_first_attribute() function returns the name of the first attribute in the entry. To get the value of the first attribute, pass the attribute name to the ldap_get_values() function or to the ldap_get_values_len() function.

The ldap_next_attribute() function gets the value of the next attribute in an entry.

After stepping through the attributes, the application should call ber_free() to free the BerElement structure allocated by the ldap_first_attribute() function if the structure is other than NULL.

Errors

If an error occurs, NULL is returned and the ld_errno field in the ld parameter is set to indicate the error. See ldap_error(3LDAP) for a description of possible error codes.

Attributes

See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also

ldap(3LDAP), ldap_first_entry(3LDAP), ldap_get_values(3LDAP), ldap_error(3LDAP), attributes(5)

Notes

The ldap_first_attribute() function allocates memory that might need to be freed by the caller by means of ber_free(3LDAP).
Synopsis

cc [ flag... ] file... -lldap [ library... ]
#include <ber.h>
#include <ldap.h>

LDAPMessage *ldap_first_entry(LDAP *ld, LDAPMessage *result);
LDAPMessage *ldap_next_entry(LDAP *ld, LDAPMessage *entry);
int ldap_count_entries(LDAP *ld, LDAPMessage *result);
LDAPMessage *ldap_first_reference(LDAP *ld, LDAPMessage *res);
LDAPMessage *ldap_next_reference(LDAP *ld, LDAPMessage *res);
int ldap_count_references(LDAP *ld, LDAPMessage *res);

Description

These functions are used to parse results received from `ldap_result(3LDAP)` or the synchronous LDAP search operation functions `ldap_search_s(3LDAP)` and `ldap_search_st(3LDAP)`.

The `ldap_first_entry()` function is used to retrieve the first entry in a chain of search results. It takes the `result` as returned by a call to `ldap_result(3LDAP)` or `ldap_search_s(3LDAP)` or `ldap_search_st(3LDAP)` and returns a pointer to the first entry in the result.

This pointer should be supplied on a subsequent call to `ldap_next_entry()` to get the next entry, the result of which should be supplied to the next call to `ldap_next_entry()`, etc. `ldap_next_entry()` will return NULL when there are no more entries. The entries returned from these calls are used in calls to the functions described in `ldap_get_dn(3LDAP)`, `ldap_first_attribute(3LDAP)`, `ldap_get_values(3LDAP)`, etc.

A count of the number of entries in the search result can be obtained by calling `ldap_count_entries()`.

`ldap_first_reference()` and `ldap_next_reference()` are used to step through and retrieve the list of continuation references from a search result chain.

The `ldap_count_references()` function is used to count the number of references that are contained in and remain in a search result chain.

Errors

If an error occurs in `ldap_first_entry()` or `ldap_next_entry()`, NULL is returned and the `ld_errno` field in the `ld` parameter is set to indicate the error. If an error occurs in `ldap_count_entries()`, -1 is returned, and `ld_errno` is set appropriately. See `ldap_error(3LDAP)` for a description of possible error codes.
Attributes  See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  
`ldap(3LDAP), ldap_result(3LDAP), ldap_search(3LDAP),
ldap_first_attribute(3LDAP), ldap_get_values(3LDAP),
ldap_get_dn(3LDAP),
attributes(5)`
**Name**
ldap_first_message, ldap_count_messages, ldap_next_message, ldap_msgtype – LDAP message processing functions

**Synopsis**
ccl flag... ] file... -lldap[ library... ]
#include <ber.h>
#include <ldap.h>

```c
int ldap_count_messages(LDAP *ld, LDAPMessage *res);
LDAPMessage *ldap_first_message(LDAP *ld, LDAPMessage *res);
LDAPMessage *ldap_next_message(LDAP *ld, LDAPMessage *msg);
int ldap_msgtype(LDAPMessage *res);
```

**Description**
ldap_count_messages() is used to count the number of messages that remain in a chain of results if called with a message, entry, or reference returned by ldap_first_message(), ldap_next_message(), ldap_first_entry(), ldap_next_entry(), ldap_first_reference(), and ldap_next_reference()

ldap_first_message() and ldap_next_message() functions are used to step through the list of messages in a result chain returned by ldap_result().

ldap_msgtype() function returns the type of an LDAP message.

**Return Values**
ldap_first_message() and ldap_next_message() return LDAPMessage which can include referral messages, entry messages and result messages.

ldap_count_messages() returns the number of messages contained in a chain of results.

**Errors**
ldap_first_message() and ldap_next_message() return NULL when no more messages exist. NULL is also returned if an error occurs while stepping through the entries, in which case the error parameters in the session handle ld will be set to indicate the error.

**Attributes**
See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**
ldap_error(3LDAP), ldap_result(3LDAP), attributes(5)
Name  ldap_friendly, ldap_friendly_name, ldap_free_friendlymap – LDAP attribute remapping functions

Synopsis  cc [ flag... ] file... -lldap [ library... ]
#include <lber.h>
#include <ldap.h>

char *ldap_friendly_name(char *filename, char *name,
    FriendlyMap **map);
void ldap_free_friendlymap(FriendlyMap **map);

Description  This function is used to map one set of strings to another. Typically, this is done for country names, to map from the two-letter country codes to longer more readable names. The mechanism is general enough to be used with other things, though.

filename is the name of a file containing the unfriendly to friendly mapping, name is the unfriendly name to map to a friendly name, and map is a result-parameter that should be set to NULL on the first call. It is then used to hold the mapping in core so that the file need not be read on subsequent calls.

For example:

    FriendlyMap *map = NULL;
    printf( "unfriendly %s => friendly %s\n", name,
        ldap_friendly_name( "ETCDIR/ldapfriendly", name, &map ) );

The mapping file should contain lines like this: unfriendlyname\tfriendlyname. Lines that begin with a '#' character are comments and are ignored.

The ldap_free_friendlymap() call is used to free structures allocated by ldap_friendly_name() when no more calls to ldap_friendly_name() are to be made.

Errors  NULL is returned by ldap_friendly_name() if there is an error opening filename, or if the file has a bad format, or if the map parameter is NULL.

Files  ETCDIR/ldapfriendly.conf

Attributes  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ldap(3LDAP), attributes(5)
The functions allow LDAP entry names (Distinguished Names, or DNs) to be obtained, parsed, converted to a user-friendly form, and tested. A DN has the form described in RFC 1779 A String Representation of Distinguished Names, unless it is an experimental DNS-style DN which takes the form of an RFC 822 mail address.

The `ldap_get_dn()` function takes an entry as returned by `ldap_first_entry(3LDAP)` or `ldap_next_entry(3LDAP)` and returns a copy of the entry's DN. Space for the DN will have been obtained by means of `malloc(3C)`, and should be freed by the caller by a call to `free(3C)`.

The `ldap_explode_dn()` function takes a DN as returned by `ldap_get_dn()` and breaks it up into its component parts. Each part is known as a Relative Distinguished Name, or RDN. `ldap_explode_dn()` returns a null-terminated array, each component of which contains an RDN from the DN. The `notypes` parameter is used to request that only the RDN values be returned, not their types. For example, the DN "cn=Bob, c=US" would return as either { "cn=Bob", "c=US", NULL } or { "Bob", "US", NULL }, depending on whether `notypes` was 0 or 1, respectively. The result can be freed by calling `ldap_value_free(3LDAP)`.

`ldap_dn2ufn()` is used to turn a DN as returned by `ldap_get_dn()` into a more user-friendly form, stripping off type names. See RFC 1781 "Using the Directory to Achieve User Friendly Naming" for more details on the UFN format. The space for the UFN returned is obtained by a call to `malloc(3C)`, and the user is responsible for freeing it by means of a call to `free(3C)`.

`ldap_is_dns_dn()` returns non-zero if the DN string is an experimental DNS-style DN (generally in the form of an RFC 822 e-mail address). It returns zero if the DN appears to be an RFC 1779 format DN.

`ldap_explode_dns()` takes a DNS-style DN and breaks it up into its component parts. `ldap_explode_dns()` returns a null-terminated array. For example, the DN "mcs.umich.edu" will return { "mcs", "umich", "edu", NULL }. The result can be freed by calling `ldap_value_free(3LDAP)`.
ldap_dns_to_dn() converts a DNS domain name into an X.500 distinguished name. A string distinguished name and the number of nameparts is returned.

**Errors** If an error occurs in ldap_get_dn(), NULL is returned and the ld_errno field in the ld parameter is set to indicate the error. See ldap_error(3LDAP) for a description of possible error codes. ldap_explode_dn(), ldap_explode_dns() and ldap_dn2ufn() will return NULL with errno(3C) set appropriately in case of trouble.

If an error in ldap_dns_to_dn() is encountered zero is returned. The caller should free the returned string if it is non-zero.

**Attributes** See attributes(5) for a description of the following attributes:

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</tr>
</tbody>
</table>

**See Also** ldap(3LDAP), ldap_first_entry(3LDAP), ldap_error(3LDAP), ldap_value_free(3LDAP)

**Notes** These functions allocate memory that the caller must free.
ldap_get_entry_controls() – get the LDAP controls included with a directory entry in a set of search results

Name
 ldap_get_entry_controls – get the LDAP controls included with a directory entry in a set of search results

Synopsis
 cc [flag ...] file... -lldap [library ...]
 #include <ldap.h>

 int ldap_get_entry_controls(LDAP *ld, LDAPMessage *entry,
 LDAPControl **serverctrlsp);

Description
 The ldap_get_entry_controls() function retrieves the LDAP v3 controls included in a directory entry in a chain of search results. The LDAP controls are specified in an array of LDAPControl structures. Each LDAPControl structure represents an LDAP control. The function takes entry as a parameter, which points to an LDAPMessage structure that represents an entry in a chain of search results.

The entry notification controls that are used with persistent search controls are the only controls that are returned with individual entries. Other controls are returned with results sent from the server. You can call ldap_parse_result() to retrieve those controls.

Errors
 ldap_get_entry_controls() returns the following error codes.

- LDAP_SUCCESS
  LDAP controls were successfully retrieved.
- LDAP_DECODING_ERROR
  An error occurred when decoding the BER-encoded message.
- LDAP_PARAM_ERROR
  An invalid parameter was passed to the function.
- LDAP_NO_MEMORY
  Memory cannot be allocated.

Attributes
 See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
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</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also
 ldap_error(3LDAP), ldap_parse_result(3LDAP), attributes(5)
ldap_getfilter, ldap_init_getfilter, ldap_init_getfilter_buf, ldap_getfilter_free,
ldap_getfirstfilter, ldap_getnextfilter, ldap_setfilteraffixes, ldap_build_filter – LDAP filter
generating functions

Synopsis

cc [ flag... ] file... -lldap [ library... ]
#include <lber.h>
#include <ldap.h>
#define LDAP_FILT_MAXSIZ 1024

LDAPFiltDesc *ldap_init_getfilter(char *file);
LDAPFiltDesc *ldap_init_getfilter_buf(char *buf, long buflen);
void ldap_getfilter_free(LDAPFiltDesc *lfdp);
LDAPFiltInfo *ldap_getfirstfilter(LDAPFiltDesc *lfdp, char *tagpat,
char *value);
LDAPFiltInfo *ldap_getnextfilter(LDAPFiltDesc *lfdp);
void ldap_setfilteraffixes(LDAPFiltDesc *lfdp, char *prefix,
char *suffix);
void ldap_build_filter(char *buf, unsigned long buflen, char *pattern,
char *prefix, char *suffix, char *attr, char *value,
char **valwords);

Description

These functions are used to generate filters to be used in ldap_search(3LDAP) or
ldap_search_s(3LDAP). Either ldap_init_getfilter or ldap_init_getfilter_buf must
be called prior to calling any of the other functions except ldap_build_filter.

ldap_init_getfilter() takes a file name as its only argument. The contents of the file must
be a valid LDAP filter configuration file (see ldapfilter.conf(4)). If the file is successfully
read, a pointer to an LDAPFiltDesc is returned. This is an opaque object that is passed in
subsequent get filter calls.

ldap_init_getfilter_buf() reads from buf, whose length is buflen, the LDAP filter
configuration information. buf must point to the contents of a valid LDAP filter configuration
file. See ldapfilter.conf(4). If the filter configuration information is successfully read, a
pointer to an LDAPFiltDesc is returned. This is an opaque object that is passed in subsequent
get filter calls.

ldap_getfilter_free() deallocates the memory consumed by ldap_init_getfilter. Once
it is called, the LDAPFiltDesc is no longer valid and cannot be used again.

ldap_getfirstfilter() retrieves the first filter that is appropriate for value. Only filter sets
that have tags that match the regular expression tagpat are considered. ldap_getfirstfilter
returns a pointer to an LDAPFiltInfo structure, which contains a filter with value inserted as
appropriate in lfi_filter, a text match description in lfi_desc, lfi_scope set to indicate
the search scope, and lfi_isexact set to indicate the type of filter. NULL is returned if no
matching filters are found. lfi_scope will be one of LDAP_SCOPE_BASE,
LDAP_SCOPE_ONELEVEL, or LDAP_SCOPE_SUBTREE. \_lfi
iseexact will be zero if the filter has any`~' or`*' characters in it and non-zero otherwise.

\ldap
getnextfilter() retrieves the next appropriate filter in the filter set that was determined when \ldap
getfirstfilter was called. It returns NULL when the list has been exhausted.

\ldap
setfilteraffixes() sets a prefix to be prepended and a suffix to be appended to all filters returned in the future.

\ldap
build_filter() constructs an LDAP search filter in buf. buflen is the size, in bytes, of the largest filter buf can hold. A pattern for the desired filter is passed in pattern. Where the string `%a' appears in the pattern it is replaced with attr. prefix is pre-pended to the resulting filter, and suffix is appended. Either can be NULL, in which case they are not used. value and valwords are used when the string `%v' appears in pattern. See ldapfilter.conf(4) for a description of how `%v' is handled.

Errors  NULL is returned by \ldap
init_getfilter if there is an error reading file. NULL is returned by \ldap
getfirstfilter and \ldap
getnextfilter when there are no more appropriate filters to return.

Files  /etc/ldap/ldapfilter.conf  LDAP filtering routine configuration file.

Attributes  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
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<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  \ldap(3LDAP), ldapfilter.conf(4), attributes(5)

Notes  The return values for all of these functions are declared in the `<\ldap.h>` header file. Some functions may allocate memory which must be freed by the calling application.
Name  
ldap_get_lang_values, ldap_get_lang_values_len – return an attribute's values that matches a specified language subtype

Synopsis  
cc [ flag ... ] file... -lldap [ library ... ]
#include <ldap.h>

char **ldap_get_lang_values(LDAP *ld, LDAPMessage *entry, const char *target, char **type);

struct berval **ldap_get_lang_values_len(LDAP *ld, LDAPMessage *entry, const char *target, char **type);

Description  
The ldap_get_lang_values() function returns an array of an attribute's string values that matches a specified language subtype. To retrieve the binary data from an attribute, call the ldap_get_lang_values_len() function instead.

ldap_get_lang_values() should be called to retrieve a null-terminated array of an attribute's string values that match a specified language subtype. The entry parameter is the entry retrieved from the directory. The target parameter should contain the attribute type the values that are required, including the optional language subtype. The type parameter points to a buffer that returns the attribute type retrieved by this function. Unlike the ldap_get_values() function, if a language subtype is specified, this function first attempts to find and return values that match that subtype, for example, cn;lang-en.

ldap_get_lang_values_len() returns a null-terminated array of pointers to berval structures, each containing the length and pointer to a binary value of an attribute for a given entry. The entry parameter is the result returned by ldap_result() or ldap_search_s() functions. The target parameter is the attribute returned by the call to ldap_first_attribute() or ldap_next_attribute(), or the attribute as a literal string, such as jpegPhoto or audio.

These functions are deprecated. Use ldap_get_values() or ldap_get_values_len() instead.

Return Values  
If successful, ldap_get_lang_values() returns a null-terminated array of the attribute's values. If the call is unsuccessful, or if no such attribute exists in the entry, it returns a NULL and sets the appropriate error code in the LDAP structure.

The ldap_get_lang_values_len() function returns a null-terminated array of pointers to berval structures, which in turn, if successful, contain pointers to the attribute's binary values. If the call is unsuccessful, or if no such attribute exists in the entry, it returns a NULL and sets the appropriate error code in the LDAP structure.

Attributes  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
</tbody>
</table>
See Also

LDAP, ldap_first_attribute(3LDAP), ldap_first_attribute(3LDAP),
ldap_get_values(3LDAP), ldap_result(3LDAP), ldap_search(3LDAP), attributes(5)
ldap_get_option, ldap_set_option – get or set session preferences in the ldap structure.

Synopsis

cc [ flag... ] file... -lldap [ library... ]
#include <lber.h>
#include <ldap.h>

LDAP ldap_set_option(LDAP *ld, int option, void *optdata[]);
LDAP ldap_get_option(LDAP *ld, int option, void optdata[]);

Description

These functions provide an LDAP structure with access to session preferences. The
ldap_get_option() function gets session preferences from the LDAP structure. The
ldap_set_option() function sets session preferences in the LDAP structure.

The ld parameter specifies the connection handle, a pointer to an LDAP structure that contains
information about the LDAP server connection. The option parameter specifies the name of
the option to be read or modified. The optdata parameter serves as a pointer to the value of the
option that you set or get.

Parameters

The following values can be specified for the option parameter:

<table>
<thead>
<tr>
<th>Option</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDAP_OPT_API_INFO</td>
<td>Retrieves basic information about the LDAP API implementation at execution time. The data type for the optdata parameter is (LDAPAPIInfo *). This option is READ-ONLY and cannot be set.</td>
</tr>
<tr>
<td>LDAP_OPT_DEREF</td>
<td>Determines how aliases are handled during a search. The data type for the optdata parameter is (int *). The following values can be specified for the optdata parameter:</td>
</tr>
<tr>
<td>LDAP_DEREF_NEVER</td>
<td>Specifies that aliases are never dereferenced.</td>
</tr>
<tr>
<td>LDAP_DEREF_SEARCHING</td>
<td>Specifies that aliases are dereferenced when searching under the base object, but not when finding the base object.</td>
</tr>
<tr>
<td>LDAP_DEREF_FINDING</td>
<td>Specifies that aliases are dereferenced when finding the base object, but not when searching under the base object.</td>
</tr>
<tr>
<td>LDAP_DEREF_ALWAYS</td>
<td>Specifies that aliases are always dereferenced when finding the base object.</td>
</tr>
</tbody>
</table>
and searching under the base object.

<table>
<thead>
<tr>
<th>LDAP_OPT_SIZELIMIT</th>
<th>Specifies the maximum number of entries returned by the server in search results. The data type for the optdata parameter is (int *). Setting the optdata parameter to LDAP_NO_LIMIT removes any size limit enforced by the client.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDAP_OPT_TIMELIMIT</td>
<td>Specifies the maximum number of seconds spent by the server when answering a search request. The data type for the optdata parameter is (int *). Setting the optdata parameter to LDAP_NO_LIMIT removes any time limit enforced by the client.</td>
</tr>
<tr>
<td>LDAP_OPT_REFERRALS</td>
<td>Determines whether the client should follow referrals. The data type for the optdata parameter is (int *). The following values can be specified for the optdata parameter:</td>
</tr>
<tr>
<td></td>
<td>LDAP_OPT_ON specifies that the client should follow referrals.</td>
</tr>
<tr>
<td></td>
<td>LDAP_OPT_OFF specifies that the client should not follow referrals.</td>
</tr>
<tr>
<td>By default, the client follows referrals.</td>
<td></td>
</tr>
<tr>
<td>LDAP_OPT_RESTART</td>
<td>Determines whether LDAP I/O operations are automatically restarted if aborted prematurely. It can be set to one of the constants LDAP_OPT_ON or LDAP_OPT_OFF.</td>
</tr>
<tr>
<td>LDAP_OPT_PROTOCOL_VERSION</td>
<td>Specifies the version of the protocol supported by the client. The data type for the optdata parameter is (int *). The version LDAP_VERSION2 or LDAP_VERSION3 can be specified. If no version is set, the default version LDAP_VERSION2 is set. To use LDAP v3 features, set the protocol version to LDAP_VERSION3.</td>
</tr>
<tr>
<td>LDAP_OPT_SERVER_CONTROLS</td>
<td>Specifies a pointer to an array of LDAPControl structures that represent the LDAP v3 server controls sent by default with every request. The data type for the optdata parameter for ldap_set_option() is (LDAPControl **). For ldap_get_option(), the data type is (LDAPControl ***).</td>
</tr>
</tbody>
</table>
**LDAP_OPT_CLIENT_CONTROLS**

Specifies a pointer to an array of LDAPControl structures that represent the LDAP v3 client controls sent by default with every request. The data type for the `optdata` parameter for `ldap_set_option()` is (LDAPControl **). For `ldap_get_option()`, the data type is (LDAPControl ***).

**LDAP_OPT_API_FEATURE_INFO**

Retrieves version information at execution time about extended features of the LDAP API. The data type for the `optdata` parameter is (LDAPAPIFeatureInfo *).

This option is READ-ONLY and cannot be set.

**LDAP_OPT_HOST_NAME**

Sets the host name or a list of hosts for the primary LDAP server. The data type for the `optdata` parameter for `ldap_set_option()` is (char *). For `ldap_get_option()`, the data type is (char **).

**LDAP_OPT_ERROR_NUMBER**

Specifies the code of the most recent LDAP error that occurred for this session. The data type for the `optdata` parameter is (int *).

**LDAP_OPT_ERROR_STRING**

Specifies the message returned with the most recent LDAP error that occurred for this session. The data type for the `optdata` parameter for `ldap_set_option()` is (char *) and for `ldap_get_option()` is (char **).

**LDAP_OPT_MATCHED_DN**

Specifies the matched DN value returned with the most recent LDAP error that occurred for this session. The data type for the `optdata` parameter for `ldap_set_option()` is (char *) and for `ldap_get_option()` is (char **).

**LDAP_OPT_REBIND_ARG**

Sets the last argument passed to the routine specified by `LDAP_OPT_REBIND_FN`. This option can also be set by calling the `ldap_set_rebind_proc()` function. The data type for the `optdata` parameter is (void *).

**LDAP_OPT_REBIND_FN**

Sets the routine to be called to authenticate a connection with another LDAP server. For example, the option is used to set the routine called during the course of a referral. This option can also be by calling the `ldap_set_rebind_proc()` function. The data type for the `optdata` parameter is (LDAP_REBINDPROC_CALLBACK *).
<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDAP_OPT_X_SASL_MECH</td>
<td>Sets the default SASL mechanism to call ldap_interactive_bind_s(). The data type for the optdata parameter is (char *).</td>
</tr>
<tr>
<td>LDAP_OPT_X_SASL_REALM</td>
<td>Sets the default SASL_REALM. The default SASL_REALM should be used during a SASL challenge in response to a SASL_CB_GETREALM request when using the ldap_interactive_bind_s() function. The data type for the optdata parameter is (char *).</td>
</tr>
<tr>
<td>LDAP_OPT_X_SASL_AUTHCID</td>
<td>Sets the default SASL_AUTHNAME used during a SASL challenge in response to a SASL_CB_AUTHNAME request when using the ldap_interactive_bind_s() function. The data type for the optdata parameter is (char *).</td>
</tr>
<tr>
<td>LDAP_OPT_X_SASL_AUTHZID</td>
<td>Sets the default SASL_USER that should be used during a SASL challenge in response to a SASL_CB_USER request when using the ldap_interactive_bind_s() function. The data type for the optdata parameter is (char *).</td>
</tr>
<tr>
<td>LDAP_OPT_X_SASL_SSF</td>
<td>A read-only option used exclusively with the ldap_get_option() function. The ldap_get_option() function performs a sasl_getprop() operation that gets the SASL_SSF value for the current connection. The data type for the optdata parameter is (sasl_ssf_t *).</td>
</tr>
<tr>
<td>LDAP_OPT_X_SASL_SSF_EXTERNAL</td>
<td>A write-only option used exclusively with the ldap_set_option() function. The ldap_set_option() function performs a sasl_setprop() operation to set the SASL_SSF_EXTERNAL value for the current connection. The data type for the optdata parameter is (sasl_ssf_t *).</td>
</tr>
<tr>
<td>LDAP_OPT_X_SASL_SECPROPS</td>
<td>A write-only option used exclusively with the ldap_set_option() function. This function performs a sasl_setprop(3SASL) operation for the SASL_SEC_PROPS value for the current connection during an ldap_interactive_bind_s() operation. The data type for the optdata parameter is (char *), a comma delimited string containing text values for any of the SASL_SEC_PROPS that should be set. The text values are:</td>
</tr>
</tbody>
</table>
noanonymous  Sets the SASL_SEC_NOANONYMOUS flag

nodict  Sets the SASL_SEC_NODICTIONARY flag

noplain  Sets the SASL_SEC_NOPLAINTEXT flag

forwardsec  Sets the SASL_SEC_FORWARD_SECRECY flag

passcred  Sets the SASL_SEC_PASS_CREDENTIALS flag

minssf=N  Sets minssf to the integer value N

maxssf=N  Sets maxssf to the integer value N

maxbufsize=N Sets maxbufsize to the integer value N

`LDAP_OPT_X_SASL_SSF_MIN`  Sets the default SSF_MIN value used during a `ldap_interactive_bind_s()` operation. The data type for the `optdata` parameter is `(char *)` numeric string.

`LDAP_OPT_X_SASL_SSF_MAX`  Sets the default SSF_MAX value used during a `ldap_interactive_bind_s()` operation. The data type for the `optdata` parameter is `(char *)` numeric string.

`LDAP_OPT_X_SASL_MAXBUFSIZE`  Sets the default SSF_MAXBUFSIZE value used during a `ldap_interactive_bind_s()` operation. The data type for the `optdata` parameter is `(char *)` numeric string.

**Return Values**  The `ldap_set_option()` and `ldap_get_option()` functions return:

- `LDAP_SUCCESS`  If successful
- `-1`  If unsuccessful

**Attributes**  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  `ldap_init(3LDAP), sasl_setprop(3SASL), attributes(5)`
There are other elements in the LDAP structure that should not be changed. No assumptions should be made about the order of elements in the LDAP structure.
ldap_get_values, ldap_get_values_len, ldap_count_values, ldap_count_values_len, ldap_value_free, ldap_value_free_len – LDAP attribute value handling functions

Synopsis

```c
c [ flag... ] file... -lldap [ library... ]
#include <ber.h>
#include <ldap.h>

char **ldap_get_values(LDAP *ld, LDAPMessage *entry, char *attr);

struct berval **ldap_get_values_len(LDAP *ld, LDAPMessage *entry, char *attr);

int ldap_count_values(char **vals);

int ldap_count_values_len(struct berval **vals);

void ldap_value_free(char **vals);

void ldap_value_free_len(struct berval *vals);
```

Description

These functions are used to retrieve and manipulate attribute values from an LDAP entry as returned by `ldap_first_entry(3LDAP)` or `ldap_next_entry(3LDAP)`. `ldap_get_values()` takes the `entry` and the attribute `attr` whose values are desired and returns a null-terminated array of the attribute’s values. `attr` may be an attribute type as returned from `ldap_first_attribute(3LDAP)` or `ldap_next_attribute(3LDAP)`, or if the attribute type is known it can simply be given.

The number of values in the array can be counted by calling `ldap_count_values()`. The array of values returned can be freed by calling `ldap_value_free()`.

If the attribute values are binary in nature, and thus not suitable to be returned as an array of `char`'s, the `ldap_get_values_len()` function can be used instead. It takes the same parameters as `ldap_get_values()`, but returns a null-terminated array of pointers to `berval` structures, each containing the length of and a pointer to a value.

The number of values in the array can be counted by calling `ldap_count_values_len()`. The array of values returned can be freed by calling `ldap_value_free_len()`.

Errors

If an error occurs in `ldap_get_values()` or `ldap_get_values_len()`, NULL returned and the `ld_errno` field in the `ld` parameter is set to indicate the error. See `ldap_error(3LDAP)` for a description of possible error codes.

Attributes

See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
See Also  ldap(3LDAP), ldap_first_entry(3LDAP), ldap_first_attribute(3LDAP),
        ldap_error(3LDAP), attributes(5)

Notes  These functions allocates memory that the caller must free.
Name
ldap_memcache, ldap_memcache_init, ldap_memcache_set, ldap_memcache_get, ldap_memcache_flush, ldap_memcache_destroy, ldap_memcache_update – LDAP client caching functions

Synopsis
cc [ flag ... ] file... -lldap [ library... ]
#include <ldap.h>

int ldap_memcache_init(unsigned long ttl, unsigned long size, char **baseDNS, struct ldap_thread_fns *thread_fns, LDAPMemCache **cache);
int ldap_memcache_set(LDAP *ld, LDAPMemCache **cache);
int ldap_memcache_get(LDAP *ld, LDAPMemCache **cache);
void ldap_memcache_flush(LDAPMemCache *cache, char *dn, int scope);
void ldap_memcache_destroy(LDAPMemCache *cache);
void ldap_memcache_update(LDAPMemCache *cache);

Description
Use the ldap_memcache functions to maintain an in-memory client side cache to store search requests. Caching improves performance and reduces network bandwidth when a client makes repeated requests. The cache uses search criteria as the key to the cached items. When you send a search request, the cache checks the search criteria to determine if that request has been previously stored. If the request was stored, the search results are read from the cache.

Make a call to ldap_memcache_init() to create the in-memory client side cache. The function passes back a pointer to an LDAPMemCache structure, which represents the cache. Make a call to the ldap_memcache_set() function to associate this cache with an LDAP connection handle, an LDAP structure. ttl is the the maximum amount of time (in seconds) that an item can be cached. If a ttl value of 0 is passed, there is no limit to the amount of time that an item can be cached. size is the maximum amount of memory (in bytes) that the cache will consume. A zero value of size means the cache has no size limit. baseDNS is an array of the base DN strings representing the base DNs of the search requests you want cached. If baseDNS is not NULL, only the search requests with the specified base DNs will be cached. If baseDNS is NULL, all search requests are cached. The thread_fns parameter takes an ldap_thread_fns structure specifying the functions that you want used to ensure that the cache is thread-safe. You should specify this if you have multiple threads that are using the same connection handle and cache. If you are not using multiple threads, pass NULL for this parameter.

ldap_memcache_set() associates an in-memory cache that you have already created by calling the ldap_memcache_init() function with an LDAP connection handle. The ld parameter should be the result of a successful call to ldap_open(3LDAP). The cache parameter should be the result of a cache created by the ldap_memcache_init() call. After you call this function, search requests made over the specified LDAP connection will use this cache. To disassociate the cache from the LDAP connection handle, make a call to the ldap_bind(3LDAP) or ldap_bind(3LDAP) function. Make a call to ldap_memcache_set() if you want to associate a
cache with multiple LDAP connection handles. For example, call the `ldap_memcache_get()` function to get the cache associated with one connection, then you can call this function and associate the cache with another connection.

The `ldap_memcache_get()` function gets the cache associated with the specified connection handle (LDAP structure). This cache is used by all search requests made through that connection. When you call this function, the function sets the `cache` parameter as a pointer to the LDAPMemCache structure that is associated with the connection handle.

`ldap_memcache_flush()` flushes search requests from the cache. If the base DN of a search request is within the scope specified by the `dn` and `scope` arguments, the search request is flushed from the cache. If no DN is specified, the entire cache is flushed. The `scope` parameter, along with the `dn` parameter, identifies the search requests that you want flushed from the cache. This argument can have one of the following values:

- `LDAP_SCOPE_BASE`
- `LDAP_SCOPE_ONELEVEL`
- `LDAP_SCOPE_SUBTREE`

`ldap_memcache_destroy()` frees the specified LDAPMemCache structure pointed to by `cache` from memory. Call this function after you are done working with a cache.

`ldap_memcache_update()` checks the cache for items that have expired and removes them. This check is typically done as part of the way the cache normally works. You do not need to call this function unless you want to update the cache at this point in time. This function is only useful in a multithreaded application, since it will not return until the cache is destroyed.

### Parameters

- **ttl**
  The maximum amount of time (in seconds) that an item can be cached
- **size**
  The maximum amount of memory (in bytes) that the cache will consume.
- **baseDNs**
  An array of the base DN strings representing the base DNs of the search requests you want cached
- **thread_fns**
  A pointer to the `ldap_thread_fns` structure.
- **cache**
  A pointer to the LDAPMemCache structure.
- **cache**
  The result of a cache created by the `ldap_memcache_init()` call
- **ld**
  The result of a successful call to `ldap_open(3LDAP)`
- **dn**
  The search requests that you want flushed from the cache
- **scope**
  The search requests that you want flushed from the cache

### Errors

The functions that have `int return values return LDAP_SUCCESS if the operation was successful. Otherwise, they return another LDAP error code. See `ldap_error(3LDAP)` for a list of the LDAP error codes.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ldap_error(3LDAP), ldap_open(3LDAP), ldap_search(3LDAP), attributes(5)
**ldap_memfree(3LDAP)**

**Name**
ldap_memfree – free memory allocated by LDAP API functions

**Synopsis**
```
cc [ flag ... ] file... -lldap [ library ... ]
#include <ber.h>
#include <ldap.h>

void ldap_memfree(void *p);
```

**Description**
The `ldap_memfree()` function frees the memory allocated by certain LDAP API functions that do not have corresponding functions to free memory. These functions include

- `ldap_get_dn(3LDAP)`,
- `ldap_first_attribute(3LDAP)`, and
- `ldap_next_attribute(3LDAP)`.

The `ldap_memfree()` function takes one parameter, *p*, which is a pointer to the memory to be freed.

**Parameters**
- *p* — A pointer to the memory to be freed.

**Return Values**
There are no return values for the `ldap_memfree()` function.

**Errors**
No errors are defined for the `ldap_memfree()` function.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**
- `ldap(3LDAP)`,
- `ldap_first_attribute(3LDAP)`,
- `ldap_get_dn(3LDAP)`,
- `ldap_next_attribute(3LDAP)`, `attributes(5)`
The function `ldap Modify_s()` is used to perform an LDAP modify operation. `dn` is the DN of the entry to modify, and `mods` is a null-terminated array of modifications to make to the entry. Each element of the `mods` array is a pointer to an LDAPMod structure, which is defined below.

```c
typedef struct ldapmod {
    int mod_op;
    char *mod_type;
    union {
        char **modv_strvals;
        struct berval **modv_bvals;
    } mod_vals;
} LDAPMod;
```

The `mod_op` field is used to specify the type of modification to perform and should be one of `LDAP_MOD_ADD`, `LDAP_MOD_DELETE`, or `LDAP_MOD_REPLACE`. The `mod_type` and `mod_values` fields specify the attribute type to modify and a null-terminated array of values to add, delete, or replace respectively.

If you need to specify a non-string value (for example, to add a photo or audio attribute value), you should set `mod_op` to the logical OR of the operation as above (for example, `LDAP_MOD_REPLACE`) and the constant `LDAP_MOD_BVALUES`. In this case, `mod_bvalues` should be used instead of `mod_values`, and it should point to a null-terminated array of struct bervals, as defined in `<lber.h>`.

For `LDAP_MOD_ADD` modifications, the given values are added to the entry, creating the attribute if necessary. For `LDAP_MOD_DELETE` modifications, the given values are deleted from the entry, removing the attribute if no values remain. If the entire attribute is to be deleted, the `mod_values` field should be set to NULL. For `LDAP_MOD_REPLACE` modifications, the attribute...
will have the listed values after the modification, having been created if necessary. All modifications are performed in the order in which they are listed.

ldap_modify_s() returns the LDAP error code resulting from the modify operation.

The ldap_modify() operation works the same way as ldap_modify_s(), except that it is asynchronous, returning the message id of the request it initiates, or −1 on error. The result of the operation can be obtained by calling ldap_result(3LDAP).

ldap_mods_free() can be used to free each element of a null-terminated array of mod structures. If freemods is non-zero, the mods pointer itself is freed as well.

The ldap_modify_ext() function initiates an asynchronous modify operation and returns LDAP_SUCCESS if the request was successfully sent to the server, or else it returns a LDAP error code if not. See ldap_error(3LDAP). If successful, ldap_modify_ext() places the message id of the request in *msgidp. A subsequent call to ldap_result(3LDAP), can be used to obtain the result of the add request.

The ldap_modify_ext_s() function initiates a synchronous modify operation and returns the result of the operation itself.

**Errors**  ldap_modify_s() returns an LDAP error code, either LDAP_SUCCESS or an error. See ldap_error(3LDAP).

ldap_modify() returns −1 in case of trouble, setting the error field of ld.

**Attributes**  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**  ldap(3LDAP), ldap_add(3LDAP), ldap_error(3LDAP), ldap_get_option(3LDAP), attributes(5)
**Synopsis**

```c
#include <lber.h>
#include <ldap.h>

int ldap_modrdn(LDAP *ld, const char *dn, const char *newrdn);
int ldap_modrdn_s(LDAP *ld, const char *dn, const char *newrdn,
                 int deleteoldrdn);

int ldap_modrdn2(LDAP *ld, const char *dn, const char *newrdn,
                 int deleteoldrdn);
int ldap_modrdn2_s(LDAP *ld, const char *dn, const char *newrdn,
                    int deleteoldrdn);

int ldap_rename(LDAP *ld, const char *dn, const char *newrdn,
                const char *newparent, int deleteoldrdn,
                LDAPControl **serverctrls, LDAPControl **clientctrls,
                int *msgidp);

int ldap_rename_s(LDAP *ld, const char *dn, const char *newrdn,
                   const char *newparent, const int deleteoldrdn,
                   LDAPControl **serverctrls, LDAPControl **clientctrls);
```

**Description**

The `ldap_modrdn()` and `ldap_modrdn_s()` functions perform an LDAP modify RDN (Relative Distinguished Name) operation. They both take `dn`, the DN (Distinguished Name) of the entry whose RDN is to be changed, and `newrdn`, the new RDN, to give the entry. The old RDN of the entry is never kept as an attribute of the entry. `ldap_modrdn()` is asynchronous. It returns the message ID of the operation it initiates. `ldap_modrdn_s()` is synchronous. It returns the LDAP error code that indicates the success or failure of the operation.

The `ldap_modrdn2()` and `ldap_modrdn2_s()` functions also perform an LDAP modify RDN operation. They take the same parameters as above. In addition, they both take the `deleteoldrdn` parameter, which is used as a boolean value to indicate whether or not the old RDN values should be deleted from the entry.

The `ldap_rename()`, `ldap_rename_s()` routines are used to change the name, that is, the RDN of an entry. These routines deprecate the `ldap_modrdn()` and `ldap_modrdn_s()` routines, as well as `ldap_modrdn2()` and `ldap_modrdn2_s()`.

The `ldap_rename()` and `ldap_rename_s()` functions both support LDAPv3 server controls and client controls.

**Errors**

The synchronous (_s) versions of these functions return an LDAP error code, either `LDAP_SUCCESS` or an error. See `ldap_error(3LDAP)`.

The asynchronous versions return −1 in the event of an error, setting the `ld_errno` field of `ld`. See `ldap_error(3LDAP)` for more details. Use `ldap_result(3LDAP)` to determine a
particular unsuccessful result.

**Attributes**  See [attributes(5)] for a description of the following attributes of the `ldap_modrdn()`, `ldap_modrdn_s()`, `ldap_modrdn2()` and `ldap_modrdn2_s()` functions:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Obsolete</td>
</tr>
</tbody>
</table>

The `ldap_rename()` and `ldap_rename_s()` functions have the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also**  [ldap(3LDAP), ldap_error(3LDAP), attributes(5)]
ldap_open, ldap_init – initialize an LDAP session

Synopsis

```c
#include <lber.h>
#include <ldap.h>

LDAP *ldap_open(const char *host, int port);
LDAP *ldap_init(const char *host, int port);
```

Description

The `ldap_open()` function initializes an LDAP session and also opens a connection to an LDAP server before it returns to the caller. Unlike `ldap_open()`, `ldap_init()` does not open a connection to the LDAP server until an operation, such as a search request, is performed.

The `ldap_open()` function is deprecated and should no longer be used. Call `ldap_init()` instead.

A list of LDAP hostnames or an IPv4 or IPv6 address can be specified with the `ldap_open()` and `ldap_init()` functions. The hostname can include a port number, separated from the hostname by a colon (`:`). A port number included as part of the hostname takes precedence over the `port` parameter. The `ldap_open()` and `ldap_init()` functions attempt connections with LDAP hosts in the order listed and return the first successful connection.

Parameters

These functions support the following parameters.

- `host` The hostname, IPv4 or IPv6 address of the host that runs the LDAP server. A space-separated list of hostnames can also be used for this parameter.
- `port` TCP port number of a connection. Supply the constant `LDAP_PORT` to obtain the default LDAP port of 389. If a host includes a port number, the default parameter is ignored.

Return Values

The `ldap_open()` and `ldap_init()` functions return a handle to an LDAP session that contains a pointer to an opaque structure. The structure must be passed to subsequent calls for the session. If a session cannot be initialized, the functions return `NULL` and `errno` should be set appropriately.

Various aspects of this opaque structure can be read or written to control the session-wide parameters. Use the `ldap_get_option(3LDAP)` to access the current option values and the `ldap_set_option(3LDAP)` to set values for these options.

Examples

**Example 1** Specifying IPv4 and IPv6 Addresses

LDAP sessions can be initialized with hostnames, IPv4 or IPv6 addresses, such as those shown in the following examples.

```c
ldap_init("hosta:636 hostb", 389)
ldap_init("192.168.82.110:389", 389)
ldap_init("[fec0::114:a00:20ff:ab3d:83ed]", 389)
```
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  errno(3C), ldap(3LDAP), ldap_bind(3LDAP), ldap_get_option(3LDAP), ldap_set_option(3LDAP), attributes(5)
ldap_parse_result, ldap_parse_extended_result, ldap_parse_sasl_bind_result – LDAP message result parser

Synopsis

cc [ flag... ] file... -lldap [ library... ]
#include <lber.h>
#include <ldap.h>

int ldap_parse_result(LDAP *ld, LDAPMessage *res, int *errcodep,
    char **matcheddn, char **errmsgp, char ***referralsp,
    LDAPControl ***serverctrlsp, int freeit);

int ldap_parse_sasl_bind_result(LDAP *ld, LDAPMessage *res,
    struct berval **servercredp, int freeit);

int ldap_parse_extended_result(LDAP *ld, LDAPMessage *res,
    char **resultoidp, struct berval **resultdata, int freeit);

Description
The `ldap_parse_extended_result()`, `ldap_parse_result()` and `ldap_parse_sasl_bind_result()` routines search for a message to parse. These functions skip messages of type LDAP_RES_SEARCH_ENTRY and LDAP_RES_SEARCH_REFERENCE.

Return Values
They return LDAP_SUCCESS if the result was successfully parsed or an LDAP error code if not (see `ldap_error(3LDAP)`).

Attributes
See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
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<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also
`ldap_error(3LDAP)`, `ldap_result(3LDAP)`, `attributes(5)`
Name: ldap_result, ldap_msgfree – wait for and return LDAP operation result

Synopsis:
```c
#include <ber.h>
#include <ldap.h>

int ldap_result(LDAP *ld, int msgid, int all,
                struct timeval *timeout, LDAPMessage **result);
int ldap_msgfree(LDAPMessage *msg);
```

Description:
The `ldap_result()` function is used to wait for and return the result of an operation previously initiated by one of the LDAP asynchronous operation functions, for example, `ldap_search(3LDAP)`, and `ldap_modify(3LDAP)`. Those functions all return -1 in case of error, and an invocation identifier upon successful initiation of the operation. The invocation identifier is picked by the library and is guaranteed to be unique across the LDAP session. It can be used to request the result of a specific operation from `ldap_result()` through the `msgid` parameter.

The `ldap_result()` function will block or not, depending upon the setting of the `timeout` parameter. If `timeout` is not a null pointer, it specifies a maximum interval to wait for the selection to complete. If `timeout` is a null pointer, the select blocks indefinitely. To effect a poll, the `timeout` argument should be a non-null pointer, pointing to a zero-valued `timeval` structure. See `select(3C)` for further details.

If the result of a specific operation is required, `msgid` should be set to the invocation identifier returned when the operation was initiated, otherwise LDAP_RES_ANY should be supplied. The `all` parameter only has meaning for search responses and is used to select whether a single entry of the search response should be returned, or all results of the search should be returned.

A search response is made up of zero or more search entries followed by a search result. If `all` is set to 0, search entries will be returned one at a time as they come in, by means of separate calls to `ldap_result()`. If it is set to a non-zero value, the search response will only be returned in its entirety, that is, after all entries and the final search result have been received.

Upon success, the type of the result received is returned and the `result` parameter will contain the result of the operation. This result should be passed to the LDAP parsing functions, (see `ldap_first_entry(3LDAP)`) for interpretation.

The possible result types returned are:
```c
#define LDAP_RES_BIND 0x61L
#define LDAP_RES_SEARCH_ENTRY 0x64L
#define LDAP_RES_SEARCH_RESULT 0x65L
#define LDAP_RES_MODIFY 0x67L
#define LDAP_RES_ADD 0x69L
#define LDAP_RES_DELETE 0x6bL
#define LDAP_RES_MODRDN 0x6dL
#define LDAP_RES_COMPARE 0x6fL
```
The `ldap_msgfree()` function is used to free the memory allocated for a result by `ldap_result()` or `ldap_search_s(3LDAP)` functions. It takes a pointer to the result to be freed and returns the type of the message it freed.

**Errors** The `ldap_result()` function returns −1 on error and 0 if the specified timeout was exceeded.

**Attributes** See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also** select(1), ldap(3LDAP), ldap_search(3LDAP), attributes(5)

**Notes** The `ldap_result()` function allocates memory for results that it receives. The memory can be freed by calling `ldap_msgfree(3LDAP).`
ldap_search(3LDAP)

Name

ldap_search, ldap_search_s, ldap_search_ext, ldap_search_ext_s, ldap_search_st – LDAP search operations

Synopsis

cc [ flag... ] file... -lldap[ library...]
#include <sys/time.h> /* for struct timeval definition */
#include <ber.h>
#include <ldap.h>

int ldap_search(LDAP *ld, char *base, int scope, char *filter, char *attrs[], int attrsonly);
int ldap_search_s(LDAP *ld, char *base, int scope, char *filter, char *attrs[], int attrsonly, LDAPMessage **res);
int ldap_search_st(LDAP *ld, char *base, int scope, char *filter, char *attrs[], int attrsonly, struct timeval *timeout, LDAPMessage **res);
int ldap_search_ext(LDAP *ld, char *base, int scope, char *filter, char **attrs, int attrsonly, LDAPControl **serverctrls, LDAPControl **clientctrls, struct timeval *timeoutp, int sizelimit, int *msgidp);
int ldap_search_ext_s(LDAP *ld, char *base, int scope, char *filter, char **attrs, int attrsonly, LDAPControl **serverctrls, LDAPControl **clientctrls, struct timeval *timeoutp, int sizelimit, LDAPMessage **res);

Description

These functions are used to perform LDAP search operations. The ldap_search_s() function does the search synchronously (that is, not returning until the operation completes). The ldap_search_st() function does the same, but allows a timeout to be specified. The ldap_search() function is the asynchronous version, initiating the search and returning the message ID of the operation it initiated.

The base is the DN of the entry at which to start the search. The scope is the scope of the search and should be one of LDAP_SCOPE_BASE, to search the object itself, LDAP_SCOPE_ONELEVEL, to search the object’s immediate children, or LDAP_SCOPE_SUBTREE, to search the object and all its descendents.

The filter is a string representation of the filter to apply in the search. Simple filters can be specified as attributetype=attributevalue. More complex filters are specified using a prefix notation according to the following BNF:

<filter> ::= '(' <filtercomp> ')
<filtercomp> ::= = <and> | <or> | <not> | <simple>
<and> ::= '&<filterlist>
<or> ::= '|<filterlist>
<not> ::= '!<filter>
<filterlist> ::= <filter> | <filter> <filterlist>
<simple> ::= <attributetype> <filtertype> <attributevalue>
<filtertype> ::= '=' | '=' | '<=' | '>='
The '~=\' construct is used to specify approximate matching. The representation for <attributetype> and <attributevalue> are as described in RFC 1778. In addition, <attributevalue> can be a single * to achieve an attribute existence test, or can contain text and *'s interspersed to achieve substring matching.

For example, the filter mail=* finds entries that have a mail attribute. The filter mail=*@terminator.rs.itd.umich.edu finds entries that have a mail attribute ending in the specified string. Use a backslash (\) to escape parentheses characters in a filter. See RFC 1588 for a more complete description of the filters that are allowed. See ldap_getfilter(3LDAP) for functions to help construct search filters automatically.

The attrs is a null-terminated array of attribute types to return from entries that match filter. If NULL is specified, all attributes are returned. The attrsonly is set to 1 when attribute types only are wanted. The attrsonly is set to 0 when both attributes types and attribute values are wanted.

The sizelimit argument returns the number of matched entries specified for a search operation. When sizelimit is set to 50, for example, no more than 50 entries are returned. When sizelimit is set to 0, all matched entries are returned. The LDAP server can be configured to send a maximum number of entries, different from the size limit specified. If 5000 entries are matched in the database of a server configured to send a maximum number of 500 entries, no more than 500 entries are returned even when sizelimit is set to 0.

The ldap_search_ext() function initiates an asynchronous search operation and returns LDAP_SUCCESS when the request is successfully sent to the server. Otherwise, ldap_search_ext() returns an LDAP error code. See ldap_error(3LDAP). If successful, ldap_search_ext() places the message ID of the request in *msgidp. A subsequent call to ldap_result(3LDAP) can be used to obtain the result of the add request.

The ldap_search_ext_s() function initiates a synchronous search operation and returns the result of the operation itself.

Errors The ldap_search_s() and ldap_search_st() functions return the LDAP error code that results from a search operation. See ldap_error(3LDAP) for details.

The ldap_search() function returns −1 when the operation terminates unsuccessfully.

Attributes See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also ldap(3LDAP), ldap_result(3LDAP), ldap_getfilter(3LDAP), ldap_error(3LDAP), attributes(5)


**Notes** The read and list functionality are subsumed by `ldap_search()` functions, when a filter such as `objectclass=*` is used with the scope LDAP_SCOPE_BASE to emulate read or the scope LDAP_SCOPE.ONELEVEL to emulate list.

The `ldap_search()` functions may allocate memory which must be freed by the calling application. Return values are contained in `<ldap.h>`.
ldap_searchprefs, ldap_init_searchprefs, ldap_init_searchprefs_buf, ldap_free_searchprefs, ldap_first_searchobj, ldap_next_searchobj – LDAP search preference configuration routines

Synopsis

```c
#include <lber.h>
#include <ldap.h>

int ldap_init_searchprefs(char **file,
                       struct ldap_searchobj ***solistp);

int ldap_init_searchprefs_buf(char **buf,
                             unsigned long len,
                       struct ldap_searchobj **solistp);

struct ldap_searchobj **ldap_free_searchprefs
                       (struct ldap_searchobj **solist);

struct ldap_searchobj **ldap_first_searchobj
                       (struct ldap_searchobj **solist);

struct ldap_searchobj **ldap_next_searchobj
                       (struct ldap_searchobj **solist, struct ldap_searchobj **so);
```

Description

These functions provide a standard way to access LDAP search preference configuration data. LDAP search preference configurations are typically used by LDAP client programs to specify which attributes a user may search by, labels for the attributes, and LDAP filters and scopes associated with those searches. Client software presents these choices to a user, who can then specify the type of search to be performed.

`ldap_init_searchprefs()` reads a sequence of search preference configurations from a valid LDAP searchpref configuration file. See `ldapsearchprefs.conf(4)`. Upon success, 0 is returned and `solistp` is set to point to a list of search preference data structures.

`ldap_init_searchprefs_buf()` reads a sequence of search preference configurations from `buf`, whose size is `buflen`. `buf` should point to the data in the format defined for an LDAP search preference configuration file. See `ldapsearchprefs.conf(4)`. Upon success, 0 is returned and `solistp` is set to point to a list of search preference data structures.

`ldap_free_searchprefs()` disposes of the data structures allocated by `ldap_init_searchprefs()`.

`ldap_first_searchpref()` returns the first search preference data structure in the list `solist`. The `solist` is typically obtained by calling `ldap_init_searchprefs()`.

`ldap_next_searchpref()` returns the search preference after `so` in the template list `solist`. A NULL pointer is returned if `so` is the last entry in the list.

Errors

`ldap_init_search_prefs()` and `ldap_init_search_prefs_buf()` return:

- `LDAP_SEARCHPREF_ERR_VERSION` **buf** points to data that is newer than can be handled.
- `LDAP_SEARCHPREF_ERR_MEM` Memory allocation problem.
Attributes  See attributes(5) for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  ldap(3LDAP), ldapsearchprefs.conf(4), attributes(5)


ldap_sort(3LDAP)

Name  ldap_sort, ldap_sort_entries, ldap_sort_values, ldap_sort_strcasecmp – LDAP entry sorting functions

Synopsis  cc [ flag... ] file... -lldap [ library... ]
          #include <lber.h>
          #include <ldap.h>

          int ldap_sort_entries(LDAP *ld, LDAPMessage **chain, char *attr,
                                int (*cmp)());
          int ldap_sort_values(LDAP *ld, char **vals, int (*cmp)());
          int ldap_sort_strcasecmp(char *a, char *b);

Description  These functions are used to sort lists of entries and values retrieved from an LDAP server. 
ldap_sort_entries() is used to sort a chain of entries retrieved from an LDAP search call 
either by DN or by some arbitrary attribute in the entries. It takes ld, the LDAP structure, 
which is only used for error reporting, chain, the list of entries as returned by 
ldap_search_s(3LDAP) or ldap_result(3LDAP), attr is the attribute to use as a key in the 
sort or NULL to sort by DN, and cmp is the comparison function to use when comparing 
values (or individual DN components if sorting by DN). In this case, cmp should be a function 
taking two single values of the attr to sort by, and returning a value less than zero, equal to 
zero, or greater than zero, depending on whether the first argument is less than, equal to, or 
greater than the second argument. The convention is the same as used by qsort(3C), which is 
called to do the actual sorting.

ldap_sort_values() is used to sort an array of values from an entry, as returned by 
ldap_get_values(3LDAP). It takes the LDAP connection structure ld, the array of values to 
sort vals, and cmp, the comparison function to use during the sort. Note that cmp will be 
passed a pointer to each element in the vals array, so if you pass the normal char ** for this 
parameter, cmp should take two char **’s as arguments (that is, you cannot pass strcasecmp 
or its friends for cmp). You can, however, pass the function ldap_sort_strcasecmp() for this 
purpose.

For example:

LDAP *ld;
LDAPMessage *res;
/* ... call to ldap_search_s( ), fill in res, retrieve sn attr ... */

/* now sort the entries on surname attribute */
if ( ldap_sort_entries( ld, &res, "sn", ldap_sort_strcasecmp() ) != 0 )
    ldap_perror( ld, "ldap_sort_entries" );

Attributes  See attributes(5) for a description of the following attributes:
The `ldap_sort_entries()` function applies the comparison function to each value of the attribute in the array as returned by a call to `ldap_get_values(3LDAP)`, until a mismatch is found. This works fine for single-valued attributes, but may produce unexpected results for multi-valued attributes. When sorting by DN, the comparison function is applied to an exploded version of the DN, without types. The return values for all of these functions are declared in the `<ldap.h>` header file. Some functions may allocate memory which must be freed by the calling application.
ldap_ufn, ldap_ufn_search_s, ldap_ufn_search_c, ldap_ufn_search_ct, ldap_ufn_setfilter, ldap_ufn_setprefix, ldap_ufn_timeout – LDAP user friendly search functions

Synopsis

```
#include <lber.h>
#include <ldap.h>
int ldap_ufn_search_c(LDAP *ld, char *ufn, char **attrs, int attrsonly, LDAPMessage **res, int (*cancelproc)(),
void *cancelparm);
int ldap_ufn_search_ct(LDAP *ld, char *ufn, char **attrs, int attrsonly, LDAPMessage **res, int (*cancelproc)(),
void *cancelparm, char *tag1, char *tag2, char *tag3);
int ldap_ufn_search_s(LDAP *ld, char *ufn, char **attrs, int attrsonly, LDAPMessage **res);
LDAPFiltDesc *ldap_ufn_setfilter(LDAP *ld, char *fname);
void ldap_ufn_setprefix(LDAP *ld, char *prefix);
int ldap_ufn_timeout(void *tvparam);
```

Description

These functions are used to perform LDAP user friendly search operations.

ldap_ufn_search_s() is the simplest form. It does the search synchronously. It takes ld to identify the LDAP connection. The ufn parameter is the user friendly name for which to search. The attrs, attrsonly and res parameters are the same as for ldap_search(3LDAP).

The ldap_ufn_search_c() function functions the same as ldap_ufn_search_s(), except that it takes cancelproc, a function to call periodically during the search. It should be a function taking a single void * argument, given by cancelparm. If cancelproc returns a non-zero result, the search will be abandoned and no results returned. The purpose of this function is to provide a way for the search to be cancelled, for example, by a user or because some other condition occurs.

The ldap_ufn_search_ct() function is like ldap_ufn_search_c(), except that it takes three extra parameters. tag1 is passed to the ldap_init_getfilter(3LDAP) function when resolving the first component of the UFN. tag2 is used when resolving intermediate components. tag3 is used when resolving the last component. By default, the tags used by the other UFN search functions during these three phases of the search are "ufn first", "ufn intermediate", and "ufn last".

The ldap_ufn_setfilter() function is used to set the ldapfilter.conf(4) file for use with the ldap_init_getfilter(3LDAP) function to fname.

The ldap_ufn_setprefix() function is used to set the default prefix (actually, it's a suffix) appended to UFNs before searching. UFNs with fewer than three components have the prefix appended first, before searching. If that fails, the UFN is tried with progressively shorter
versions of the prefix, stripping off components. If the UFN has three or more components, it is tried by itself first. If that fails, a similar process is applied with the prefix appended.

The `ldap_ufn_timeout()` function is used to set the timeout associated with `ldap_ufn_search_s()` searches. The `timeout` parameter should actually be a pointer to a `struct timeval`. This is so `ldap_ufn_timeout()` can be used as a cancelproc in the above functions.

**Attributes**  
See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

**See Also** `gettimeofday(3C), ldap(3LDAP), ldap_search(3LDAP), ldap_getfilter(3LDAP), ldapfilter.conf(4), ldap_error(3LDAP), attributes(5)`

**Notes** These functions may allocates memory. Return values are contained in `<ldap.h>`.
**Name**
ldap_url, ldap_is_ldap_url, ldap_url_parse, ldap_url_parse_nodn, ldap_free_urldesc, 
ldap_url_search, ldap_url_search_s, ldap_url_search_st, ldap_dns_to_url, ldap_dn_to_url –
LDAP Uniform Resource Locator functions

**Synopsis**
cc [ flag... ] file... -lldap [ library... ]
#include <ber.h>
#include <ldap.h>

int ldap_is_ldap_url(char *url);

int ldap_url_parse(char *url, LDAPURLDesc **ludpp);

int ldap_url_parse_nodn(char *url, LDAPURLDesc **ludpp);

void ldap_free_urldesc(LDAPURLDesc *ludp);

int ldap_url_search(LDAP *ld, char *url, int attrsonly);

int ldap_url_search_s(LDAP *ld, char *url, 
	int attrsonly, LDAPMessage **res);

int ldap_url_search_st(LDAP *ld, char *url, int attrsonly, 
	struct timeval *timeout, LDAPMessage **res);

char *ldap_dns_to_url(LDAP *ld, char *dns_name, char *attrs, 
	char *scope, char *filter);

char *ldap_dn_to_url(LDAP *ld, char *dn, int nameparts);

**Description**
These functions support the use of LDAP URLs (Uniform Resource Locators). The following shows the formatting used for LDAP URLs.

```
ldap://hostport/dn?[attributes]?scope?[filter]]
```

where:
*hostport* Host name with an optional :portnumber.
*dn* Base DN to be used for an LDAP search operation.
*attributes* Comma separated list of attributes to be retrieved.
*scope* One of these three strings: base one sub (default=base).
*filter* LDAP search filter as used in a call to `ldap_search(3LDAP)`.

The following is an example of an LDAP URL:

```
ldap://ldap.itd.umich.edu/c=US?o,description?one?o=umich
```

URLs preceded URL: or wrapped in angle-brackets are tolerated. URLs can also be preceded by URL: and wrapped in angle-brackets.
ldap_is_ldap_url() returns a non-zero value if url looks like an LDAP URL (as opposed to some other kind of URL). It can be used as a quick check for an LDAP URL; the ldap_url_parse() function should be used if a more thorough check is needed.

ldap_url_parse() breaks down an LDAP URL passed in url into its component pieces. If successful, zero is returned, an LDAP URL description is allocated, filled in, and ludpp is set to point to it. See RETURN VALUES for values returned upon error.

ldap_url_parse_nodn() acts just like ldap_url_parse() but does not require dn in the LDAP URL.

ldap_free_urldesc() should be called to free an LDAP URL description that was obtained from a call to ldap_url_parse().

ldap_url_search() initiates an asynchronous LDAP search based on the contents of the url string. This function acts just like ldap_search(3LDAP) except that many search parameters are pulled out of the URL.

ldap_url_search_s() performs a synchronous LDAP search based on the contents of the url string. This function acts just like ldap_search_s(3LDAP) except that many search parameters are pulled out of the URL.

ldap_url_search_st() performs a synchronous LDAP URL search with a specified timeout. This function acts just like ldap_search_st(3LDAP) except that many search parameters are pulled out of the URL.

ldap_dns_to_url() locates the LDAP URL associated with a DNS domain name. The supplied DNS domain name is converted into a distinguished name. The directory entry specified by that distinguished name is searched for a labeled URI attribute. If successful then the corresponding LDAP URL is returned. If unsuccessful then that entry’s parent is searched and so on until the target distinguished name is reduced to only two nameparts. If dns_name is NULL then the environment variable LOCALDOMAIN is used. If attrs is not NULL then it is appended to the URL’s attribute list. If scope is not NULL then it overrides the URL’s scope. If filter is not NULL then it is merged with the URL’s filter. If an error is encountered then zero is returned, otherwise a string URL is returned. The caller should free the returned string if it is non-zero.

ldap_dn_to_url() locates the LDAP URL associated with a distinguished name. The number of nameparts in the supplied distinguished name must be provided. The specified directory entry is searched for a labeled URI attribute. If successful then the LDAP URL is returned. If unsuccessful then that entry’s parent is searched and so on until the target distinguished name is reduced to only two nameparts. If an error is encountered then zero is returned, otherwise a string URL is returned. The caller should free the returned string if it is non-zero.
Return Values  Upon error, one of these values is returned for `ldap_url_parse()`:

<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>LDAP_URL_ERR_BADSCOPE</td>
<td>URL scope string is invalid.</td>
</tr>
<tr>
<td>LDAP_URL_ERR_HOSTPORT</td>
<td>URL hostport is invalid.</td>
</tr>
<tr>
<td>LDAP_URL_ERR_MEM</td>
<td>Can't allocate memory space.</td>
</tr>
<tr>
<td>LDAP_URL_ERR_NODN</td>
<td>URL has no DN (required).</td>
</tr>
<tr>
<td>LDAP_URL_ERR_NOTLDAP</td>
<td>URL doesn't begin with <code>ldap://</code>.</td>
</tr>
</tbody>
</table>

Attributes  See `attributes(5)` for a description of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>

See Also  `ldap(3LDAP), ldap_search(3LDAP), attributes(5)`

An LDAP URL Format, Tim Howes and Mark Smith, December 1995. Internet Draft (work in progress). Currently available at this URL.

ftp://ds.internic.net/internet-drafts/draft-ietf-asid-ldap-format-03.txt
**ldap_version**

### Name
ldap_version – get version information about the LDAP SDK for C

### Synopsis
```c
#include <ldap.h>

int ldap_version(LDAPVERSION *ver);
```

### Description
A call to this function returns the version information for the LDAP SDK for C. This is a deprecated function. Use `ldap_get_option(3LDAP)` instead. The version information is returned in the LDAPVersion structure pointed to by `ver`. If `NULL` is passed for `ver`, then only the SDK version will be returned.

### Return Values
The `ldap_version()` function returns the version number of the LDAP SDK for C, multiplied by 100. For example, for version 1.0 of the LDAP SDK for C, the function returns 100.

### Attributes
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Obsolete</td>
</tr>
</tbody>
</table>

### See Also
`ldap_get_option(3LDAP)`, `attributes(5)`
listen(3SOCKET)

Name
listen – listen for connections on a socket

Synopsis
cc [ flag ... ] file ... -lsocket -lnsl [ library ... ]
#include <sys/types.h>
#include <sys/socket.h>

int listen(int s, int backlog);

Description
To accept connections, a socket is first created with socket(3SOCKET), a backlog for incoming connections is specified with listen() and then the connections are accepted with accept(3SOCKET). The listen() call applies only to sockets of type SOCK_STREAM or SOCK_SEQPACKET.

The backlog parameter defines the maximum length the queue of pending connections may grow to.

If a connection request arrives with the queue full, the client will receive an error with an indication of ECONNREFUSED for AF_UNIX sockets. If the underlying protocol supports retransmission, the connection request may be ignored so that retries may succeed. For AF_INET and AF_INET6 sockets, the TCP will retry the connection. If the backlog is not cleared by the time the tcp times out, the connect will fail with ETIMEDOUT.

Return Values
A 0 return value indicates success; −1 indicates an error.

Errors
The call fails if:
EBADF       The argument s is not a valid file descriptor.
ENOTSOCK    The argument s is not a socket.
EOPNOTSUPP  The socket is not of a type that supports the operation listen().

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also
accept(3SOCKET), connect(3SOCKET), socket(3SOCKET), attributes(5), socket.h(3HEAD)

Notes
There is currently no backlog limit.
The `listen()` function marks a connection-mode socket, specified by the `socket` argument, as accepting connections, and limits the number of outstanding connections in the socket's listen queue to the value specified by the `backlog` argument.

If `listen()` is called with a `backlog` argument value that is less than 0, the function sets the length of the socket's listen queue to 0.

The implementation may include incomplete connections in the queue subject to the queue limit. The implementation may also increase the specified queue limit internally if it includes such incomplete connections in the queue subject to this limit.

Implementations may limit the length of the socket's listen queue. If `backlog` exceeds the implementation-dependent maximum queue length, the length of the socket's listen queue will be set to the maximum supported value.

The socket in use may require the process to have appropriate privileges to use the `listen()` function.

Upon successful completions, `listen()` returns 0. Otherwise, −1 is returned and `errno` is set to indicate the error.

The `listen()` function will fail if:

- **EBADF** The `socket` argument is not a valid file descriptor.
- **EDESTADDRREQ** The socket is not bound to a local address, and the protocol does not support listening on an unbound socket.
- **EINVAL** The `socket` is already connected.
- **ENOTSOCK** The `socket` argument does not refer to a socket.
- **EOPNOTSUPP** The socket protocol does not support `listen()`.

The `listen()` function may fail if:

- **EACCES** The calling process does not have the appropriate privileges.
- **EINVAL** The `socket` has been shut down.
- **ENOBUFS** Insufficient resources are available in the system to complete the call.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
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<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  accept(3XNET), connect(3XNET), socket(3XNET), attributes(5), standards(5)
The netdir functions provide a generic interface for name-to-address mapping that will work with all transport protocols. This interface provides a generic way for programs to convert transport specific addresses into common structures and back again. The netconfig structure, described on the netconfig(4) manual page, identifies the transport.

The netdir_getbyname() function maps the machine name and service name in the nd_hostserv structure to a collection of addresses of the type understood by the transport identified in the netconfig structure. This function returns all addresses that are valid for that transport in the nd_addrlist structure. The nd_hostserv structure contains the following members:

```c
char *h_host; /* host name */
char *h_serv; /* service name */
```

The nd_addrlist structure contains the following members:

```c
int n_cnt; /* number of addresses */
struct netbuf *n_addrs;
```

The netdir_getbyname() function accepts some special-case host names. The host names are defined in <netdir.h>. The currently defined host names are:

- **HOST_SELF**: Represents the address to which local programs will bind their endpoints. HOST_SELF differs from the host name provided by gethostname(3C), which represents the address to which remote programs will bind their endpoints.
HOST_ANY Represents any host accessible by this transport provider. HOST_ANY allows applications to specify a required service without specifying a particular host name.

HOST_SELF_CONNECT Represents the host address that can be used to connect to the local host.

HOST_BROADCAST Represents the address for all hosts accessible by this transport provider. Network requests to this address are received by all machines.

All fields of the nd_hostserv structure must be initialized.

To find the address of a given host and service on all available transports, call the netdir_getbyname() function with each struct netconfig structure returned by getnetconfig(3NSL).

The netdir_getbyaddr() function maps addresses specified in the netbuf structure pointed to by netaddr to service names. The function returns service, a list of host and service pairs that yield these addresses. If more than one tuple of host and service name is returned, the first tuple contains the preferred host and service names:

```c
struct nd_hostservlist {
    int *h_cnt; /* number of hostservs found */
    struct hostserv *h_hostservs;
};
```

The netdir_free() structure is used to free the structures allocated by the name to address translation functions. The ptr parameter points to the structure that has to be freed. The parameter struct_type identifies the structure:

```c
struct netbuf   ND_ADDR
struct nd_addrlist ND_ADDRLIST
struct hostserv  ND_HOSTSERV
struct nd_hostservlist ND_HOSTSERVLIST
```

The free() function is used to free the universal address returned by the taddr2uaddr() function.

The netdir_options() function is used to do all transport-specific setups and option management. fildes is the associated file descriptor. option, fildes, and pointer_to_args are passed to the netdir_options() function for the transport specified in config. Currently four values are defined for option:

```c
ND_SET_BROADCAST
ND_SET_RESERVEDPORT
ND_CHECK_RESERVEDPORT
```
ND_MERGEADDR

The taddr2uaddr() and uaddr2taddr() functions support translation between universal addresses and TLI type netbufs. The taddr2uaddr() function takes a struct netbuf data structure and returns a pointer to a string that contains the universal address. It returns NULL if the conversion is not possible. This is not a fatal condition as some transports do not support a universal address form.

The uaddr2taddr() function is the reverse of the taddr2uaddr() function. It returns the struct netbuf data structure for the given universal address.

If a transport provider does not support an option, netdir_options returns -1 and the error message can be printed through netdir_perror() or netdir_sperror().

The specific actions of each option follow.

ND_SET_BROADCAST
Sets the transport provider up to allow broadcast if the transport supports broadcast. fildes is a file descriptor into the transport, that is, the result of a t_open of /dev/udp. pointer_to_args is not used. If this completes, broadcast operations can be performed on file descriptor fildes.

ND_SET_RESERVEDPORT
Allows the application to bind to a reserved port if that concept exists for the transport provider. fildes is an unbound file descriptor into the transport. If pointer_to_args is NULL, fildes is bound to a reserved port. If pointer_to_args is a pointer to a netbuf structure, an attempt is made to bind to any reserved port on the specified address.

ND_CHECK_RESERVEDPORT
Used to verify that the address corresponds to a reserved port if that concept exists for the transport provider. fildes is not used. pointer_to_args is a pointer to a netbuf structure that contains the address. This option returns 0 only if the address specified in pointer_to_args is reserved.

ND_MERGEADDR
Used to take a "local address" such as a 0.0.0.0 TCP address and return a "real address" to which client machines can connect. fildes is not used. pointer_to_args is a pointer to a struct nd_mergearg which has the following members:

char s_uaddr; /* server's universal address */
char c_uaddr; /* client's universal address */
char m_uaddr; /* the result */

If s_uaddr is an address such as 0.0.0.1.12, and the call is successful m_uaddr is set to an address such as 192.11.109.89.1.12. For most transports, m_uaddr is identical to s_uaddr.
The `netdir_perror()` function prints an error message in standard output that states the cause of a name-to-address mapping failure. The error message is preceded by the string given as an argument.

The `netdir_perror()` function returns a string with an error message that states the cause of a name-to-address mapping failure.

The `netdir_perror()` function returns a pointer to a buffer which contains the error message string. The buffer is overwritten on each call. In multithreaded applications, this buffer is implemented as thread-specific data.

The `netdir_getbyaddr()` function returns 0 on success and a non-zero value on failure.

**Attributes** See attributes(5) for descriptions of the following attributes:

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</table>

**See Also** `gethostname(3C), getnetconfig(3NSL), getnetpath(3NSL), netconfig(4), attributes(5)`
**Name**
ns_sign, ns_sign_tcp, ns_sign_tcp_init, ns_verify, ns_verify_tcp, ns_verify_tcp_init, ns_find_tsig – TSIG system

**Synopsis**
cc [ flag... ] file... -lresolv -lsocket -lnsl [ library...]
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/in.h>
#include <arpa/inet.h>

```
int ns_sign(u_char *msg, int *msglen, int msgsize, int error, void *k,
    const u_char *querysig, int querysiglen, u_char *sig, int *siglen,
    time_t in_timesigned);
int ns_sign_tcp(u_char *msg, int *msglen, int msgsize, int error,
    ns_tcp_tsig_state *state, int done);
int ns_sign_tcp_init(void *k, const u_char *querysig, int querysiglen,
    ns_tcp_tsig_state *state);
int ns_verify(u_char *msg, int *msglen, void *k, const u_char *querysig,
    int querysiglen, u_char *sig, int *siglen, time_t in_timesigned,
    int nostrip);
int ns_verify_tcp(u_char *msg, int *msglen, ns_tcp_tsig_state *state,
    int required);
int ns_verify_tcp_init(void *k, const u_char *querysig, int querysiglen,
    ns_tcp_tsig_state *state);

u_char *ns_find_tsig(u_char *msg, u_char *eom);
```

**Parameters**

**ns_sign()**

- *msg* the incoming DNS message, which will be modified
- *msglen* the length of the DNS message, on input and output
- *msgsize* the size of the buffer containing the DNS message on input
- *error* the value to be placed in the TSIG error field
- *k* the (DST_KEY *) to sign the data
- *querysig* for a response, the signature contained in the query
- *querysiglen* the length of the query signature
- *sig* a buffer to be filled with the generated signature
- *siglen* the length of the signature buffer on input, the signature length on output

**ns_sign_tcp()**

- *msg* the incoming DNS message, which will be modified
- *msglen* the length of the DNS message, on input and output
- *msgsize* the size of the buffer containing the DNS message on input
The TSIG functions are used to implement transaction/request security of DNS messages.

The `ns_sign()` and `ns_verify()` functions are the basic routines. The `ns_sign_tcp()` and `ns_verify_tcp()` functions are used to sign/verify TCP messages that may be split into multiple packets, such as zone transfers. The `ns_sign_tcp_init()` and

The value to be placed in the TSIG error field.

The state of the operation.

Non-zero value signifies that this is the last packet.

The (DST_KEY *) to sign the data.

For a response, the signature contained in the query.

The length of the query signature.

The state of the operation, which this initializes.

The incoming DNS message, which will be modified.

The length of the DNS message, on input and output.

The (DST_KEY *) to sign the data.

For a response, the signature contained in the query.

The length of the query signature.

A buffer to be filled with the signature contained.

The length of the signature buffer on input, the signature length on output.

Non-zero value means that the TSIG is left intact.

The incoming DNS message, which will be modified.

The length of the DNS message, on input and output.

The state of the operation.

Non-zero value signifies that a TSIG record must be present at this step.

The (DST_KEY *) to verify the data.

For a response, the signature contained in the query.

The length of the query signature.

The state of the operation, which this initializes.

The incoming DNS message.

The length of the DNS message.

**Description**

The TSIG functions are used to implement transaction/request security of DNS messages.
ns_verify_tcp_init() functions initialize the state structure necessary for TCP operations. The ns_find_tsig() function locates the TSIG record in a message if one is present.

Return Values
The ns_find_tsig() function returns a pointer to the TSIG record if one is found, and NULL otherwise.

All other functions return 0 on success, modifying arguments when necessary.

The ns_sign() and ns_sign_tcp() functions return the following values:
-1 bad input data
-ns_r_badkey The key was invalid or the signing failed.
NS_TSIG_ERROR_NO_SPACE The message buffer is too small.

The ns_verify() and ns_verify_tcp() functions return the following values:
-1 bad input data
NS_TSIG_ERROR_FORMERR The message is malformed.
NS_TSIG_ERROR_NO_TSIG The message does not contain a TSIG record.
NS_TSIG_ERROR_ID_MISMATCH The TSIG original ID field does not match the message ID.
-ns_r_badkey Verification failed due to an invalid key.
-ns_r_badsig Verification failed due to an invalid signature.
-ns_r_badtime Verification failed due to an invalid timestamp.
ns_r_badkey Verification succeeded but the message had an error of BADKEY.
ns_r_badsig Verification succeeded but the message had an error of BADSIG.
ns_r_badtime Verification succeeded but the message had an error of BADTIME.

Attributes
See attributes(5) for descriptions of the following attributes:

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</tbody>
</table>

See Also
resolver(3RESOLV), attributes(5)
rcmd(3SOCKET)

Name  rcmd, rcmd_af, rresvport, rresvport_af, ruserok – routines for returning a stream to a remote command

Synopsis cc [ flag ... ] file... -lsocket -lnsl [ library... ]
#include <netdb.h>
#include <unistd.h>

int rcmd(char **ahost, unsigned short inport, const char *luser,
         const char *ruser, const char *cmd, int *fd2p);

int rcmd_af(char **ahost, unsigned short inport, const char *luser,
            const char *ruser, const char *cmd, int *fd2p, int af);

int rresvport(int *port);

int rresvport_af(int *port, int af);

int ruserok(const char *rhost, int suser, const char *ruser,
            const char *luser);

Description The rcmd() function is used by the superuser to execute a command on a remote machine with an authentication scheme based on reserved port numbers. An AF_INET socket is returned with rcmd(). The rcmd_af() function supports AF_INET, AF_INET6 or AF_UNSPEC for the address family. An application can choose which type of socket is returned by passing AF_INET or AF_INET6 as the address family. The use of AF_UNSPEC means that the caller will accept any address family. Choosing AF_UNSPEC provides a socket that best suits the connectivity to the remote host.

The rresvport() function returns a descriptor to a socket with an address in the privileged port space. The rresvport_af() function is the equivalent to rresvport(), except that you can choose AF_INET or AF_INET6 as the socket address family to be returned by rresvport_af(). AF_UNSPEC does not apply to the rresvport() function.

The ruserok() function is a routine used by servers to authenticate clients that request as service with rcmd.

All of these functions are present in the same file and are used by the in.rshd(1M) server among others.

The rcmd() and rcmd_af() functions look up the host *ahost using getaddrinfo(3SOCKET) and return −1 if the host does not exist. Otherwise, *ahost is set to the standard name of the host and a connection is established to a server residing at the Internet port inport.

If the connection succeeds, a socket in the Internet domain of type SOCK_STREAM is returned to the caller. The socket is given to the remote command as standard input (file descriptor 0) and standard output (file descriptor 1). If fd2p is non-zero, an auxiliary channel to a control process is set up and a descriptor for it is placed in *fd2p. The control process returns diagnostic output file (descriptor 2) from the command on the auxiliary channel. The control process also accepts bytes on this channel as signal numbers to be forwarded to the process.
group of the command. If fd2p is 0, the standard error (file descriptor 2) of the remote command is made the same as its standard output. No provision is made for sending arbitrary signals to the remote process, other than possibly sending out-of-band data.

The protocol is described in detail in *in.rshd(1M)*.

The *rresvport()* and *rresvport_af()* functions are used to obtain a socket bound to a privileged port number. The socket is suitable for use by *rcmd()* and *rresvport_af()* and several other routines. Privileged Internet ports are those in the range 1 to 1023. Only the superuser is allowed to bind a socket to a privileged port number. The application must pass in *port*, which must be in the range 512 to 1023. The system first tries to bind to that port number. If it fails, the system then tries to bind to another unused privileged port, if one is available.

The *ruserok()* function takes a remote host name returned by the *gethostbyaddr()* function with two user names and a flag to indicate whether the local user's name is that of the superuser. See *gethostbyname(3NSL)*. The *ruserok()* function then checks the files */etc/hosts.equiv* and possibly */.rhosts* in the local user's home directory to see if the request for service is allowed. A 0 value is returned if the machine name is listed in the */etc/hosts.equiv* file, or if the host and remote user name are found in the */.rhosts* file. Otherwise, the *ruserok()* function returns −1. If the superuser flag is 1, the */etc/hosts.equiv* is not checked.

The error code EAGAIN is overloaded to mean "All network ports in use."

**Return Values**
The *rcmd()* and *rcmd_af()* functions return a valid socket descriptor upon success. The functions returns −1 upon error and print a diagnostic message to standard error.

The *rresvport()* and *rresvport_af()* functions return a valid, bound socket descriptor upon success. The functions return −1 upon error with the global value *errno* set according to the reason for failure.

**Files**

*/etc/hosts.equiv* system trusted hosts and users

*/.rhosts* user's trusted hosts and users

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>

This interface is Unsafe in multithreaded applications. Unsafe interfaces should be called only from the main thread.
See Also  rlogin(1), rsh(1), in.rexed(1M), in.rshd(1M), Intro(2), getaddrinfo(3SOCKET),
gethostbyname(3NSL), rexec(3SOCKET), attributes(5)
recv(3SOCKET)

Name  recv, recvfrom, recvmsg – receive a message from a socket

Synopsis  cc [ flag... ] file... -lsocket -lnsl [ library... ]
 #include <sys/socket.h>

ssize_t recv(int s, void *buf, size_t len, int flags);
ssize_t recvfrom(int s, void *buf, size_t len, int flags,
    struct sockaddr *from, socklen_t *fromlen);
ssize_t recvmsg(int s, struct msghdr *msg, int flags);

Description  The recv(), recvfrom(), and recvmsg() functions are used to receive messages from another socket. The s socket is created with socket(3SOCKET).

If from is a non-NULL pointer, the source address of the message is filled in. The value-result parameter fromlen is initialized to the size of the buffer associated with from and modified on return to indicate the actual size of the address stored in the buffer. The length of the message is returned. If a message is too long to fit in the supplied buffer, excess bytes may be discarded depending on the type of socket from which the message is received. See socket(3SOCKET).

If no messages are available at the socket, the receive call waits for a message to arrive. If the socket is non-blocking, -1 is returned with the external variable errno set to EWOULDBLOCK. See fcntl(2).

For processes on the same host, recvmsg() can be used to receive a file descriptor from another process, but it cannot receive ancillary data. See libxnet(3LIB).

If a zero-length buffer is specified for a message, an EOF condition results that is indistinguishable from the successful transfer of a file descriptor. For that reason, one or more bytes of data should be provided when recvmsg() passes a file descriptor.

The select(3C) call can be used to determine when more data arrives.

The flags parameter is formed by an OR operation on one or more of the following:

MSG_OOB      Read any out-of-band data present on the socket rather than the regular in-band data.
MSG_PEEK     Peek at the data present on the socket. The data is returned, but not consumed to allow a subsequent receive operation to see the same data.
MSG_WAITALL  Messages are blocked until the full amount of data requested is returned. The recv() function can return a smaller amount of data if a signal is caught, the connection is terminated, MSG_PEEK is specified, or if an error is pending for the socket.
MSG_DONTWAIT Pending messages received on the connection are returned. If data is unavailable, the function does not block. This behavior is the equivalent to specifying O_NONBLOCK on the file descriptor of a socket, except that write
requests are unaffected.

The recvmsg() function call uses a msghdr structure defined in <sys/socket.h> to minimize the number of directly supplied parameters.

**Return Values**

Upon successful completion, these functions return the number of bytes received. Otherwise, they return -1 and set errno to indicate the error.

**Errors**

The recv(), recvfrom(), and recvmsg() functions return errors under the following conditions:

- **EBADF** The s file descriptor is invalid.
- **EINVAL** The MSG_OOB flag is set and no out-of-band data is available.
- **EINTR** The operation is interrupted by the delivery of a signal before any data is available to be received.
- **EIO** An I/O error occurs while reading from or writing to the file system.
- **ENOMEM** Insufficient user memory is available to complete operation.
- **ENOSR** Insufficient STREAMS resources are available for the operation to complete.
- **ENOTSOCK** s is not a socket.
- **ESTALE** A stale NFS file handle exists.
- **EWOULDBLOCK** The socket is marked non-blocking and the requested operation would block.
- **ECONNREFUSED** The requested connection was refused by the peer. For connected IPv4 and IPv6 datagram sockets, this indicates that the system received an ICMP Destination Port Unreachable message from the peer.

The recv() and recvfrom() functions fail under the following conditions:

- **EINVAL** The len argument overflows a ssize_t.

The recvmsg() function returns errors under the following conditions:

- **EINVAL** The msg iovlen member of the msghdr structure pointed to by msg is less than or equal to 0, or greater than [IOV_MAX]. See Intro(2) for a definition of [IOV_MAX].
- **EINVAL** One of the iov_len values in the msg_iov array member of the msghdr structure pointed to by msg is negative, or the sum of the iov_len values in the msg_iov array overflows a ssize_t.

**Attributes**

See attributes(5) for descriptions of the following attributes:
recv(3SOCKET)

+---------------------------------+------------------+
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</tbody>
</table>

See Also  
`fcntl(2), ioctl(2), read(2), connect(3SOCKET), getsockopt(3SOCKET), libxnet(3LIB), select(3C), send(3SOCKET), socket(3SOCKET), socket.h(3HEAD), attributes(5)`
The **recv()** function receives a message from a connection-mode or connectionless-mode socket. It is normally used with connected sockets because it does not permit the application to retrieve the source address of received data. The function takes the following arguments:

- **socket** Specifies the socket file descriptor.
- **buffer** Points to a buffer where the message should be stored.
- **length** Specifies the length in bytes of the buffer pointed to by the **buffer** argument.
- **flags** Specifies the type of message reception. Values of this argument are formed by logically OR'ing zero or more of the following values:
  - **MSG_PEEK** Peeks at an incoming message. The data is treated as unread and the next **recv()** or similar function will still return this data.
  - **MSG_OOB** Requests out-of-band data. The significance and semantics of out-of-band data are protocol-specific.
  - **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, if the connection is terminated, if **MSG_PEEK** was specified, or if an error is pending for the socket.

The **recv()** function returns the length of the message written to the buffer pointed to by the **buffer** argument. For message-based sockets such as **SOCK_DGRAM** and **SOCK_SEQPACKET**, the entire message must be read in a single operation. If a message is too long to fit in the supplied buffer, and **MSG_PEEK** is not set in the **flags** argument, the excess bytes are discarded. For stream-based sockets such as **SOCK_STREAM**, message boundaries are ignored. In this case, data is returned to the user as soon as it becomes available, and no data is discarded.

If the **MSG_WAITALL** flag is not set, data will be returned only up to the end of the first message.

If no messages are available at the socket and **O_NONBLOCK** is not set on the socket’s file descriptor, **recv()** blocks until a message arrives. If no messages are available at the socket and **O_NONBLOCK** is set on the socket’s file descriptor, **recv()** fails and sets **errno** to **EAGAIN** or **EWOULDQUEUE**.
The `recv()` function is identical to `recvfrom(3XNET)` with a zero `address_len` argument, and to `read()` if no flags are used.

The `select(3C)` and `poll(2)` functions can be used to determine when data is available to be received.

Upon successful completion, `recv()` returns the length of the message in bytes. If no messages are available to be received and the peer has performed an orderly shutdown, `recv()` returns 0. Otherwise, –1 is returned and `errno` is set to indicate the error.

The `recv()` function will fail if:

- **EAGAIN**
- **EWOULDBLOCK**
  - The socket's file descriptor is marked `O_NONBLOCK` and no data is waiting to be received; or `MSG_OOB` is set and no out-of-band data is available and either the socket's file descriptor is marked `O_NONBLOCK` or the socket does not support blocking to await out-of-band data.
- **EBADF**
  - The socket argument is not a valid file descriptor.
- **ECONNRESET**
  - A connection was forcibly closed by a peer.
- **EFAULT**
  - The buffer parameter cannot be accessed or written.
- **EINVAL**
  - The `MSG_OOB` flag is set and no out-of-band data is available.
- **ENOTCONN**
  - A receive is attempted on a connection-mode socket that is not connected.
- **ENOTSOCK**
  - The socket argument does not refer to 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.

The `recv()` function may fail if:

- **EIO**
  - An I/O error occurred while reading from or writing to the file system.
- **ENOBUFS**
  - Insufficient resources were available in the system to perform the operation.
- **ENOMEM**
  - Insufficient memory was available to fulfill the request.
- **ENOSR**
  - There were insufficient STREAMS resources available for the operation to complete.

See `attributes(5)` for descriptions of the following attributes:
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See Also poll(2), recvmsg(3XNET), recvfrom(3XNET), select(3C), send(3XNET), sendmsg(3XNET), sendto(3XNET), shutdown(3XNET), socket(3XNET), attributes(5), standards(5)
**recvfrom** – receive a message from a socket

### Synopsis

```c
#include <sys/socket.h>

ssize_t recvfrom(int socket, void *restrict buffer, size_t length, int flags, struct sockaddr *restrict address, socklen_t *restrict address_len);
```

### Description

The `recvfrom()` function receives a message from a connection-mode or connectionless-mode socket. It is normally used with connectionless-mode sockets because it permits the application to retrieve the source address of received data.

The function takes the following arguments:

- **socket**
  Specifies the socket file descriptor.

- **buffer**
  Points to the buffer where the message should be stored.

- **length**
  Specifies the length in bytes of the buffer pointed to by the `buffer` argument.

- **flags**
  Specifies the type of message reception. Values of this argument are formed by logically OR'ing zero or more of the following values:

  - **MSG_PEEK**
    Peeks at an incoming message. The data is treated as unread and the next `recvfrom()` or similar function will still return this data.

  - **MSG_OOB**
    Requests out-of-band data. The significance and semantics of out-of-band data are protocol-specific.

  - **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, if the connection is terminated, if MSG_PEEK was specified, or if an error is pending for the socket.

- **address**
  A null pointer, or points to a `sockaddr` structure in which the sending address is to be stored. The length and format of the address depend on the address family of the socket.

- **address_len**
  Specifies the length of the `sockaddr` structure pointed to by the `address` argument.

The `recvfrom()` function returns the length of the message written to the buffer pointed to by the `buffer` argument. For message-based sockets such as `SOCK_DGRAM` and `SOCK_SEQPACKET`, the entire message must be read in a single operation. If a message is too long to fit in the supplied buffer, and MSG_PEEK is not set in the `flags` argument, the excess bytes are discarded. For stream-based sockets such as `SOCK_STREAM`, message boundaries are ignored. In this case, data is returned to the user as soon as it becomes available, and no data is discarded.
If the `MSG_WAITALL` flag is not set, data will be returned only up to the end of the first message.

Not all protocols provide the source address for messages. If the `address` argument is not a null pointer and the protocol provides the source address of messages, the source address of the received message is stored in the `sockaddr` structure pointed to by the `address` argument, and the length of this address is stored in the object pointed to by the `address_len` argument.

If the actual length of the address is greater than the length of the supplied `sockaddr` structure, the stored address will be truncated.

If the `address` argument is not a null pointer and the protocol does not provide the source address of messages, the the value stored in the object pointed to by `address` is unspecified.

If no messages are available at the socket and `O_NONBLOCK` is not set on the socket's file descriptor, `recvfrom()` blocks until a message arrives. If no messages are available at the socket and `O_NONBLOCK` is set on the socket's file descriptor, `recvfrom()` fails and sets `errno` to `EAGAIN` or `EWOULDBLOCK`.

**Usage**

The `select(3C)` and `poll(2)` functions can be used to determine when data is available to be received.

**Return Values**

Upon successful completion, `recvfrom()` returns the length of the message in bytes. If no messages are available to be received and the peer has performed an orderly shutdown, `recvfrom()` returns 0. Otherwise the function returns -1 and sets `errno` to indicate the error.

**Errors**

The `recvfrom()` function will fail if:

- `EAGAIN` The socket's file descriptor is marked `O_NONBLOCK` and no data is waiting to be received, or `MSG_OOB` is set and no out-of-band data is available and either the socket's file descriptor is marked `O_NONBLOCK` or the socket does not support blocking to await out-of-band data.

- `EWOULDBLOCK` A connection was forcibly closed by a peer.

- `EBADF` The buffer, `address` or `address_len` parameter can not be accessed or written.

- `EFAULT` A signal interrupted `recvfrom()` before any data was available.

- `EINVAL` The `MSG_OOB` flag is set and no out-of-band data is available.

- `ENOTCONN` A receive is attempted on a connection-mode socket that is not connected.

- `ENOTSOCK` The `socket` argument does not refer to 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.

The recvfrom() function may fail if:

EIO        An I/O error occurred while reading from or writing to the file system.
ENOBUFFS   Insufficient resources were available in the system to perform the operation.
ENOMEM      Insufficient memory was available to fulfill the request.
ENOSR      There were insufficient STREAMS resources available for the operation to complete.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  poll(2), recv(3XNET), recvmsg(3XNET), select(3C) send(3XNET), sendmsg(3XNET), sendto(3XNET), shutdown(3XNET), socket(3XNET), attributes(5), standards(5)
recvmsg - receive a message from a socket

Synopsis

cc [ flag ... ] file ... -lxnet [ library ... ]  
#include <sys/socket.h>

ssize_t recvmsg(int socket, struct msghdr *message, int flags);

Description

The recvmsg() function receives a message from a connection-mode or connectionless-mode socket. It is normally used with connectionless-mode sockets because it permits the application to retrieve the source address of received data.

The recvmsg() function receives messages from unconnected or connected sockets and returns the length of the message.

The recvmsg() function returns the total length of the message. For message-based sockets such as SOCK_DGRAM and SOCK_SEQPACKET, the entire message must be read in a single operation. If a message is too long to fit in the supplied buffers, and MSG_PEEK is not set in the flags argument, the excess bytes are discarded, and MSG_TRUNC is set in the msg_flags member of the msghdr structure. For stream-based sockets such as SOCK_STREAM, message boundaries are ignored. In this case, data is returned to the user as soon as it becomes available, and no data is discarded.

If the MSG_WAITALL flag is not set, data will be returned only up to the end of the first message.

If no messages are available at the socket, and O_NONBLOCK is not set on the socket's file descriptor, recvmsg() blocks until a message arrives. If no messages are available at the socket and O_NONBLOCK is set on the socket's file descriptor, the recvmsg() function fails and sets errno to EAGAIN or EWOULDBLOCK.

In the msghdr structure, defined in socket.h(3HEAD), the msg_name and msg_namelen members specify the source address if the socket is unconnected. If the socket is connected, the msg_name and msg_namelen members are ignored. The msg_name member may be a null pointer if no names are desired or required.

The msg_control and msg_controllen members specify a buffer to receive ancillary data sent along with a message. Ancillary data consists of a sequence of pairs. Each pair is composed of a cmsghdr structure followed by a data array. The cmsghdr structure, defined in socket.h(3HEAD), contains descriptive information which allows an application to correctly parse data. The data array contains the ancillary data message.

If ancillary data is not transferred, msg_control is set to NULL and msg_controllen is set to 0.

The msg_iov and msg_iovlen fields of the msghdr structure are used to specify where the received data will be stored. msg_iov points to an array of iovar structures. The msg_iovlen must be set to the dimension of this array. In each iovar structure, the iovar_base field specifies a storage area and the iovar_len field gives its size in bytes. Each storage area indicated by msg_iov is filled with received data in turn until all of the received data is stored or all of the areas have been filled.
If the SO_TIMESTAMP option has been enabled through setsockopt(), then a struct timeval is returned following the cmsghdr, and the cms_len field of the cmsghdr indicates the size of the struct timeval.

On successful completion, the msg_flags member of the message header is the bitwise-inclusive OR of all of the following flags that indicate conditions detected for the received message:

- **MSG_EOR**: End of record was received (if supported by the protocol).
- **MSG_OOB**: Out-of-band data was received.
- **MSG_TRUNC**: Normal data was truncated.
- **MSG_CTRUNC**: Control data was truncated.

### Parameters
The function takes the following arguments:

- **socket**: Specifies the socket file descriptor.
- **message**: Points to a msghdr structure, containing both the buffer to store the source address and the buffers for the incoming message. The length and format of the address depend on the address family of the socket. The msg_flags member is ignored on input, but may contain meaningful values on output.
- **flags**: Specifies the type of message reception. Values of this argument are formed by logically OR'ing zero or more of the following values:
  - **MSG_OOB**: Requests out-of-band data. The significance and semantics of out-of-band data are protocol-specific.
  - **MSG_PEEK**: Peeks at the incoming message.
  - **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, if the connection is terminated, if MSG_PEEK was specified, or if an error is pending for the socket.

### Usage
The select(3C) and poll(2) functions can be used to determine when data is available to be received.

### Return Values
Upon successful completion, recvmsg() returns the length of the message in bytes. If no messages are available to be received and the peer has performed an orderly shutdown, recvmsg() returns 0. Otherwise, −1 is returned and errno is set to indicate the error.

### Errors
The recvmsg() function will fail if:
The socket's file descriptor is marked O_NONBLOCK and no data is waiting to be received; or MSG_OOB is set and no out-of-band data is available and either the socket's file descriptor is marked O_NONBLOCK or the socket does not support blocking to await out-of-band data.

EBADF The socket argument is not a valid open file descriptor.

ECONNRESET A connection was forcibly closed by a peer.

EFAULT The message parameter, or storage pointed to by the msg_name, msg_control or msg_iov fields of the message parameter, or storage pointed to by the iovvec structures pointed to by the msg_iov field can not be accessed or written.

EINTR This function was interrupted by a signal before any data was available.

EINVAL The sum of the iov_len values overflows an ssize_t, or the MSG_OOB flag is set and no out-of-band data is available.

EMSGSIZE The msg_iovlen member of the msghdr structure pointed to by message is less than or equal to 0, or is greater than IOV_MAX.

ENOTCONN A receive is attempted on a connection-mode socket that is not connected.

ENOTSOCK The socket argument does not refer to 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.

The recvmsg () function may fail if:

EIO An I/O error occurred while reading from or writing to the file system.

ENOBUFS Insufficient resources were available in the system to perform the operation.

ENOMEM Insufficient memory was available to fulfill the request.

ENOSR There were insufficient STREAMS resources available for the operation to complete.

Attributes See attributes(5) for descriptions of the following attributes:

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recvmsg(3XNET)

<table>
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</table>

See Also poll(2), recv(3XNET), recvfrom(3XNET), select(3C), send(3XNET), sendmsg(3XNET), sendto(3XNET), setsockopt(3XNET), shutdown(3XNET), socket(3XNET), socket.h(3HEAD), attributes(5), standards(5)
Name  resolver, res_state, res_ninit, fp_resstat, res_hostalias, res_nquery, res_nsec, res_nsecdomain, res_nmkquery, res_nsec, res_nendsign, dns_comp, dn_expand, hstrerror, res_init, res_query, res_search, res_mkquery, res_send, herror, res_getservers, res_setservers, res_ndestroy – resolver interface

Synopsis  BIND 8.2.2 Interfaces

cc [ flag ... ] file ... -lresolv -lsocket -lnsl [ library ... ]
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>
#include <netdb.h>
typedef struct __res_state *res_state;
int res_ninit(res_state statp);
void res_ndestroy(res_state statp);
void fp_resstat(const res_state statp, FILE *fp);
const char *res_hostalias(const res_state statp, const char *name, char *buf, size_t buflen);
int res_nsec(query(res_state statp, const char *dname, int class, int type, uchar_t *answer, int anslen);
int res_nsec(search(res_state statp, const char *dname, int class, int type, u_char *answer, int anslen);
int res_nsecdomain(res_state statp, const char *name, const char *domain, int class, int type, u_char *answer, int anslen);
int res_nsecquery(res_state statp, 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);
int res_nsecsend(res_state statp, const u_char *msg, int msglen, u_char *answer, int anslen);
void res_nsecclose(res_state statp);
int res_nsecendsign(res_state statp, const uchar_t *msg, int msglen, ns_tsig_key *key, u_char_t *answer, int anslen);
int dn_comp(const char *exp_dn, u_char *comp_dn, int length, u_char **dnptrs, **lastdnptr);
int dn_expand(const u_char *msg, *comorig, *comp_dn, char *exp_dn, int length);
const char *hstrerror(int err);
The routines are used for making, sending, and interpreting query and reply messages with Domain Name System (DNS) servers. State information is kept in `statp` and is used to control the behavior of these functions. Set `statp` to all zeros prior to making the first call to any of these functions. The `res_ndestroy()` function should be called to free memory allocated by `res_ninit()` after the last use of `statp`.

The functions `res_init()`, `res_query()`, `res_search()`, `res_mkquery()`, `res_send()`, and `herror()` are deprecated. They are supplied for backwards compatibility. They use global configuration and state information that is kept in the structure `_res` rather than state information referenced through `statp`.

Most of the values in `statp` and `_res` are initialized to reasonable defaults on the first call to `res_ninit()` or `res_init()` and can be ignored. Options stored in `statp->options` or `_res.options` are defined in `<resolv.h>`. They are stored as a simple bit mask containing the bitwise OR of the options enabled.

**RES_INIT**

True if the initial name server address and default domain name are initialized, that is, `res_init()` or `res_ninit()` has been called.

```c
void res_setservers(res_state statp, const union res_sockaddr_union *set,
   int cnt);

int res_getservers(res_state statp, union res_sockaddr_union *set,
   int cnt);

Deprecated Interfaces

cc [ flag ... ] file ... -lresolv -lsocket -lnsl [ library ... ]
#include <sys/types.h>
#include <netinet/in.h>
#include <arpa/nameser.h>
#include <resolv.h>
#include <netdb.h>

int res_init(void)
int res_query(const char *dname, int class, int type,
   u_char *answer, int anslen);

int res_search(const char *dname, int class, int type,
   u_char *answer, int anslen);

int res_mkquery(int op, const char *dname, int class,
   int type, const uchar_t *data, int datalen,
   const uchar_t *newrr, u_char *buf, int buflen);

int res_send(const u_char *msg, int msglen, u_char *answer,
   int anslen);

void herror(const char *s);
```
RES_DEBUG
Print debugging messages.

RES_AONLY
Accept authoritative answers only. With this option, res_send() will continue until it finds an authoritative answer or finds an error. Currently this option is not implemented.

RES_USEVC
Use TCP connections for queries instead of UDP datagrams.

RES_STAYOPEN
Use with RES_USEVC to keep the TCP connection open between queries. This is a useful option for programs that regularly do many queries. The normal mode used should be UDP.

RES_IGNORE
Ignore truncation errors; that is, do not retry with TCP.

RES_RECURSE
Set the recursion-desired bit in queries. This is the default. res_send() and res_nsend() do not do iterative queries and expect the name server to handle recursion.

RES_DEFNAMES
If set, res_search() and res_nsearch() append the default domain name to single-component names, that is, names that do not contain a dot. This option is enabled by default.

RES_DNSRCH
If this option is set, res_search() and res_nsearch() search for host names in the current domain and in parent domains. See hostname(1). This option is used by the standard host lookup routine gethostbyname(3NSL). 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_BLAST
If the RES_BLAST option is defined, resolver() queries will be sent to all servers. If the RES_BLAST option is not defined, but RES_ROTATE is, the list of nameservers are rotated according to a round-robin scheme. RES_BLAST overrides RES_ROTATE.

RES_ROTATE
This option causes res_nsend() and res_send() to rotate the list of nameservers in statp->nsaddr_list or _res.nsaddr_list.

RES_KEEP TSIG
This option causes res_nsend() to leave the message unchanged after TSIG verification. Otherwise the TSIG record would be removed and the header would be updated.

The res_ninit() and res_init() routines read the configuration file, if any is present, to get the default domain name, search list and the Internet address of the local nameserver(s). See resolv.conf(4). If no server is configured, res_init() or res_ninit() will try to obtain name resolution services from the host on which it is running. The current domain name is defined by domainname(1M), or by the hostname if it is not specified in the configuration file. Use the environment variable LOCALDOMAIN to override the domain name. This environment
variable may contain several blank-separated tokens if you wish to override the search list on a per-process basis. This is similar to the search command in the configuration file. You can set the RES_OPTIONS environment variable to override certain internal resolver options. You can otherwise set them by changing fields in the statp/_res structure. Alternatively, they are inherited from the configuration file's options command. See resolv.conf(4) for information regarding the syntax of the RES_OPTIONS environment variable. Initialization normally occurs on the first call to one of the other resolver routines.

The res_nquery() and res_query() functions provide interfaces to the server query mechanism. They construct a query, send it to the local server, await a response, and make 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. res_nquery() and res_query() return the length of the answer, or -1 upon error.

The res_nquery() and res_query() routines return a length that may be bigger than anslen. In that case, retry the query with a larger buf. The answer to the second query may be larger still, so it is recommended that you supply a buf larger than the answer returned by the previous query. answer must be large enough to receive a maximum UDP response from the server or parts of the answer will be silently discarded. The default maximum UDP response size is 512 bytes.

The res_nsearch() and res_search() routines make a query and wait a response, just like res_nquery() and res_query(). In addition, they implement the default and search rules controlled by the RES_DEFNAMES and RES_DNSRCH options. They return the length of the first successful reply which is stored in answer. On error, they return -1.

The res_nsearch() and res_search() routines return a length that may be bigger than anslen. In that case, retry the query with a larger buf. The answer to the second query may be larger still, so it is recommended that you supply a buf larger than the answer returned by the previous query. answer must be large enough to receive a maximum UDP response from the server or parts of the answer will be silently discarded. The default maximum UDP response size is 512 bytes.

The res_nquerydomain() function calls res_query() on the concatenation of name and domain, removing a trailing dot from name if domain is NULL.

These routines are used by res_nquery() and res_query(). The res_nmkquery() and res_mkquery() functions construct a standard query message and place it in buf. The routine 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 is given by dname. newrr is currently unused but is intended for making update messages.
The `res_nsend()`, `res_send()`, and `res_nsendsigned()` routines send a pre-formatted query that returns an answer. The routine calls `res_ninit()` or `res_init()`. If `RES_INIT` is not set, the routine sends the query to the local name server and handles timeouts and retries. Additionally, the `res_nsendsigned()` uses TSIG signatures to add authentication to the query and verify the response. In this case, only one name server will be contacted. The routines return the length of the reply message, or -1 if there are errors.

The `res_nsend()` and `res_send()` routines return a length that may be bigger than `anslen`. In that case, retry the query with a larger `buf`. The answer to the second query may be larger still, so it is recommended that you supply a `buf` larger than the answer returned by the previous query. `answer` must be large enough to receive a maximum UDP response from the server or parts of the `answer` will be silently discarded. The default maximum UDP response size is 512 bytes.

The function `fp_resstat()` prints out the active flag bits in `statp->options` preceded by the text ";; res options:" on file.

The function `res_hostalias()` looks up `name` in the file referred to by the `HOSTALIASES` environment variable and returns the fully qualified host name. If `name` is not found or an error occurs, NULL is returned. `res_hostalias()` stores the result in `buf`.

The `res_nclose()` function closes any open files referenced through `statp`. The `res_ndestroy()` function calls `res_nclose()`, then frees any memory allocated by `res_ninit()` referenced through `statp`.

The `dn_comp()` function compresses the domain name `exp_dn` and stores it in `comp_dn`. The `dn_comp()` function returns the size of the compressed name, or -1 if there were errors. `length` is the size of the array pointed to by `comp_dn`.

The `dnptrs` parameter is a pointer to the head of the list of pointers to previously compressed names in the current message. The first pointer must point to the beginning of the message. The list ends with NULL. The limit to the array is specified by `lastdnptr`.

A side effect of calling `dn_comp()` is to update the list of pointers for labels inserted into the message by `dn_comp()` as the name is compressed. If `dnptrs` is NULL, names are not compressed. If `lastdnptr` is NULL, `dn_comp()` does not update the list of labels.

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 that message. The uncompressed name is placed in the buffer indicated by `exp_dn`, which is of size `length`. The `dn_expand()` function returns the size of the compressed name, or -1 if there was an error.
The variables `statp->res_h_errno` and `_res.res_h_errno` and external variable `h_errno` are set whenever an error occurs during a resolver operation. The following definitions are given in `<netdb.h>`:

```c
#define NETDB_INTERNAL -1 /* see errno */
#define NETDB_SUCCESS 0 /* no problem */
#define HOST_NOT_FOUND 1 /* Authoritative Answer Host not found */
#define TRY_AGAIN 2 /* Non-Authoritative not found, or SERVFAIL */
#define NO_RECOVERY 3 /* Non-Recoverable: FORMERR, REFUSED, NOTIMP*/
#define NO_DATA 4 /* Valid name, no data for requested type */
```

The `herror()` function writes a message to the diagnostic output consisting of the string parameters, the constant string `": "`, and a message corresponding to the value of `h_errno`.

The `hstrerror()` function returns a string, which is the message text that corresponds to the value of the `err` parameter.

The functions `res_getservers()` and `res_setservers()` are used to get and set the list of servers to be queried.

**Examples**

**EXAMPLE 1** The following example shows basic usage of the resolver’s API.

```c
#include <resolv.h>
#include <string.h>

int main(int argc, char **argv) {
    int len;
    struct __res_state statp;
    union msg {
        uchar_t buf[NS_MAXMSG];
        HEADER h;
    } resbuf;

    /* Initialize resolver */
    memset(&statp, 0, sizeof(statp));
    if (res_ninit(&statp) < 0) {
        fprintf(stderr, "Can't initialize statp.\n");
        return (1);
    }

    /* Turning on DEBUG mode keeps this example simple,
     * without need to output anything.
     */
    statp.options |= RES_DEBUG;

    /* Search for A type records */
```
The following example shows basic usage of the resolver's API.

```c
len = res_nsearch(&statp, "example.com", C_IN, T_A, 
    resbuf.buf, NS_MAXMSG);
if (len < 0) {
    fprintf(stderr, "Error occurred during search.\n");
    return (1);
}
if (len > NS_MAXMSG) {
    fprintf(stderr, "The buffer is too small.\n");
    return (1);
}
/* ... Process the received answer ... */
/* Cleanup */
res_ndestroy(&statp);
return (0);
```

**Files**  
`/etc/resolv.conf` resolver configuration file

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Unsafe for deprecated interfaces; MT-Safe for all others.</td>
</tr>
</tbody>
</table>

**See Also**  
`domainname(1M), gethostbyname(3NSL), libresolv(3LIB), resolv.conf(4), attributes(5)`


**Notes**  When the caller supplies a work buffer, for example the *answer* buffer argument to `res_nsend()` or `res_send()`, the buffer should be aligned on an eight byte boundary. Otherwise, an error such as a SIGBUS may result.
rexec(3SOCKET)

**Name**  
rexec, rexec_af – return stream to a remote command

**Synopsis**  
c
cc [ flag ... ] file... -lsocket -lns1 [ library... ]
#include <netdb.h>
#include <unistd.h>

```c
int rexec(char **ahost, unsigned short inport, const char *user,
        const char *passwd, const char *cmd, int *fd2p);
int rexec_af(char **ahost, unsigned short inport, const char *user,
         const char *passwd, const char *cmd, int *fd2p, int af);
```

**Description**  
The rexec() and rexec_af() functions look up the host `ahost` using `getaddrinfo(3SOCKET)` and return −1 if the host does not exist. Otherwise `ahost` is set to the standard name of the host. The username and password are used in remote host authentication. When a username and password are not specified, the `.netrc` file in the user's home directory is searched for the appropriate information. If the search fails, the user is prompted for the information.

The rexec() function always returns a socket of the AF_INET address family. The rexec_af() function supports AF_INET, AF_INET6, or AF_UNSPEC for the address family. An application can choose which type of socket is returned by passing AF_INET or AF_INET6 as the address family. The use of AF_UNSPEC means that the caller will accept any address family. Choosing AF_UNSPEC provides a socket that best suits the connectivity to the remote host.

The port `inport` specifies which DARPA Internet port to use for the connection. The port number used must be in network byte order, as supplied by a call to `htons(3XNET)`. The protocol for connection is described in detail in `in.rexed(1M)`.

If the call succeeds, a socket of type SOCK_STREAM is returned to the caller, and given to the remote command as its standard input and standard output. If `fd2p` is non-zero, an auxiliary channel to a control process is set up and a file descriptor for it is placed in `*fd2p`. The control process returns diagnostic output (file descriptor 2), from the command on the auxiliary channel. The control process also accepts bytes on this channel as signal numbers to be forwarded to the process group of the command. If `fd2p` is 0, the standard error (file descriptor 2) of the remote command is made the same as its standard output. No provision is made for sending arbitrary signals to the remote process, other than possibly sending out-of-band data.

There is no way to specify options to the socket() call made by the rexec() or rexec_af() functions.

**Return Values**  
If rexec() succeeds, a file descriptor number is returned of the socket type SOCK_STREAM and the address family AF_INET. The parameter `ahost` is set to the standard name of the host. If the value of `fd2p` is other than NULL, a file descriptor number is placed in `*fd2p` which represents the standard error stream of the command.

If rexec_af() succeeds, the routine returns a file descriptor number of the socket type SOCK_STREAM in the address family AF_INET or AF_INET6, as determined by the value of the `af` parameter.
If either `reexec()` or `reexec_af()` fails, −1 is returned.

**Attributes** See `attributes(5)` for descriptions of the following attributes:

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<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
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</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>

This interface is Unsafe in multithreaded applications. Unsafe interfaces should be called only from the main thread.

**See Also** `in.rexecd(1M), getaddrinfo(3SOCKET), gethostname(3NSL), getservbyname(3SOCKET), htonl(3XNET), socket(3SOCKET), attributes(5)`
Name  rpc - library routines for remote procedure calls

Synopsis  cc [ flag ... ] file ... -lnsl [ library ... ]
           #include <rpc/rpc.h>
           #include <netconfig.h>

Description  These routines allow C language programs to make procedure calls on other machines across a network. First, the client sends a request to the server. On receipt of the request, the server calls a dispatch routine to perform the requested service, and then sends back a reply.

All RPC routines require the header <rpc/rpc.h>. Routines that take a netconfig structure also require that <netconfig.h> be included. Applications using RPC and XDR routines should be linked with the libnsl library.

In the case of multithreaded applications, the -mt option must be specified on the command line at compilation time to enable a thread-specific version of rpc_createerr(). See rpc_clnt_create(3NSL) and threads(5).

When used in multithreaded applications, client-side routines are MT-Safe. CLIENT handles can be shared between threads; however, in this implementation, requests by different threads are serialized (that is, the first request will receive its results before the second request is sent). See rpc_clnt_create(3NSL).

When used in multithreaded applications, server-side routines are usually Unsafe. In this implementation the service transport handle, SVCXPRT contains a single data area for decoding arguments and encoding results. See rpc_svc_create(3NSL). Therefore, this structure cannot be freely shared between threads that call functions that do this. Routines that are affected by this restriction are marked as unsafe for MT applications. See rpc_svc_calls(3NSL).

Nettyp  Some of the high-level RPC interface routines take a nettype string as one of the parameters (for example, clnt_create(), svc_create(), rpc_reg(), rpc_call()). This string defines a class of transports which can be used for a particular application.

nettype can be one of the following:

netpath  Choose from the transports which have been indicated by their token names in the NETPATH environment variable. If NETPATH is unset or NULL, it defaults to visible. netpath is the default nettype.

visible  Choose the transports which have the visible flag (v) set in the /etc/netconfig file.

circuit_v  This is same as visible except that it chooses only the connection oriented transports (semantics tpi_cots or tpi_cots_ord) from the entries in the /etc/netconfig file.

datagram_v  This is same as visible except that it chooses only the connectionless datagram transports (semantics tpi_clts) from the entries in the /etc/netconfig file.
circuit_n  This is same as netpath except that it chooses only the connection oriented
datagram transports (semantics tpi_cots or tpi_cots_ord).

datagram_n  This is same as netpath except that it chooses only the connectionless
datagram transports (semantics tpi_clts).

udp  This refers to Internet UDP.
tcp  This refers to Internet TCP.

If nettype is NULL, it defaults to netpath. The transports are tried in left to right order in the
NETPATH variable or in top to down order in the /etc/netconfig file.

Derived Types  In a 64-bit environment, the derived types are defined as follows:

typedef uint32_t rpcprog_t;
typedef uint32_t rpcvers_t;
typedef uint32_t rpcproc_t;
typedef uint32_t rpcprot_t;
typedef uint32_t rpcport_t;
typedef int32_t rpc_inline_t;

In a 32-bit environment, the derived types are defined as follows:

typedef unsigned long rpcprog_t;
typedef unsigned long rpcvers_t;
typedef unsigned long rpcproc_t;
typedef unsigned long rpcprot_t;
typedef unsigned long rpcport_t;
typedef long rpc_inline_t;

Data Structures  Some of the data structures used by the RPC package are shown below.

The AUTH Structure

union des_block {
        struct {
                u_int32  high;
                u_int32  low;
        } key;
        char    c[8];
};
typedef union des_block des_block;
extern bool_t xdr_des_block( );

/* Authentication info. Opaque to client. */
struct opaque_auth {
    enum_t oa_flavor; /* flavor of auth */
    caddr_t oa_base; /* address of more auth stuff */
    uint_t oa_length; /* not to exceed MAX_AUTH_BYTES */
};

/* Auth handle, interface to client side authenticators. */
typedef struct {
    struct opaque_auth ah_cred;
    struct opaque_auth ah_verf;
    union des_block ah_key;
    struct auth_ops {
        void(*ah_nextverf)( ); /* nextverf & serialize */
        int(*ah_marshall)( ); /* validate verifier */
        int(*ah_validate)( ); /* refresh credentials */
        void(*ah_destroy)( ); /* destroy this structure */
    } *ah_ops;
    caddr_t ah_private;
} AUTH;

The CLIENT Structure
/*
* Client rpc handle.
* Created by individual implementations.
* Client is responsible for initializing auth.
*/
typedef struct {
    AUTH *cl_auth; /* authenticator */
    struct clnt_ops {
        enum clnt_stat (*cl_call)( ); /* call remote procedure */
        void (*cl_abort)( ); /* abort a call */
        void (*cl_geterr)( ); /* get specific error code */
        bool_t (*cl_freeres)( ); /* frees results */
        void (*cl_destroy)( ); /* destroy this structure */
        bool_t (*cl_control)( ); /* the ioctl() of rpc */
        int (*cl_settimers)( ); /* set rpc level timers */
    } *cl_ops;
    caddr_t cl_private; /* private stuff */
    char *cl_netid; /* network identifier */
    char *cl_tp; /* device name */
} CLIENT;
The SVCXPRT Structure

typedef struct {
    int xp_fd; /* file descriptor for the
    ushort_t xp_port; /* obsolete */
    struct xp_ops {
        bool_t (*xp_recv)( ); /* receive incoming requests */
        enum xprt_stat (*xp_stat)( ); /* get transport status */
        bool_t (*xp_getargs)( ); /* get arguments */
        bool_t (*xp_reply)( ); /* send reply */
        bool_t (*xp_freeargs)( ); /* free mem allocated for args */
        void (*xp_destroy)( ); /* destroy this struct */
    } *xp_ops;
    int xp_addrlen; /* length of remote addr. 
                     Obsolete */
    char *xp_tp; /* transport provider device name */
    char *xp_netid; /* network identifier */
    struct netbuf xp_ltaddr; /* local transport address */
    struct netbuf xp_rtaddr; /* remote transport address */
    char xp_raddr[16]; /* remote address. Obsolete */
    struct opaque_auth xp_verf; /* raw response verifier */
    caddr_t xp_p1; /* private: for use by svc ops */
    caddr_t xp_p2; /* private: for use by svc ops */
    caddr_t xp_p3; /* private: for use by svc lib */
    int xp_type; /* transport type */
} SVCXPRT;

The svc_reg Structure

struct svc_reg {
    rpcprog_t rq_prog; /* service program number */
    rpcvers_t rq_vers; /* service protocol version */
    rpcproc_t rq_proc; /* the desired procedure */
    struct opaque_auth rq_cred; /* raw creds from the wire */
    caddr_t rq_clntcred; /* read only cooked cred */
    SVCXPRT *rq_xprt; /* associated transport */
};
The XDR Structure

/*
* XDR operations.
* XDR_ENCODE causes the type to be encoded into the stream.
* XDR_DECODE causes the type to be extracted from the stream.
* XDR_FREE can be used to release the space allocated by an XDR_DECODE
* request.
*/
enum xdr_op {
    XDR_ENCODE=0,
    XDR_DECODE=1,
    XDR_FREE=2
};

/*
* This is the number of bytes per unit of external data.
*/
#define BYTES_PER_XDR_UNIT (4)
#define RNDUP(x) ((((x) + BYTES_PER_XDR_UNIT - 1) / 
    BYTES_PER_XDR_UNIT) \ * BYTES_PER_XDR_UNIT)

/*
* A xdrproc_t exists for each data type which is to be encoded or
* decoded. The second argument to the xdrproc_t is a pointer to
* an opaque pointer. The opaque pointer generally points to a
* structure of the data type to be decoded. If this points to 0,
* then the type routines should allocate dynamic storage of the
* appropriate size and return it.
* bool_t (*xdrproc_t)(XDR *, caddr_t *);
*/
typedef bool_t (*xdrproc_t)( );

/*
* The XDR handle.
* Contains operation which is being applied to the stream,
* an operations vector for the particular implementation
*/
typedef struct {
    enum xdr_op x_op; /* operation; fast additional param */
    struct xdr_ops {
        bool_t (*x_getlong)( ); /* get long from underlying stream */
        bool_t (*x_putchar)( ); /* put long to underlying stream */
        bool_t (*x_getbytes)( ); /* get bytes from underlying stream */
        bool_t (*x_putchar)( ); /* put bytes to underlying stream */
        uint_t (*x_getpostn)( ); /* returns bytes off from beginning */
        bool_t (*x_setpostn)( ); /* reposition the stream */
        rpc_inline_t *(*x_inline)( ); /* buf quick ptr to buffered data */
        void (*x_destroy)( ); /* free privates of this xdr_stream */
        bool_t (*x_control)( ); /* changed/retrieve client object info*/
        bool_t (*x_getint32)( ); /* get int from underlying stream */
    } xdr_ops;
} xdr_stream;
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**Files** /etc/netconfig

**Attributes** See attributes(5) for descriptions of the following attributes:

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<tr>
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**See Also**
getnetconfig(3NSL), getnetpath(3NSL), rpc_clnt_auth(3NSL), rpc_clnt_calls(3NSL), rpc_clnt_create(3NSL), rpc_svc_calls(3NSL), rpc_svc_create(3NSL), rpc_svc_err(3NSL), rpc_svc_reg(3NSL), rpc_xdr(3NSL), rpcbind(3NSL), secure_rpc(3NSL), threads(5), xdr(3NSL), netconfig(4), rpc(4), attributes(5), environ(5)
Name rpcbind, rpcb_getmaps, rpcb_getaddr, rpcb_gettime, rpcb_rmtcall, rpcb_set, rpcb_unset –
library routines for RPC bind service

Synopsis #include <rpc/rpc.h>

struct rpcblist *rpcb_getmaps(const struct netconfig *nnetconf,
    const char *host);

bool_t rpcb_getaddr(const rpcprog_t prognum, const rpcvers_t versnum,
    const struct netconfig *netconf, struct netbuf *svcaddr,
    const char *host);

bool_t rpcb_gettime(const char *host, time_t *timep);

enum clnt_stat rpcb_rmtcall(const struct netconfig *netconf,
    const char *host, const rpcprog_t prognum,
    const rpcvers_t versnum, const rpcproc_t procnum,
    const xdrproc_t inproc, const caddr_t in,
    const xdrproc_t outproc caddr_t out,,,
    const struct timeval tout, struct netbuf *svcaddr);

bool_t rpcb_set(const rpcprog_t prognum, const rpcvers_t versnum,
    const struct netconfig *netconf, const struct netbuf *svcaddr);

bool_t rpcb_unset(const rpcprog_t prognum, const rpcvers_t versnum,
    const struct netconfig *netconf);

Description These routines allow client C programs to make procedure calls to the RPC binder service.

rpcbind maintains a list of mappings between programs and their universal addresses. See
rpcbind(1M).

Routines rpcb_getmaps() An interface to the rpcbind service, which returns a list of the current
RPC program-to-address mappings on host. It uses the transport
specified through netconf to contact the remote rpcbind service on host.
This routine will return NULL, if the remote rpcbind could not be
contacted.

rpcb_getaddr() An interface to the rpcbind service, which finds the address of the
service on host that is registered with program number prognum,
version versnum, and speaks the transport protocol associated with
netconf. The address found is returned in svcaddr. svcaddr should be
preallocated. This routine returns TRUE if it succeeds. A return value of
FALSE means that the mapping does not exist or that the RPC system
failed to contact the remote rpcbind service. In the latter case, the global
variable rpc_createerr contains the RPC status. See
rpc_clnt_create(3NSL).

rpcb_gettime() This routine returns the time on host in timep. If host is NULL,
rpcb_gettime() returns the time on its own machine. This routine
returns TRUE if it succeeds, FALSE if it fails. rpcb_gettime() can be used
to synchronize the time between the client and the remote server. This routine is particularly useful for secure RPC.

**rpcb_rmtcall()**

An interface to the rpcbind service, which instructs rpcbind on *host* to make an RPC call on your behalf to a procedure on that host. The netconfig structure should correspond to a connectionless transport. The parameter *svcaddr* will be modified to the server's address if the procedure succeeds. See rpc_call() and clnt_call() in rpc_clnt_calls(3NSL) for the definitions of other parameters.

This procedure should normally be used for a "ping" and nothing else. This routine allows programs to do lookup and call, all in one step.

Note: Even if the server is not running rpcbind does not return any error messages to the caller. In such a case, the caller times out.

Note: rpcb_rmtcall() is only available for connectionless transports.

**rpcb_set()**

An interface to the rpcbind service, which establishes a mapping between the triple [prognum, versnum, netconf->nc_netid] and svcaddr on the machine's rpcbind service. The value of nc_netid must correspond to a network identifier that is defined by the netconfig database. This routine returns TRUE if it succeeds, FALSE otherwise. See also svc_reg() in rpc_svc_calls(3NSL). If there already exists such an entry with rpcbind, rpcb_set() will fail.

**rpcb_unset()**

An interface to the rpcbind service, which destroys the mapping between the triple [prognum, versnum, netconf->nc_netid] and the address on the machine's rpcbind service. If netconf is NULL, rpcb_unset() destroys all mapping between the triple [prognum, versnum, all-transports] and the addresses on the machine's rpcbind service. This routine returns TRUE if it succeeds, FALSE otherwise. Only the owner of the service or the super-user can destroy the mapping. See also svc_unreg() in rpc_svc_calls(3NSL).

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**
rpcbind(1M), rpcinfo(1M), rpc_clnt_calls(3NSL), rpc_clnt_create(3NSL), rpc_svc_calls(3NSL), attributes(5)
Name  rpc_clnt_auth, auth_destroy, authnone_create, authsys_create, authsys_create_default – library routines for client side remote procedure call authentication

Synopsis

```c
void auth_destroy(AUTH *auth);

AUTH *authnone_create (void)

AUTH *authsys_create(const char *host, const uid_t uid, const gid_t gid,
            const int len, const gid_t *aup_gids);

AUTH *authsys_create_default(void)
```

Description

These routines are part of the RPC library that allows C language programs to make procedure calls on other machines across the network, with desired authentication.

These routines are normally called after creating the CLIENT handle. The cl_auth field of the CLIENT structure should be initialized by the AUTH structure returned by some of the following routines. The client’s authentication information is passed to the server when the RPC call is made.

Only the NULL and the SYS style of authentication is discussed here. For the DES style authentication, please refer to secure_rpc(3NSL).

The NULL and SYS style of authentication are safe in multithreaded applications. For the MT-level of the DES style, see its pages.

Routines

The following routines require that the header <rpc/rpc.h> be included (see rpc(3NSL) for the definition of the AUTH data structure).

```c
#include <rpc/rpc.h>

auth_destroy() A function macro that destroys the authentication information associated with auth. Destruction usually involves deallocation of private data structures. The use of auth is undefined after calling auth_destroy().

authnone_create() Create and return an RPC authentication handle that passes nonusable authentication information with each remote procedure call. This is the default authentication used by RPC.

authsys_create() Create and return an RPC authentication handle that contains AUTH_SYS authentication information. The parameter host is the name of the machine on which the information was created; uid is the user’s user ID; gid is the user’s current group ID; len and aup_gids refer to a counted array of groups to which the user belongs.

authsys_create_default Call authsys_create() with the appropriate parameters.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
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</tr>
</tbody>
</table>

See Also  rpc(3NSL), rpc_clnt_calls(3NSL), rpc_clnt_create(3NSL), secure_rpc(3NSL), attributes(5)
**Name**  
rpc_clnt_calls, clnt_call, clnt_send, clnt_freeres, clnt_geterr, clnt_perrno, clnt_perror, clnt_sperrno, clnt_sperror, rpc_broadcast, rpc_broadcast_exp, rpc_call – library routines for client side calls

**Synopsis**  
```
#include <rpc/rpc.h>

enum clnt_stat clnt_call(CLIENT *clnt, const rpcproc_t procnum,  
 const xdrproc_t inproc, const caddr_t in, const xdrproc_t outproc,  
 caddr_t out, const struct timeval tout);

enum clnt_stat clnt_send (CLIENT *clnt, const u_long procnum,  
 const xdrproc_t proc, const caddr_t in);

bool_t clnt_freeres(CLIENT *clnt, const xdrproc_t outproc,  
 caddr_t out);

void clnt_geterr(const CLIENT *clnt, struct rpc_err *errp);

void clnt_perrno(const enum clnt_stat stat);

void clnt_perror(const CLIENT *clnt, const char *s);

char *clnt_sperrno(const enum clnt_stat stat);

char *clnt_sperror(const CLIENT *clnt, const char *s);

enum clnt_stat rpc_broadcast(const rpcprog_t prognum,  
 const rpcvers_t versnum, const rpcproc_t procnum,  
 const xdrproc_t inproc, const caddr_t in,  
 const xdrproc_t outproc, caddr_t out,  
 const resultproc_t eachresult, const char *nettype);

enum clnt_stat rpc_broadcast_exp(const rpcprog_t prognum,  
 const rpcvers_t versnum, const rpcproc_t procnum,  
 const xdrproc_t inproc, const caddr_t in,  
 const xdrproc_t outproc, caddr_t out,  
 const resultproc_t eachresult, const char *nettype, const int inittime,  
 const int waittime, const char *nettype);

enum clnt_stat rpc_call(const char *host, const rpcprog_t prognum,  
 const rpcvers_t versnum, const rpcproc_t procnum,  
 const xdrproc_t inproc, const char *in,  
 const xdrproc_t outproc, char *out, const char *nettype);
```  

**Description**  
RPC library routines allow C language programs to make procedure calls on other machines across the network. First, the client calls a procedure to send a request to the server. Upon receipt of the request, the server calls a dispatch routine to perform the requested service and then sends back a reply.

The `clnt_call()`, `rpc_call()`, and `rpc_broadcast()` routines handle the client side of the procedure call. The remaining routines deal with error handling.

Some of the routines take a `CLIENT` handle as one of the parameters. A `CLIENT` handle can be created by an RPC creation routine such as `clnt_create()`. See `rpc_clnt_create(3NSL)`. 

These routines are safe for use in multithreaded applications. CLIENT handles can be shared between threads; however, in this implementation requests by different threads are serialized. In other words, the first request will receive its results before the second request is sent.

Routines

See rpc(3NSL) for the definition of the CLIENT data structure.

clnt_call()  A function macro that calls the remote procedure procnum associated with the client handle, clnt, which is obtained with an RPC client creation routine such as clnt_create(). See rpc_clnt_create(3NSL). The parameter inproc is the XDR function used to encode the procedure's parameters, and outproc is the XDR function used to decode the procedure's results. in is the address of the procedure's argument(s), and out is the address of where to place the result(s). tout is the time allowed for results to be returned, which is overridden by a time-out set explicitly through clnt_control(). See rpc_clnt_create(3NSL).

If the remote call succeeds, the status returned is RPC_SUCCESS. Otherwise, an appropriate status is returned.

clnt_send()  Use the clnt_send() function to call a remote asynchronous function.

The clnt_send() function calls the remote function procnum() associated with the client handle, clnt, which is obtained with an RPC client creation routine such as clnt_create(). See rpc_clnt_create(3NSL). The parameter proc is the XDR function used to encode the procedure's parameters. The parameter in is the address of the procedure's argument(s).

By default, the blocking I/O mode is used. See the clnt_control(3NSL) man page for more information on I/O modes.

The clnt_send() function does not check if the program version number supplied to clnt_create() is registered with the rpcbind service. Use clnt_create_vers() instead of clnt_create() to check on incorrect version number registration. clnt_create_vers() will return a valid handle to the client only if a version within the range supplied to clnt_create_vers() is supported by the server.

RPC_SUCCESS is returned when a request is successfully delivered to the transport layer. This does not mean that the request was received. If an error is returned, use the clnt_geterr() routine...
to find the failure status or the clnt_perrno() routine to translate the failure status into error messages.

clint_freeses() A function macro that frees any data allocated by the RPC/XDR system when it decoded the results of an RPC call. The parameter out is the address of the results, and outproc is the XDR routine describing the results. This routine returns 1 if the results were successfully freed; otherwise it returns 0.

clint_geterr() A function macro that copies the error structure out of the client handle to the structure at address errp.

clint_errno() Prints a message to standard error corresponding to the condition indicated by stat. A newline is appended. It is normally used after a procedure call fails for a routine for which a client handle is not needed, for instance rpc_call().

clint_perror() Prints a message to the standard error indicating why an RPC call failed; clint is the handle used to do the call. The message is prepended with string s and a colon. A newline is appended. This routine is normally used after a remote procedure call fails for a routine that requires a client handle, for instance clnt_call().

clint_sperrno() Takes the same arguments as clnt_errno(), but instead of sending a message to the standard error indicating why an RPC call failed, returns a pointer to a string that contains the message. clint_sperrno() is normally used instead of clnt_errno() when the program does not have a standard error, as a program running as a server quite likely does not. clnt_sperrno() is also used if the programmer does not want the message to be output with printf(), or if a message format different than that supported by clnt_errno() is to be used. See printf(3C). Unlike clnt_sperror() and clnt_spcreateerror(), clnt_sperrno() does not return a pointer to static data. Therefore, the result is not overwritten on each call. See rpc_clnt_create(3NSL).

clint_sperror() Similar to clnt_perror(), except that like clnt_sperrno(), it returns a string instead of printing to standard error. However, clnt_sperror() does not append a newline at the end of the message. clnt_sperror() returns a pointer to a buffer that is overwritten on each call. In multithreaded applications, this buffer is implemented as thread-specific data.
rpc_broadcast()  Similar to rpc_call(), except that the call message is broadcast to all the connectionless transports specified by nettype. If nettype is NULL, it defaults to netpath. Each time it receives a response, this routine calls eachresult( ), whose form is:

```
bool_t eachresult(caddr_t out, const struct netbuf *addr, const struct netconfig *netconf);
```

where out is the same as out passed to rpc_broadcast(), except that the remote procedure's output is decoded there. addr points to the address of the machine that sent the results, and netconf is the netconfig structure of the transport on which the remote server responded. If eachresult() returns 0, rpc_broadcast() waits for more replies; otherwise, it returns with appropriate status.

The broadcast file descriptors are limited in size to the maximum transfer size of that transport. For Ethernet, this value is 1500 bytes. rpc_broadcast() uses AUTH_SYS credentials by default. See rpc_clnt_auth(3NSL).

rpc_broadcast_exp()  Similar to rpc_broadcast(), except that the initial timeout, inittime and the maximum timeout, waittime, are specified in milliseconds.

```
inittime
```

is the initial time that rpc_broadcast_exp() waits before resending the request. After the first resend, the retransmission interval increases exponentially until it exceeds waittime.

rpc_call()  Calls the remote procedure associated with prognum, versnum, and procnum on the machine, host. The parameter inproc is used to encode the procedure's parameters, and outproc is used to decode the procedure's results. in is the address of the procedure's argument(s), and out is the address of where to place the result(s). nettype can be any of the values listed on rpc(3NSL). This routine returns RPC_SUCCESS if it succeeds, or it returns an appropriate status. Use the clnt_perror() routine to translate failure status into error messages.

The rpc_call() function uses the first available transport belonging to the class nettype on which it can create a connection. You do not have control of timeouts or authentication using this routine.

Attributes  See attributes(5) for descriptions of the following attributes:
See Also  printf(3C), rpc(3NSL), rpc_clnt_auth(3NSL), rpc_clnt_create(3NSL), attributes(5)
**Name**

rpc_clnt_create, clnt_control, clnt_create, clnt_create_timed, clnt_create_vers, clnt_create_vers_timed, clnt_destroy, clnt_dg_create, clnt_pcreateerror, clnt_raw_create, clnt_spcreateerror, clnt_tli_create, clnt_tp_create, clnt_tp_create_timed, clnt_vc_create, rpc_createerr, clnt_door_create – library routines for dealing with creation and manipulation of CLIENT handles

**Synopsis**

```
#include <rpc/rpc.h>

bool_t clnt_control(CLIENT *clnt, const uint_t req, char *info);
CLIENT *clnt_create(const char *host, const rpcprog_t prognum,
                    const rpcvers_t versnum, const char *nettype);
CLIENT *clnt_create_timed(const char *host, const rpcprog_t prognum,
                          const rpcvers_t versnum, const char *nettype,
                          const struct timeval *timetout);
CLIENT *clnt_create_vers (const char *host,
                          const rpcprog_t prognum, rpcvers_t *vers_outp,
                          const rpcvers_t vers_low, const rpcvers_t vers_high,
                          const char *nettype);
CLIENT *clnt_create_vers_timed(const char *host,
                             const rpcprog_t prognum, rpcvers_t *vers_outp,
                             const rpcvers_t vers_low, const rpcvers_t vers_high,
                             char *nettype, const struct timeval *timeout);
void clnt_destroy(CLIENT *clnt);
CLIENT *clnt_dg_create(const int fildes,
                      const struct netbuf *svcaddr, const rpcprog_t prognum,
                      const rpcvers_t versnum, const uint_t sendsz,
                      const uint_t recsz);
void clnt_pcreateerror(const char *s);
CLIENT *clnt_raw_create(const rpcprog_t prognum,
                        const rpcvers_t versnum);
char *clnt_spcreateerror(const char *s);
CLIENT *clnt_tli_create(const int fildes,
                    const struct netconfig *netconf, const struct netbuf *svcaddr,
                    const rpcprog_t prognum, const rpcvers_t versnum,
                    const uint_t sendsz, const uint_t recsz);
CLIENT *clnt_tp_create(const char *host,
                    const rpcprog_t prognum, const rpcvers_t versnum,
                    const struct netconfig *netconf);
CLIENT *clnt_tp_create_timed(const char *host,
                            const rpcprog_t prognum, const rpcvers_t versnum,
                            const struct netconfig *netconf, const struct timeval *timeout);
```
RPC library routines allow C language programs to make procedure calls on other machines across the network. First a CLIENT handle is created and then the client calls a procedure to send a request to the server. On receipt of the request, the server calls a dispatch routine to perform the requested service, and then sends a reply.

These routines are MT-Safe. In the case of multithreaded applications, the -mt option must be specified on the command line at compilation time. When the -mt option is specified, rpc_createerr becomes a macro that enables each thread to have its own rpc_createerr. See threads(5).

See rpc(3NSL) for the definition of the CLIENT data structure.

clint_control() is a function macro to change or retrieve various information about a client object. req indicates the type of operation, and info is a pointer to the information. For both connectionless and connection-oriented transports, the supported values of req and their argument types and what they do are:

- **CLSET_TIMEOUT**: struct timeval * set total timeout
- **CLGET_TIMEOUT**: struct timeval * get total timeout
- **CLGET_SERVER_ADDR**: struct netbuf * get server's address
- **CLGET_SVC_ADDR**: struct netbuf * get server's address
- **CLGET_FD**: int * get associated file descriptor
- **CLSET_FD_CLOSE**: void close the file descriptor when destroying the client handle (see clnt_destroy())
- **CLSET_FD_NCLOSE**: void do not close the file descriptor when destroying the client handle
- **CLGET_VERS**: rpcvers_t get the RPC program's version number associated with the client handle
- **CLSET_VERS**: rpcvers_t set the RPC program's version number associated with the client handle. This assumes that the RPC server for this
new version is still listening
at the address of the previous
version.

\texttt{CLGET\_XID} \hspace{1em} \texttt{uint32\_t} \hspace{1em} get the XID of the previous
remote procedure call

\texttt{CLSET\_XID} \hspace{1em} \texttt{uint32\_t} \hspace{1em} set the XID of the next
remote procedure call

\texttt{CLGET\_PROG} \hspace{1em} \texttt{rpcprog\_t} \hspace{1em} get program number

\texttt{CLSET\_PROG} \hspace{1em} \texttt{rpcprog\_t} \hspace{1em} set program number

The following operations are valid for connection-oriented transports only:

\texttt{CLSET\_IO\_MODE} \hspace{1em} \texttt{rpciomode\_t\*} \hspace{1em} set the IO mode used
to send one-way requests. The argument for this operation
can be either:

- \texttt{RPC\_CL\_BLOCKING} \hspace{1em} all sending operations block
  until the underlying transport protocol has
  accepted requests. If you specify this argument
  you cannot use flush and getting and setting buffer
  size is meaningless.

- \texttt{RPC\_CL\_NONBLOCKING} \hspace{1em} sending operations do not
  block and return as soon as requests enter the buffer.
  You can now use non-blocking I/O. The requests in the
  buffer are pending. The requests are sent to
  the server as soon as a two-way request is sent
  or a flush is done. You are responsible for flushing
  the buffer. When you choose \texttt{RPC\_CL\_NONBLOCKING} argument
  you have a choice of flush modes as specified by
  \texttt{CLSET\_FLUSH\_MODE}.

\texttt{CLGET\_IO\_MODE} \hspace{1em} \texttt{rpciomode\_t\*} \hspace{1em} get the current IO mode

\texttt{CLSET\_FLUSH\_MODE} \hspace{1em} \texttt{rpcflushmode\_t\*} \hspace{1em} set the flush mode.
  The flush mode can only be used in non-blocking I/O mode.
  The argument can be either of the following:

- \texttt{RPC\_CL\_BESTEFFORT\_FLUSH} \hspace{1em} All flushes send requests
  in the buffer until the transport end-point blocks.
  If the transport connection is congested, the call
  returns directly.

- \texttt{RPC\_CL\_BLOCKING\_FLUSH} \hspace{1em} Flush blocks until the
  underlying transport protocol accepts all pending
  requests into the queue.

\texttt{CLGET\_FLUSH\_MODE} \hspace{1em} \texttt{rpcflushmode\_t\*} \hspace{1em} get the current flush mode.

\texttt{CLFLUSH} \hspace{1em} \texttt{rpcflushmode\_t} \hspace{1em} flush the pending requests.
  This command can only be used in non-blocking I/O mode.
  The flush policy depends on which of the following
  parameters is specified:

- \texttt{RPC\_CL\_DEFAULT\_FLUSH}, or \texttt{NULL}: \hspace{1em} The flush is done
  according to the current flush mode policy
  (see \texttt{CLSET\_FLUSH\_MODE} option).

- \texttt{RPC\_CL\_BESTEFFORT\_FLUSH}: \hspace{1em} The flush tries
to send pending requests without blocking; the call returns directly. If the transport connection is congested, this call could return without the request being sent.

- RPC_CL_BLOCKING_FLUSH: The flush sends all pending requests. This call will block until all the requests have been accepted by the transport layer.

CLSET_CONNMAXREC_SIZE int* set the buffer size.

It is not possible to dynamically resize the buffer if it contains data.
The default size of the buffer is 16 kilobytes.

CLGET_CONNMAXREC_SIZE int* get the current size of the buffer

CLGET_CURRENT_REC_SIZE int* get the size of the pending requests stored in the buffer. Use of this command is only recommended when you are in non-blocking I/O mode. The current size of the buffer is always zero when the handle is in blocking mode as the buffer is not used in this mode.

The following operations are valid for connectionless transports only:

CLSET_RETRY_TIMEOUT struct timeval * set the retry timeout

CLGET_RETRY_TIMEOUT struct timeval * get the retry timeout

The retry timeout is the time that RPC waits for the server to reply before retransmitting the request.

clnt_control() returns TRUE on success and FALSE on failure.

clnt_create()
Generic client creation routine for program prognum and version versnum. host identifies the name of the remote host where the server is located. nettype indicates the class of transport protocol to use. The transports are tried in left to right order in NETPATH variable or in top to bottom order in the netconfig database.

clnt_create() tries all the transports of the nettype class available from the NETPATH environment variable and the netconfig database, and chooses the first successful one. A default timeout is set and can be modified using clnt_control(). This routine returns NULL if it fails. The clnt_pcreateerror() routine can be used to print the reason for failure.

Note that clnt_create() returns a valid client handle even if the particular version number supplied to clnt_create() is not registered with the rpcbind service. This mismatch will be discovered by a clnt_call later (see rpc_clnt_calls(3NSL)).
clnt_create_timed()
Generic client creation routine which is similar to clnt_create() but which also has the additional parameter timeout that specifies the maximum amount of time allowed for each transport class tried. In all other respects, the clnt_create_timed() call behaves exactly like the clnt_create() call.

clnt_create_vers()
Generic client creation routine which is similar to clnt_create() but which also checks for the version availability. host identifies the name of the remote host where the server is located. nettype indicates the class transport protocols to be used. If the routine is successful it returns a client handle created for the highest version between vers_low and vers_high that is supported by the server. vers_outp is set to this value. That is, after a successful return vers_low <= vers_outp <= vers_high. If no version between vers_low and vers_high is supported by the server then the routine fails and returns NULL. A default timeout is set and can be modified using clnt_control(). This routine returns NULL if it fails. The clnt_pcreateerror() routine can be used to print the reason for failure.

Note: clnt_create() returns a valid client handle even if the particular version number supplied to clnt_create() is not registered with the rpcbind service. This mismatch will be discovered by a clnt_call later (see rpc_clnt_calls(3NSL)). However, clnt_create_vers() does this for you and returns a valid handle only if a version within the range supplied is supported by the server.

clnt_create_vers_timed()
Generic client creation routine similar to clnt_create_vers() but with the additional parameter timeout, which specifies the maximum amount of time allowed for each transport class tried. In all other respects, the clnt_create_vers_timed() call behaves exactly like the clnt_create_vers() call.

clnt_destroy()
A function macro that destroys the client’s RPC handle. Destruction usually involves deallocation of private data structures, including clnt itself. Use of clnt is undefined after calling clnt_destroy(). If the RPC library opened the associated file descriptor, or CLSET_FD_CLOSE was set using clnt_control(), the file descriptor will be closed.

The caller should call auth_destroy(clnt->cl_auth) (before calling clnt_destroy()) to destroy the associated AUTH structure (see rpc_clnt_auth(3NSL)).

clnt_dg_create()
This routine creates an RPC client for the remote program prognum and version versnum; the client uses a connectionless transport. The remote program is located at address svcaddr. The parameter fildes is an open and bound file descriptor. This routine will resend the call message in intervals of 15 seconds until a response is received or until the call times out. The total time for the call to time out is specified by clnt_call() (see clnt_call() in rpc_clnt_calls(3NSL)). The retry time out and the total time out periods can be changed.
using clnt_control(). The user may set the size of the send and receive buffers with the parameters \texttt{sendsz} and \texttt{recvsz}; values of 0 choose suitable defaults. This routine returns NULL if it fails.

\textbf{clnt_pcreateerror()}

Print a message to standard error indicating why a client RPC handle could not be created. The message is prepended with the string \texttt{s} and a colon, and appended with a newline.

\textbf{clnt_raw_create()}

This routine creates an RPC client handle for the remote program \texttt{prognum} and version \texttt{versnum}. The transport used to pass messages to the service is a buffer within the process's address space, so the corresponding RPC server should live in the same address space; (see \texttt{svc_raw_create()} in \texttt{rpc_svc_create(3NSL)}). This allows simulation of RPC and measurement of RPC overheads, such as round trip times, without any kernel or networking interference. This routine returns NULL if it fails. \texttt{clnt_raw_create()} should be called after \texttt{svc_raw_create()}. 

\textbf{clnt_spcreateerror()}

Like \texttt{clnt_pcreateerror()}, except that it returns a string instead of printing to the standard error. A newline is not appended to the message in this case.

Warning: returns a pointer to a buffer that is overwritten on each call. In multithread applications, this buffer is implemented as thread-specific data.

\textbf{clnt_tli_create()}

This routine creates an RPC client handle for the remote program \texttt{prognum} and version \texttt{versnum}. The remote program is located at address \texttt{svcaddr}. If \texttt{svcaddr} is NULL and it is connection-oriented, it is assumed that the file descriptor is connected. For connectionless transports, if \texttt{svcaddr} is NULL, RPC\_UNKNOWNADDR error is set. \texttt{fildes} is a file descriptor which may be open, bound and connected. If it is RPC\_ANYFD, it opens a file descriptor on the transport specified by \texttt{netconf}. If \texttt{fildes} is RPC\_ANYFD and \texttt{netconf} is NULL, a RPC\_UNKNOWNPROTO error is set. If \texttt{fildes} is unbound, then it will attempt to bind the descriptor. The user may specify the size of the buffers with the parameters \texttt{sendsz} and \texttt{recvsz}; values of 0 choose suitable defaults. Depending upon the type of the transport (connection-oriented or connectionless), \texttt{clnt_tli_create()} calls appropriate client creation routines. This routine returns NULL if it fails. The \texttt{clnt_pcreateerror()} routine can be used to print the reason for failure. The remote rpcbind service (see \texttt{rpcbind(1M)}) is not consulted for the address of the remote service.

\textbf{clnt_tp_create()}

Like \texttt{clnt_create()} except \texttt{clnt_tp_create()} tries only one transport specified through \texttt{netconf}.

\texttt{clnt_tp_create()} creates a client handle for the program \texttt{prognum}, the version \texttt{versnum}, and for the transport specified by \texttt{netconf}. Default options are set, which can be changed using \texttt{clnt_control()} calls. The remote rpcbind service on the host \texttt{host} is consulted for the address of the remote service. This routine returns NULL if it fails. The \texttt{clnt_pcreateerror()} routine can be used to print the reason for failure.
clnt_tp_create_timed()
Like clnt_tp_create() except clnt_tp_create_timed() has the extra parameter timeout which specifies the maximum time allowed for the creation attempt to succeed. In all other respects, the clnt_tp_create_timed() call behaves exactly like the clnt_tp_create() call.

clnt_vc_create()
This routine creates an RPC client for the remote program prognum and version versnum; the client uses a connection-oriented transport. The remote program is located at address svcaddr. The parameter fildes is an open and bound file descriptor. The user may specify the size of the send and receive buffers with the parameters sendsz and recvsz; values of 0 choose suitable defaults. This routine returns NULL if it fails.

The address svcaddr should not be NULL and should point to the actual address of the remote program. clnt_vc_create() does not consult the remote rpcbind service for this information.

rpc_createerr
A global variable whose value is set by any RPC client handle creation routine that fails. It is used by the routine clnt_pcreateerror() to print the reason for the failure.

In multithreaded applications, rpc_createerr becomes a macro which enables each thread to have its own rpc_createerr.

clnet_door_create()
This routine creates an RPC client handle over doors for the given program prognum and version versnum. Doors is a transport mechanism that facilitates fast data transfer between processes on the same machine. The user may set the size of the send buffer with the parameter sendsz. If sendsz is 0, the corresponding default buffer size is 16 Kbyte. The clnt_door_create() routine returns NULL if it fails and sets a value for rpc_createerr.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>All</td>
</tr>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  rpcbind(1M), rpc(3NSL), rpc_clnt_auth(3NSL), rpc_clnt_calls(3NSL), rpc_svc_create(3NSL), svc_raw_create(3NSL), threads(5), attributes(5)
rpc_control–libraryroutineformanipulatingglobalRPCattributesforclientandserver
applications

**Synopsis**

\[ \text{bool_t } \text{rpc_control}(\text{int } \text{op}, \text{void } \ast \text{info}); \]

This RPC library routine allows applications to set and modify global RPC attributes that
apply to clients as well as servers. At present, it supports only server side operations. This
function allows applications to set and modify global attributes that apply to client as well as
server functions. \textit{op} indicates the type of operation, and \textit{info} is a pointer to the operation
specific information. The supported values of \textit{op} and their argument types, and what they do
are:

- \textbf{RPC_SVC_MTMODE_SET} \textbf{int * set multithread mode}
- \textbf{RPC_SVC_MTMODE_GET} \textbf{int * get multithread mode}
- \textbf{RPC_SVC_THRMAX_SET} \textbf{int * set maximum number of threads}
- \textbf{RPC_SVC_THRMAX_GET} \textbf{int * get maximum number of threads}
- \textbf{RPC_SVC_THRTOTAL_GET} \textbf{int * get number of active threads}
- \textbf{RPC_SVC_THRCREATES_GET} \textbf{int * get number of threads created}
- \textbf{RPC_SVC_THRERRORS_GET} \textbf{int * get number of thread create errors}
- \textbf{RPC_SVC_USE_POLLFD} \textbf{int * set number of file descriptors to unlimited}
- \textbf{RPC_SVC_CONNMAXREC_SET} \textbf{int * set non-blocking max rec size}
- \textbf{RPC_SVC_CONNMAXREC_GET} \textbf{int * get non-blocking max rec size}

There are three multithread (MT) modes. These are:

- \textbf{RPC_SVC_MT_NONE} Single threaded mode \textit{(default)}
- \textbf{RPC_SVC_MT_AUTO} Automatic MT mode
- \textbf{RPC_SVC_MT_USER} User MT mode

Unless the application sets the Automatic or User MT modes, it will stay in the default (single
threaded) mode. See the Network Interfaces Programmer’s Guide for the meanings of these
modes and programming examples. Once a mode is set, it cannot be changed.

By default, the maximum number of threads that the server will create at any time is 16. This
allows the service developer to put a bound on thread resources consumed by a server. If a
server needs to process more than 16 client requests concurrently, the maximum number of
threads must be set to the desired number. This parameter may be set at any time by the
server.

Set and get operations will succeed even in modes where the operations don’t apply. For
example, you can set the maximum number of threads in any mode, even though it makes
sense only for the Automatic MT mode. All of the get operations except \textbf{RPC_SVC_MTMODE_GET}
apply only to the Automatic MT mode, so values returned in other modes may be undefined.

By default, RPC servers are limited to a maximum of 1024 file descriptors or connections due
to limitations in the historical interfaces \texttt{svc_fdset(3NSL)} and \texttt{svc_getreqset(3NSL)}. Applications
written to use the preferred interfaces of \texttt{svc_pollfd(3NSL)} and \texttt{svc_getreq_poll(3NSL)} can use an unlimited number of file descriptors. Setting \textit{info} to
point to a non-zero integer and \textit{op} to \textbf{RPC_SVC_USE_POLLFD} removes the limitation.
Connection oriented RPC transports read RPC requests in blocking mode by default. Thus, they may be adversely affected by network delays and broken clients. 

RPC_SVC_CONNMAXREC_SET enables non-blocking mode and establishes the maximum record size (in bytes) for RPC requests; RPC responses are not affected. Buffer space is allocated as needed up to the specified maximum, starting at the maximum or RPC_MAXDATASIZE, whichever is smaller.

The value established by RPC_SVC_CONNMAXREC_SET is used when a connection is created, and it remains in effect for that connection until it is closed. To change the value for existing connections on a per-connection basis, see svc_control(3NSL).

RPC_SVC_CONNMAXREC_GET retrieves the current maximum record size. A zero value means that no maximum is in effect, and that the connections are in blocking mode.

info is a pointer to an argument of type int. Non-connection RPC transports ignore RPC_SVC_CONNMAXREC_SET and RPC_SVC_CONNMAXREC_GET.

Return Values This routine returns TRUE if the operation was successful and returns FALSE otherwise.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also rpcbind(1M), rpc(3NSL), rpc_svc_calls(3NSL), attributes(5)

Network Interfaces Programmer’s Guide
rpc_gss_getcred - get credentials of client

Synopsis

```c
#include <rpc/rpcsec_gss.h>

bool_t rpc_gss_getcred(struct svc_req *req, rpc_gss_rawcred_t **rcred,
                        rpc_gss_ucred **ucred, void **cookie);
```

Description

`rpc_gss_getcred()` is used by a server to fetch the credentials of a client. These credentials may either be network credentials (in the form of a `rpc_gss_rawcred_t` structure) or UNIX credentials.

For more information on RPCSEC_GSS data types, see the `rpcsec_gss(3NSL)` man page.

Parameters

Essentially, `rpc_gss_getcred()` passes a pointer to a request (`svc_req`) as well as pointers to two credential structures and a user-defined cookie; if `rpc_gss_getcred()` is successful, at least one credential structure is "filled out" with values, as is, optionally, the cookie.

`req` Pointer to the received service request. `svc_req` is an RPC structure containing information on the context of an RPC invocation, such as program, version, and transport information.

`rcred` A pointer to an `rpc_gss_rawcred_t` structure pointer. This structure contains the version number of the RPCSEC_GSS protocol being used; the security mechanism and QOPs for this session (as strings); principal names for the client (as a `rpc_gss_principal_t` structure) and server (as a string); and the security service (integrity, privacy, etc., as an enum). If an application is not interested in these values, it may pass `NULL` for this parameter.

`ucred` The caller's UNIX credentials, in the form of a pointer to a pointer to a `rpc_gss_ucred_t` structure, which includes the client's uid and gids. If an application is not interested in these values, it may pass `NULL` for this parameter.

`cookie` A four-byte quantity that an application may use in any manner it wants to; RPC does not interpret it. (For example, a cookie may be a pointer or index to a structure that represents a context initiator.) See also `rpc_gss_set_callback(3NSL)`.

Return Values

`rpc_gss_getcred()` returns `TRUE` if it is successful; otherwise, use `rpc_gss_get_error()` to get the error associated with the failure.

Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/rpcsec</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>
See Also  

rpc(3NSL), rpc_gss_set_callback(3NSL), rpc_gss_set_svc_name(3NSL), rpcsec_gss(3NSL), attributes(5)

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Name  rpc_gss_get_error — get error codes on failure

Synopsis  

```c
#include <rpc/rpcsec_gss.h>

bool_t rpc_gss_get_error(rpc_gss_error_t *error);
```

Description  

`rpc_gss_get_error()` fetches an error code when an RPCSEC_GSS routine fails.

`rpc_gss_get_error()` uses a `rpc_gss_error_t` structure of the following form:

```c
typedef struct {
   int rpc_gss_error;          // RPCSEC_GSS error
   int system_error;           // system error
} rpc_gss_error_t;
```

Currently the only error codes defined for this function are

```c
#define RPC_GSS_ER_SUCCESS 0 /* no error */
#define RPC_GSS_ER_SYSTEMERROR 1 /* system error */
```

Parameters  Information on RPCSEC_GSS data types for parameters may be found on the `rpcsec_gss(3NSL)` man page.

- error  A `rpc_gss_error_t` structure. If the `rpc_gss_error` field is equal to `RPC_GSS_ER_SYSTEMERROR`, the `system_error` field will be set to the value of `errno`.

Return Values  Unless there is a failure indication from an invoked RPCSEC_GSS function, `rpc_gss_get_error()` does not set `error` to a meaningful value.

Attributes  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
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<td>system/library/security/rpcsec</td>
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</tbody>
</table>

See Also  `perror(3C), rpc(3NSL), rpcsec_gss(3NSL), attributes(5)`

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Notes  Only system errors are currently returned.
**Name**
rpc_gss_get_mechanisms, rpc_gss_get_mech_info, rpc_gss_get_versions, rpc_gss_is_installed - get information on mechanisms and RPC version

**Synopsis**
#include <rpc/rpcsec_gss.h>

char **rpc_gss_get_mechanisms();
char **rpc_gss_get_mech_info(char *mech, rpc_gss_service_t *service);
bool_t rpc_gss_get_versions(u_int *vers_hi, u_int *vers_lo);
bool_t rpc_gss_is_installed(char *mech);

**Description**
These "convenience functions" return information on available security mechanisms and versions of RPCSEC_GSS.

rpc_gss_get_mechanisms() Returns a list of supported security mechanisms as a null-terminated list of character strings.

rpc_gss_get_mech_info() Takes two arguments: an ASCII string representing a mechanism type, for example, kerberosv5, and a pointer to a rpc_gss_service_t enum. rpc_gss_get_mech_info() will return NULL upon error or if no /etc/gss/qop file is present. Otherwise, it returns a null-terminated list of character strings of supported Quality of Protections (QOPs) for this mechanism. NULL or empty list implies only that the default QOP is available and can be specified to routines that need to take a QOP string parameter as NULL or an empty string.

rpc_gss_get_versions() Returns the highest and lowest versions of RPCSEC_GSS supported.

rpc_gss_is_installed() Takes an ASCII string representing a mechanism, and returns TRUE if the mechanism is installed.

**Parameters**
Information on RPCSEC_GSS data types for parameters may be found on the rpcsec_gss(3NSL) man page.

mech An ASCII string representing the security mechanism in use. Valid strings may also be found in the /etc/gss/mech file.

service A pointer to a rpc_gss_service_t enum, representing the current security service (privacy, integrity, or none).

vers_hi vers_lo The highest and lowest versions of RPCSEC_GSS supported.

**Files**
/etc/gss/mech File containing valid security mechanisms
/etc/gss/qop File containing valid QOP values
Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
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<td>system/library/security/rpcsec</td>
</tr>
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<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  rpc(3NSL), rpcsec_gss(3NSL), mech(4), qop(4), attributes(5)

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Notes

This function will change in a future release.
rpc_gss_get_principal_name (3NSL)

Name  rpc_gss_get_principal_name – Get principal names at server

Synopsis  #include <rpc/rpcsec_gss.h>

    bool_t rpc_gss_get_principal_name(rpc_gss_principal_t principal,
        char *mech, char *name, char *node, char *domain);

Description  Servers need to be able to operate on a client's principal name. Such a name is stored by the
server as a rpc_gss_principal_t structure, an opaque byte string which can be used either
directly in access control lists or as database indices which can be used to look up a UNIX
credential. A server may, for example, need to compare a principal name it has received with
the principal name of a known entity, and to do that, it must be able to generate
rpc_gss_principal_t structures from known entities.

rpc_gss_get_principal_name() takes as input a security mechanism, a pointer to a
rpc_gss_principal_t structure, and several parameters which uniquely identify an entity on
a network: a user or service name, a node name, and a domain name. From these parameters it
constructs a unique, mechanism-dependent principal name of the rpc_gss_principal_t
structure type.

Parameters  How many of the identifying parameters (name , node, and domain) are necessary to specify
depends on the mechanism being used. For example, Kerberos V5 requires only a user name
but can accept a node and domain name. An application can choose to set unneeded
parameters to NULL.

Information on RPCSEC_GSS data types for parameters may be found on the
rpcsec_gss (3NSL) man page.

principal  An opaque, mechanism-dependent structure representing the client's principal
name.

mech  An ASCII string representing the security mechanism in use. Valid strings may
be found in the /etc/gss/mech file, or by using rpc_gss_get_mechanisms() .

name  A UNIX login name (for example, 'gwashington') or service name, such as 'nfs'.

node  A node in a domain; typically, this would be a machine name (for example,
'valleyforge').

domain  A security domain; for example, a DNS or NIS domain name
'eng.company.com').

Return Values  rpc_gss_get_principal_name() returns TRUE if it is successful; otherwise, use
rpc_gss_get_error() to get the error associated with the failure.

Files  /etc/gss/mech    File containing valid security mechanisms
Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/rpcsec</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also

free(3C), rpc(3NSL), rpc_gss_get_mechanisms(3NSL), rpc_gss_set_svc_name(3NSL), rpcsec_gss(3NSL), mech(4), attributes(5)

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Notes

Principal names may be freed up by a call to free(3C). A principal name need only be freed in those instances where it was constructed by the application. (Values returned by other routines point to structures already existing in a context, and need not be freed.)
### Description
Performing a security transformation on a piece of data generally produces data with a different (usually greater) length. For some transports, such as UDP, there is a maximum length of data which can be sent out in one data unit. Applications need to know the maximum size a piece of data can be before it's transformed, so that the resulting data will still "fit" on the transport. These two functions return that maximum size.

`rpc_gss_max_data_length()` is the client-side version; `rpc_gss_svc_max_data_length()` is the server-side version.

### Parameters
- **handle**: An RPC context handle of type `AUTH`, returned when a context is created (for example, by `rpc_gss_seccreate()`). Security service and QOP are bound to this handle, eliminating any need to specify them.
- **max tp unit len**: The maximum size of a piece of data allowed by the transport.
- **req**: A pointer to an RPC `svc_req` structure, containing information on the context (for example, program number and credentials).

### Return Values
Both functions return the maximum size of untransformed data allowed, as an int.

### Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
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<tbody>
<tr>
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<td>system/library/security/rpcsec</td>
</tr>
<tr>
<td>MT-Level</td>
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</tr>
</tbody>
</table>

### See Also
`rpc(3NSL), rpcsec_gss(3NSL), attributes(5)`

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rpc_gss_mech_to_oid(3NSL)

**Name**
rpc_gss_mech_to_oid, rpc_gss_qop_to_num – map mechanism, QOP strings to non-string values

**Synopsis**

```c
#include <rpc/rpcsec_gss.h>

bool_t rpc_gss_mech_to_oid(char *mech, rpc_gss_OID *oid);
bool_t rpc_gss_qop_to_num(char *qop, char *mech, u_int *num);
```

**Description**

Because in-kernel RPC routines use non-string values for mechanism and Quality of Protection (QOP), these routines exist to map strings for these attributes to their non-string counterparts. (The non-string values for QOP and mechanism are also found in the `/etc/gss/qop` and `/etc/gss/mech` files, respectively.) `rpc_gss_mech_to_oid()` takes a string representing a mechanism, as well as a pointer to a `rpc_gss_OID` object identifier structure. It then gives this structure values corresponding to the indicated mechanism, so that the application can now use the OID directly with RPC routines. `rpc_gss_qop_to_num()` does much the same thing, taking strings for QOP and mechanism and returning a number.

**Parameters**

Information on RPCSEC_GSS data types for parameters may be found on the `rpcsec_gss(3NSL)` man page.

- `mech` An ASCII string representing the security mechanism in use. Valid strings may be found in the `/etc/gss/mech` file.
- `oid` An object identifier of type `rpc_gss_OID`, whose elements are usable by kernel-level RPC routines.
- `qop` This is an ASCII string which sets the quality of protection (QOP) for the session. Appropriate values for this string may be found in the file `/etc/gss/qop`.
- `num` The non-string value for the QOP.

**Return Values**

Both functions return TRUE if they are successful, FALSE otherwise.

**Files**

- `/etc/gss/mech` File containing valid security mechanisms
- `/etc/gss/qop` File containing valid QOP values

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<tbody>
<tr>
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<td>system/library/security/rpcsec</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**

- `rpc(3NSL), rpc_gss_get_error(3NSL), rpc_gss_get_mechanisms(3NSL), rpcsec_gss(3NSL), mech(4), qop(4), attributes(5)`
Name  rpc_gss_seccreate – create a security context using the RPCSEC_GSS protocol

Synopsis  #include <rpc/rpcsec_gss.h>

AUTH *rpc_gss_seccreate(CLIENT *clnt, char *principal, char *mechanism,
                        rpc_gss_service_t service_type, char *qop,
                        rpc_gss_options_req_t *options_req,
                        rpc_gss_options_ret_t *options_ret);

Description  rpc_gss_seccreate() is used by an application to create a security context using the
RPCSEC_GSS protocol, making use of the underlying GSS-API network layer.
rpc_gss_seccreate() allows an application to specify the type of security mechanism (for
example, Kerberos v5), the type of service (for example, integrity checking), and the Quality
of Protection (QOP) desired for transferring data.

Parameters  Information on RPCSEC_GSS data types for parameters may be found on the
rpcsec_gss(3NSL) man page.

  clnt  This is the RPC client handle. clnt may be obtained, for example, from
clnt_create().

  principal  This is the identity of the server principal, specified in the form service@host,
where service is the name of the service the client wishes to access and host is
the fully qualified name of the host where the service resides — for example,
nfs@mymachine.eng.company.com.

  mechanism  This is an ASCII string which indicates which security mechanism to use with
this data. Appropriate mechanisms may be found in the file /etc/gss/mech;
additionally, rpc_gss_get_mechanisms() returns a list of supported security
mechanisms (as null-terminated strings).

  service_type  This sets the initial type of service for the session — privacy, integrity,
authentication, or none.

  qop  This is an ASCII string which sets the quality of protection (QOP) for the
session. Appropriate values for this string may be found in the file
/etc/gss/qop. Additionally, supported QOPs are returned (as
null-terminated strings) by rpc_gss_get_mech_info().

  options_req  This structure contains options which are passed directly to the underlying
GSS-API layer. If the caller specifies NULL for this parameter, defaults are used.
(See NOTES, below.)

  options_ret  These GSS-API options are returned to the caller. If the caller does not need to
see these options, then it may specify NULL for this parameter. (See NOTES,
below.)
rpc_gss_seccreate() returns a security context handle (an RPC authentication handle) of type AUTH. If rpc_gss_seccreate() cannot return successfully, the application can get an error number by calling rpc_gss_get_error().

Files
/etc/gss/mech File containing valid security mechanisms
/etc/gss/qop File containing valid QOP values.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<tbody>
<tr>
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<td>system/library/security/rpcsec</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also
auth_destroy(3NSL), rpc(3NSL), rpc_gss_get_error(3NSL), rpc_gss_get_mechanisms(3NSL), rpcsec_gss(3NSL), mech(4), qop(4), attributes(5)

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Notes
Contexts may be destroyed normally, with auth_destroy(). See auth_destroy(3NSL)
Name  rpc_gss_set_callback – specify callback for context

Synopsis  #include <rpc/rpcsec_gss.h>

    bool_t rpc_gss_set_callback(struct rpc_gss_callback_t *cb);

Description  A server may want to specify a callback routine so that it knows when a context gets first used. This user-defined callback may be specified through the rpc_gss_set_callback() routine. The callback routine is invoked the first time a context is used for data exchanges, after the context is established for the specified program and version.

The user-defined callback routine should take the following form:

    bool_t callback(struct svc_req *req, gss_cred_id_t deleg,
                     gss_ctx_id_t gss_context, rpc_gss_lock_t *lock, void **cookie);

Parameters  rpc_gss_set_callback() takes one argument: a pointer to a rpc_gss_callback_t structure. This structure contains the RPC program and version number as well as a pointer to a user-defined callback() routine. (For a description of rpc_gss_callback_t and other RPCSEC_GSS data types, see the rpcsec_gss(3NSL) man page.)

The user-defined callback() routine itself takes the following arguments:

    req  Pointer to the received service request. svc_req is an RPC structure containing information on the context of an RPC invocation, such as program, version, and transport information.

    deleg  Delegated credentials, if any. (See NOTES, below.)

    gss_context  GSS context (allows server to do GSS operations on the context to test for acceptance criteria). See NOTES, below.

    lock  This parameter is used to enforce a particular QOP and service for a session. This parameter points to a RPCSEC_GSS rpc_gss_lock_t structure. When the callback is invoked, the rpc_gss_lock_t.locked field is set to TRUE, thus locking the context. A locked context will reject all requests having different values for QOP or service than those specified by the raw_cred field of the rpc_gss_lock_t structure.

    cookie  A four-byte quantity that an application may use in any manner it wants to — RPC does not interpret it. (For example, the cookie could be a pointer or index to a structure that represents a context initiator.) The cookie is returned, along with the caller's credentials, with each invocation of rpc_gss_getcred().

Return Values  rpc_gss_set_callback() returns TRUE if the use of the context is accepted; false otherwise.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/rpcsec</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  rpc(3NSL), rpc_gss_getcred(3NSL), rpcsec_gss(3NSL), attributes(5)

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Notes  If a server does not specify a callback, all incoming contexts will be accepted.

Because the GSS-API is not currently exposed, the deleg and gss_context arguments are mentioned for informational purposes only, and the user-defined callback function may choose to do nothing with them.
Name  rpc_gss_set_defaults – change service, QOP for a session

Synopsis  #include <rpc/rpcsec_gss.h>

    bool_t rpc_gss_set_defaults(AUTH *auth, rpc_gss_service_t service, char *qop);

Description  rpc_gss_set_defaults() allows an application to change the service (privacy, integrity, authentication, or none) and Quality of Protection (QOP) for a transfer session. New values apply to the rest of the session (unless changed again).

Parameters  Information on RPCSEC_GSS data types for parameters may be found on the rpcsec_gss(3NSL) man page.

    auth  An RPC authentication handle returned by rpc_gss_seccreate().

    service  An enum of type rpc_gss_service_t, representing one of the following types of security service: authentication, privacy, integrity, or none.

    qop  A string representing Quality of Protection. Valid strings may be found in the file /etc/gss/qop or by using rpc_gss_get_mech_info().

Return Values  rpc_gss_set_svc_name() returns TRUE if it is successful; otherwise, use rpc_gss_get_error() to get the error associated with the failure.

Files  /etc/gss/qop  File containing valid QOPs

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
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</tbody>
</table>

See Also  rpc(3NSL), rpc_gss_get_mech_info(3NSL), rpcsec_gss(3NSL), qop(4), attributes(5)

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rpc_gss_set_svc_name(3NSL)

**Name**
rpc_gss_set_svc_name - send a principal name to a server

**Synopsis**
```
#include <rpc/rpcsec_gss.h>

bool_t rpc_gss_set_svc_name(char *principal, char *mechanism,
       u_int req_time, u_int program, u_int version);
```

**Description**
rpc_gss_set_svc_name() sets the name of a principal the server is to represent. If a server is going to act as more than one principal, this procedure can be invoked for every such principal.

**Parameters**
Information on RPCSEC_GSS data types for parameters may be found on the rpcsec_gss(3NSL) man page.

- **principal** An ASCII string representing the server's principal name, given in the form of service@host.
- **mech** An ASCII string representing the security mechanism in use. Valid strings may be found in the /etc/gss/mech file, or by using rpc_gss_get_mechanisms().
- **req_time** The time, in seconds, for which a credential should be valid. Note that the req_time is a hint to the underlying mechanism. The actual time that the credential will remain valid is mechanism dependent. In the case of kerberos the actual time will be GSS_C_INDEFINITE.
- **program** The RPC program number for this service.
- **version** The RPC version number for this service.

**Return Values**
rpc_gss_set_svc_name() returns TRUE if it is successful; otherwise, use rpc_gss_get_error() to get the error associated with the failure.

**Files**
/etc/gss/mech File containing valid security mechanisms

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
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<td>system/library/security/rpcsec</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**
rpc(3NSL), rpc_gss_get_mechanisms(3NSL), rpc_gss_get_principal_name(3NSL), rpcsec_gss(3NSL), mech(4), attributes(5)

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**rpcsec_gss** – security flavor incorporating GSS-API protections

**Synopsis**
```
cc [ flag... ] file... -lnsl [ library... ]
#include <rpc/rpcsec_gss.h>
```

**Description**

RPCSEC_GSS is a security flavor which sits "on top" of the GSS-API (Generic Security Service API) for network transmissions. Applications using RPCSEC_GSS can take advantage of GSS-API security features; moreover, they can use any security mechanism (such as RSA public key or Kerberos) that works with the GSS-API.

The GSS-API offers two security services beyond the traditional authentication services (AUTH_DH, AUTH_SYS, and AUTH_KERB): integrity and privacy. With integrity, the system uses cryptographic checksumming to ensure the authenticity of a message (authenticity of originator, recipient, and data); privacy provides additional security by encrypting data. Applications using RPCSEC_GSS specify which service they wish to use. Type of security service is mechanism-independent.

Before exchanging data with a peer, an application must establish a context for the exchange. RPCSEC_GSS provides a single function for this purpose, `rpc_gss_seccreate()`, which allows the application to specify the security mechanism, Quality of Protection (QOP), and type of service at context creation. (The QOP parameter sets the cryptographic algorithms to be used with integrity or privacy, and is mechanism-dependent.) Once a context is established, applications can reset the QOP and type of service for each data unit exchanged, if desired.

Valid mechanisms and QOPs may be obtained from configuration files or from the name service. Each mechanism has a default QOP.

Contexts are destroyed with the usual RPC `auth_destroy()` call.

**Data Structures**

Some of the data structures used by the RPCSEC_GSS package are shown below.

**rpc_gss_service_t**

This enum defines the types of security services the context may have. `rpc_gss_seccreate()` takes this as one argument when setting the service type for a session.

```c
typedef enum {
    rpc_gss_svc_default = 0,
    rpc_gss_svc_none = 1,
    rpc_gss_svc_integrity = 2,
    rpc_gss_svc_privacy = 3
} rpc_gss_service_t;
```

**rpc_gss_options_req_t**

Structure containing options passed directly through to the GSS-API. `rpc_gss_seccreate()` takes this as an argument when creating a context.

```c
typedef struct {
    int req_flags; /*GSS request bits */
    int time_req; /*requested credential lifetime */
} rpc_gss_options_req_t;
```
gss_cred_id_t my_cred; /*GSS credential struct*/
gss_channel_bindings_t;
input_channel_bindings;
} rpc_gss_options_req_t;

rpc_gss_OID
This data type is used by in-kernel RPC routines, and thus is mentioned here for informational purposes only.

typedef struct {
  u_int  length;
  void *elements
} *rpc_gss_OID;

rpc_gss_options_ret_t
Structure containing GSS-API options returned to the calling function, rpc_gss_seccreate(). MAX_GSS_MECH is defined as 128.

typedef struct {
  int  major_status;
  int  minor_status;
  u_int rpcsec_version  /*vers. of RPCSEC_GSS */
  int  ret_flags
  int  time_req
  gss_ctx_id_t  gss_context;
  char actual_mechanism[MAX_GSS_MECH]; /*mechanism used*/
} rpc_gss_options_ret_t;

rpc_gss_principal_t
The (mechanism-dependent, opaque) client principal type. Used as an argument to the rpc_gss_get_principal_name() function, and in the gsscred table. Also referenced by the rpc_gss_rawcred_t structure for raw credentials (see below).

typedef struct {
  int  len;
  char name[1];
} *rpc_gss_principal_t;

rpc_gss_rawcred_t
Structure for raw credentials. Used by rpc_gss_getcred() and rpc_gss_set_callback().

typedef struct {
  u_int  version;  /*RPC version # */
  char  *mechanism;  /*security mechanism*/
  char  *qop;  /*Quality of Protection*/
  rpc_gss_principal_t client_principal;  /*client name*/
  char  *svc_principal;  /*server name*/
  rpc_gss_service_t service;  /*service (integrity, etc.)*/
} rpc_gss_rawcred_t;
**rpc_gss_ucred_t**

Structure for UNIX credentials. Used by `rpc_gss_getcred()` as an alternative to `rpc_gss_rawcred_t`.

```c
typedef struct {
    uid_t uid; /*user ID*/
    gid_t gid; /*group ID*/
    short gidlen;
    gid_t *gidlist; /*list of groups*/
} rpc_gss_ucred_t;
```

**rpc_gss_callback_t**

Callback structure used by `rpc_gss_set_callback()`.

```c
typedef struct {
    u_int program; /*RPC program #*/
    u_int version; /*RPC version #*/
    bool_t (*callback)(); /*user-defined callback routine*/
} rpc_gss_callback_t;
```

**rpc_gss_lock_t**

Structure used by a callback routine to enforce a particular QOP and service for a session. The `locked` field is normally set to FALSE; the server sets it to TRUE in order to lock the session. (A locked context will reject all requests having different QOP and service values than those found in the raw_cred structure.) For more information, see the `rpc_gss_set_callback(3NSL)` man page.

```c
typedef struct {
    bool_t locked;
    rpc_gss_rawcred_t *raw_cred;
} rpc_gss_lock_t;
```

**rpc_gss_error_t**

Structure used by `rpc_gss_get_error()` to fetch an error code when a RPCSEC_GSS routine fails.

```c
typedef struct {
    int rpc_gss_error;
    int system_error; /*same as errno*/
} rpc_gss_error_t;
```

**Index to Routines**

The following lists RPCSEC_GSS routines and the manual reference pages on which they are described. An (S) indicates it is a server-side function:

<table>
<thead>
<tr>
<th>Routine</th>
<th>(Manual Page)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>rpc_gss_seccreate</code></td>
<td>(3NSL)</td>
<td>Create a secure RPCSEC_GSS context</td>
</tr>
<tr>
<td><code>rpc_gss_set_defaults</code></td>
<td>(3NSL)</td>
<td>Switch service, QOP for a session</td>
</tr>
</tbody>
</table>
The `gsscred` utility manages the `gsscred` table, which contains mappings of principal names between network and local credentials. See `gsscred(1M)`.

**Files**
- `/etc/gss/mech` List of installed mechanisms
- `/etc/gss/qop` List of valid QOPs

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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**See Also**
- `gsscred(1M)`, `rpc(3NSL)`, `rpc_clnt_auth(3NSL)`, `xdr(3NSL)`, `attributes(5)`, `environ(5)`
- *ONC+ Developer's Guide*

Name  rpc_soc, authdes_create, authunix_create, authunix_create_default, callrpc, clnt_broadcast, clntraw_create, clnttcp_create, clntudp_bufcreate, clntudp_create, get_myaddress, getrpccport, pmap_getmaps, pmap_getport, pmap_rmtcall, pmap_set, pmap_unset, registerpc, svc_fds, svc_getcaller, svc_getreq, svc_register, svc_unregister, svcfd_create, svcraw_create, svctcp_create, svcudp_bufcreate, svcudp_create, xdr_authunix_parms – obsolete library routines for RPC

Synopsis  #define PORTMAP
#include <rpc/rpc.h>

AUTH *authdes_create(char *name, uint_t window,
    struct sockaddr_in *syncaddr, des_block *ckey);

AUTH *authunix_create(char *host, uid_t uid, gid_t gid,
    int grouplen, gid_t *gidlistp);

AUTH *authunix_create_default(void);

callrpc(char *host, rpcprog_t prognum, rpcvers_t versnum,
    rpcproc_t procnum, xdrproc_t inproc, char *in,
    xdrproc_t outproc, char *out);

enum clnt_stat clnt_broadcast(rpcprog_t prognum, rpcvers_t versnum,
    rpcproc_t procnum, xdrproc_t inproc, char *in,
    xdrproc_t outproc, char *out, resultproc_t eachresult);

CLIENT *clntraw_create(rpcproc_t procnum, rpcvers_t versnum);

CLIENT *clnttcp_create(struct sockaddr_in *addr,
    rpcprog_t prognum, rpcvers_t versnum, int *fdp,
    uint_t sendz, uint_t recvsz);

CLIENT *clntudp_bufcreate(struct sockaddr_in *addr, rpcprog_t prognum,
    rpcvers_t versnum, struct timeval wait,
    int *fdp, uint_t sendz, uint_t recvsz);

CLIENT *clntudp_create(struct sockaddr_in *addr,
    rpcprog_t prognum, struct timeval wait, int *fdp);

void get_myaddress(struct sockaddr_in *addr);

ushort getrpccport(char *host, rpcprog_t prognum,
    rpcvers_t versnum, rpcprot_t proto);

struct pmaplist *pmap_getmaps(struct sockaddr_in *addr);

ushort pmap_getport(struct sockaddr_in *addr,
    rpcprog_t prognum, rpcvers_t versnum,
    rpcprot_t protocol);

enum clnt_stat pmap_rmtcall(struct sockaddr_in *addr,
    rpcprog_t prognum, rpcvers_t versnum,
    rpcproc_t progcnum, caddr_t in, xdrproc_t inproc,
    caddr_t out, cdrproc_t outproc,
    struct timeval tout, rpcport_t *portp);
bool_t pmap_set(rpcprog_t prognum, rpcvers_t versnum, rpcprot_t protocol, u_short port);

bool_t pmap_unset(rpcprog_t prognum, rpcvers_t versnum);

int svc_fds;

struct sockaddr_in *svc_getcaller(SVCXPRT *xprt);

void svc_getreq(int rdfds);

SVCXPR *svcfd_create(int fd, uint_t sendsz, uint_t recvsz);

SVCXPR *svcraw_create(void)

SVCXPR *svtcp_create(int fd, uint_t sendsz, uint_t recvsz);

SVCXPR *svcudp_bufcreate(int fd, uint_t sendsz, uint_t recvsz);

SVCXPR *svcudp_create(int fd);

registerrpc(rpcprog_t prognum, rpcvers_t versnum, rpcproc_t procnum, char *(*procname)(), xdrproc_t inproc, xdrproc_t outproc);

bool_t svc_register(SVCXPRT *xprt, rpcprog_t prognum, rpcvers_t versnum,
                    void (*dispatch(), int protocol);

void svc_unregister(rpcprog_t prognum, rpcvers_t versnum);

bool_t xdr_authunix_parms(XDR *xdrs, struct authunix_parms *supp);

**Description**

RPC routines allow C programs to make procedure calls on other machines across the network. First, the client calls a procedure to send a request to the server. Upon receipt of the request, the server calls a dispatch routine to perform the requested service, and then sends back a reply. Finally, the procedure call returns to the client.

The routines described in this manual page have been superseded by other routines. The preferred routine is given after the description of the routine. New programs should use the preferred routines, as support for the older interfaces may be dropped in future releases.

**File Descriptors**

Transport independent RPC uses TLI as its transport interface instead of sockets.

Some of the routines described in this section (such as clnttcp_create()) take a pointer to a file descriptor as one of the parameters. If the user wants the file descriptor to be a socket, then the application will have to be linked with both librpcsoc and libnsl. If the user passed RPC_ANYSOCK as the file descriptor, and the application is linked with libnsl only, then the routine will return a TLI file descriptor and not a socket.
The following routines require that the header `<rpc/rpc.h>` be included. The symbol PORTMAP should be defined so that the appropriate function declarations for the old interfaces are included through the header files.

authdes_create() is the first of two routines which interface to the RPC secure authentication system, known as DES authentication. The second is authdes_getucred(), below. Note: the keyserver daemon `keyserv(1M)` must be running for the DES authentication system to work.

authdes_create(), used on the client side, returns an authentication handle that will enable the use of the secure authentication system. The first parameter `name` is the network name, or `netname`, of the owner of the server process. This field usually represents a hostname derived from the utility routine `host2netname()`, but could also represent a user name using `user2netname()`. See `secure_rpc(3NSL)`. The second field is window on the validity of the client credential, given in seconds. A small window is more secure than a large one, but choosing too small of a window will increase the frequency of resynchronizations because of clock drift. The third parameter `syncaddr` is optional. If it is NULL, then the authentication system will assume that the local clock is always in sync with the server’s clock, and will not attempt resynchronizations. If an address is supplied, however, then the system will use the address for consulting the remote time service whenever resynchronization is required. This parameter is usually the address of the RPC server itself. The final parameter `ckey` is also optional. If it is NULL, then the authentication system will generate a random DES key to be used for the encryption of credentials. If it is supplied, however, then it will be used instead.

This routine exists for backward compatibility only, and it is made obsolete by authdes_seccreate(). See `secure_rpc(3NSL)`.

authunix_create() Create and return an RPC authentication handle that contains UX authentication information. The parameter `host` is the name of the machine on which the information was created; `uid` is the user’s user ID; `gid` is the user’s
current group ID; grouplen and gidlistp refer to a counted array of groups to which the user belongs.

It is not very difficult to impersonate a user.

This routine exists for backward compatibility only, and it is made obsolete by authsys_create(). See rpc_clnt_auth(3NSL).

authunix_create_default() Call authunix_create() with the appropriate parameters.

This routine exists for backward compatibility only, and it is made obsolete by authsys_create_default(). See rpc_clnt_auth(3NSL).

callrpc() Call the remote procedure associated with prognum, versnum, and procnum on the machine, host. The parameter inproc is used to encode the procedure’s parameters, and outproc is used to decode the procedure’s results; in is the address of the procedure’s argument, and out is the address of where to place the result(s). This routine returns 0 if it succeeds, or the value of enum clnt_stat cast to an integer if it fails. The routine clnt_perrno() is handy for translating failure statuses into messages. See rpc_clnt_calls(3NSL).

You do not have control of timeouts or authentication using this routine. This routine exists for backward compatibility only, and is made obsolete by rpc_call(). See rpc_clnt_calls(3NSL).

clnt_stat_clnt_broadcast() Like callrpc(), except the call message is broadcast to all locally connected broadcast nets. Each time the caller receives a response, this routine calls eachresult(), whose form is:

eachresult(char *out, struct sockaddr_in *addr);

where out is the same as out passed to clnt_broadcast(), except that the remote procedure’s output is decoded there; addr points to the address of the machine that sent the results. If eachresult() returns 0, clnt_broadcast() waits for more replies; otherwise it returns with appropriate status. If eachresult() is NULL, clnt_broadcast() returns without waiting for any replies.
Broadcast packets are limited in size to the maximum transfer unit of the transports involved. For Ethernet, the callers argument size is approximately 1500 bytes. Since the call message is sent to all connected networks, it may potentially lead to broadcast storms. `cInf_broadca(lt()` uses SBAUTH_SYS credentials by default. See `rpc_cInf_auth(3NSL)`. This routine exists for backward compatibility only, and is made obsolete by `rpc_broadca(lt()`. See `rpc_cInf_calls(3NSL).

**cInfraw_create()**

This routine creates an internal, memory-based RPC client for the remote program `prognum`, version `versnum`. The transport used to pass messages to the service is actually a buffer within the process’s address space, so the corresponding RPC server should live in the same address space. See `svrcInfraw_create()`. This allows simulation of RPC and acquisition of RPC overheads, such as round trip times, without any kernel interference. This routine returns NULL if it fails.

This routine exists for backward compatibility only. It has the same functionality as `cInf_raw_create()`. See `rpc_cInf_create(3NSL)`, which obsoletes it.

**cInftcp_create()**

This routine creates an RPC client for the remote program `prognum`, version `versnum`; the client uses TCP/IP as a transport. The remote program is located at Internet address `addr`. If `addr->sin_port` is 0, then it is set to the actual port that the remote program is listening on. The remote `rpcbind` service is consulted for this information. The parameter `*fdp` is a file descriptor, which may be open and bound; if it is `RPC_ANYSOCK`, then this routine opens a new one and sets `*fdp`. Refer to the File Descriptor section for more information. Since TCP-based RPC uses buffered I/O, the user may specify the size of the send and receive buffers with the parameters `sendsz` and `recvsz`. Values of 0 choose suitable defaults. This routine returns NULL if it fails.

This routine exists for backward compatibility only. `cInf_create()`, `cInf_tli_create()`, or `cInf_vc_crea(lt)` should be used instead. See `rpc_cInf_create(3NSL).`
clntudp_bufcreate() Create a client handle for the remote program prognum, on versnum; the client uses UDP/IP as the transport. The remote program is located at the Internet address addr. If addr->sin_port is 0, it is set to port on which the remote program is listening on (the remote rpcbind service is consulted for this information). The parameter *fdp is a file descriptor, which may be open and bound. If it is RPC_ANYSOCK, then this routine opens a new one and sets *fdp. Refer to the File Descriptor section for more information. The UDP transport resends the call message in intervals of wait time until a response is received or until the call times out. The total time for the call to time out is specified by clnt_call(). See rpc_clnt_calls(3NSL). If successful it returns a client handle, otherwise it returns NULL. The error can be printed using the clnt_pcreateerror() routine. See rpc_clnt_create(3NSL).

The user can specify the maximum packet size for sending and receiving by using sendsz and recvsz arguments for UDP-based RPC messages.

If addr->sin_port is 0 and the requested version number versnum is not registered with the remote portmap service, it returns a handle if at least a version number for the given program number is registered. The version mismatch is discovered by a clnt_call() later (see rpc_clnt_calls(3NSL)).

This routine exists for backward compatibility only. clnt_tli_create() or clnt_dg_create() should be used instead. See rpc_clnt_create(3NSL).

clnudp_create() This routine creates an RPC client handle for the remote program prognum, version versnum; the client uses UDP/IP as a transport. The remote program is located at Internet address addr. If addr->sin_port is 0, then it is set to actual port that the remote program is listening on. The remote rpcbind service is consulted for this information. The parameter *fdp is a file descriptor, which may be open and bound; if it is RPC_ANYSOCK, then this routine opens a new one and sets *fdp. Refer to the File Descriptor section for more information. The UDP transport resends the call message in intervals of wait time until a response is received or until the call times out. The total time for
the call to time out is specified by clnt_call(). See 
`rpc_clnt_calls(3NSL).` clntudp_create() returns a 
client handle on success, otherwise it returns NULL. The 
error can be printed using the clnt_pcreateerror() 
routine. See `rpc_clnt_create(3NSL).`

Since UDP-based RPC messages can only hold up to 8 
Kbytes of encoded data, this transport cannot be used for 
procedures that take large arguments or return huge 
results.

This routine exists for backward compatibility only. 
clnt_create(), clnt_tli_create(), or 
clnt_dg_create() should be used instead. See 
`rpc_clnt_create(3NSL).`

get_myaddress() 
Places the local system's IP address into *addr, without 
consulting the library routines that deal with /etc/hosts. 
The port number is always set to htons(PMAPPORT).

This routine is only intended for use with the RPC library. 
It returns the local system's address in a form compatible 
with the RPC library, and should not be taken as the 
system's actual IP address. In fact, the *addr buffer's host 
address part is actually zeroed. This address may have 
only local significance and should not be assumed to be 
an address that can be used to connect to the local system 
by remote systems or processes.

This routine remains for backward compatibility only. 
The routine netdir_getbyname() should be used with 
the name HOST_SELF to retrieve the local system's network 
address as a netbuf structure. See `netdir(3NSL).`

getrpcport() 
getrpcport() returns the port number for the version 
`versnum of the RPC program prognum running on host` 
and using protocol `proto`. getrpcport() returns 0 if the 
RPC system failed to contact the remote portmap service, 
the program associated with `prognum` is not registered, or 
there is no mapping between the program and a port.

This routine exists for backward compatibility only. 
Enhanced functionality is provided by `rpcb_getaddr()`. 
See `rpcbind(3NSL).`
pmaplist()  
A user interface to the portmap service, which returns a list of the current RPC program-to-port mappings on the host located at IP address addr. This routine can return NULL. The command 'rpcinfo -p' uses this routine.

This routine exists for backward compatibility only, enhanced functionality is provided by rpcb_getmaps(). See rpcbind(3NSL).

pmap_getport()  
A user interface to the portmap service, which returns the port number on which waits a service that supports program prognum, version versnum, and speaks the transport protocol associated with protocol. The value of protocol is most likely IPPROTO_UDP or IPPROTO_TCP. A return value of 0 means that the mapping does not exist or that the RPC system failed to contact the remote portmap service. In the latter case, the global variable rpc_createerr contains the RPC status.

This routine exists for backward compatibility only, enhanced functionality is provided by rpcb_getaddr(). See rpcbind(3NSL).

pmap_rmtcall()  
Request that the portmap on the host at IP address *addr make an RPC on the behalf of the caller to a procedure on that host. *portp is modified to the program’s port number if the procedure succeeds. The definitions of other parameters are discussed in callrpc() and clnt_call(). See rpc_clnt_calls(3NSL).

This procedure is only available for the UDP transport.

If the requested remote procedure is not registered with the remote portmap then no error response is returned and the call times out. Also, no authentication is done.

This routine exists for backward compatibility only, enhanced functionality is provided by rpcb_rmtcall(). See rpcbind(3NSL).

pmap_set()  
A user interface to the portmap service, that establishes a mapping between the triple [prognum, versnum, protocol] and port on the machine’s portmap service. The value of protocol may be IPPROTO_UDP or IPPROTO_TCP. Formerly, the routine failed if the requested port was found to be in use. Now, the routine only fails if it finds that port is still
bound. If \textit{port} is not bound, the routine completes the requested registration. This routine returns 1 if it succeeds, 0 otherwise. Automatically done by \texttt{svc_register()}. This routine exists for backward compatibility only, enhanced functionality is provided by \texttt{rpcb_set()}. See \texttt{rpcbind(3NSL)}.

\textbf{pmap_unset()}

A user interface to the \texttt{portmap} service, which destroys all mapping between the triple \texttt{[prognum, versnum, all-protocols]} and \textit{port} on the machine's \texttt{portmap} service. This routine returns one if it succeeds, 0 otherwise. This routine exists for backward compatibility only, enhanced functionality is provided by \texttt{rpcb_unset()}. See \texttt{rpcbind(3NSL)}.

\textbf{svc_fds()}

A global variable reflecting the RPC service side's read file descriptor bit mask; it is suitable as a parameter to the \texttt{select()} call. This is only of interest if a service implementor does not call \texttt{svc_run()}, but rather does his own asynchronous event processing. This variable is read-only, yet it may change after calls to \texttt{svc_getreq()} or any creation routines. Do not pass its address to \texttt{select()}! Similar to \texttt{svc_fdset}, but limited to 32 descriptors.

This interface is made obsolete by \texttt{svc_fdset}. See \texttt{rpc_svc_calls(3NSL)}.

\textbf{svc_getcaller()}

This routine returns the network address, represented as a \texttt{struct sockaddr_in}, of the caller of a procedure associated with the RPC service transport handle, \textit{xprt}.

This routine exists for backward compatibility only, and is obsolete. The preferred interface is \texttt{svc_getrpccaller()}. See \texttt{rpc_svc_reg(3NSL)}, which returns the address as a \texttt{struct netbuf}.

\textbf{svc_getreq()}

This routine is only of interest if a service implementor does not call \texttt{svc_run()}, but instead implements custom asynchronous event processing. It is called when the \texttt{select()} call has determined that an RPC request has arrived on some RPC file descriptors; \texttt{rdfds} is the resultant read file descriptor bit mask. The routine returns when all
file descriptors associated with the value of rdfs have been serviced. This routine is similar to svc_getreqset() but is limited to 32 descriptors.

This interface is made obsolete by svc_getreqset()

svcfd_create()  
Create a service on top of any open and bound descriptor. Typically, this descriptor is a connected file descriptor for a stream protocol. Refer to the File Descriptor section for more information. sendsz and recvsz indicate sizes for the send and receive buffers. If they are 0, a reasonable default is chosen.

This interface is made obsolete by svc_fd_create() (see rpc_svc_create(3NSL)).

svcraw_create()  
This routine creates an internal, memory-based RPC service transport, to which it returns a pointer. The transport is really a buffer within the process’s address space, so the corresponding RPC client should live in the same address space; see clnt_raw_create(). This routine allows simulation of RPC and acquisition of RPC overheads (such as round trip times), without any kernel interference. This routine returns NULL if it fails.

This routine exists for backward compatibility only, and has the same functionality of svc_raw_create(). See rpc_svc_create(3NSL), which obsoletes it.

svctcp_create()  
This routine creates a TCP/IP-based RPC service transport, to which it returns a pointer. The transport is associated with the file descriptor fd, which may be RPC_ANYSOCK, in which case a new file descriptor is created. If the file descriptor is not bound to a local TCP port, then this routine binds it to an arbitrary port. Refer to the File Descriptor section for more information. Upon completion, xprt->xp_fd is the transport’s file descriptor, and xprt->xp_port is the transport’s port number. This routine returns NULL if it fails. Since TCP-based RPC uses buffered I/O, users may specify the size of buffers; values of 0 choose suitable defaults.

This routine exists for backward compatibility only. svc_create(), svc_tli_create(), or svc_vc_create() should be used instead. See rpc_svc_create(3NSL).
svcudp_bufcreate()  This routine creates a UDP/IP-based RPC service transport, to which it returns a pointer. The transport is associated with the file descriptor \textit{fd}. If \textit{fd} is \texttt{RPC\_ANYSOCK} then a new file descriptor is created. If the file descriptor is not bound to a local UDP port, then this routine binds it to an arbitrary port. Upon completion, \texttt{xprt->xp\_fd} is the transport's file descriptor, and \texttt{xprt->xp\_port} is the transport's port number. Refer to the File Descriptor section for more information. This routine returns NULL if it fails.

The user specifies the maximum packet size for sending and receiving UDP-based RPC messages by using the \texttt{sendsz} and \texttt{recvsz} parameters.

This routine exists for backward compatibility only. \texttt{svc\_tli\_create()}, or \texttt{svc\_dg\_create()} should be used instead. See \texttt{rpc\_svc\_create(3NSL)}.

svcudp_create()  This routine creates a UDP/IP-based RPC service transport, to which it returns a pointer. The transport is associated with the file descriptor \textit{fd}, which may be \texttt{RPC\_ANYSOCK}, in which case a new file descriptor is created. If the file descriptor is not bound to a local UDP port, then this routine binds it to an arbitrary port. Upon completion, \texttt{xprt->xp\_fd} is the transport's file descriptor, and \texttt{xprt->xp\_port} is the transport's port number. This routine returns NULL if it fails.

Since UDP-based RPC messages can only hold up to 8 Kbytes of encoded data, this transport cannot be used for procedures that take large arguments or return huge results.

This routine exists for backward compatibility only. \texttt{svc\_create()}, \texttt{svc\_tli\_create()}, or \texttt{svc\_dg\_create()} should be used instead. See \texttt{rpc\_svc\_create(3NSL)}.

registerrpc()  Register program \texttt{prognum}, procedure \texttt{procname}, and version \texttt{versnum} with the RPC service package. If a request arrives for program \texttt{prognum}, version \texttt{versnum}, and procedure \texttt{procnum}, \texttt{procname} is called with a pointer to its parameter(s). \texttt{procname} should return a pointer to its static result(s). \texttt{inproc} is used to decode the parameters.
while `outproc` is used to encode the results. This routine returns 0 if the registration succeeded, −1 otherwise.

`svc_run()` must be called after all the services are registered.

This routine exists for backward compatibility only, and it is made obsolete by `rpc_reg()`.

### svc_register()

Associates `prognum` and `versnum` with the service dispatch procedure, `dispatch`. If `protocol` is 0, the service is not registered with the `portmap` service. If `protocol` is non-zero, then a mapping of the triple `[prognum, versnum, protocol]` to `xprt->xp_port` is established with the local `portmap` service (generally `protocol` is 0, `IPPROTO_UDP` or `IPPROTO_TCP`). The procedure `dispatch` has the following form:

```
dispatch(struct svc_req *request, SVCXPRT *xprt);
```

The `svc_register()` routine returns one if it succeeds, and 0 otherwise.

This routine exists for backward compatibility only. Enhanced functionality is provided by `svc_reg()`.

### svc_unregister()

Remove all mapping of the double `[prognum, versnum]` to dispatch routines, and of the triple `[prognum, versnum, all-protocols]` to port number from `portmap`.

This routine exists for backward compatibility. Enhanced functionality is provided by `svc_unreg()`.

### xdr_authunix_parms()

Used for describing UNIX credentials. This routine is useful for users who wish to generate these credentials without using the RPC authentication package.

This routine exists for backward compatibility only, and is made obsolete by `xdr_authsys_parms()`. See `rpc_xdr(3NSL)`.

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>

Networking Library Functions 453
These interfaces are unsafe in multithreaded applications. Unsafe interfaces should be called only from the main thread.
rpc_svc_calls(3NSL)

### Name
rpc_svc_calls, svc_dg_enablecache, svc_done, svc_exit, svc_fdset, svc_freeargs, svc_getargs, svc_getreq_common, svc_getreq_poll, svc_getreqset, svc_getrpccaller, svc_max_pollfd, svc_pollfd, svc_run, svc_sendreply, svc_getcallerucred, svc_fd_negotiate_ucred – library routines for RPC servers

### Synopsis
```c
cc [ flag... ] file... -lnsl [ library...]
#include <rpc/rpc.h>

int svc_dg_enablecache(SVCXPRT *xprt, const uint_t cache_size);
int svc_done(SVCXPRT *xprt);
void svc_exit(void);
void svc_fd_negotiate_ucred(int fd);
bool_t svc_freeargs(const SVCXPRT *xprt, const txdrproc_t inproc,
                    caddr_t in);
bool_t svc_getargs(const SVCXPRT *xprt, const xdrproc_t inproc,
                   caddr_t in);
int svc_getcallerucred(const SVCXPRT *xprt, ucred_t **ucred);
void svc_getreq_common(const int fd);
void svc_getreqset(fd_set *rdfds);
void svc_getreq_poll(struct pollfd *pfdp, const int pollretval);
struct netbuf *svc_getrpccaller(const SVCXPRT *xprt);
void svc_run(void);
bool_t svc_sendreply(const SVCXPRT *xprt, const xdrproc_t outproc,
                     caddr_t outint svc_max_pollfd;
fd_set svc_fdset;
pollfd_t *svc_pollfd;
```

### Description
These routines are part of the RPC library which allows C language programs to make procedure calls on other machines across the network.

These routines are associated with the server side of the RPC mechanism. Some of them are called by the server side dispatch function. Others, such as `svc_run()`, are called when the server is initiated.

Because the service transport handle `SVCXPRT` contains a single data area for decoding arguments and encoding results, the structure cannot freely be shared between threads that call functions to decode arguments and encode results. When a server is operating in the Automatic or User MT modes, however, a copy of this structure is passed to the service dispatch procedure in order to enable concurrent request processing. Under these circumstances, some routines which would otherwise be Unsafe, become Safe. These are
marked as such. Also marked are routines that are Unsafe for multithreaded applications, and are not to be used by such applications. See `rpc(3NSL)` for the definition of the `SVCXPRT` data structure.

The `svc_dg_enablecache()` function allocates a duplicate request cache for the service endpoint `xprt`, large enough to hold `cache_size` entries. Once enabled, there is no way to disable caching. The function returns 1 if space necessary for a cache of the given size was successfully allocated, and 0 otherwise. This function is Safe in multithreaded applications.

The `svc_done()` function frees resources allocated to service a client request directed to the service endpoint `xprt`. This call pertains only to servers executing in the User MT mode. In the User MT mode, service procedures must invoke this call before returning, either after a client request has been serviced, or after an error or abnormal condition that prevents a reply from being sent. After `svc_done()` is invoked, the service endpoint `xprt` should not be referenced by the service procedure. Server multithreading modes and parameters can be set using the `rpc_control()` call. This function is Safe in multithreaded applications. It will have no effect if invoked in modes other than the User MT mode.

The `svc_exit()` function when called by any of the RPC server procedures or otherwise, destroys all services registered by the server and causes `svc_run()` to return. If RPC server activity is to be resumed, services must be reregistered with the RPC library either through one of the `rpc_svc_create(3NSL)` functions, or using `xprt_register(3NSL)`. The `svc_exit()` function has global scope and ends all RPC server activity.

The `svc_frearargs()` function macro frees any data allocated by the RPC/XDR system when it decoded the arguments to a service procedure using `svc_getargs()`. This routine returns `TRUE` if the results were successfully freed, and `FALSE` otherwise. This function macro is Safe in multithreaded applications utilizing the Automatic or User MT modes.

The `svc_getargs()` function macro decodes the arguments of an RPC request associated with the RPC service transport handle `xprt`. The parameter `in` is the address where the arguments will be placed; `inproc` is the XDR routine used to decode the arguments. This routine returns `TRUE` if decoding succeeds, and `FALSE` otherwise. This function macro is Safe in multithreaded applications utilizing the Automatic or User MT modes.

The `svc_getreq_common()` function is called to handle a request on a file descriptor.

The `svc_getreq_poll()` function is only of interest if a service implementor does not call `svc_run()`, but instead implements custom asynchronous event processing. It is called when `poll(2)` has determined that an RPC request has arrived on some RPC file descriptors; `pollretval` is the return value from `poll(2)` and `pfdp` is the array of `pollfd` structures on which the `poll(2)` was done. It is assumed to be an array large enough to contain the maximal number of descriptors allowed. The `svc_getreq_poll()` function macro is Unsafe in multithreaded applications.

The `svc_getreqset()` function is only of interest if a service implementor does not call `svc_run()`, but instead implements custom asynchronous event processing. It is called when
select(3C) has determined that an RPC request has arrived on some RPC file descriptors; 
rdfds is the resultant read file descriptor bit mask. The routine returns when all file descriptors 
associated with the value of rd fds have been serviced. This function macro is Unsafe in multithreaded applications.

The svc_getrpc caller() function is the approved way of getting the network address of the 
caller of a procedure associated with the RPC service transport handle xprt. This function 
macro is Safe in multithreaded applications.

The svc_run() function never returns. In single-threaded mode, the function waits for RPC 
requests to arrive. When an RPC request arrives, the svc_run() function calls the appropriate 
 service procedure. This procedure is usually waiting for the poll(2) library call to return.

Applications that execute in the Automatic or the User MT mode should invoke the 
svc_run() function exactly once. In the Automatic MT mode, the svc_run() function creates 
threads to service client requests. In the User MT mode, the function provides a framework 
for service developers to create and manage their own threads for servicing client requests.

The svc_fdset global variable reflects the RPC server’s read file descriptor bit mask. This is 
only of interest if service implementors do not call svc_run(), but rather do their own 
asynchronous event processing. This variable is read-only may change after calls to 
svc_getreqset() or after any creation routine. Do not pass its address to select(3C). 
Instead, pass the address of a copy. multithreaded applications executing in either the 
Automatic MT mode or the user MT mode should never read this variable. They should use 
 auxiliary threads to do asynchronous event processing. The svc_fdset variable is limited to 
1024 file descriptors and is considered obsolete. Use of svc_pollfd is recommended instead.

The svc_pollfd global variable points to an array of pollfd_t structures that reflect the RPC 
server’s read file descriptor array. This is only of interest if service implementors do not 
call svc_run() but rather do their own asynchronous event processing. This variable is 
read-only, and it may change after calls to svc_getreq_poll() or any creation routines. Do 
no pass its address to poll(2). Instead, pass the address of a copy. By default, svc_pollfd is 
limited to 1024 entries. Use rpc_control(3NSL) to remove this limitation. multithreaded 
applications executing in either the Automatic MT mode or the user MT mode should never 
be read this variable. They should use auxiliary threads to do asynchronous event processing.

The svc_max_pollfd global variable contains the maximum length of the svc_pollfd array. 
This variable is read-only, and it may change after calls to svc_getreq_poll() or any creation 
routines.

The svc_sendreply() function is called by an RPC service dispatch routine to send the results 
of a remote procedure call. The xprt parameter is the transport handle of the request. The 
outproc parameter is the XDR routine used to encode the results. The out parameter is the 
address of the results. This routine returns TRUE if it succeeds, FALSE otherwise. The 
svc_sendreply() function macro is Safe in multithreaded applications that use the 
Automatic or the User MT mode.
The `svc_fd_negotiate_ucred()` function is called by an RPC server to inform the underlying transport that the function wishes to receive ucreds for local calls, including those over IP transports.

The `svc_getcallerucred()` function attempts to retrieve the `ucred_t` associated with the caller. The function returns 0 when successful and -1 when not.

When successful, the `svc_getcallerucred()` function stores the pointer to a freshly allocated `ucred_t` in the memory location pointed to by the `ucred` argument if that memory location contains the null pointer. If the memory location is non-null, the function reuses the existing `ucred_t`. When `ucred` is no longer needed, a credential allocated by `svc_getcallerucred()` should be freed with `ucred_free(3C)`.

### Attributes

See attributes(5) for descriptions of attribute types and values.

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>See below.</td>
</tr>
</tbody>
</table>

The `svc_fd_negotiate_ucred()`, `svc_dg_enablecache()`, `svc_getrpccaller()`, and `svc_getcallerucred()` functions are Safe in multithreaded applications. The `svc_freeargs()`, `svc_getargs()`, and `svc_sendreply()` functions are Safe in multithreaded applications that use the Automatic or the User MT mode. The `svc_getreq_common()`, `svc_getreqset()`, and `svc_getreq_poll()` functions are Unsafe in multithreaded applications and should be called only from the main thread.

### See Also

`rpcgen(1)`, `poll(2)`, `getpeerucred(3C)`, `rpc(3NSL)`, `rpc_control(3NSL)`, `rpc_svc_create(3NSL)`, `rpc_svc_err(3NSL)`, `rpc_svc_reg(3NSL)`, `select(3C)`, `ucred_free(3C)`, `xprt_register(3NSL)`, attributes(5)
**Name**

rpc_svc_create, svc_control, svc_create, svc_destroy, svc_dg_create, svc_fd_create,
svc_raw_create, svc_tli_create, svc_tp_create, svc_vc_create, svc_door_create – server handle
creation routines

**Synopsis**

```
#include <rpc/rpc.h>

bool_t svc_control(SVCXPRT *svc, const uint_t req, void *info);
int svc_create(const void (*dispatch)const struct svc_req *,
    const SVCXPRT *, const rpcprog_t prognum, const rpcvers_t versnum,
    const char *nettype);
void svc_destroy(SVCXPRT *xprt);
SVCXPRT *svc_dg_create(const int fildes, const uint_t sendsz,
    const uint_t recvsz);
SVCXPRT *svc_fd_create(const int fildes, const uint_t sendsz,
    const uint_t recvsz);
SVCXPRT *svc_raw_create(void)
SVCXPRT *svc_tli_create(const int fildes, const struct netconfig *netconf,
    const struct t_bind *bind_addr, const uint_t sendsz,
    const uint_t recvsz);
SVCXPRT *svc_tp_create(const void (*dispatch)(const struct svc_req *,
    const SVCXPRT *), const rpcprog_t prognum, const rpcvers_t versnum,
    const struct netconfig *netconf);
SVCXPRT *svc_vc_create(const int fildes, const uint_t sendsz,
    const uint_t recvsz);
SVCXPRT *svc_door_create(void (*dispatch)(struct svc_req *,
    const struct svc_req *, SVCXPRT *),
   const rpcprog_t prognum, const rpcvers_t versnum,
   const uint_t sendsz);
```

**Description**

These routines are part of the RPC library which allows C language programs to make
procedure calls on servers across the network. These routines deal with the creation of service
handles. Once the handle is created, the server can be invoked by calling svc_run().

**Routines**

See **rpc(3NSL)** for the definition of the SVCXPRT data structure.

**svc_control()**

A function to change or retrieve information about a service object. *req* indicates the type
of operation and *info* is a pointer to the information. The supported values of *req*, their
argument types, and what they do are:

- **SVCGET_VERSQUIET**
  If a request is received for a program number served by this server but the version
  number is outside the range registered with the server, an **RPC_PROGVERSMISMATCH** error
  will normally be returned. *info* should be a pointer to an integer. Upon successful
  completion of the SVCGET_VERSQUIET request, *info* contains an integer which describes
the server’s current behavior: 0 indicates normal server behavior, that is, an
RPC_PROGVERSMISMATCH error will be returned. 1 indicates that the out of range request
will be silently ignored.

**SVCSET_VERSQUIET**
If a request is received for a program number served by this server but the version
number is outside the range registered with the server, an RPC_PROGVERSMISMATCH error
will normally be returned. It is sometimes desirable to change this behavior. *info should
be a pointer to an integer which is either 0, indicating normal server behavior and an
RPC_PROGVERSMISMATCH error will be returned, or 1, indicating that the out of range
request should be silently ignored.

**SVCGET_XID**
Returns the transaction ID of connection—oriented and connectionless transport
service calls. The transaction ID assists in uniquely identifying client requests for a given
RPC version, program number, procedure, and client. The transaction ID is extracted
from the service transport handle *svc*. *info must be a pointer to an unsigned long. Upon
successful completion of the SVCGET_XID request, *info contains the transaction ID.
Note that rendezvous and raw service handles do not define a transaction ID. Thus, if
the service handle is of rendezvous or raw type, and the request is of type SVCGET_XID, svc_control() will return FALSE. Note also that the transaction ID read by the server
can be set by the client through the suboption CLSET_XID in clnt_control(). See clnt_create(3NSL)

**SVCSET_RECVERRHANDLER**
Attaches or detaches a disconnection handler to the service handle, *svc, that will be
called when a transport error arrives during the reception of a request or when the
server is waiting for a request and the connection shuts down. This handler is only
useful for a connection oriented service handle.

*info contains the address of the error handler to attach, or NULL to detach a previously
defined one. The error handler has two arguments. It has a pointer to the erroneous
service handle. It also has an integer that indicates if the full service is closed (when equal
to zero), or that only one connection on this service is closed (when not equal to zero).

```c
void handler (const SVCXPRT *svc, const bool_t isAConnection);
```

With the service handle address, *svc, the error handler is able to detect which
connection has failed and to begin an error recovery process. The error handler can be
called by multiple threads and should be implemented in an MT-safe way.

**SVCGET_RECVERRHANDLER**
Upon successful completion of the SVCGET_RECVERRHANDLER request, *info contains the
address of the handler for receiving errors. Upon failure, *info contains NULL.
SVCSET_CONNMAXREC
Set the maximum record size (in bytes) and enable non-blocking mode for this service handle. Value can be set and read for both connection and non-connection oriented transports, but is silently ignored for the non-connection oriented case. The info argument should be a pointer to an int.

SVCGET_CONNMAXREC
Get the maximum record size for this service handle. Zero means no maximum in effect and the connection is in blocking mode. The result is not significant for non-connection oriented transports. The info argument should be a pointer to an int.

This routine returns TRUE if the operation was successful. Otherwise, it returns false.

svc_create()
svc_create() creates server handles for all the transports belonging to the class nettype.

nettype defines a class of transports which can be used for a particular application. The transports are tried in left to right order in NETPATH variable or in top to bottom order in the netconfig database. If nettype is NULL , it defaults to netpath.

svc_create() registers itself with the rpcbind service (see rpcbind(1M)). dispatch is called when there is a remote procedure call for the given prognum and versnum; this requires calling svc_run() (see svc_run() in rpc_svc_reg(3NSL)). If svc_create() succeeds, it returns the number of server handles it created, otherwise it returns 0 and an error message is logged.

svc_destroy()
A function macro that destroys the RPC service handle xprt. Destruction usually involves deallocation of private data structures, including xprt itself. Use of xprt is undefined after calling this routine.

svc_dg_create()
This routine creates a connectionless RPC service handle, and returns a pointer to it. This routine returns NULL if it fails, and an error message is logged. sendsz and recvsz are parameters used to specify the size of the buffers. If they are 0, suitable defaults are chosen. The file descriptor fildes should be open and bound. The server is not registered with rpcbind(1M).

Warning: since connectionless-based RPC messages can only hold limited amount of encoded data, this transport cannot be used for procedures that take large arguments or return huge results.

svc_fd_create()
This routine creates a service on top of an open and bound file descriptor, and returns the handle to it. Typically, this descriptor is a connected file descriptor for a connection-oriented transport. sendsz and recvsz indicate sizes for the send and receive buffers. If they are 0, reasonable defaults are chosen. This routine returns NULL if it fails, and an error message is logged.
svc_raw_create()

This routine creates an RPC service handle and returns a pointer to it. The transport is really a buffer within the process's address space, so the corresponding RPC client should live in the same address space; (see clnt_raw_create() in rpc_clnt_create(3NSL)). This routine allows simulation of RPC and acquisition of RPC overheads (such as round trip times), without any kernel and networking interference. This routine returns NULL if it fails, and an error message is logged.

Note: svc_run() should not be called when the raw interface is being used.

svc_tli_create()

This routine creates an RPC server handle, and returns a pointer to it. fildes is the file descriptor on which the service is listening. If fildes is RPC_ANYFD, it opens a file descriptor on the transport specified by netconf. If the file descriptor is unbound and bindaddr is non-null fildes is bound to the address specified by bindaddr, otherwise fildes is bound to a default address chosen by the transport. In the case where the default address is chosen, the number of outstanding connect requests is set to 8 for connection-oriented transports. The user may specify the size of the send and receive buffers with the parameters sendsz and recvsz; values of 0 choose suitable defaults. This routine returns NULL if it fails, and an error message is logged. The server is not registered with the rpcbind(1M) service.

svc_tp_create()

svc_tp_create() creates a server handle for the network specified by netconf, and registers itself with the rpcbind service. dispatch is called when there is a remote procedure call for the given prognum and versnum; this requires calling svc_run(). svc_tp_create() returns the service handle if it succeeds, otherwise a NULL is returned and an error message is logged.

svc_vc_create()

This routine creates a connection-oriented RPC service and returns a pointer to it. This routine returns NULL if it fails, and an error message is logged. The users may specify the size of the send and receive buffers with the parameters sendsz and recvsz; values of 0 choose suitable defaults. The file descriptor fildes should be open and bound. The server is not registered with the rpcbind(1M) service.

svc_door_create()

This routine creates an RPC server handle over doors and returns a pointer to it. Doors is a transport mechanism that facilitates fast data transfer between processes on the same machine. for the given program The user may set the size of the send buffer with the parameter sendsz. If sendsz is 0, the corresponding default buffer size is 16 Kbyte. If successful, the svc_door_create() routine returns the service handle. Otherwise it returns NULL and sets a value for rpc_createerr. The server is not registered with rpcbind(1M). The SVCSET_CONNMAXREC and SVCGET_CONNMAXREC svc_control() requests can be used to set and change the maximum allowed request size for the doors transport.
Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
<td>All</td>
</tr>
<tr>
<td>Availability</td>
<td>system/library</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also rpcbind(1M), rpc(3NSL), rpc_clnt_create(3NSL), rpc_svc_calls(3NSL), rpc_svc_err(3NSL), rpc_svc_reg(3NSL), attributes(5)
These routines are part of the RPC library which allows C language programs to make procedure calls on other machines across the network. These routines can be called by the server side dispatch function if there is any error in the transaction with the client.

See `rpc(3NSL)` for the definition of the `SVCPRT` data structure.

```c
#include <rpc/rpc.h>

void svcerr_auth(const SVCXPRT* xprt, const enum auth_stat why);
    Called by a service dispatch routine that refuses to perform a remote procedure call due to an authentication error.

void svcerr_decode(const SVCXPRT* xprt);
    Called by a service dispatch routine that cannot successfully decode the remote parameters (see `svc_getargs()` in `rpc_svc_reg(3NSL)`).

void svcerr_noproc(const SVCXPRT* xprt);
    Called by a service dispatch routine that does not implement the procedure number that the caller requests.

void svcerr_noprog(const SVCXPRT* xprt);
    Called when the desired program is not registered with the RPC package. Service implementors usually do not need this routine.

void svcerr_progvers(const SVCXPRT* xprt, const rpcvers_t low_vers, const rpcvers_t high_vers);
    Called when the desired version of a program is not registered with the RPC package. `low_vers` is the lowest version number, and `high_vers` is the highest version number. Service implementors usually do not need this routine.

void svcerr_systemerr(const SVCXPRT* xprt);
    Called by a service dispatch routine when it detects a system error not covered by any particular protocol. For example, if a service can no longer allocate storage, it may call this routine.

void svcerr_weakauth(const SVCXPRT* xprt);
    Called by a service dispatch routine that refuses to perform a remote procedure call due to insufficient (but correct) authentication parameters. The routine calls `svcerr_auth(xprt, AUTH_TOO_WEAK)`.

Attributes See `attributes(5)` for descriptions of the following attributes:
### rpc_svc_err(3NSL)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**  
`rpc(3NSL), rpc_svc_calls(3NSL), rpc_svc_create(3NSL), rpc_svc_reg(3NSL), attributes(5)`
rpc_svc_input, svc_add_input, svc_remove_input – declare or remove a callback on a file descriptor

Synopsis

```c
#include <rpc/rpc.h>

typedef void (*svc_callback_t)(svc_input_id_t id, int fd,
   unsigned int events, void *cookie);

typedef void (*svc_callback_t)(svc_input_id_t id, int fd,
   unsigned int events, void *cookie);

svc_input_id_t svc_add_input(int fd, unsigned int events,
   svc_callback_t callback, void *cookie);

int svc_remove_input(svc_input_id id);
```

Description

The following RPC routines are used to declare or remove a callback on a file descriptor.

`svc_add_input()` This function is used to register a callback function on a file descriptor, `fd`. The file descriptor, `fd`, is the first parameter to be passed to `svc_add_input()`. This callback function will be automatically called if any of the events specified in the `events` parameter occur on this descriptor. The `events` parameter is used to specify when the callback is invoked. This parameter is a mask of poll events to which the user wants to listen. See `poll(2)` for further details of the events that can be specified.

The callback to be invoked is specified using the `callback` parameter. The `cookie` parameter can be used to pass any data to the `callback` function. This parameter is a user-defined value which is passed as an argument to the `callback` function, and it is not used by the Sun RPC library itself.

Several callbacks can be registered on the same file descriptor as long as each callback registration specifies a separate set of event flags.

The `callback` function is called with the registration `id`, the `fd` file descriptor, an `events` value, which is a bitmask of all events concerning the file descriptor, and the `cookie` user-defined value.

Upon successful completion, the function returns a unique identifier for this registration, that can be used later to remove this callback. Upon failure, `-1` is returned and `errno` is set to indicate the error.

The `svc_add_input()` function will fail if:

- EINVAL The `fd` or `events` parameters are invalid.
EEXIST A callback is already registered to the file descriptor with one of the specified events.

ENOMEM Memory is exhausted.

svc_remove_input() This function is used to unregister a callback function on a file descriptor, \( fd \). The \( id \) parameter specifies the registration to be removed.

Upon successful completion, the function returns zero. Upon failure, -1 is returned and \( errno \) is set to indicate the error.

The \( svc\_remove\_input() \) function will fail if:

EINVAL The \( id \) parameter is invalid.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Architecture</td>
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</tr>
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</tr>
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<td>MT-Level</td>
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</tbody>
</table>

See Also poll(2), rpc(3NSL), attributes(5)
### Name
rpc_svc_reg, rpc_reg, svc_reg, svc_unreg, svc_auth_reg, xprt_register, xprt_unregister – library routines for registering servers

### Description
These routines are a part of the RPC library which allows the RPC servers to register themselves with `rpcbind()` (see `rpcbind(1M)`), and associate the given program and version number with the dispatch function. When the RPC server receives a RPC request, the library invokes the dispatch routine with the appropriate arguments.

### Routines
See `rpc(3NSL)` for the definition of the SVCXPRT data structure.

```c
#include <rpc/rpc.h>

bool_t rpc_reg(const rpcprog_t prognum, const rpcvers_t versnum, const rpcproc_t procnun,
               char * procnuname, const xdrproc_t inproc, const xdrproc_t outproc, const char * nettype);

int svc_reg(const SVCXPRT *xprt, const rpcprog_t prognum, const rpcvers_t versnum, const
            void (*dispatch)( ), const struct netconfig *netconf);

int svc_auth_reg(const int cred_flavor, const enum auth_stat (*handler)());
```

The `svc_reg()` routine returns 1 if it succeeds, and 0 otherwise.

```c
void svc_unreg(const rpcprog_t prognum, const rpcvers_t versnum);
```

Remove from the `rpcbind` service, all mappings of the triple `[prognum, versnum, all-transports]` to network address and all mappings within the RPC service package of the double `[prognum, versnum]` to dispatch routines.

```c
int svc_auth_reg(const int cred_flavor, const enum auth_stat (*handler)());
```

Registers the service authentication routine `handler` with the dispatch mechanism so that it can be invoked to authenticate RPC requests received with authentication type `cred_flavor`. This interface allows developers to add new authentication types to their RPC applications without needing to modify the libraries. Service implementors usually do not need this routine.

Typical service application would call `svc_auth_reg()` after registering the service and prior to calling `svc_run()`. When needed to process an RPC credential of type `cred_flavor`, the `handler` procedure will be called with two parameters `(struct svc_req *rqst, struct...`
The `svc_auth_reg()` routine returns 0 if the registration is successful, 1 if `cred_flavor` already has an authentication handler registered for it, and −1 otherwise.

```c
void xprt_register(const SVCXPRT *xprt);
```

After RPC service transport handle `xprt` is created, it is registered with the RPC service package. This routine modifies the global variable `svc_fdset` (see `rpc_svc_calls(3NSL)`). Service implementors usually do not need this routine.

```c
void xprt_unregister(const SVCXPRT *xprt);
```

Before an RPC service transport handle `xprt` is destroyed, it unregisters itself with the RPC service package. This routine modifies the global variable `svc_fdset` (see `rpc_svc_calls(3NSL)`). Service implementors usually do not need this routine.

### Attributes

See `attributes(5)` for descriptions of the following attributes:

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</table>

### See Also

`inetd(1M)`, `rpcbind(1M)`, `rpc(3NSL)`, `rpc_svc_calls(3NSL)`, `rpc_svc_create(3NSL)`, `rpc_svc_err(3NSL)`, `rpcbind(3NSL)`, `select(3C)`, `attributes(5)`
Name  rpc_xdr, xdr_accepted_reply, xdr_authsys_parms, xdr_callhdr, xdr_callmsg, 
xdr_opaque_auth, xdr_rejected_reply, xdr_replymsg – XDR library routines for remote 
procedure calls

Synopsis  bool_t xdr_accepted_reply(XDR *xdrs, const struct accepted_reply *ar);
=bool_t xdr_authsys_parms(XDR *xdrs, struct authsys_parms *aupp);
= void xdr_callhdr(XDR *xdrs, struct rpc_msg *chdr);
= bool_t xdr_callmsg(XDR *xdrs, struct rpc_msg *cmsg);
= bool_t xdr_opaque_auth(XDR *xdrs, struct opaque_auth *ap);
= bool_t xdr_rejected_reply(XDR *xdrs, const struct rejected_reply *rr);
= bool_t xdr_replymsg(XDR *xdrs, const struct rpc_msg *rmsg);

Description  These routines are used for describing the RPC messages in XDR language. They should 
normally be used by those who do not want to use the RPC package directly. These routines 
return TRUE if they succeed, FALSE otherwise.

Routines  See rpc(3NSL) for the definition of the XDR data structure.

#include <rpc/rpc.h>

xdr_accepted_reply()  Used to translate between RPC reply messages and their external 
representation. It includes the status of the RPC call in the XDR 
language format. In the case of success, it also includes the call 
results.

xdr_authsys_parms()  Used for describing UNIX operating system credentials. It 
includes machine-name, uid, gid list, etc.

xdr_callhdr()  Used for describing RPC call header messages. It encodes the 
static part of the call message header in the XDR language 
format. It includes information such as transaction ID, RPC 
version number, program and version number.

xdr_callmsg()  Used for describing RPC call messages. This includes all the RPC 
call information such as transaction ID, RPC version number, 
program number, version number, authentication information, 
etc. This is normally used by servers to determine information 
about the client RPC call.

xdr_opaque_auth()  Used for describing RPC opaque authentication information 
messages.

xdr_rejected_reply()  Used for describing RPC reply messages. It encodes the rejected 
RPC message in the XDR language format. The message could be 
rejected either because of version number mis-match or because 
of authentication errors.
xdr_repymsg()  Used for describing RPC reply messages. It translates between the RPC reply message and its external representation. This reply could be either an acceptance, rejection or NULL.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
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<th>ATTRIBUTE TYPE</th>
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</tr>
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<tr>
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</tr>
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</table>

See Also  rpc(3NSL), xdr(3NSL), attributes(5)
Name  rstat, havedisk – get performance data from remote kernel

Synopsis  cc [ flag ... ] file ... -lrpcsVC [ library ... ]
include <rpc/rpc.h>
#include <rpcsvc/rstat.h>

enum clnt_stat rstat(char *host, struct statstime *statp);
int havedisk(char *host);

Protocol  /usr/include/rpcsVC/rstat.x

Description  These routines require that the rpc.rstatd(1M) daemon be configured and available on the remote system indicated by host. The rstat() protocol is used to gather statistics from remote kernel. Statistics will be available on items such as paging, swapping, and cpu utilization.

rstat() fills in the statstime structure statp for host. statp must point to an allocated statstime structure. rstat() returns RPC_SUCCESS if it was successful; otherwise a enum clnt_stat is returned which can be displayed using clnt_perrno(3NSL).

havedisk() returns 1 if host has disk, 0 if it does not, and -1 if this cannot be determined.

The following XDR routines are available in librpcsvc:
xdr_statstime
xdr_statsvar

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
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</tbody>
</table>

See Also  rup(1), rpc.rstatd(1M), rpc_clnt_calls(3NSL), attributes(5)
rusers(3RPC)

**Name**  rusers, rnusers – return information about users on remote machines

**Synopsis**  
```
cc [ flag ... ] file ... -lrpcsvc [ library ... ]
#include <rpc/rpc.h>
#include <rpcsvc/rusers.h>

enum clnt_stat rusers(char *host, struct utmpidlearr *up);
int rnusers(char *host);
```

**Protocol**  
```
/usr/include/rpcsvc/rusers.x
```

**Description**  These routines require that the `rpc.rusersd(1M)` daemon be configured and available on the remote system indicated by `host`. The `rusers()` protocol is used to retrieve information about users logged in on the remote system.

`rusers()` fills the `utmpidlearr` structure with data about `host`, and returns 0 if successful. `up` must point to an allocated `utmpidlearr` structure. If `rusers()` returns successful it will have allocated data structures within the `up` structure, which should be freed with `xdr_free(3NSL)` when you no longer need them:

```
xdr_free(xdr_utmpidlearr, up);
```

On error, the returned value can be interpreted as an `enum clnt_stat` and can be displayed with `clnt_perror(3NSL)` or `clnt_sperrno(3NSL).

See the header `<rpcsvc/rusers.h>` for a definition of struct `utmpidlearr`.

`rnusers()` returns the number of users logged on to `host` (−1 if it cannot determine that number).

The following XDR routines are available in `librpcsvc`:
```
xdr_utmpidlearr
```

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
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</table>

**See Also**  `rusers(1), rpc.rusersd(1M), rpc_clnt_calls(3NSL), xdr_free(3NSL), attributes(5)`
Name  rwall – write to specified remote machines

Synopsis  
cc [ flag ... ] file ... -lrpcsvc [ library ... ]
#include <rpc/rpc.h>
#include <rpcsvc/rwall.h>

    enum clnt_stat rwall(char *host, char *msg);

Protocol  /usr/include/rpcsvc/rwall.x

Description  These routines require that the rpc.rwalld(1M) daemon be configured and available on the remote system indicated by host.

    rwall() executes wall(1M) on host. The rpc.rwalld process on host prints msg to all users logged on to that system. rwall() returns RPC_SUCCESS if it was successful; otherwise a enum clnt_stat is returned which can be displayed using clnt_perror(3NSL).

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tbody>
</table>

See Also  rpc.rwalld(1M), wall(1M), rpc_clnt_calls(3NSL), attributes(5)
sasl_authorize_t—the SASL authorization callback

Synopsis

cc { flag ... } file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_authorize_t(sasl_conn_t *conn, const char *requested_user,
                    unsigned alen, const char *auth_identity, unsigned rlen,
                    const char *def_realm, unsigned urlen, struct propctx *propctx);

Description

sasl_authorize_t() is a typedef function prototype that defines the interface associated with
the SASL_CB_PROXY_POLICY callback.

Use the sasl_authorize_t() interface to check whether the authorized user auth_identity
can act as the user requested_user. For example, the user root may want to authenticate with
root’s credentials but as the user tmartin, with all of tmartin’s rights, not root’s. A server
application should be very careful when it determines which users may proxy as other users.

Parameters

conn The SASL connection context.
requested_user The identity or username to authorize. requested_user is null-terminated.
rlen The length of requested_user.
auth_identity The identity associated with the secret. auth_identity is null-terminated.
alen The length of auth_identity.
default_realm The default user realm as passed to sasl_server_new(3SASL).
urlen The length of the default realm
propctx Auxiliary properties

Return Values

Like other SASL callback functions, sasl_authorize_t() returns an integer that corresponds
to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors

SASL_OK The call to sasl_authorize_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes

See attributes(5) for information on the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/libsasl</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT–Safe</td>
</tr>
</tbody>
</table>
See Also  sasl_errors(3SASL), sasl_server_new(3SASL), attributes(5)
The SASL auxiliary properties are used to obtain properties from external sources during the authentication process. For example, a mechanism might need to query an LDAP server to obtain the authentication secret. The application probably needs other information from the LDAP server as well, such as the home directory of the UID. The auxiliary property interface allows the two to cooperate and results in only a single query against the property sources.

Property lookups take place directly after user canonicalization occurs. Therefore, all request should be registered with the context before user canonicalization occurs. Requests can also be registered by using the `sasl_auxprop_request(3SASL)` function. Most of the auxiliary property functions require a property context that can be obtained by calling `sasl_auxprop_getctx(3SASL)`.

**prop_new()**  
The `prop_new()` function creates a new property context. It is unlikely that application developers will use this call.

**prop_dup()**  
The `prop_dup()` function duplicates a given property context.

**prop_request()**  
The `prop_request()` function adds properties to the request list of a given context.
The `prop_get()` function returns a null-terminated array of `struct propval` from the given context.

The `prop_getnames()` function fills in an array of `struct propval` based on a list of property names. The `vals` array is at least as long as the `names` array. The values that are filled in by this call persist until the next call on the context to `prop_request()`, `prop_clear()`, or `prop_dispose()`. If a name specified was never requested, then its associated values entry will be set to `NULL`.

The `prop_getnames()` function returns the number of matching properties that were found or a SASL error code.

The `prop_clear()` function clears values and requests from a property context. If the value of `requests` is 1, then `requests` is cleared. Otherwise, the value of `requests` is 0.

The `prop_erase()` function securely erases the value of a property. `name` is the name of the property to erase.

The `prop_dispose()` function disposes of a property context and nullifies the pointer.

The `prop_format()` function formats the requested property names into a string. The `prop_format()` function is not intended to be used by the application. The function is used only by auxprop plug-ins.

The `prop_set()` function adds a property value to the context. The `prop_set()` function is used only by auxprop plug-ins.

The `prop_setvals()` function adds multiple values to a single property. The `prop_setvals()` function is used only by auxprop plug-ins.

**Parameters**

- `conn` The `sasl_conn_t` for which the request is being made
- `ctx` The property context.
- `estimate` The estimate of the total storage needed for requests and responses. The library default is implied by a value of 0.
- `names` The null-terminated array of property names. `names` must persist until the requests are cleared or the context is disposed of with a call to `prop_dispose()`.
- `name` The name of the property.
  For `prop_set()`, `name` is the named of the property to receive the new value, or `NULL`. The value will be added to the same property as the last call to either `prop_set()` or `prop_setvals()`.
- `outbuf` The caller-allocated buffer of length `outmax` that the resulting string, including the `NULL` terminator, will be placed in.
- `outlen` If non-`NULL`, contains the length of the resulting sting, excluding the `NULL` terminator.
**outmax**  The maximum length of the output buffer, including the NULL terminator.

**requests**  The request list for a given context.

**sep**  The separator to use for the string.

**seplen**  The length of the separator. The the values is less than 0, then strlen will be used as sep.

**vallen**  The length of the property.

**vals**  The value string.

**value**  A value for the property of length vallen.

**values**  A null-terminated array of values to be added to the property.

**Errors**  The sasl_auxprop() functions that return an int will return a SASL error code. See sasl_errors(3SASL). Those sasl_auxprop() functions that return a pointer will return a valid pointer upon success and return NULL upon failure.

**Attributes**  See attributes(5) for descriptions of the following attributes:

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**See Also**  sasl_auxprop_getctx(3SASL), sasl_auxprop_request(3SASL), sasl_errors(3SASL), attributes(5)
sasl_auxprop_add_plugin(3SASL)

Name  sasl_auxprop_add_plugin – add a SASL auxiliary property plug-in

Synopsis  
```
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/saslplug.h>
```

```
int sasl_auxprop_add_plugin(const char *plugname,
   sasl_auxprop_plug_init_t *cplugfunc);
```

Description  Use the sasl_auxprop_add_plugin() interface to add a auxiliary property plug-in to the current list of auxiliary property plug-ins in the SASL library.

Parameters  
- **plugname**  The name of the auxiliary property plug-in.
- **cplugfunc**  The value of cplugfunc is filled in by the sasl_auxprop_plug_init_t structure.

Return Values  sasl_auxprop_add_plugin() returns an integer that corresponds to a SASL error code.

Errors  
- **SASL_OK**  The call to sasl_client_add_plugin() was successful.
- **SASL_BADVERS**  Version mismatch with plug-in.
- **SASL_NOMEM**  Memory shortage failure.

See also  sasl_errors(3SASL) for information on other SASL error codes.

Attributes  See attributes(5) for descriptions of the following attributes:

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</tbody>
</table>

See Also  sasl_errors(3SASL), attributes(5)
sasl_auxprop_getctx – acquire an auxiliary property context

Synopsis

cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

struct propctx *sasl_auxprop_getctx(sasl_conn_t *conn);

Description

The sasl_auxprop_getctx() interface returns an auxiliary property context for the given sasl_conn_t on which the sasl auxiliary property functions can operate. See sasl_auxprop(3SASL).

Parameters

conn The sasl_conn_t for which the request is being made

Return Values

sasl_auxprop_getctx() returns a pointer to the context, upon success. sasl_auxprop_getctx() returns NULL upon failure.

Attributes

See attributes(5) for descriptions of the following attributes:

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</table>

See Also

attributes(5)
Name  sasl_auxprop_request – request auxiliary properties from SASL

Synopsis  cc [ flag ... ] file ... -lsasl  [ library ... ]
#include <sasl/sasl.h>

int sasl_auxprop_request(sasl_conn_t *conn, const char **propnames);

Description  The sasl_auxprop_request() interface requests that the SASL library obtain properties from any auxiliary property plugins that might be installed, for example, the user’s home directory from an LDAP server. The lookup occurs just after username canonicalization is complete. Therefore, the request should be made before the call to sasl_server_start(3SASL), but after the call to sasl_server_new(3SASL).

Parameters  
- **conn**  The sasl_conn_t for which the request is being made
- **propnames**  A null-terminated array of property names to request. This array must persist until a call to sasl_dispose(3SASL) on the sasl_conn_t.

Errors  sasl_auxprop_request() returns SASL_OK upon success. See sasl_errors(3SASL) for a discussion of other SASL error codes.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/libsasl</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  sasl_dispose(3SASL), sasl_errors(3SASL), sasl_server_new(3SASL), sasl_server_start(3SASL), attributes(5)
Name  sasl_canonuser_add_plugin – add a SASL user canonicalization plug-in

Synopsis  
```
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/saslplug.h>
```

```c
int sasl_canonuser_add_plugin(const char *plugname,
        sasl_canonuser_plug_init_t *cplugfunc);
```

Description  Use the `sasl_canonuser_add_plugin()` interface to add a user canonicalization plug-in to the current list of user canonicalization plug-ins in the SASL library.

Parameters  
- `plugname`  The name of the user canonicalization plug-in.
- `cplugfunc`  The value of `cplugfunc` is filled in by the `sasl_canonuser_plug_init_t` structure.

Return Values  `sasl_server_add_plugin()` returns an integer that corresponds to a SASL error code.

Errors  
- `SASL_OK`  The call to `sasl_client_add_plugin()` was successful.
- `SASL_BADVERS`  Version mismatch with plug-in.
- `SASL_NOMEM`  Memory shortage failure.

See also `sasl_errors(3SASL)` for information on other SASL error codes.

Attributes  See `attributes(5)` for descriptions of the following attributes:

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</thead>
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<tr>
<td>Availability</td>
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<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT–Safe</td>
</tr>
</tbody>
</table>

See Also  `sasl_errors(3SASL)`, `attributes(5)`
sasl_canon_user_t (3SASL)

Name
sasl_canon_user_t – the canon user callback

Synopsis
cc [ flag ... ] file ... -lsasl  [ library ... ]
#include <sasl/sasl.h>

int sasl_canon_user_t (sasl_conn_t *conn, void *context, const char *user,
unsigned ulen, unsigned flags, const char *user_realm, char *out_user,
unsigned *out_umax, unsigned *out_ulen);

Description
The sasl_canon_user_t() interface is the callback function for an application-supplied user canonical function. This function is subject to the requirements of all canonical functions. It must copy the result into the output buffers, but the output buffers and the input buffers can be the same.

Parameters
conn  The SASL connection context.
context  The context from the callback record.
user  Username. The form of user is not canonical.
ulen  Length of user. The form of ulen is not canonical.
flags  One of the following values, or a bitwise OR of both:
SASL_CU_AUTHID  Indicates the authentication ID is canonical
SASL_CU_AUTHZID  Indicates the authorization ID is canonical
user_realm  Realm of authentication.
out_user  The output buffer for the user name.
out_max  The maximum length for the user name.
out_len  The actual length for the user name.

Return Values
Like other SASL callback functions, sasl_canon_user_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors
SASL_OK  The call to sasl_canon_user_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
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<td>Committed</td>
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<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>
See Also  

`sasl_errors(3SASL), sasl_server_new(3SASL), attributes(5)`
Name  sasl_chalprompt_t – prompt for input in response to a challenge

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]
          #include <sasl/sasl.h>
          int sasl_chalprompt_t(void *context, int id, const char *challenge,
                           const char *prompt, const char *defresult, const char **result,
                           unsigned *len);

Description Use the sasl_chalprompt_t() callback interface to prompt for input in response to a server challenge.

Parameters  context The context from the callback record.
  id The callback id. id can have a value of SASL_CB_ECHOPROMPT or SASL_CB_NOECHOPROMPT
  challenge The server’s challenge.
  prompt A prompt for the user.
  defresult The default result. The value of defresult can be NULL
  result The user’s response. result is a null-terminated string.
  len The length of the user’s response.

Return Values Like other SASL callback functions, sasl_chalprompt_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors  SASL_OK The call to sasl_chalprompt_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes See attributes(5) for information on the following attributes:

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<td>Availability</td>
<td>system/library/security/libsasl</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  sasl_errors(3SASL), sasl_server_new(3SASL), attributes(5)


Name sasl_checkapop – check an APOP challenge or response

Synopsis cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_checkapop(sasl_conn_t *conn, const char *challenge,
                   unsigned charlen, const char *response, unsigned resplen);

Description The sasl_checkapop() interface checks an APOP challenge or response. APOP is an option POP3 authentication command that uses a shared secret password. See RFC 1939.

If sasl_checkapop() is called with a NULL challenge, sasl_checkapop() will check to see if the APOP mechanism is enabled.

Parameters conn The sasl_conn_t for which the request is being made
challenge The challenge sent to the client
challen The length of challenge
response The client response
resplens The length of response

Return Values sasl_checkapop() returns an integer that corresponds to a SASL error code.

Errors SASL_OK Indicates that the authentication is complete

All other error codes indicate an error situation that must be handled, or the authentication session should be quit. See sasl_errors(3SASL) for information on SASL error codes.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/libsasl</td>
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<tr>
<td>Interface Stability</td>
<td>Obsolete</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also sasl_errors(3SASL), attributes(5)

sasl_checkpass–check a plaintext password

Synopsis

```
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_checkpass(sasl_conn_t *conn, const char *user, unsigned userlen,
                    const char *pass, unsigned passlen);
```

Description

The `sasl_checkpass()` interface checks a plaintext password. The `sasl_checkpass()` interface is used for protocols that had a login method before SASL, for example, the `LOGIN` command in IMAP. The password is checked with the `pwcheck_method`.

The `sasl_checkpass()` interface is a server interface. You cannot use it to check passwords from a client.

The `sasl_checkpass()` interface checks the possible repositories until it succeeds or there are no more repositories. If `sasl_server_userdb_checkpass_t` is registered, `sasl_checkpass()` tries it first.

Use the `pwcheck_method` SASL option to specify which `pwcheck` methods to use.

The `sasl_checkpass()` interface supports the transition of passwords if the SASL option `auto_transition` is on.

If `user` is `NULL`, check is plaintext passwords are enabled.

Parameters

- **conn**: The `sasl_conn_t` for which the request is being made
- **pass**: Plaintext password to check
- **passlen**: The length of `pass`
- **user**: User to query in current `user_domain`
- **userlen**: The length of username.

Return Values

`sasl_checkpass()` returns an integer that corresponds to a SASL error code.

Errors

- **SASL_OK**: Indicates that the authentication is complete

  All other error codes indicate an error situation that must be handled, or the authentication session should be quit. See `sasl_errors(3SASL)` for information on SASL error codes.

Attributes

See `attributes(5)` for descriptions of the following attributes:

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<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
### sasl_checkpass(3SASL)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>MT-Error</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  
`sasl_errors(3SASL), attributes(5)`
Name  sasl_client_add_plugin – add a SASL client plug-in

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/saslplug.h>

int sasl_client_add_plugin(const char *plugname,
                           sasl_client_plug_init_t *cplugfunc);

Description  Use the sasl_client_add_plugin() interface to add a client plug-in to the current list of
client plug-ins in the SASL library.

Parameters  plugname  The name of the client plug-in.
            cplugfunc  The value of cplugfunc is filled in by the sasl_client_plug_init_t structure.

Return Values  sasl_client_add_plugin() returns an integer that corresponds to a SASL error code.

Errors  SASL_OK  The call to sasl_client_add_plugin() was successful.
        SASL_BADVERS  Version mismatch with plug-in.
        SASL_NOMEM  Memory shortage failure.

See sasl_errors(3SASL) for information on other SASL error codes.

Attributes  See attributes(5) for descriptions of the following attributes:

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<td>Committed</td>
</tr>
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<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  sasl_errors(3SASL), attributes(5)
sasl_client_init

### Synopsis
```
cc [ flag ...] file ... -lsasl [ library ...]
#include <sasl/sasl.h>

int sasl_client_init(const sasl_callback_t *callbacks);
```

### Description
Use the `sasl_client_init()` function to initialize SASL. The `sasl_client_init()` function must be called before any calls to `sasl_client_start(3SASL)`. The call to `sasl_client_init()` initializes all SASL client drivers, for example, authentication mechanisms. SASL client drivers are usually found in the `/usr/lib/sasl` directory.

### Parameters
- **callbacks**: Specifies the base callbacks for all client connections.

### Return Values
The `sasl_client_init()` function returns an integer that corresponds to a SASL error code.

### Errors
- **SASL_OK**: The call to `sasl_client_init()` was successful.
- **SASL_BADVERS**: There is a mismatch in the mechanism version.
- **SASL_BADPARAM**: There is an error in the configuration file.
- **SASL_NOMEM**: There is not enough memory to complete the operation.

All other error codes indicate an error situation that must be handled, or the authentication session should be quit. See `sasl_errors(3SASL)` for information on SASL error codes.

### Attributes
See `attributes(5)` for descriptions of the following attributes:

<table>
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<tr>
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<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>

### See Also
- `sasl_errors(3SASL)`
- `attributes(5)`

### Notes
While most of `libsasl` is MT-Safe, no other `libsasl` function should be called until this function completes.
Name  sasl_client_new – create a new client authentication object

Synopsis  cc [ flag ... ] file ... -lsasl  [ library ... ]
#include <sasl/sasl.h>

int sasl_client_new(const char *service, const char *serverFQDN,
  const char *iplocalport, const char *ipremoteport,
  const sasl_callback_t *prompt_supp, unsigned flags,
  sasl_conn_t **pconn);

Description  Use the sasl_client_new() interface to create a new SASL context. This SASL context will be
  used for all SASL calls for one connection. The context handles both authentication and the
  integrity and encryption layers after authentication.

Parameters  service  The registered name of the service that uses SASL, usually the protocol
  name, for example, IMAP.

  serverFQDN  The fully qualified domain name of the server, for example,
  serverhost.cmu.edu.

  iplocalport  The IP and port of the local side of the connection, or NULL. If iplocalport is
  NULL, mechanisms that require IP address information are disabled. The
  iplocalport string must be in one of the following formats:
  ■  a.b.c.d:port (IPv4)
  ■  [e:f:g:h:i:j:k:l]:port (IPv6)
  ■  [e:f:g:h:i:j:a.b.c.d]:port (IPv6)
  ■  a.b.c.d;port (IPv4)
  ■  e:f:g:h:i:j:k:l;port (IPv6)
  ■  e:f:g:h:i:j:a.b.c.d;port (IPv6)

  ipremoteport  The IP and port of the remote side of the connection, or NULL.

  prompt_supp  A list of the client interactions supported that are unique to this connection.
  If this parameter is NULL, the global callbacks specified in
  sasl_client_init(3SASL) are used.

  flags  Usage flags. For clients, the flag SASL_NEED_PROXY is available.

  pconn  The connection context allocated by the library. The pconn structure is used
  for all future SASL calls for this connection.

Return Values  sasl_client_new() returns an integer that corresponds to a SASL error code.

Errors  SASL_OK  The call to sasl_client_new() was successful.

  SASL_NOMECH  No mechanism meets the requested properties.

  SASL_BADPARAM  There is an error in the configuration file or passed parameters.
SASL NOMEM

There is not enough memory to complete the operation.

All other error codes indicate an error situation that must be handled, or the authentication
session should be quit. See `sasl_errors(3SASL)` for information on SASL error codes.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

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<thead>
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</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/libsasl</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**

`sasl_client_init(3SASL), sasl_errors(3SASL), attributes(5)`
Name  sasl_client_plug_init_t - client plug-in entry point

Synopsis  
```
c  [  flag ...  ]  file ... -lsasl  [  library ...  ]
#include <sasl/saslplug.h>
```

```
int sasl_client_plug_init_t(const sasl_utils_t *utils, int max_version,
   int *out_version, sasl_client_plug_t **pluglist, int *plugcount);
```

Description  The *sasl_client_plug_init_t()* callback function is the client plug-in entry point.

Parameters  
- **utils**  The utility callback functions.
- **max_version**  The highest client plug-in version supported.
- **out_version**  The client plug-in version of the result.
- **pluglist**  The list of client mechanism plug-ins.
- **plugcount**  The number of client mechanism plug-ins.

Return Values  Like other SASL callback functions, *sasl_client_plug_init_t()* returns an integer that corresponds to a SASL error code. See `<sasl.h>` for a complete list of SASL error codes.

Errors  
- **SASL_OK**  The call to *sasl_client_plug_init_t()* was successful.

See *sasl_errors(3SASL)* for information on SASL error codes.

Attributes  See *attributes(5)* for descriptions of the following attributes:

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<td>MT-Level</td>
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</tbody>
</table>

See Also  *sasl_errors(3SASL), attributes(5)*
### Synopsis

```c
#include <sasl/sasl.h>

int sasl_client_start(sasl_conn_t *conn, const char *mechlist, sasl_interact_t **prompt_need, const char **clientout, unsigned **clientoutlen, const char **mech);
```

### Description

Use the `sasl_client_start()` interface to select a mechanism for authentication and start the authentication session. The `mechlist` parameter holds the list of mechanisms that the client might like to use. The mechanisms in the list are not necessarily supported by the client, nor are the mechanisms necessarily valid. SASL determines which of the mechanisms to use based upon the security preferences specified earlier. The list of mechanisms is typically a list of mechanisms that the server supports, acquired from a capability request.

If `SASL_INTERACT` is returned, the library needs some values to be filled in before it can proceed. The `prompt_need` structure is filled in with requests. The application fulfills these requests and calls `sasl_client_start()` again with identical parameters. The `prompt_need` parameter is the same pointer as before, but it is filled in by the application.

### Parameters

- **conn**: The SASL connection context.
- **mechlist**: A list of mechanism that the server has available. Punctuation is ignored.
- **prompt_need**: A list of prompts that are needed to continue, if necessary.
- **clientout**: `clientout` and `clientoutlen` are created. They contain the initial client response to send to the server. It is the job of the client to send them over the network to the server. Any protocol specific encoding that is necessary, for example base64 encoding, must be done by the client.
  
  If the protocol lacks client-send-first capability, then set `clientout` to NULL. If there is no initial client-send, then `*clientout` will be set to NULL on return.
- **clientoutlen**: Contains the name of the chosen SASL mechanism, upon success.
- **mech**: Contains the name of the chosen SASL mechanism, upon success.

### Return Values

`sasl_client_start()` returns an integer that corresponds to a SASL error code.

### Errors

- **SASL_CONTINUE**: The call to `sasl_client_start()` was successful, and more steps are needed in the authentication.

All other error codes indicate an error situation that must be handled, or the authentication session should be quit. See `sasl_errors(3SASL)` for information on SASL error codes.

### Attributes

See `attributes(5)` for descriptions of the following attributes:
sasl_client_start(3SASL)

<table>
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</tbody>
</table>

**See Also**  
sasl_errors(3SASL), attributes(5)
Name
sasl_client_step – acquire an auxiliary property context

Synopsis
c [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

```c
int sasl_client_step(sasl_conn_t *conn, const char *serverin,
                      sasl_interact_t **unsigned serverinlen, prompt_need,
                      const char **clientout, sasl_interact_t **unsigned *clientoutlen);
```

Description
Use the `sasl_client_step()` interface performs a step in the authentication negotiation. `sasl_client_step()` returns SASL_OK if the complete negotiation is successful. If the negotiation on step is completed successfully, but at least one more step is required, `sasl_client_step()` returns SASL_CONTINUE. A client should not assume an authentication negotiation is successful because the server signaled success through the protocol. For example, if the server signaled OK Authentication succeeded in IMAP, `sasl_client_step()` should be called one more time with a `serverinlen` of zero.

If a call to `sasl_client_step()` returns SASL_INTERACT, the library requires some values before `sasl_client_step()` can proceed. The `prompt_need` structure will be filled with the requests. The application should fulfill these requests and call `sasl_client_step()` again with identical parameters. The `prompt_need` parameter will be the same pointer as before, but it will have been filled in by the application.

Parameters
- **conn**
  The SASL connection context.
- **serverin**
  The data given by the server. The data is decoded if the protocol encodes requests sent over the wire.
- **serverinlen**
  The length of the `serverin`.
- **clientout**
  The length of the `clientout`.
- **clientoutlen**
  `clientout` and `clientoutlen` are created. They contain the initial client response to send to the server. It is the job of the client to send them over the network to the server. Any protocol specific encoding that is necessary, for example base64 encoding, must be done by the client.
- **prompt_need**
  A list of prompts that are needed to continue, if necessary.

Return Values
`sasl_client_step()` returns an integer that corresponds to a SASL error code.

Errors
- **SASL_OK**
  The call to `sasl_client_start()` was successful. Authentication is complete.
- **SASL_CONTINUE**
  The call to `sasl_client_start()` was successful, but at least one more step is required for authentication.
- **SASL_INTERACT**
  The library requires some values before `sasl_client_step()` can proceed.
All other error codes indicate an error situation that must be handled, or the authentication session should be quit. See `sasl_errors(3SASL)` for information on SASL error codes.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
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<tbody>
<tr>
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<td>system/library/security/libasasl</td>
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<tr>
<td>Interface Stability</td>
<td>Committed</td>
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<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**

`sasl_errors(3SASL), attributes(5)`
Name  sasl_decode – decode data received

Synopsis  cc [ flag ... ] file ... -lsasl  [ library ... ]
#include <sasl/sasl.h>

int sasl_decode(sasl_conn_t *conn, const char *input, unsigned inputlen,
               const char **output, unsigned *outputlen);

Description  Use the sasl_decode() interface to decode data received. After authentication, call this
function on all data received. The data is decoded from encrypted or signed form to plain data.
If no security lay is negotiated, the output is identical to the input.

Do not give sasl_decode() more data than the negotiated maxbufsize. See
sasl_getprop(3SASL).

sasl_decode() can complete successfully although the value of outputlen is zero. If this is the
case, wait for more data and call sasl_decode() again.

Parameters  conn  The SASL connection context.
input  Data received.
inlen  The length of input
output  The decoded data. output must be allocated or freed by the library.
inlen  The length of output.

Return Values  sasl_decode() returns an integer that corresponds to a SASL error code.

Errors  SASL_OK  The call to sasl_decode() was successful.
See sasl_errors(3SASL) for information on SASL error codes.

Attributes  See attributes(5) for descriptions of the following attributes:

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</table>

See Also  sasl_errors(3SASL), sasl_getprop(3SASL), attributes(5)
sasl_decode64 – decode base64 string

Synopsis


c [ flag ... ] file ... -lsasl [ library ... ]

#include <sasl/saslutil.h>

int sasl_decode64(const char *in, unsigned inlen, char *out,
                   unsigned outmax, unsigned *outlen);

Description

Use the sasl_decode64() interface to decode a base64 encoded buffer.

Parameters

in          Input data.
inlen       The length of the input data.
out          The output data. The value of out can be the same as in. However, there must be
             enough space.
outlen       The length of the actual output.
outmax       The maximum size of the output buffer.

Return Values

sasl_decode64() returns an integer that corresponds to a SASL error code.

Errors

SASL_OK   The call to sasl_decode64() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes

See attributes(5) for descriptions of the following attributes:

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See Also

sasl_errors(3SASL), attributes(5)
Name  sasl_dispose – dispose of a SASL connection object

Synopsis  
```
c c [flag ...] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

void sasl_dispose(sasl_conn_t **pconn);
```

Description  Use the sasl_dispose() interface when a SASL connection object is no longer needed. Generally, the SASL connection object is no longer needed when the protocol session is completed, not when authentication is completed, as a security layer may have been negotiated.

Parameters  
- `pconn`  The SASL connection context

Return Values  sasl_dispose() has no return values.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  attributes(5)
sasl_done(3SASL)

Name sasl_done – dispose of all SASL plug-ins

Synopsis cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

 void sasl_encode(void)

Description Make a call to the sasl_done() interface when the application is completely done with the
SASL library. You must call sasl_dispose(3SASL) before you make a call to sasl_done().

Return Values sasl_done() has no return values.

Attributes See attributes(5) for descriptions of the following attributes:

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See Also sasl_dispose(3SASL), attributes(5)
# sasl_encode(3SASL)

## Name
sasl_encode, sasl_encodev – encode data for transport to an authenticated host

## Synopsis
```
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_encode(sasl_conn_t *conn, const char *input, unsigned inputlen,
const char **output, unsigned *outputlen);
int sasl_encodev(sasl_conn_t *conn, const struct iovec *invec,
unsigned numiov, const char *outputlen);
```

## Description
The `sasl_encode()` interface encodes data to be sent to a remote host for which there has been a successful authentication session. If there is a negotiated security, the data is signed or encrypted, and the output is sent without modification to the remote host. If there is no security layer, the output is identical to the input.

The `sasl_encodev()` interface functions the same as the `sasl_encode()` interface, but operates on a `struct iovec` instead of a character buffer.

## Parameters
- **conn** The SASL connection context.
- **input** Data.
- **inputlen** `input` length.
- **output** The encoded data. `output` must be allocated or freed by the library.
- **outputlen** The length of `output`.
- **invec** A pointer to set of `iovec` structures.
- **numiov** The number of `iovec` structures in the `invec` set.

## Return Values
`sasl_encode()` returns an integer that corresponds to a SASL error code.

## Errors
- **SASL_OK** The call to `sasl_encode()` or `sasl_encodev()` was successful.

See `sasl_errors(3SASL)` for information on SASL error codes.

## Attributes
See `attributes(5)` for descriptions of the following attributes:

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## See Also
`attributes(5)`
Name  sasl_encode64 – encode base64 string

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]

#include <sasl/saslutil.h>

int sasl_encode64(const char *in, unsigned inlen, char *out,
                   unsigned outmax, unsigned *outlen);

Description  Use the sasl_encode64() interface to convert an octet string into a base64 string. This routine is useful for SASL profiles that use base64, such as the IMAP (IMAP4) and POP (POP_AUTH) profiles. The output is null-terminated. If outlen is non-NULL, the length is placed in the outlen.

Parameters  in  Input data.

inlen  The length of the input data.

out  The output data. The value of out can be the same as in. However, there must be enough space.

outlen  The length of the actual output.

outmax  The maximum size of the output buffer.

Return Values  sasl_encode64() returns an integer that corresponds to a SASL error code.

Errors  SASL_OK  The call to sasl_encode64() was successful.

SASL_BUFOVER  The output buffer was too small.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  sasl_errors(3SASL), attributes(5)
Name  sasl_erasebuffer – erase buffer

Synopsis  cc [ flag ... ] file ... -lsasl  [ library ... ]
#include <sasl/saslutil.h>

    void sasl_erasebuffer(char *pass, unsigned len);

Description  Use the sasl_erasebuffer() interface to erase a security sensitive buffer or password. The
implementation may use recovery-resistant erase logic.

Parameters  pass  A password
    len  The length of the password

Return Values  The sasl_erasebuffer() interface returns no return values.

Errors  None.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  attributes(5)
sasl_errdetail – retrieve detailed information about an error

#include <sasl/sasl.h>

const char * sasl_errdetail(sasl_conn_t *conn);

The sasl_errdetail() interface returns an internationalized string that is a message that describes the error that occurred on a SASL connection. The sasl_errdetail() interface provides a more user friendly error message than the SASL error code returned when SASL indicates that an error has occurred on a connection. See sasl_errors(3SASL).

Parameters
conn The SASL connection context for which the inquiry is made.

Return Values sasl_errdetail() returns the string that describes the error that occurred, or NULL, if there was an error retrieving it.

Attributes See attributes(5) for descriptions of the following attributes:

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See Also sasl_errors(3SASL), sasl_seterror(3SASL), attributes(5)
Name  sasl_errors – SASL error codes

Synopsis  
#include <sasl/sasl.h>

Description  This man page describes the general error codes that can be returned by calls into the SASL library. The meaning of the error code can vary slightly based upon the context of the call from which it is returned.

Errors

Common Result Codes  

- **SASL_OK**  The call was successful.
- **SASL_CONTINUE**  Another step is required for authentication.
- **SASL_FAILURE**  Generic failure.
- **SASL_NOMEM**  Memory shortage failure.
- **SASL_BUFOVER**  Overflowed buffer.
- **SASL_NOMECH**  The mechanism was not supported, or no mechanisms matched the requirements.
- **SASL_BADPROT**  The protocol was bad, invalid or cancelled.
- **SASL_NOT_DONE**  Cannot request information. Not applicable until later in the exchange.
- **SASL_BADPARAM**  An invalid parameter was supplied.
- **SASL_TRYAGAIN**  Transient failure, for example, a weak key.
- **SASL_BADMAC**  Integrity check failed.
- **SASL_NOTINIT**  SASL library not initialized.

Client Only Result Codes

- **SASL_INTERACT**  Needs user interaction.
- **SASL_BADSERV**  Server failed mutual authentication step.
- **SASL_WONGMECH**  Mechanism does not support the requested feature.

Server Only Result Codes

- **SASL_BADAUTH**  Authentication failure.
- **SASL_NOAUTHZ**  Authorization failure.
- **SASL_TOOWeak**  The mechanism is too weak for this user.
- **SASL_ENCRYPT**  Encryption is needed to use this mechanism.
- **SASL_TRANS**  One time use of a plaintext password will enable requested mechanism for user.
- **SASL_EXPIRED**  The passphrase expired and must be reset.
- **SASL_DISABLED**  Account disabled.
SASL_NOUSER User not found.
SASL_BADVERS Version mismatch with plug-in.
SASL_NOVERIFY The user exists, but there is no verifier for the user.
SASL_PWLOCK Passphrase locked.
SASL_NOCHANGE The requested change was not needed.
SASL_WEAKPASS The passphrase is too weak for security policy.
SASL_NOUSERPASS User supplied passwords are not permitted.

Attributes See attributes(5) for descriptions of the following attributes:

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See Also attributes(5)
sasl_errstring – translate a SASL return code to a human-readable form

**Synopsis**

cc [ flag ...] file ... -lsasl [ library ...]
#include <sasl/sasl.h>

const char * sasl_errstring(int saslerr, const char *langlist,
const char **outlang);

**Description**
The `sasl_errstring()` interface is called to convert a SASL return code from an integer into a human readable string.

You should not used the `sasl_errstring()` interface to extract error code information from SASL. Applications should use `sasl_errdetail(3SASL)` instead, which contains this error information and more.

The `sasl_errstring()` interface supports only `i-default` and `i-local` at this time.

**Parameters**

- **saslerr** The error number to be translated.
- **langlist** A comma-separated list of languages. See RFC 1766. If the `langlist` parameter has a NULL value, the default language, `i-default`, is used.
- **outlang** The language actually used. The `outlang` parameter can be NULL. The returned error string is in UTF-8.

**Return Values**
The `sasl_errstring()` returns the string that describes the error that occurred, or NULL, if there was an error retrieving it.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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**See Also**
`sasl_errors(3SASL), sasl_seterror(3SASL), attributes(5)`

Name  sasl_getcallback_t – callback function to lookup a sasl_callback_t for a connection

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]
           #include <sasl/saslplug.h>

           int sasl_getcallback_t(sasl_conn_t *conn, unsigned long callbacknum,
                          int (**proc)( ), void **pcontext);

Description  The sasl_getcallback_t() function is a callback to lookup a sasl_callback_t for a connection.

Parameters  conn  The connection to lookup a callback for.

callbacknum  The number of the callback.

proc  Pointer to the callback function. The value of proc is set to NULL upon failure.

pcontext  Pointer to the callback context. The value of pcontext is set to NULL upon failure.

Return Values  Like other SASL callback functions, sasl_getcallback_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors  SASL_OK  The call to sasl_getcallback_t() was successful.

SASL_FAIL  Unable to find a callback of the requested type.

SASL_INTERACT  The caller must use interaction to get data.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  sasl_errors(3SASL), attributes(5)
**Name**
sasl_getopt_t – the SASL get option callback function

**Synopsis**
```c
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_getopt_t(void *context, const char *plugin_name,
                  const char *option, const char **result, unsigned *len);
```

**Description**
The `sasl_getopt_t()` function allows a SASL configuration to be encapsulated in the caller's configuration system. Some implementations may use default configuration file(s) if this function is omitted. Configuration items are arbitrary strings and are plug-in specific.

**Parameters**
- **context**: The option context from the callback record.
- **plugin_name**: The name of the plug-in. If the value of `plugin_name` is NULL, the plug-in is a general SASL option.
- **option**: The name of the option.
- **result**: The value of `result` is set and persists until the next call to `sasl_getopt_t()` in the same thread. The value of `result` is unchanged if `option` is not found.
- **len**: The length of `result`. The value of `result` can be NULL.

**Return Values**
Like other SASL callback functions, `sasl_getopt_t()` returns an integer that corresponds to a SASL error code. See `<sasl.h>` for a complete list of SASL error codes.

**Errors**
- **SASL_OK**: The call to `sasl_getopt_t()` was successful.

See `sasl_errors(3SASL)` for information on SASL error codes.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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See Also `sasl_errors(3SASL), attributes(5)`
Name  sasl_getpath_t – the SASL callback function to indicate location of the security mechanism drivers

Synopsis  
```
cc [ flag ... ] file ... -lsasl [ library ... ]  
#include <sasl/sasl.h>

int sasl_getpath_t(void *context, char **path);
```

Description  Use the sasl_getpath_t() function to enable the application to use a different location for the SASL security mechanism drivers, which are shared library files. If the sasl_getpath_t() callback is not used, SASL uses /usr/lib/sasl by default.

Parameters  
- **context**  The getpath context from the callback record
- **path**  The path(s) for the location of the SASL security mechanism drivers. The values for path are colon-separated.

Return Values  Like other SASL callback functions, sasl_getpath_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors  
- **SASL_OK**  The call to sasl_getpath_t() was successful.

See also  sasl_errors(3SASL) for information on SASL error codes.

Attributes  See attributes(5) for information on SASL attributes:

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See Also  sasl_errors(3SASL), attributes(5)
Name: sasl_getprop – get a SASL property

Synopsis

```c
#include <sasl/sasl.h>

int sasl_getprop(sasl_conn_t *conn, int propnum, const void **pvalue);
```

Description

Use the `sasl_getprop()` interface to get the value of a SASL property. For example, after successful authentication, a server may want to know the authorization name. Similarly, a client application may want to know the strength of the security level that was negotiated.

Parameters

- **conn**: The SASL connection context.
- **propnum**: The identifier for the property requested.
- **pvalue**: The value of the SASL property. This value is filled in upon a successful call.

Possible SASL values include:

- **SASL_USERNAME**: A pointer to a null-terminated username.
- **SASL_SSF**: The security layer security strength factor. If the value of `SASL_SSF` is 0, a call to `sasl_encode()` or `sasl_decode()` is unnecessary.
- **SASL_MAXOUTBUF**: The maximum size of output buffer returned by the selected security mechanism.
- **SASL_DEFUSERREALM**: Server authentication realm used.
- **SASL_GETOPTCTX**: The context for `getopt()` callback.
- **SASL_IPLOCALPORT**: Local address string.
- **SASL_IPREMOTEPORT**: Remote address string.
- **SASL_SERVICE**: Service passed on to `sasl_*_new()`.
- **SASL_SERVERFQDN**: Server FQDN passed on to `sasl_*_new()`.
- **SASL_AUTHSOURCE**: Name of authentication source last used. Useful for failed authentication tracking.
- **SASL_MECHNAME**: Active mechanism name, if any.
- **SASL_PLUGERR**: Similar to `sasl_errdetail()`.

Errors

- **SASL_OK**: The call to `sasl_getprop()` was successful.

See `sasl_errors(3SASL)` for information on SASL error codes.

Attributes

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See Also  `sasl_errors(3SASL), attributes(5)`
sasl_getrealm_t(3SASL)

Name  sasl_getrealm_t - the realm acquisition callback function

Synopsis  

cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_getrealm_t(void *context, int id, const char **availrealms,
const char **result);

Description  Use the sasl_getrealm_t() function when there is an interaction with SASL_CB_GETREALM as the type.

If a mechanism would use this callback, but it is not present, then the first realm listed is automatically selected. A mechanism can still force the existence of a getrealm callback by SASL_CB_GETREALM to its required_prompts list.

Parameters  
context  The context from the callback record
id  The callback ID (SASL_CB_GETREALM)
availrealms  A string list of the vailable realms. availrealms is a null-terminated sting that can be empty.
result  The chosen realm. result is a null-terminated string.

Return Values  Like other SASL callback functions, sasl_getrealm_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors  SASL_OK  The call to sasl_getrealm_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  sasl_errors(3SASL), attributes(5)

Networking Library Functions  515
Name sasl_getsecret_t – the SASL callback function for secrets (passwords)

Synopsis cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_getsecret_t(sasl_conn_t *conn, void *context,
                     int id, sasl_secret_t **psecret);

Description Use the sasl_getsecret_t() function to retrieve the secret from the application. Allocate a sasl_secret_t to length sizeof(sasl_secret_t)+<length of secret>. sasl_secret_t has two fields of len which contain the length of secret in bytes and the data contained in secret. The secret string does not need to be null-terminated.

Parameters
conn The connection context
context The context from the callback structure
id The callback ID
psecret To cancel, set the value of psecret to NULL. Otherwise, set the value to the password structure. The structure must persist until the next call to sasl_getsecret_t() in the same connection. Middleware erases password data when it is done with it.

Return Values Like other SASL callback functions, sasl_getsecret_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors SASL_OK The call to sasl_getsecret_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/libsasl</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also sasl_errors(3SASL), attributes(5)
Name sasl_getsimple_t – the SASL callback function for username, authname and realm

Synopsis cc { flag ... } file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_getsimple_t(void *context, int id, const char **result, unsigned *len);

Description Use the sasl_getsimple_t() callback function to retrieve simple data from the application such as the authentication name, the authorization name, and the realm. The id parameter indicates which value is requested.

Parameters context The context from the callback structure.

id The callback ID. Possible values for id include:

SASL_CB_USER Client user identity for login.
SASL_CB_AUTHNAME Client authentication name.
SASL_CB_LANGUAGE Comma-separated list of languages pursuant to RFC 1766.
SASL_CB_CNONCE The client-nonce. This value is used primarily for testing.

result To cancel user, set the value of result with a null-terminated string. If the value of result is NULL, then the user is cancelled.

len The length of result.

Return Values Like other SASL callback functions, sasl_getsimple_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors SASL_OK The call to sasl_getsimple_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes See attributes(5) for descriptions of the following attributes:

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<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also sasl_errors(3SASL), attributes(5)

Name: sasl_global_listmech – retrieve a list of the supported SASL mechanisms

Synopsis:

```
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

const char ** sasl_global_listmech( );
```

Description: The `sasl_global_listmech()` interface returns a null-terminated array of strings that lists all of the mechanisms that are loaded by either the client or server side of the library.

Return Values: A successful call to `sasl_global_listmech()` returns a pointer to the array. On failure, NULL is returned. The SASL library is uninitialized.

Attributes: See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>system/library/security/libasl</td>
</tr>
<tr>
<td>Interface Stability</td>
<td>Obsolete</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also: attributes(5)
Name  sasl_idle – perform precalculations during an idle period

Synopsis  cc { flag ... } file ... -lsasl { library ... }
          #include <sasl/sasl.h>
          int sasl_idle(sasl_conn_t *conn);

Description   Use the sasl_idle() interface during an idle period to allow the SASL library or any
               mechanisms to perform any necessary precalculation.

Parameters  conn   The SASL connection context. The value of conn can be NULL in order to complete a
               precalculation before the connection takes place.

Return Values  sasl_idle() returns the following values:
               1   Indicates action was taken
               0   Indicates no action was taken

Attributes   See attributes(5) for descriptions of the following attributes:

<table>
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</tr>
</tbody>
</table>

See Also  attributes(5)
**sasl_listmech**

**Name**
sasl_listmech – retrieve a list of the supported SASL mechanisms

**Synopsis**

```c
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_listmech(sasl_conn_t *conn, const char *user, const char *prefix,
                  const char *sep, const char *suffix, const char **result,
                  unsigned *plen, int *pcount);
```

**Description**
The `sasl_listmech()` interface returns a string listing the SASL names of all the mechanisms available to the specified user. This call is typically given to the client through a capability command or initial server response. Client applications need this list so that they know what mechanisms the server supports.

**Parameters**
- **conn** The SASL context for this connection user restricts the mechanism list to those mechanisms available to the user. This parameter is optional.
- **user** Restricts security mechanisms to those available to that user. The value of `user` may be NULL, and it is not used if called by the client application.
- **prefix** Appended to the beginning of `result`.
- **sep** Appended between mechanisms.
- **suffix** Appended to the end of `result`.
- **result** A null-terminated result string. `result` must be allocated or freed by the library.
- **plen** The length of the result filled in by the library. The value of `plen` may be NULL.
- **pcount** The number of mechanisms available. The value of `pcount` is filled in by the library. The value of `pcount` may be NULL.

**Return Values**
sasl_listmech() returns an integer that corresponds to a SASL error code.

**Errors**
- **SASL_OK** The call to `sasl_listmech()` was successful.

See sasl_errors(3SASL) for information on SASL error codes.

**Attributes**
See attributes(5) for descriptions of the following attributes:

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<td>MT-Safe</td>
</tr>
</tbody>
</table>
See Also  sasl_errors(3SASL), attributes(5)
sasl_log_t—the SASL logging callback function

Synopsis

cc [ flag ... ] file ... -lsasl  [ library ... ]
#include <sasl/sasl.h>

int sasl_log_t(void *context, int level, const char *message);

Description

Use the sasl_log_t() function to log warning and error messages from the SASL library. syslog(3C) is used, unless another logging function is specified.

Parameters

context  The logging context from the callback record.
level  The logging level. Possible values for level include:

SASL_LOG_NONE  Do not log anything.
SASL_LOG_ERR  Log unusual errors. This is the default log level.
SASL_LOG_FAIL  Log all authentication failures.
SASL_LOG_WARN  Log non-fatal warnings.
SASL_LOG_NOTE  Log non-fatal warnings (more verbose than SASL_LOG_WARN).
SASL_LOG_DEBUG  Log non-fatal warnings (more verbose than SASL_LOG_NOTE).
SASL_LOG_TRACE  Log traces of internal protocols.
SASL_LOG_PASS  Log traces of internal protocols, including passwords.

message  The message to log

Return Values

Like other SASL callback functions, sasl_log_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors

SASL_OK  The call to sasl_log_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes

See attributes(5) for descriptions of the following attributes:

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</tr>
</tbody>
</table>
See Also  
sasl_errors(3SASL), syslog(3C), attributes(5)
sasl_server_add_plugin – add a SASL server plug-in

**Synopsis**
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/saslplug.h>

```c
int sasl_server_add_plugin(const char *plugname,
                           sasl_server_plug_init_t *cplugfunc);
```

**Description**
Use the `sasl_server_add_plugin()` interface to add a server plug-in to the current list of
client plug-ins in the SASL library.

**Parameters**
- `plugname`  The name of the server plug-in.
- `cplugfunc`  The value of `cplugfunc` is filled in by the `sasl_server_plug_init_t` structure.

**Return Values**
- `sasl_server_add_plugin()` returns an integer that corresponds to a SASL error code.
- `SASL_OK`    The call to `sasl_client_add_plugin()` was successful.
- `SASL_BADVERS`  Version mismatch with plug-in.
- `SASL_NOMEM`  Memory shortage failure.

See `sasl_errors(3SASL)` for information on other SASL error codes.

**Attributes**
See attributes(5) for descriptions of the following attributes:

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<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**
- `sasl_errors(3SASL)`, `attributes(5)`
**Name**
sasl_server_init – SASL server authentication initialization

**Synopsis**
```
c c [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_server_init(const sasl_callback *callbacks, const char *appname);
```

**Description**
Use the `sasl_server_init()` interface to initialize SASL. You must call `sasl_server_init()` before you make a call to `sasl_server_start()`. `sasl_server_init()` may be called only once per process. A call to `sasl_server_init()` initializes all SASL mechanism drivers, that is, the authentication mechanisms. The SASL mechanism drivers are usually found in the `/usr/lib/sasl` directory.

**Parameters**
- `callbacks` Specifies the base callbacks for all client connections.
- `appname` The name of the application for lower level logging. For example, the sendmail server calls `appname` this way:
  ```c
  sasl_server_init(srvcallbacks, "Sendmail")
  ```

**Return Values**
`sasl_server_init()` returns an integer that corresponds to a SASL error code.

**Errors**
- **SASL_OK** The call to `sasl_server_init()` was successful.
  
  All other error codes indicate an error situation that must be handled, or the authentication session should be quit. See `sasl_errors(3SASL)` for information on SASL error codes.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>

**See Also**
`sasl_errors(3SASL), attributes(5)`

**Notes**
While most of `libsasl` is MT-Safe, no other `libsasl` function should be called until this function completes.
Name
sasl_server_new – create a new server authentication object

Synopsis
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_server_new(const char *service, const char *serverFQDN,
const char *user_realm, const char *iplocalport,
const char *ipremoteport, const sasl_callback_t *callbacks,
unsigned flags, sasl_conn_t **pconn);

Description
Use the sasl_server_new() interface to create a new SASL context. This context will be used for all SASL calls for one connection. The new SASL context handles both authentication and integrity or encryption layers after authentication.

Parameters

service
The registered name of the service that uses SASL. The registered name is usually the protocol name, for example, IMAP.

serverFQDN
The fully-qualified server domain name. If the value of serverFQDN is NULL, use gethostname(3C). The serverFQDN parameter is useful for multi-homed servers.

user_realm
The domain of the user agent. The user_realm is usually not necessary. The default value of user_realm is NULL.

iplocalport
The IP address and port of the local side of the connection. The value of iplocalport may be NULL. If iplocalport is NULL, mechanisms that require IP address information are disabled. The iplocalport string must be in one of the following formats:
- a.b.c.d:port (IPv4)
- [e:f:g:h:i:j:k:l]:port (IPv6)
- [e:f:g:h:i:j:a.b.c.d]:port (IPv6)

The following older formats are also supported:
- a.b.c.d:port (IPv4)
- e:f:g:h:i:j:k:l:port (IPv6)

ipremoteport
The IP address and port of the remote side of the connection. The value of ipremoteport may be NULL. See iplocalport.

callbacks
Callbacks, for example: authorization, lang, and new getopt context.

flags
Usage flags. For servers, the flags SASL_NEED_PROXY and SASL_SUCCESS_DATA are available.

pconn
A pointer to the connection context allocated by the library. This structure will be used for all future SASL calls for this connection.
Return Values  sasl_server_new() returns an integer that corresponds to a SASL error code.

Errors  SASL_OK  The call to sasl_server_new() was successful.

All other error codes indicate an error situation that must be handled, or the authentication session should be quit. See sasl_errors(3SASL) for information on SASL error codes.

Attributes  See attributes(5) for descriptions of the following attributes:

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<tr>
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<tr>
<td>Availability</td>
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<td>Committed</td>
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<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
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</tbody>
</table>

See Also  gethostname(3C), sasl_errors(3SASL), attributes(5)
Name

sasl_server_plug_init_t – server plug-in entry point

Synopsis

```c
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/saslplug.h>

int sasl_server_plug_init_t(const sasl_utils_t *utils, int max_version,
                          int *out_version, sasl_client_plug_t **pluglist, int *plugcount);
```

Description

The `sasl_server_plug_init_t()` callback function is the server plug-in entry point.

Parameters

- **utils**: The utility callback functions.
- **max_version**: The highest server plug-in version supported.
- **out_version**: The server plug-in version of the result.
- **pluglist**: The list of server mechanism plug-ins.
- **plugcount**: The number of server mechanism plug-ins.

Return Values

Like other SASL callback functions, `sasl_server_plug_init_t()` returns an integer that corresponds to a SASL error code. See `<sasl.h>` for a complete list of SASL error codes.

Errors

- **SASL_OK**: The call to `sasl_server_plug_init_t()` was successful.

See also `sasl_errors(3SASL)` for information on SASL error codes.

Attributes

See `attributes(5)` for descriptions of the following attributes:

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<tr>
<td>Availability</td>
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<td>Committed</td>
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<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also

`sasl_errors(3SASL), attributes(5)`
The `sasl_server_start()` interface begins the authentication with the mechanism specified by the `mech` parameter. `sasl_server_start()` fails if the mechanism is not supported.

**Parameters**
- `conn`: The SASL context for this connection.
- `mech`: The mechanism name that the client requested.
- `clientin`: The initial response from the client. The value of `clientin` is `NULL` if the protocol lacks support for the client-send-first or if the other end did not have an initial send. No initial client send is distinct from an initial send of a null string. The protocol must account for this difference.
- `clientinlen`: The length of the initial response.
- `serverout`: Created by the plugin library. The value of `serverout` is the initial server response to send to the client. `serverout` is allocated or freed by the library. It is the job of the client to send it over the network to the server. Protocol specific encoding, for example base64 encoding, must be done by the server.
- `serveroutlen`: The length of the initial server challenge.

**Return Values**
- `sasl_server_start()` returns an integer that corresponds to a SASL error code.

**Errors**
- `SASL_OK`: Authentication completed successfully.
- `SASL_CONTINUE`: The call to `sasl_server_start()` was successful, and more steps are needed in the authentication.

All other error codes indicate an error situation that must be handled, or the authentication session should be quit. See `sasl_errors(3SASL)` for information on SASL error codes.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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</tbody>
</table>
See Also  gethostname(3C), sasl_errors(3SASL), attributes(5)
The `sasl_server_step()` performs a step in the authentication negotiation.

**Parameters**
- `conn`: The SASL context for this connection.
- `clientin`: The data given by the client. The data is decoded if the protocol encodes requests that are sent over the wire.
- `clientinlen`: The length of `clientin`.
- `serverout`: Set by the library and sent to the client.
- `serveroutlen`: Unssigned

**Return Values**
`sasl_server_step()` returns an integer that corresponds to a SASL error code.

**Errors**
- **SASL_OK**: The whole authentication completed successfully.
- **SASL_CONTINUE**: The call to `sasl_server_step()` was successful, and at least one more step is needed for the authentication.

All other error codes indicate an error situation that you must handle, or you should quit the authentication session. See `sasl_errors(3SASL)` for information on SASL error codes.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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</tbody>
</table>

**See Also**
- `sasl_errors(3SASL)`, `attributes(5)`
sasl_server_userdb_checkpass_t (3SASL)

**Name**  sasl_server_userdb_checkpass_t – plaintext password verification callback function

**Synopsis**  
```
cc [ flag ... ] file ... -lsasl  [ library ... ]
#include <sasl/sasl.h>

int sasl_sasl_server_userdb_checkpass_t(sasl_conn_t *conn, void *context, 
    const char *user, const char *pass, unsigned passlen, struct propctx *propctx);
```

**Description**  Use the sasl_sasl_server_userdb_checkpass_t() callback function to verify a plaintext password against the callback supplier's user database. Verification allows additional ways to encode the userPassword property.

**Parameters**
- **conn**: The SASL connection context.
- **context**: The context from the callback record.
- **user**: A null-terminated user name with user@realm syntax.
- **pass**: The password to check. This string cannot be null-terminated.
- **passlen**: The length of pass.
- **propctx**: The property context to fill in with userPassword.

**Return Values**  Like other SASL callback functions, sasl_sasl_server_userdb_checkpass_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

**Errors**
- **SASL_OK**: The call to sasl_sasl_server_userdb_checkpass_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

**Attributes**  See attributes(5) for descriptions of the following attributes:

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<td>Availability</td>
<td>system/library/security/libldap</td>
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<td>MT-Safe</td>
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</tbody>
</table>

**See Also**  sasl_errors(3SASL), attributes(5)
Name  sasl_server_userdb_setpass_t – user database plaintext password setting callback function

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]
          #include <sasl/sasl.h>
          
          int sasl_server_userdb_setpass_t(sasl_conn_t *conn, void *context,
                                          const char *user, const char *pass, unsigned passlen, struct propctx *propctx,
                                          unsigned flags);

Description  Use the sasl_server_userdb_setpass_t() callback function to store or change a a plaintext password in the callback supplier’s user database.

Parameters  
  conn  The SASL connection context.
  context  The context from the callback record.
  user  A null-terminated user name with user@realm syntax.
  pass  The password to check. This string cannot be null-terminated.
  passlen  The length of pass.
  propctx  Auxiliary properties. The value of propctx is not stored.
  flags  See sasl_setpass(3SASL). sasl_server_userdb_setpass_t() uses the same flags that are passed to sasl_setpass().

Return Values  Like other SASL callback functions, sasl_server_userdb_setpass_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors  SASL_OK  The call to sasl_server_userdb_setpass_t() was successful.

See Also  sasl_errors(3SASL), sasl_setpass(3SASL), attributes(5)

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  sasl_errors(3SASL), sasl_setpass(3SASL), attributes(5)
sasl_set_alloc(3SASL)

Name  sasl_set_alloc – set the memory allocation functions used by the SASL library

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]
          #include <sasl/sasl.h>

          void sasl_set_alloc(sasl_malloc_t *m, sasl_calloc_t *c, sasl_realloc_t *r,
                              sasl_free_t *f);

Description  Use the sasl_set_alloc() interface to set the memory allocation routines that the SASL library and plug-ins will use.

Parameters  c  A pointer to a malloc() function
            f  A pointer to a free() function
            m  A pointer to a calloc() function
            r  A pointer to a realloc() function

Return Values  sasl_set_alloc() has no return values.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</thead>
<tbody>
<tr>
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<td>Obsolete</td>
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<tr>
<td>MT-Level</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>

See Also  attributes(5)

Notes  While most of libsasl is MT-Safe, sasl_set_* modifies the global state and should be considered Unsafe.
sasl_seterror(3SASL)

Name
sasl_seterror – set the error string

Synopsis
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

void sasl_seterror(sasl_conn_t *conn, unsigned flags,
const char *fmt, ...);

Description
The sasl_seterror() interface sets the error string that will be returned by
sasl_errdetail(3SASL). Use syslog(3C) style formatting, that is, use printf()—style with
%m as the most recent errno error.

The sasl_seterror() interface is primarily used by server callback functions and internal
plug-ins, for example, with the sasl_authorize_t callback. The sasl_seterror() interface
triggers a call to the SASL logging callback, if any, with a level of SASL_LOG_FAIL, unless the
SASL_NOLOG flag is set.

Make the message string sensitive to the current language setting. If there is no
SASL_CB_LANGUAGE callback, message strings must be i-default. Otherwise, UTF-8 is used.
Use of RFC 2482 for mixed-language text is encouraged.

If the value of conn is NULL, the sasl_seterror() interface fails.

Parameters
conn The sasl_conn_t for which the call to sasl_seterror() applies.
flags If set to SASL_NOLOG, the call to sasl_seterror() is not logged.
fmt A syslog(3C) style format string.

Return Values
sasl_seterror() has no return values.

Attributes
See attributes(5) for descriptions of the following attributes:

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</table>

See Also
sasl_errdetail(3SASL), syslog(3C), attributes(5)

Whistler, K. and Adams, G. RFC 2482, Language Tagging in Unicode Plain Text. Network
Name  sasl_set_mutex – set the mutex lock functions used by the SASL library

Synopsis  
```c
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

void sasl_set_mutex(sasl_mutex_alloc_t *a, sasl_mutex_lock_t *l,
                    sasl_mutex_unlock_t *u, sasl_mutex_free_t *f);
```

Description  Use the `sasl_set_mutex()` interface to set the mutex lock routines that the SASL library and plug-ins will use.

Parameters  
- `a` A pointer to the mutex lock allocation function
- `f` A pointer to the mutex free or destroy function
- `l` A pointer to the mutex lock function
- `u` A pointer to the mutex unlock function

Return Values  sasl_set_mutex() has no return values.

Attributes  See `attributes(5)` for descriptions of the following attributes:

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See Also  attributes(5)

Notes  While most of `libsasl` is MT-Safe, `sasl_set_*` modifies the global state and should be considered Unsafe.
Name
sasl_setpass – set the password for a user

Synopsis
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_setpass(sasl_conn_t *conn, const char *user, const char *pass,
                unsigned passlen, const char *oldpass, unsigned oldpasslen,
                unsigned flags);

Description
Use the sasl_setpass() interface to set passwords. sasl_setpass() uses the
SASL_CB_SERVER_USERDB_SETPASS callback, if one is supplied. Additionally, if any server
mechanism plugins supply a setpass callback, the setpass callback would be called. None of the
server mechanism plugins currently supply a setpass callback.

Parameters
conn The SASL connection context
user The username for which the password is set
pass The password to set
passlen The length of pass
oldpass The old password, which is optional
oldpasslen The length of oldpass, which is optional
flags Refers to flags, including, SASL_SET_CREATE and SASL_SET_DISABLE. Use these
flags to create and disable accounts.

Return Values
sasl_setpass() returns an integer that corresponds to a SASL error code.

Errors
SASL_OK The call to sasl_setpass() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes
See attributes(5) for descriptions of the following attributes:

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</table>

See Also
sasl_errors(3SASL), sasl_getprop(3SASL), attributes(5)
Name  sasl_setprop – set a SASL property

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

int sasl_setprop(sasl_conn_t *conn, int propnum, const void *pvalue);

Description  Use the sasl_setprop() interface to set the value of a SASL property. For example, an
application can use sasl_setprop() to tell the SASL library about any external negotiated
security layer like TLS.

sasl_setprop() uses the following flags.

SASL_AUTH_EXTERNAL  External authentication ID that is a pointer of type const char

SASL_SSF_EXTERNAL  External SSF active of type sasl_ssf_t

SASL_DEFUSERREALM  User realm that is a pointer of type const char

SASL_SEC_PROPS  sasl_security_properties_t, that can be freed after the call

SASL_IPLOCALPORT  A string that describes the local ip and port in the form a.b.c.d:p
or [e:f:g:h:i:j:k:l]:port or one of the older forms, a.b.c.d:p
or e:f:g:j:i:j:k:l;port

SASL_IPREMOTEPORT  A string that describes the remote ip and port in the form
a.b.c.d:p or [e:f:g:h:i:j:k:l]:port or one of the older forms,
a.b.c.d:p or e:f:g:j:i:j:k:l;port

Parameters  conn  The SASL connection context
propnum  The identifier for the property requested
pvalue  Contains a pointer to the data. The application must ensure that the data type is
correct, or the application can crash.

Return Values  sasl_setprop() returns an integer that corresponds to a SASL error code.

Errors  SASL_OK  The call to sasl_setprop() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes  See attributes(5) for descriptions of the following attributes:

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</table>
See Also  sasl_errors(3SASL), attributes(5)
Name  sasl_utf8verify  – encode base64 string

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]
          #include <sasl/saslutil.h>

          int sasl_utf8verify(const char *str, unsigned len);

Description  Use the sasl_utf8verify() interface to verify that a string is valid UTF-8 and does not
              contain NULL, a carriage return, or a linefeed. If len == 0, strlen(str) will be used.

Parameters  

          str  A string

          len  The length of the string

Return Values  sasl_utf8verify() returns an integer that corresponds to a SASL error code.

Errors  

          SASL_OK  The call to sasl_utf8verify() was successful.

          SASL_BADPROT  There was invalid UTF-8, or an error was found.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  attributes(5)
Name  
sasl_verifyfile_t – the SASL file verification callback function

Synopsis  
cc [ flag ... ] file ... -lsasl [ library ... ]
#include <sasl/sasl.h>

typedef enum {
    SASL_VRFY_PLUGIN, /* a DLL/shared library plugin */
    SASL_VRFY_CONF,  /* a configuration file */
    SASL_VRFY_PASSWD, /* a password storage file */
    SASL_VRFY_OTHER /* some other file type */
} sasl_verifyfile_typet;

int sasl_verifyfile_t(void *context, const char *file, sasl_verifyfile_t type);

Description  
Use the sasl_verifyfile_t() callback function check whether a given file can be used by the SASL library. Applications use sasl_verifyfile_t() to check the environment to ensure that plugins or configuration files cannot be written to.

Parameters  
context The context from the callback record
file The full path of the file to verify
type The type of the file

Return Values  
Like other SASL callback functions, sasl_verifyfile_t() returns an integer that corresponds to a SASL error code. See <sasl.h> for a complete list of SASL error codes.

Errors  
SASL_OK The call to sasl_verifyfile_t() was successful.

See sasl_errors(3SASL) for information on SASL error codes.

Attributes  
See attributes(5) for descriptions of the following attributes:

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See Also  
sasl_errors(3SASL), attributes(5)
Name  sasl_version – get SASL library version information

Synopsis  cc [ flag ... ] file ... -lsasl [ library ... ]
          #include <sasl/sasl.h>

          void sasl_version(const char **implementation, int *version);

Description  Use the sasl_version() interface to obtain the version of the SASL library.

Parameters  implementation  A vendor-defined string that describes the implementation. The value of
             implementation returned is Sun SASL.

             version  A vendor-defined representation of the version number.

Return Values  The sasl_version() interface has no return values.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  attributes(5)
Name  sctp_bindx – add or remove IP addresses to or from an SCTP socket

Synopsis  cc [ flag... ] file... -lsctp
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

int sctp_bindx(int sock, void *addrs, int addrcnt, int flags);

Description  The sctp_bindx() function adds or removes addresses to or from an SCTP socket. If sock is an Internet Protocol Version 4 (IPv4) socket, addrs should be an array of sockaddr_in structures containing IPv4 addresses. If sock is an Internet Protocol Version 6 (IPv6) socket, addrs should be an array of sockaddr_in6 structures containing IPv6 or IPv4-mapped IPv6 addresses. The addrcnt is the number of array elements in addrs. The family of the address type is used with addrcnt to determine the size of the array.

The flags parameter is a bitmask that indicates whether addresses are to be added or removed from a socket. The flags parameter is formed by bitwise OR of zero or more of the following flags:

SCTP_BINDX_ADD_ADDR Indicates that addresses from addrs should be added to the SCTP socket.
SCTP_BINDX_REM_ADDR Indicates that addresses from addrs should be removed from the SCTP socket.

These two flags are mutually exclusive. If flags is formed by a bitwise OR of both SCTP_BINDX_ADD_ADDR and SCTP_BINDX_REM_ADDR, the sctp_bindx() function will fail.

Prior to calling sctp_bindx() on an SCTP endpoint, the endpoint should be bound using bind(3SOCKET). On a listening socket, a special INADDR_ANY value for IP or an unspecified address of all zeros for IPv6 can be used in addrs to add all IPv4 or IPv6 addresses on the system to the socket. The sctp_bindx() function can also be used to add or remove addresses to or from an established association. In such a case, messages are exchanged between the SCTP endpoints to update the address lists for that association if both endpoints support dynamic address reconfiguration.

Return Values  Upon successful completion, the sctp_bindx() function returns 0. Otherwise, the function returns -1 and sets errno to indicate the error.

Errors  The sctp_bindx() call fails under the following conditions.

EBADF  The sock argument is an invalid file descriptor.
ENOTSOCK  The sock argument is not a socket.
EINVAL  One or more of the IPv4 or IPv6 addresses is invalid.
EINVAL  The endpoint is not bound.
The last address is requested to be removed from an established association.

Attributes  See attributes(5) for descriptions of the following attributes:

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</table>

See Also  bind(3SOCKET), in.h(3HEAD), libscpt(3LIB), listen(3SOCKET),
scpt_freeladdr(3SOCKET), scpt_freeaddr(3SOCKET), scpt_getladdr(3SOCKET),
scpt_getpaddr(3SOCKET), socket(3SOCKET), inet(7P), inet6(7P), ip(7P), ip6(7P),
sctp(7P)

Notes  IPv4-mapped addresses are not recommended.
sctp_connectx(3SOCKET)

Name  
sctp_connectx – connect an SCTP socket

Synopsis  
cc [ flag... ] file... -lsctp [ library... ]
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

int sctp_connectx(int sd, struct sockaddr *addrs, int addrcnt, sctp_assoc_t *aid);

Parameters

sd  
The socket descriptor.

addrs  
If sd is an IPv4 socket, addrs should be an array of sockaddr_in structures containing IPv4 addresses. If sd is an IPv6 socket, addrs should be an array of sockaddr_in6 structures containing IPv6 or IPv4-mapped IPv6 addresses.

addrcnt  
The number of addresses in the array addrs.

aid  
If the function returns successfully, the association identifier for the newly created association is returned in aid. This parameter is applicable only to one-to-many style SCTP sockets.

Description

The sctp_connectx() function requests an SCTP association to be made on a socket. This is similar to connect(3SOCKET) except that an array of peer addresses can be given.

Much like sctp_bindx(3SOCKET), this function allows a caller to specify multiple addresses at which a peer can be reached. The SCTP stack tries each addresses in the array in a round robin fashion to set up the association. Note that the list of addresses passed in is only used for setting up the association. It does not necessarily equal the set of addresses the peer uses for the resulting association. If the caller wants to find out the set of peer addresses, it must use sctp_getpaddr(3SOCKET) to retrieve them after the association has been set up.

Return Values

Upon successful completion, 0 is returned. Otherwise, -1 is returned and errno is set to indicate the error.

Errors

The sctp_connectx() function will fail if:

EADDRINUSE  
The address is already in use.

EADDRNOTAVAIL  
No local address is available for this operation.

EAFNOSUPPORT  
Addresses in the specified address family cannot be used with this socket.

EALREADY  
The socket is non-blocking and a previous connection attempt has not yet been completed.

EBADF  
The sd parameter is not a valid file descriptor.
ECONNREFUSED The attempt to connect was forcefully rejected. The calling program should use `connect(3SOCKET)` to close the socket descriptor, and issue another `socket(3SOCKET)` call to obtain a new descriptor before making another attempt.

EFAULT A parameter cannot be accessed.

EINTR The connect attempt was interrupted before it is completed. The attempt will be established asynchronously.

EINVAL A parameter provided is invalid for this operation.

EISCONN The socket is already connected.

ENETUNREACH The network is not reachable from this host.

ENOBUFS Insufficient memory is available to complete the operation.

EOPNOTSUPP The operation is not supported in this type of socket.

ETIMEDOUT The attempt timed out.

EWOULDBLOCK The socket is marked as non-blocking and the requested operation would block.

Attributes See `attributes(5)` for descriptions of the following attributes:

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See Also `connect(3SOCKET)`, `libsctp(3LIB)`, `sctp_bindx(3SOCKET)`, `sctp_getpaddrs(3SOCKET)`, `socket(3SOCKET)`, `attributes(5)`, `sctp(7P)`
sctp_getladdrs, sctp_freeladdrs – returns all locally bound addresses on an SCTP socket

cc [ flag... ] file... -lsctp -lnsl
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

int sctp_getladdrs(int sock, sctp_assoc_t id, void **addrs);
void sctp_freeladdrs(void *addrs);

The sctp_getladdrs() function queries addresses to which an SCTP socket is bound. The sctp_freeladdrs() function releases resources that are allocated to hold the addresses.

The sctp_getladdrs() function returns all the locally bound addresses on the SCTP socket sock. On completion addrs points to a dynamically allocated array of sockaddr_in structures for an Internet Protocol (IPv4) socket or an array of sockaddr_in6 structures for an Internet Protocol Version 6 (IPv6) socket. The addrs parameter must not be NULL. For an IPv4 SCTP socket, the addresses returned in the sockaddr_in structures are IPv4 addresses. For an IPv6 SCTP socket, the addresses in the sockaddr_in6 structures can be IPv6 addresses or IPv4-mapped IPv6 addresses.

If sock is a one-to-many style SCTP socket, id specifies the association of interest. A value of 0 to id returns locally-bound addresses regardless of a particular association. If sock is a one-to-one style SCTP socket, id is ignored.

The sctp_freeladdrs() function frees the resources allocated by sctp_getladdrs(). The addrs parameter is the array of addresses allocated by sctp_getladdrs().

Upon successful completion, the sctp_getladdrs() function returns the number of addresses in the addrs array. Otherwise, the function returns -1 and sets errno to indicate the error.

The sctp_getladdrs() call fails under the following conditions.

EBADF The sock argument is an invalid file descriptor.
ENOTSOCK The sock argument is not a socket.
EINVAL The addrs argument is NULL.
EINVAL The id argument is an invalid socket.

See attributes(5) for descriptions of the following attributes:

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See Also  bind(3SOCKET), in.h(3HEAD), libsctp(3LIB), sctp_freepaddrs(3SOCKET),
sctp_getpaddrs(3SOCKET), socket(3SOCKET), attributes(5), inet(7P), inet6(7P),
ip(7P), ip6(7P), sctp(7P)
sctp_getpaddrs(3SOCKET)

Name  sctp_getpaddrs, sctp_freepaddrs – returns all peer addresses on an SCTP association

Synopsis  cc [ flag... ] file... -socket -nlsl -lsctp [ library... ]
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

int sctp_getpaddrs(int sock, sctp_assoc_t id, void **addrs);
void sctp_freepaddrs(void *addrs);

Description  The sctp_getpaddrs() queries the peer addresses in an SCTP association. The sctp_freepaddrs() function releases resources that are allocated to hold the addresses.

The sctp_getpaddrs() function returns all the peer addresses in the SCTP association identified by sock. On completion addrs points to a dynamically allocated array of sockaddr_in structures for an Internet Protocol (IPv4) socket or an array of sockaddr_in6 structures for an Internet Protocol Version 6 (IPv6) socket. The addrs parameter must not be NULL. For an IPv4 SCTP socket, the addresses returned in the sockaddr_in structures are IPv4 addresses. For an IPv6 SCTP socket, the addresses in the sockaddr_in6 structures can be IPv6 addresses or IPv4-mapped IPv6 addresses.

If sock is a one-to-many style SCTP socket, id specifies the association of interest. If sock is a one-to-one style SCTP socket, id is ignored.

The sctp_freepaddrs() function frees the resources allocated by sctp_getpaddrs(). The addrs parameter is the array of addresses allocated by sctp_getpaddrs().

Return Values  Upon successful completion, the sctp_getpaddrs() function returns the number of addresses in the addrs array. Otherwise, the function returns -1 and sets errno to indicate the error.

Errors  The sctp_getpaddrs() succeeds unless one of the following conditions exist.

EBADF  The sock argument is an invalid file descriptor.
ENOTSOCK  The sock argument is not a socket.
EINVAL  The addrs argument is NULL.
EINVAL  The id argument is an invalid association identifier for a one-to-many style SCTP socket.
ENOTCONN  The specified socket is not connected.

Attributes  See attributes(5) for descriptions of the following attributes:

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sctp_getpaddrs(3SOCKET)

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See Also  
bind(3SOCKET), in.h(3HEAD), libsctp(3LIB), sctp_freeladdr(3SOCKET),  
sctp_getladdr(3SOCKET), socket(3SOCKET), attributes(5), inet(7P), inet6(7P),  
ip(7P), ip6(7P), sctp(7P)
Name  sctp_opt_info – examine SCTP level options for an SCTP endpoint

Synopsis  cc [ flag... ] file... -lsocket -lnsl -lsctp [ library... ]
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

int sctp_opt_info(int sock, sctp_assoc_t id, int opt, void *arg, socklen_t *len);

Description  The sctp_opt_info() returns SCTP level options associated with the SCTP socket sock. If sock is a one-to-many style socket, id refers to the association of interest. If sock is a one-to-one socket or if sock is a branched-off one-to-many style socket, id is ignored. The opt parameter specifies the SCTP option to get. The arg structure is an option-specific structure buffer allocated by the caller. The len parameter is the length of the option specified.

Following are the currently supported values for the opt parameter. When one of the options below specifies an association id, the id is relevant for only one-to-many style SCTP sockets. The association id can be ignored for one-to-one style or branched-off one-to-many style SCTP sockets.

SCTP_RTOINFO

Returns the protocol parameters used to initialize and bind retransmission timeout (RTO) tunable. The following structure is used to access these parameters:

struct sctp_rtoinfo {
    sctp_assoc_t srto_assoc_id;
    uint32_t srto_initial;
    uint32_t srto_max;
    uint32_t srto_min;
};

where:
	srto_assoc_id Association ID specified by the caller
    srto_initial Initial RTO value
    srto_max Maximum value for the RTO
    srto_min Minimum value for the RTO

SSCTP_ASSOCINFO

Returns association-specific parameters. The following structure is used to access the parameters:

struct sctp_assocparams {
    sctp_assoc_t sasoc_assoc_id;
    uint16_t sasoc_asocmaxrxt;
    uint16_t sasoc_number_peer_destinations;
    uint32_t sasoc_peer_rwnd;
    uint32_t sasoc_local_rwnd;
    uint32_t sasoc_cookie_life;
};

where:
srto_assoc_id | Association ID specified by the caller
sasoc_asocmaxrxt | Maximum retransmission count for the association
sasoc_number_peer_destinations | Number of addresses the peer has
sasoc_peer_rwnd | Current value of the peer’s receive window
sasoc_local_rwnd | Last reported receive window sent to the peer
sasoc_cookie_life | Association cookie lifetime used when issuing cookies

All parameters with time values are in milliseconds.

SCTP_DEFAULT_SEND_PARAM
Returns the default set of parameters used by the sendto() function on this association. The following structure is used to access the parameters:

```c
struct sctp_sndrcvinfo {
    uint16_t sinfo_stream;
    uint16_t sinfo_ssn;
    uint16_t sinfo_flags;
    uint32_t sinfo_ppid;
    uint32_t sinfo_context;
    uint32_t sinfo_timetolive;
    uint32_t sinfo_tsn;
    uint32_t sinfo_cumtsn;
    sctp_assoc_t sinfo_assoc_id;
};
```

where:
- **sinfo_stream**: Default stream for sendmsg()
- **sinfo_ssn**: Always returned as 0
- **sinfo_flags**: Default flags for sendmsg() that include the following:
  - MSG_UNORDERED
  - MSG_ADDR_OVER
  - MSG_ABORT
  - MSG_EOF
  - MSG_PR_SCTP
- **sinfo_ppid**: Default payload protocol identifier for sendmsg()
- **sinfo_context**: Default context for sendmsg()
- **sinfo_timetolive**: Time to live in milliseconds for a message on the sending side. The message expires if the sending side does not start the first transmission for the message within the specified time period. If the sending side starts the first
transmission before the time period expires, the message is sent as a normal reliable message. A value of 0 indicates that the message does not expire. When MSG_PR_SCTP is set in sinfo_flags, the message expires if it is not acknowledged within the time period.

sinfo_tsn Always returned as 0
sinfo_cumtsn Always returned as 0
sinfo_assoc_id Association ID specified by the caller

SCTP_PEER_ADDR_PARAMS
Returns the parameters for a specified peer address of the association. The following structure is used to access the parameters:

```
struct sctp_paddrparams {
    sctp_assoc_t spp_assoc_id;
    struct sockaddr_storage spp_address;
    uint32_t spp_hbinterval;
    uint16_t spp_pathmaxrxt;
    uint32_t spp_pathmtu;
    uint32_t spp_flags;
    uint32_t spp_ipv6_flowlabel;
    uint8_t spp_ipv4_tos;
};
```

where:

spp_assoc_id
Association ID specified by the caller.

spp_address
Peer’s address.

spp_hbinterval
Heartbeat interval in milliseconds.

spp_pathmaxrxt
Maximum number of retransmissions to an address before it is considered unreachable.

spp_pathmtu
The current path MTU of the peer address. It is the number of bytes available in an SCTP packet for chunks. Providing a value of 0 does not change the current setting. If a positive value is provided and SPP_PMTUD_DISABLE is set in spp_flags, the given value is used as the path MTU. If SPP_PMTUD_ENABLE is set in spp_flags, the spp_pathmtu field is ignored.

spp_ipv6_flowlabel
This field is used in conjunction with the SPP_IPV6_FLOWLABEL flag. This setting has precedence over any IPv6 layer setting.
spp_ipv4_tos
This field is used in conjunction with the SPP_IPV4_TOS flag. This setting has precedence over any IPv4 layer setting.

spp_flags
These flags are used to control various features on an association. The flag field is a bit mask which may contain zero or more of the following options:

SPP_HB_ENABLE
Enable heartbeats on the specified address.

SPP_HB_DISABLE
Disable heartbeats on the specified address. Note that SPP_HB_ENABLE and SPP_HB_DISABLE are mutually exclusive, only one of these two should be specified. Enabling both fields will have undetermined results.

SPP_HB_DEMAND
Request a user initiated heartbeat to be made immediately. This must not be used in conjunction with a wildcard address.

SPP_HB_TIME_IS_ZERO
Specifies that the time for heartbeat delay is to be set to the value of 0 milliseconds.

SPP_PMTUD_ENABLE
This field will enable PMTU discovery upon the specified address.

SPP_PMTUD_DISABLE
This field will disable PMTU discovery upon the specified address. Note that if the address field is empty then all addresses on the association are affected. Note also that SPP_PMTUD_ENABLE and SPP_PMTUD_DISABLE are mutually exclusive. Enabling both will have undetermined results.

SPP_IPV6_FLOWLABEL
Setting this flag enables the setting of the IPV6 flowlabel value. The value is obtained in the spp_ipv6_flowlabel field.

Upon retrieval, this flag will be set to indicate that the spp_ipv6_flowlabel field has a valid value returned. If a specific destination address is set (in the spp_address field), the value returned is that of the address. If just an association is specified (and no address), then the association’s default flowlabel is returned. If neither an association nor a destination is specified, then the socket’s default flowlabel is returned. For non IPv6 sockets, this flag will be left cleared.

SPP_IPV4_TOS
Setting this flag enables the setting of the IPV4 TOS value associated with either the association or a specific address. The value is obtained in the spp_ipv4_tos field.

Upon retrieval, this flag will be set to indicate that the spp_ipv4_tos field has a valid value returned. If a specific destination address is set when called (in the spp_address field) then that specific destination address’ TOS value is returned. If just an
association is specified then the association default TOS is returned. If neither an
association nor a destination is specified, then the sockets default TOS is returned.

SCTP_STATUS
Returns the current status information about the association. The following structure is
used to access the parameters:

```c
struct sctp_status {
    sctp_assoc_t sstat_assoc_id;
    int32_t sstat_state;
    uint32_t sstat_rwnd;
    uint16_t sstat_unackdata;
    uint16_t sstat_penddata;
    uint16_t sstat_intrms;
    uint16_t sstat_outstrms;
    uint16_t sstat_fragmentation_point;
    struct sctp_paddrinfo sstat_primary;
};
```

where:

- **sstat_assoc_id**: Association ID specified by the caller
- **sstat_state**: Current state of the association which might be one of the following:
  - SCTP_CLOSED
  - SCTP_BOUND
  - SCTP_LISTEN
  - SCTP_COOKIE_WAIT
  - SCTP_COOKIE_ECHOED
  - SCTP_ESTABLISHED
  - SCTP_SHUTDOWN_PENDING
  - SCTP_SHUTDOWN_SENT
  - SCTP_SHUTDOWN_RECEIVED
  - SCTP_SHUTDOWN_ACK_SENT
- **sstat_rwnd**: Current receive window of the association peer
- **sstat_unackdata**: Number of unacked DATA chunks
- **sstat_penddata**: Number of DATA chunks pending receipt
- **sstat_intrms**: Number of inbound streams
- **sstat_outstrms**: Number of outbound streams
- **sstat_fragmentation_point**: Size at which SCTP fragmentation occurs
- **sstat_primary**: Information about the primary peer address

**sstat_primary** has the following structure

```c
struct sctp_paddrinfo {
    sctp_assoc_t spinfo_assoc_id;
};
```
```c
struct sockaddr_storage spinfo_address;
int32_t spinfo_state;
uint32_t spinfo_cwnd;
uint32_t spinfo_srtt;
uint32_t spinfo_rto;
uint32_t spinfo_mtu;
```

where:

- `spinfo_assoc_id` Association ID specified by the caller
- `spinfo_address` Primary peer address
- `spinfo_state` State of the peer address: `SCTP_ACTIVE` or `SCTP_INACTIVE`
- `spinfo_cwnd` Congestion window of the peer address
- `spinfo_srtt` Smoothed round-trip time calculation of the peer address
- `spinfo_rto` Current retransmission timeout value of the peer address in milliseconds
- `spinfo_mtu` P-MTU of the address

**Return Values**

Upon successful completion, the `sctp_opt_info()` function returns 0. Otherwise, the function returns -1 and sets `errno` to indicate the error.

**Errors**

The `sctp_opt_info()` call fails under the following conditions.

- **EBADF** The `sock` argument is an invalid file descriptor.
- **ENOTSOCK** The `sock` argument is not a socket.
- **EINVAL** The association `id` is invalid for a one-to-many style SCTP socket.
- **EINVAL** The input buffer length is insufficient for the option specified.
- **EINVAL** The peer address is invalid or does not belong to the association.
- **EAFNOSUPPORT** The address family for the peer’s address is other than `AF_INET` or `AF_INET6`.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:
### sctp_opt_info(3SOCKET)

<table>
<thead>
<tr>
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</tr>
</tbody>
</table>

**See Also**  
`in.h(3HEAD), libsctp(3LIB), getsockopt(3SOCKET), setsockopt(3SOCKET), socket(3SOCKET), inet(7P), inet6(7P), ip(7P), ip6(7P), sctp(7P)`
The `sctp_peeloff()` function branches off an existing association from a one-to-many style SCTP socket into a separate socket file descriptor. The resulting branched-off socket is a one-to-one style SCTP socket and is confined to operations allowed on a one-to-one style SCTP socket.

The `sock` argument is a one-to-many socket. The association specified by the `id` argument is branched off `sock`.

Upon successful completion, the `sctp_peeloff()` function returns the file descriptor that references the branched-off socket. The function returns -1 if an error occurs.

The `sctp_peeloff()` function fails under the following conditions.
- **EOPNOTSUPP** The `sock` argument is not a one-to-many style SCTP socket.
- **EINVAL** The `id` is 0 or greater than the maximum number of associations for `sock`.
- **EMFILE** Failure to create a new user file descriptor or file structure.

See attributes(5) for descriptions of the following attributes:

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See Also
- in.h(3HEAD), libsctp(3LIB), socket(3SOCKET), sctp(7P)
Name  sctp_recvmsg – receive message from an SCTP socket

Synopsis  cc [ flag... ] file... -lsctp
               -lsocket -lnsl
             [ library... ]

#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

ssize_t sctp_recvmsg(int s, void *msg, size_t len, struct sockaddr *from, socklen_t *fromlen, struct sctp_sndrcvinfo *sinfo, int *msg_flags);

Description  The sctp_recvmsg() function receives a message from the SCTP endpoint s.

In addition to specifying the message buffer msg and the length len of the buffer, the following parameters can be set:

from  Pointer to an address, filled in with the sender's address

fromlen  Size of the buffer associated with the from parameter

sinfo  Pointer to an sctp_sndrcvinfo structure, filled in upon the receipt of the message

msg_flags  Message flags such as MSG_CTRUNC, MSG_NOTIFICATION, MSG_EOR

The sinfo parameter is filled in only when the caller has enabled sctp_data_io_events by calling setsockopt() with the socket option SCTP_EVENTS.

Return Values  Upon successful completion, the sctp_recvmsg() function returns the number of bytes received. The function returns -1 if an error occurs.

Errors  The sctp_recvmsg() function fails under the following conditions.

EBADF  The s argument is an invalid file descriptor.

ENOTSOCK  The s argument is not a socket.

EOPNOTSUPP  MSG_OOB is set as a flag.

ENOTCONN  There is no established association.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  accept(3SOCKET), bind(3SOCKET), connect(3SOCKET), in.h(3HEAD), libsctp(3LIB), listen(3SOCKET), recvmsg(3SOCKET), sctp_opt_info(3SOCKET), setsockopt(3SOCKET), socket(3SOCKET), socket.h(3HEAD), sctp(7P)
**Name**  
sctp_recvv – receive a message from an SCTP socket

**Synopsis**  
cc [ flag... ] file... -lsocket -lnsl -lsctp [ library... ]
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

ssize_t sctp_recvv(int sd, const struct iovec *iov, int iovlen,
struct sockaddr *from, socklen_t *fromlen, void *info,
socklen_t *infolen, unsigned int *infotype, int *flags);

**Parameters**

- **sd**: The socket descriptor.
- **iov**: The scatter buffer containing the received message.
- **iovlen**: The number of elements in iov.
- **from**: A pointer to a buffer to be filled with the sender address of the received message.
- **fromlen**: The size of the from buffer. Upon return, it is set to the actual size of the sender’s address.
- **info**: A pointer to the buffer to hold the attributes of the received message. The structure type of info is determined by the **infotype** parameter.
- **infolen**: The size of the info buffer. Upon return, it is set to the actual size of returned info buffer.
- **infotype**: The type of the info buffer. The defined values are:
  - SCTP_RECVV_NOINFO: If both SCTP_RECVRCVINFO and SCTP_RECVNXTINFO options are not enabled, no attribute will be returned. If only the SCTP_RECVNXTINFO option is enabled but there is no next message in the buffer, there will also no attribute be returned. In these cases, **infotype** will be set to SCTP_RECVV_NOINFO.
  - SCTP_RECVV_RCINFO: The type of info is struct sctp_rcvinfo and the attribute is about the received message.
  - SCTP_RECVV_NXTINFO: The type of info is struct sctp_nxtinfo and the attribute is about the next message in receive buffer. This is the case when only the SCTP_RECVNXTINFO option is enabled and there is a next message in the buffer.
  - SCTP_RECVV_RN: The type of info is struct sctp_recvv_rn. The recvv_rcvinfo field is the attribute of the received message and the recvv_nxtinfo field is the attribute of the next message in buffer. This is the case when both SCTP_RECVRCVINFO and SCTP_RECVNXTINFO options are enabled and there is a next message in the receive buffer.
flags Flag for receive as in `recvmsg(3SOCKET)`. On return, its value will be different from what was set in to the call. It has the same value as `rcv_flags`.

Description The `sctp_recvv()` function provides an extensible way for the SCTP stack to pass up different SCTP attributes associated with a received message to an application.

There are two types of attributes which can be returned by this call: the attribute of the received message and the attribute of the next message in receive buffer. The caller enables the `SCTP_RECVRCVINFO` and `SCTP_RECVNXTINFO` socket option to receive these attributes respectively. Attributes of the received message are returned in `struct sctp_rcvinfo` and attributes of the next message are returned in `struct sctp_nxtinfo`. If both options are enabled, both attributes are returned using the following structure.

```c
struct sctp_recvv_rn {
    struct sctp_rcvinfo recvv_rcvinfo;
    struct sctp_nxtinfo recvv_nxtinfo;
};
```

The `sctp_rcvinfo` structure is defined as:

```c
struct sctp_rcvinfo {
    uint16_t rcv_sid;
    uint16_t rcv_ssn;
    uint16_t rcv_flags;
    uint32_t rcv_ppid;
    uint32_t rcv_tsn;
    uint32_t rcv_cumtsn;
    uint32_t rcv_context;
    sctp_assoc_t rcv_assoc_id;
};
```

- `rcv_sid` The stream number of the received message.
- `rcv_ssn` The stream sequence number that the peer endpoint assigned to the DATA chunk of this message. For fragmented messages, this is the same number for all deliveries of the message (if more than one `sctp_recvv()`) is needed to read the message).
- `rcv_flags` This field may be set to following values:
  - `SCTP_UNORDERED` This flag is set when the message was sent unordered.
- `rcv_ppid` This value is the same information that is passed by the peer socket to its SCTP stack. The SCTP stack performs no byte order modification of this field.
- `rcv_tsn` The transmission sequence number that the peer endpoint assigned to the received message.
rcv_cumtsn  The current cumulative transmission sequence number of the association known to the SCTP stack.

rcv_assoc_id  The association identifier of the association of the received message. This field applies only to a one-to-many style socket.

rcv_context  This value is an opaque 32 bit context datum that was set by the caller with the SCTP_CONTEXT socket option. This value is passed back to the upper layer if an error occurs on the transmission of a message and is retrieved with each undelivered message.

The sctp_nxtinfo structure is defined as follows:

```c
struct sctp_nxtinfo {
    uint16_t nxt_sid;
    uint16_t nxt_flags;
    uint32_t nxt_ppid;
    size_t nxt_length;
    sctp_assoc_t nxt_assoc_id;
};
```

`nxt_sid`  The stream number of the next message.

`nxt_flags`  This field can contain any of the following flags and is composed of a bitwise OR of the following values:

- **SCTP_UNORDERED**  The next message was sent unordered.
- **SCTP_COMPLETE**  The entire message has been received and is in the socket buffer. This flag has special implications with respect to the `nxt_length` field.
- **SCTP_NOTIFICATION**  The next message is not a user message but instead is a notification.

`nxt_ppid`  This value is the same information that was passed by the peer socket to its SCTP stack when sending the next message. The SCTP stack performs no byte order modification of this field.

`nxt_length`  The length of the message currently received in the socket buffer. This might not be the entire length of the next message since a partial delivery may be in progress. Only if the flag SCTP_COMPLETE is set in the `nxt_flags` field does this field represent the entire next message size.

`nxt_assoc_id`  The association identifier of the association of the next message. This field applies only to a one-to-many style socket.

New structures can be defined to hold new types of attributes. The new structures do not need to be based on `struct sctp_recv_rn` or `struct sctp_rcvinfo`. 
Return Values  Upon successful completion, the `sctp_recvv()` function returns the number of bytes received. The function returns -1 if an error occurs and `errno` is set to indicate the error.

Errors  The `sctp_recvv()` function will fail if:

- **EBADF**  The `sd` parameter is not a valid file descriptor.
- **EFAULT**  A parameter cannot be accessed.
- **EINTR**  The operation was interrupted by delivery of a signal before any data could be buffered to be sent.
- **EINVAL**  A parameter provided is invalid for this operation.
- **ENOBUFS**  Insufficient memory is available to complete the operation.
- **EWOULDBLOCK**  The socket is marked as non-blocking, and the requested operation would block.

Attributes  See attributes(5) for descriptions of the following attributes:

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<td>Safe</td>
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See Also  `libsctp(3LIB), recvmsg(3SOCKET), setsockopt(3SOCKET), socket(3SOCKET), attributes(5), sctp(7P)`
sctp_send() sends messages from one-to-one and one-to-many style SCTP endpoints. The following parameters can be set:

- `s`: Socket created by `socket(3SOCKET)`
- `msg`: Message to be sent
- `len`: Size of the message to be sent in bytes

The caller completes the `sinfo` parameter with values used to send a message. Such values might include the stream number, payload protocol identifier, time to live, and the SCTP message flag and context. For a one-to-many socket, the association ID can be specified in the `sinfo` parameter to send a message to the association represented in the ID.

Flags supported for `sctp_send()` are reserved for future use.

Upon successful completion, the `sctp_send()` function returns the number of bytes sent. The function returns -1 if an error occurs.

The `sctp_send()` function fails under the following conditions:

- **EBADF**: The `s` argument is an invalid file descriptor.
- **ENOTSOCK**: The `s` argument is not a socket.
- **EOPNOTSUPP** or **MSG_ABORT** or **MSG_EOF** is set in the `sinfo_flags` field of `sinfo` for a one-to-one style SCTP socket.
- **EPIPE**: The socket is shutting down and no more writes are allowed.
- **EAGAIN**: The socket is non-blocking and the transmit queue is full.
- **ENOTCONN**: There is no established association.
- **EINVAL**: Control message length is incorrect.
- **EINVAL**: Specified destination address does not belong to the association.
- **EINVAL**: The `stream_no` is outside the number of outbound streams supported by the association.
- **EAFNOSUPPORT**: Address family of the specified destination address is other than AF_INET or AF_INET6.
Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  accept(3SOCKET), bind(3SOCKET), connect(3SOCKET), in.h(3HEAD), libsctp(3LIB),
listen(3SOCKET), sctp_sendmsg(3SOCKET), sendmsg(3SOCKET), socket(3SOCKET),
socket.h(3HEAD), sctp(7P)
Name  sctp_sendmsg – send message from an SCTP socket

Synopsis  cc [ flag... ] file... -lsocket -lnsl -lsctp [ library... ]
          #include <sys/types.h>
          #include <sys/socket.h>
          #include <netinet/sctp.h>

          ssize_t sctp_sendmsg(int s, const void *msg, size_t len,
                               const struct sockaddr *to, socklen_t tolen, uint32_t ppid,
                               uint32_t flags, uint16_t stream_no, uint32_t timetolive,
                               uint32_t context);

Description  The sctp_sendmsg() function sends a message from the SCTP endpoint s.

In addition to specifying msg as the message buffer and len as the length of the buffer, the following parameters can be set:

to  Destination address
tolen  Length of the destination address
ppid  Application-specified payload protocol identifier
stream_no  Target stream for the message
timetolive  Time period in milliseconds after which the message expires if transmission for the message has not been started. A value of 0 indicates that the message does not expire. When the MSG_PR_SCTP flag is set the message expires, even if transmission has started, unless the entire message is transmitted within the timetolive period.
context  Value returned when an error occurs in sending a message

The flags parameter is formed from the bitwise OR of zero or more of the following flags:

MSG_UNORDERED  This flag requests un-ordered delivery of the message. If this flag is clear the message is considered an ordered send.

MSG_ABORT  When set, this flag causes the specified association to abort by sending an ABORT to the peer. The flag is used only for one-to-many style SCTP socket associations.

MSG_EOF  When set, this flag invokes a graceful shutdown on a specified association. The flag is used only for one-to-many style SCTP socket associations.

MSG_PR_SCTP  This flag indicates that the message is treated as partially reliable. The message expires unless the entire message is successfully transmitted within the time period specified in the timetolive parameter.
MSG_PR_SCTP implements timed reliability service for SCTP messages. As yet, no common standard has been defined for the service and the interface is considered unstable.

The initial call to sctp_sendmsg() can be used to create an association, but it cannot be used subsequently on an existing association. Since sctp_sendmsg() always uses 0 internally as the association ID, it is not suitable for use on one-to-many sockets.

Return Values Upon successful completion, the sctp_sendmsg() function returns the number of bytes sent. The function returns -1 if an error occurs.

Errors The sctp_sendmsg() function will fail if:

EBADF The s argument is an invalid file descriptor.
ENOTSOCK The s argument is not a socket.
EOPNOTSUPP MSG_OOB is set as a flag.
EOPNOTSUPP MSG_ABORT or MSG_EOF is set on a one-to-one style SCTP socket.
EPIPE The socket is shutting down and no more writes are allowed.
EAGAIN The socket is non-blocking and the transmit queue is full.
ENOTCONN There is no established association.
EINVAL Control message length is incorrect.
EINVAL Specified destination address does not belong to the association.
EAFNOSUPPORT Address family of the specified destination address is other than AF_INET or AF_INET6.

Attributes See attributes(5) for descriptions of the following attributes:

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See Also accept(3SOCKET), bind(3SOCKET), connect(3SOCKET), in.h(3HEAD), libsctp(3LIB), listen(3SOCKET), sendmsg(3SOCKET), socket(3SOCKET), socket.h(3HEAD), attributes(5), sctp(7P)
sctp_sendv–sendamessagetoanSCTPsocket

cc [ flag... ] file... -lsctp -lnsl -lsctp [ library... ]
#include <sys/types.h>
#include <sys/socket.h>
#include <netinet/sctp.h>

ssize_t sctp_sendv(int sd, const struct iovec *iov, int iovcnt,
 struct sockaddr *addrs, int addrcnt, void *info, socklen_t infolen,
 unsigned int infotype, int flags);

sd
The socket descriptor.

iov
The message to be sent. The data in the buffer are treated as one single user
message.

iovcnt
The number of elements in iov.

addrs
An array of addresses to be used to set up an association or one single address to
be used to send the message. Pass in NULL if the caller does not want to set up an
association nor want to send the message to a specific address.

addrcnt
The number of addresses in the addrs array.

info
A pointer to the buffer containing the attribute associated with the message to be
sent. The type is indicated by info_type parameter.

infolen
The length in bytes of info.

infotype
Identifies the type of the information provided in info. The defined values are:

SCTP_SENDV_SNDINFO
  The type of info is struct sctp_sndinfo.

SCTP_SENDV_PRINFO
  The type of info is struct sctp_prinfo.

SCTP_SENDV_AUTHINFO
  The type of info is struct sctp_authinfo (not supported).

SCTP_SENDV_SPA
  The type of info is struct sctp_sendv_spa.

flags
The same flags as used by sendmsg(3SOCKET) (for example, MSG_DONTROUTE).

Description
The sctp_sendv() function provides an extensible way for an application to communicate
different send attributes to the SCTP stack when sending a message. This function can also be
used to set up an association. The addrs array is similar to the addr array used by
sctp_connectx(3SOCKET).

There are three types of attributes which can be used to describe a message to be sent. They are
represented by struct sctp_sndinfo, struct sctp_prinfo, and struct sctp_authinfo.
The following structure `sctp_sendv_spa` is defined to be used when more than one of the above attributes are needed to describe a message to be sent.

```c
struct sctp_sendv_spa {
    uint32_t sendv_flags;
    struct sctp_sndinfo sendv_sndinfo;
    struct sctp_prinfo sendv_prinfo;
    struct sctp_authinfo sendv_authinfo;
};
```

The `sendv_flags` field holds a bitwise OR of `SCTP_SEND_SNDINFO_VALID`, `SCTP_SEND_PRINFO_VALID`, and `SCTP_SEND_AUTHINFO_VALID`, indicating whether the `sendv_sndinfo`, `sendv_prinfo`, and `sendv_authinfo` fields contain valid information.

The `sctp_sndinfo` structure is defined as:

```c
struct sctp_sndinfo {
    uint16_t snd_sid;
    uint16_t snd_flags;
    uint32_t snd_ppid;
    uint32_t snd_context;
    sctp_assoc_t snd_assoc_id;
};
```

- **snd_sid**: This value holds the stream number to send the message to. If a sender specifies an invalid stream number, an error value is returned and the call fails.

- **snd_flags**: This field is a bitwise OR of the following flags:
  - **SCTP_UNORDERED**: This flag requests the unordered delivery of the message.
  - **SCTP_ADDR_OVER**: This flag requests the SCTP stack to override the primary destination address and send the message to the given address in `addrs`. Only one address can be given in this case. If this flag is not specified and `addrs` is not NULL, this call is treated as a connect request. This flag is applicable to one-to-many style sockets only.
  - **SCTP_ABORT**: Setting this flag causes the specified association to be aborted by sending an ABORT message to the peer. The ABORT message will contain an error cause 'User Initiated Abort' with cause code 12. The specific information the cause of this error is provided in `msg_iov`.
  - **SCTP_EOF**: Setting this flag invokes the SCTP graceful shutdown procedures on the specified association. Graceful shutdown assures that all data queued by both endpoints is successfully transmitted before closing the association.
SCTP_SENDALL
This flag requests that the message is sent to all associations that are currently established on the socket. This flag is applicable to one-to-many style sockets only.

snd_ppid
An unsigned integer that is passed to the remote end in each user message (SCTP DATA chunk). The SCTP stack performs no byte order modification of this field. For example, if the DATA chunk has to contain a given value in network byte order, the SCTP user has to perform the htonl(3SOCKET) computation.

snd_context
This value is an opaque 32 bit context datum. It is passed back to the caller if an error occurs on the transmission of the message and is retrieved with each undelivered message.

snd_assoc_id
When sending a message, this holds the identifier for the association which the message is sent to. When this call is used to set up an association, the association identifier of the newly created association is returned in this field. This field is applicable to one-to-many style sockets only.

The sctp_prinfo structure is defined as:

```c
struct sctp_prinfo {
    uint16_t pr_policy;
    uint32_t pr_value;
};
```

pr_policy
This field specifies which partial reliability (PR-SCTP) policy is used to send the message. If it is SCTP_PR_SCTP_NONE, the message is sent reliably (the default is normal send). If it is SCTP_PR_SCTP_TTL, “timed reliability” as defined in RFC 3758 is used. In this case, the lifetime is provided in pr_value.

pr_value
The meaning of this field depends on the PR-SCTP policy specified by the pr_policy field. It is ignored when SCTP_PR_SCTP_NONE is specified. In case of SCTP_PR_SCTP_TTL, this field specifies the lifetime in milliseconds of the message.

When new send attributes are needed, new structures can be defined. Those new structures do not need to be based on any of the above defined structures.

The struct sctp_sndinfo attribute for one-to-many style sockets must always be used in order to specify the association the message is to be sent to. The only case where it is not needed is when this call is used to set up a new association.

The caller provides a list of addresses in the addrs parameter to set up an association. This function will behave like calling sctp_connectx(), first using the list of addresses, and then calling sendmsg() with the given message and attributes. For an one-to-many style socket, if a struct sctp_sndinfo attribute is provided, the snd_assoc_id field must be 0. When this
function returns, the `snd_assoc_id` field will contain the association identifier of the newly established association. The `struct sctp_sndinfo` attribute is not required to set up an association for one-to-many style sockets. If this attribute is not provided, the caller can enable the `SCTP_ASSOC_CHANGE` notification and use the `SCTP_COMM_UP` message to find out the association identifier.

If the caller wants to send the message to a specific peer address (overriding the primary address), it can provide the specific address in the `addr` parameter and provide a `struct sctp_sndinfo` attribute with the `snd_flags` field set to `SCTP_ADDR_OVER`.

This function can also be used to terminate an association. The caller provides an `sctp_sndinfo` attribute with the `snd_flags` set to `SCTP_EOF`. In this case, the length of the message would be zero.

Sending a message using `sctp_sendv()` is atomic unless explicit EOR marking is enabled on the socket specified by `sd`.

**Return Values**

Upon successful completion, the number of bytes sent is returned. Otherwise, -1 is returned and `errno` is set to indicate the error.

**Errors**
The `sctp_sendv()` function will fail if:

- **EADDRINUSE** The address is already in use.
- **EADDRNOTAVAIL** No local address is available for this operation.
- **EAFNOSUPPORT** Addresses in the specified address family cannot be used with this socket.
- **EBADF** The `sd` parameter is not a valid file descriptor.
- **ECONNREFUSED** The attempt to connect was forcefully rejected. The calling program should close the socket descriptor using `close()` and issue another `socket()` call to obtain a new descriptor before making another attempt.
- **EFAULT** A parameter cannot be accessed.
- **EINTR** The operation was interrupted by delivery of a signal before any data could be buffered to be sent.
- **EINVAL** A parameter provided is invalid for this operation.
- **EMSGSIZE** The message is too large to be sent all at once.
- **ENETUNREACH** The network is not reachable from this host.
- **ENOBUFS** Insufficient memory is available to complete the operation.
- **EOPNOTSUPP** Operation not supported in this type of socket.
- **EPIPE** The peer end point has shutdown the association.
ETIMEDOUT  Attempt timed out.
EWOULDBLOCK  The socket is marked as non-blocking, and the requested operation would block.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  htonl(3SOCKET), libsctp(3LIB), sctp_connectx(3SOCKET), sendmsg(3SOCKET), socket(3SOCKET), attributes(5), sctp(7P)
**Name**

`sdp_add_origin`, `sdp_add_name`, `sdp_add_information`, `sdp_add_uri`, `sdp_add_email`, `sdp_add_phone`, `sdp_add_connection`, `sdp_add_bandwidth`, `sdp_add_repeat`, `sdp_add_time`, `sdp_add_zone`, `sdp_add_key`, `sdp_add_attribute`, `sdp_add_media` – add specific SDP fields to the SDP session structure.

**Synopsis**

```c
cc [ flag...] file... -lcommputil [ library...]
#include <sdp.h>

int sdp_add_origin(sdp_session_t *session, const char *name,
                    uint64_t id, uint64_t ver, const char *nettype,
                    const char *addrtype, const char *address);

int sdp_add_name(sdp_session_t *session, const char *name);

int sdp_add_information(char **information, const char *value);

int sdp_add_uri(sdp_session_t *session, const char *uri);

int sdp_add_email(sdp_session_t *session, const char *email);

int sdp_add_phone(sdp_session_t *session, const char *phone);

int sdp_add_connection(sdp_conn_t **conn, const char *nettype,
                        const char *addrtype, const char *address,
                        uint8_t ttl, int addrcount);

int sdp_add_bandwidth(sdp_bandwidth_t **bw, const char *type,
                      uint64_t value);

int sdp_add_repeat(sdp_time_t *time, uint64_t interval,
                   uint64_t duration, const char *offset);

int sdp_add_time(sdp_session_t *session, uint64_t starttime,
                 uint64_t stoptime, sdp_time_t **time);

int sdp_add_zone(sdp_session_t *session, uint64_t time,
                 const char *offset);

int sdp_add_key(sdp_key_t **key, const char *method,
                const char *enckey);

int sdp_add_attribute(sdp_attr_t **attr, const char *name,
                       const char *value);

int sdp_add_media(sdp_session_t *session, const char *name,
                  uint_t port, int portcount, const char *protocol,
                  const char *format, sdp_media_t **media);
```

**Description**

The caller has to first call `sdp_new_session(3COMMPUTIL)` and get pointer to a session structure. Then that pointer is used as argument in the following functions and the session structure is constructed. Once the structure is built the caller converts it to a string representation using `sdp_session_to_str(3COMMPUTIL)`. 
The `sdp_add_origin()` function adds ORIGIN (o=) SDP field to the session structure (sdp_session_t) using `name`, `id`, `ver`, `nettype`, `addrtype`, and `address`.

The `sdp_add_name()` function adds NAME (s=) SDP field to the session structure (sdp_session_t) using `name`.

The `sdp_add_information()` function adds INFO (i=) SDP field to the session structure (sdp_session_t) or media structure (sdp_media_t) using value. Since this field can be either in the media section or the session section of an SDP description the caller has to pass `&session→s_info` or `&media→m_info` as the first argument.

The `sdp_add_uri()` function adds URI (u=) SDP field to the session structure (sdp_session_t) using `uri`.

The `sdp_add_email()` function adds EMAIL (e=) SDP field to the session structure (sdp_session_t) using `email`.

The `sdp_add_phone()` function adds PHONE (p=) SDP field to the session structure (sdp_session_t) using `phone`.

The `sdp_add_connection()` function adds CONNECTION (c=) SDP field to the session structure (sdp_session_t) or the media structure (sdp_media_t) using `nettype`, `addrtype`, `address`, `ttl`, and `addrcount`. While adding an IP4 or IP6 unicast address the `ttl` and `addrcount` should be set to 0. For multicast address the `ttl` should be set a reasonable value (0 - 255) and `addrcount` cannot be 0. Also since this field can be either in the media section or the session section of an SDP description, the caller has to pass `&session→s_conn` or `&media→m_conn` as the first argument.

The `sdp_add_bandwidth()` function adds BANDWIDTH (b=) SDP field to the session structure (sdp_session_t) or the media structure (sdp_media_t) using `type` and `value`. Since this field can be either in the media section or the session section of an SDP description, the caller has to pass `&session→s_bw` or `&media→m_bw` as the first argument.

The `sdp_add_time()` function adds the TIME (t=) SDP field to the session structure using `startime` and `stoptime`. The pointer to the newly created time structure is returned in `time`. This pointer is then used in `sdp_add_repeat()` function.

The `sdp_add_repeat()` function adds the REPEAT (r=) SDP field to the session structure using interval, duration and offset. Here, offset is a string holding one or more offset values, for example "60" or "60 1d 3h".

The `sdp_add_zone()` function adds the ZONE (z=) SDP field to the session structure using `time` and `offset`. To add multiple time and offset values in a single zone field, call this function once for each pair. See the example below.

The `sdp_add_key()` function adds the KEY (k=) SDP field to the session structure (sdp_session_t) or media structure (sdp_media_t) using `method` and `enckey`. Since this field can be either in the media section or the session section of an SDP description, the caller has to pass `&session→s_key` or `&media→m_key` as the first argument.
The `sdp_add_attribute()` function adds the ATTRIBUTE (a=) SDP field to the session structure (`sdp_session_t`) or media structure (`sdp_media_t`) using `name` and `value`. Since this field can be either in the media section or the session section of an SDP description, the caller has to pass `&session→s_attr` or `&media→m_attr` as the first argument.

The `sdp_add_media()` function adds the MEDIA (m=) SDP field to the session structure (`sdp_session_t`) using `name`, `port`, `portcount`, `protocol`, and `format`. Here, `format` is a string holding possibly more than one value, for example, “0 31 32 97”. The pointer to the newly created media structure is returned in `media`. This pointer is then used to add SDP fields specific to that media section.

**Return Values** These functions return 0 on success and the appropriate error value on failure. The value of `errno` is not changed by these calls in the event of an error.

**Errors** These functions will fail if:

- **EINVAL** Mandatory parameters are not provided (they are null).
- **ENOMEM** The allocation of memory failed.

**Examples**

**EXAMPLE 1** Build an SDP session structure

In the following example we see how to build an SDP session structure using the functions described on this manual page. We first get a pointer to `sdp_session_t` structure by calling `sdp_new_session()`. Then to this newly created structure we add various SDP fields. Once the structure is built we obtain a string representation of the structure using `sdp_session_to_str()` function. Since its caller responsibility to free the session we call `sdp_free_session()` towards the end.

```c
/* SDP Message we will be building */
v=0\r\n
o=Alice 2890844526 2890842807 IN IP4 10.47.16.5\r\n
s=-\r\n
i=A Seminar on the session description protocol\r\n
u=http://www.example.com/seminars/sdp.pdf\r\n
E=alice@example.com (Alice Smith)\r\n
p=+1 911-345-1160\r\n
c=IN IP4 10.47.16.5\r\n
b=CT:1024\r\n
t=2854678930 2854679000\r\n
r=604800 3600 0 90000\r\n
a=recvonly\r\n
m=audio 49170 RTP/AVP 0\r\n
i=audio media\r\n
b=CT:1000\r\n
k=prompt\r\n
m=video 51372 RTP/AVP 99 90\r\n
i=video media\r\n
```

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EXAMPLE 1 Build an SDP session structure (Continued)

a=rtpmap:99 h232-199/90000\n
a=rtpmap:90 h263-1998/90000\n
*/

#include stdio.h
#include string.h
#include errno.h
#include sdp.h

int main ()
{
    sdp_session_t *my_sess;
    sdp_media_t *my_media;
    sdp_time_t *my_time;
    char *b_sdp;

    my_sess = sdp_new_session();
    if (my_sess == NULL) {
        return (ENOMEM);
    }

    my_sess->version = 0;
    if (sdp_add_name(my_sess, "-")) != 0)
        goto err_ret;

    if (sdp_add_origin(my_sess, "Alice", 2890844526ULL, 2890842807ULL,
                       "IN", "IP4", "10.47.16.5") != 0)
        goto err_ret;

    if (sdp_add_information(&my_sess->s_info, "A Seminar on the session"  
                             "description protocol") != 0)
        goto err_ret;

    if (sdp_add_uri (my_sess, "http://www.example.com/seminars/sdp.pdf")
             != 0)
        goto err_ret;

    if (sdp_add_email(my_sess, "alice@example.com (Alice smith)") != 0)
        goto err_ret;

    if (sdp_add_phone(my_sess, "+1 911-345-1160") != 0)
        goto err_ret;

    if (sdp_add_connection(&my_sess->s_conn, "IN", "IP4", "10.47.16.5", 
                           0, 0) != 0)
        goto err_ret;

    if (sdp_add_bandwidth(&my_sess->s_bw, "CT", 1024) != 0)
        goto err_ret;

    if (sdp_add_time(my_sess, 2854678930ULL, 2854679000ULL, &my_time)
                    != 0)
        goto err_ret;

    if (sdp_add_repeat(my_time, 604800ULL, 3600ULL, "0 90000") != 0)
EXAMPLE 1  Build an SDP session structure  (Continued)

    goto err_ret;
    if (sdp_add_zone(my_sess, 288284526ULL, "-1h") != 0)
        goto err_ret;
    if (sdp_add_zone(my_sess, 2898848070ULL, "0h") != 0)
        goto err_ret;
    if (sdp_add_attribute(&my_sess->s_attr, "sendrecv", NULL) != 0)
        goto err_ret;
    if (sdp_add_media(my_sess, "audio", 49170, 1, "RTP/AVP",
                     0, &my_media) != 0)
        goto err_ret;
    if (sdp_add_information(&my_media->m_info, "audio media") != 0)
        goto err_ret;
    if (sdp_add_bandwidth(&my_media->m_bw, "CT", 1000) != 0)
        goto err_ret;
    if (sdp_add_key(&my_media->m_key, "prompt", NULL) != 0)
        goto err_ret;
    if (sdp_add_media(my_sess, "video", 51732, 1, "RTP/AVP",
                     "99 90", &my_media) != 0)
        goto err_ret;
    if (sdp_add_information(&my_media->m_info, "video media") != 0)
        goto err_ret;
    if (sdp_add_attribute(&my_media->m_attr, "rtpmap",
                          "99 h232-199/90000") != 0)
        goto err_ret;
    if (sdp_add_attribute(&my_media->m_attr, "rtpmap",
                          "90 h263-1998/90000") != 0)
        goto err_ret;
    b_sdp = sdp_session_to_str(my_sess, &error);
    /*
     * b_sdp is the string representation of my_sess structure
     */
    free(b_sdp);
    sdp_free_session(my_sess);
    return (0);

err_ret:
    free(b_sdp);
    sdp_free_session(my_sess);
    return (1);
}

Attributes  See attributes(5) for descriptions of the following attributes:
ATTRIBUTES

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
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</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  
libcommputil(3LIB), sdp_new_session(3COMMPUTIL), sdp_parse(3COMMPUTIL), sdp_session_to_str(3COMMPUTIL), attributes(5)
sdp_clone_session – clone an SDP session structure

### Synopsis

```
cc [ flag...] file... -lcommputil [ library...]
#include <sdp.h>

sdp_session_t *sdp_clone_session(const sdp_session_t *session);
```

### Description

The `sdp_clone_session()` function clones the input SDP session structure and returns the cloned structure. The resulting cloned structure has all the SDP fields from the input structure. The caller is responsible for freeing the returned cloned structure using `sdp_free_session()`, described on the `sdp_new_session(3COMMPUTIL)` manual page.

### Return Values

The `sdp_clone_session()` function returns the cloned structure on success and NULL on failure.

### Attributes

See `attributes(5)` for descriptions of the following attributes:

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</tr>
</tbody>
</table>

### See Also

`libcommputil(3LIB), sdp_new_session(3COMMPUTIL), attributes(5)`
sdp_delete_all_field(3COMMPUTIL)

**Name**
sdp_delete_all_field, sdp_delete_all_media_field – delete all SDP fields

**Synopsis**
cc [ flag...] file... -lcommputil [ library...]
#include <sdp.h>

    int sdp_delete_all_field(sdp_session_t *session,
                      const char field);

    int sdp_delete_all_media_field(sdp_media_t *media,
                      const char field);

**Description**
The `sdp_delete_all_field()` function deletes all the occurrences of the specified SDP field from the session structure. For example, if the session structure has 3 bandwidth (b=) fields, then when this function is called with `SDP_BANDWIDTH_FIELD`, all the three bandwidth fields are deleted from the session structure.

The `sdp_delete_all_media_field()` function deletes all the occurrences of the specified SDP field from the specified media structure. For example, if the caller wants to delete all the attribute fields in a media structure, calling this function with `SDP_ATTRIBUTE_FIELD` argument would delete all the attribute fields in the media structure.

**Return Values**
Upon successful completion, these functions return 0. Otherwise, the appropriate error value is returned. The value of `errno` is not changed by these calls in the event of an error.

**Errors**
These functions will fail if:

    EINVAL     The `session` or `media` argument is NULL or the field type is unknown.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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</tbody>
</table>

**See Also**
libcommputil(3LIB), attributes(5)
sdp_delete_media(3COMMPUTIL)

Name  
sdp_delete_media, sdp_delete_attribute – delete the specified media or attribute from the appropriate list

Synopsis  
cc [ flag...] file... -lcommputil [ library...
#include <sdp.h>

int sdp_delete_media(sdp_media_t **l_media, sdp_media_t *media);
int sdp_delete_attribute(sdp_attr_t **l_attr, sdp_attr_t *attr);

Description  
The sdp_delete_media() function deletes the specified media from the media list. It is similar to deleting a node in a linked list. The function first finds the media that needs to be deleted using sdp_find_media(3COMMPUTIL). The found media is then passed to sdp_delete_media() to delete it. The function frees the memory allocated to media structure after deleting it.

The sdp_delete_attribute() function deletes the specified attribute from the attribute list. It is similar to deleting a node in a linked list. The function first finds the attribute that needs to be deleted using sdp_find_media_rtpmap(3COMMPUTIL) or sdp_find_attribute(3COMMPUTIL). The found attribute is then passed to sdp_delete_attribute() to delete it. The function frees the memory allocated to attribute structure after deleting it.

Return Values  
Upon successful completion, these functions return 0. Otherwise, the appropriate error value is returned. The value of errno is not changed by these calls in the event of an error.

Errors  
These functions will fail if:

EINVAL  
The mandatory input parameters are not provided or are NULL.

Attributes  
See attributes(5) for descriptions of the following attributes:

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</tbody>
</table>

See Also  
libcommputil(3LIB), sdp_find_attribute(3COMMPUTIL),
sdp_find_media(3COMMPUTIL), sdp_find_media_rtpmap(3COMMPUTIL),
attributes(5)
Name  sdp_find_attribute – find the attribute from the attribute list

Synopsis  cc [ flag...] file... -lcommputil [ library...]

#include <sdp.h>

sdp_attr_t *sdp_find_attribute(sdp_attr_t *attr, const char *name);

Description  The sdp_find_attribute() function searches the attribute list attr for the specified attribute name. If the attribute is found it returns the pointer to that attribute. Otherwise it returns NULL.

Return Values  The sdp_find_attribute() function returns the attribute (sdp_attr_t *) on success and NULL when the search fails or when mandatory input parameters are NULL.

Examples  EXAMPLE 1  An (incomplete) SDP description that contains one media section: audio.

m=audio 49170 RTP/AVP 0 8
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
a=sendonly
a=ptime:10000
a=maxptime:20000

/*
 * Assuming that above description is parsed using sdp_parse and that
 * the parsed structure is in "session" sdp_session_t structure.
 */

sdp_attr_t *ptime;
sdp_attr_t *max_ptime;
sdp_media_t *media = session->s_media;

if ((ptime = sdp_find_attribute(media->m_attr,"ptime")) == NULL)
   /* ptime attribute not present */
else if((max_ptime = sdp_find_attribute(media->m_attr,"maxptime")) == NULL)
   /* max_ptime attribute not present */

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
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<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>
See Also  libcommputil(3LIB), sdp_parse(3COMMPUTIL), attributes(5)
Name  sdp_find_media – find the specified media from the media list

Synopsis  cc [ flag...] file... -lcommputil [ library...]

#include <sdp.h>

sdp_media_t *sdp_find_media(sdp_media_t *media, const char *name);

Description  The sdp_find_media() function searches the media list for the media specified by name. If the media is found it returns the pointer to the media. Otherwise it returns NULL.

Return Values  The sdp_find_media() function returns the media (sdp_media_t *) on success and NULL when the search fails or the mandatory input parameters are NULL.

Examples  EXAMPLE 1  An (incomplete) SDP description that contains two media sections: audio and video.

m=audio 49170 RTP/AVP 0 8
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
m=video 51372 RTP/AVP 31 32
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000

/*
 * Assuming that above description is parsed using sdp_parse() and that
 * the parsed structure is in "session" sdp_session_t structure.
 */

sdp_media_t *my_media;
my_media = sdp_find_media(session->s_media, "video");

/*
 * my_media now points to the structure containing video media section
 * information
 */

Attributes  See attributes(5) for descriptions of the following attributes:

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</tbody>
</table>

See Also  libcommputil(3LIB), sdp_parse(3COMMPUTIL), attributes(5)
**Name**  
sdp_find_media_rtpmap – find the rtpmap attribute in the specified media

**Synopsis**  
cc [ flag...] file... -lcommputil [ library...]

```
#include <sdp.h>

sdp_attr_t *sdp_find_media_rtpmap(sdp_media_t *media, const char *format);
```

**Description**  
The `sdp_find_media_rtpmap` function searches the attribute list of the specified media structure, `media`, for the specified `format`. If the search is successful a pointer to that `rtpmap` attribute is returned. Otherwise it returns `NULL`.

**Return Values**  
The `sdp_find_media_rtpmap` function returns the attribute (`sdp_attr_t *`) on success and `NULL` when the search fails or the mandatory input parameters are `NULL`.

**Examples**  
**EXAMPLE 1**  
An (incomplete) SDP description that contains two media sections: audio and video.

```
m=audio 49170 RTP/AVP 0 8
a=rtpmap:0 PCMU/8000
a=rtpmap:8 PCMA/8000
m=video 51372 RTP/AVP 31 32
a=rtpmap:31 H261/90000
a=rtpmap:32 MPV/90000
```

```
/*
 * Assuming that above description is parsed using sdp_parse() and that
 * the parsed structure is in "session" sdp_session_t structure.
 */

sdp_media_t  *video;
sdp_attr_t   *mpv;

video = sdp_find_media(session->s_media, "video);
mpv = sdp_find_media_rtpmap(video, "32");
```

```
/*
 * Now the attribute structure sdp_attr_t, mpv will be having
 * values from the attribute field "a=rtpmap:32 MPV/90000"
 */
```

**Attributes**  
See attributes(5) for descriptions of the following attributes:

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</table>
See Also  libcommputil(3LIB), sdp_parse(3COMMPUTIL), attributes(5)
sdp_new_session, sdp_free_session – allocate a new SDP session structure

Synopsis

cc [ flag...] file... -lcommputil [ library...]  
#include <sdp.h>

sdp_session_t *sdp_new_session();
void sdp_free_session(sdp_session_t *session);

Description

The `sdp_new_session()` function allocates memory for an SDP session structure specified by `session`, assigns a version number to the session structure, and returns a new session structure. It is the responsibility of the user to free the memory allocated to the session structure using the `sdp_free_session()` function.

The `sdp_free_session()` function destroys the SDP session structure and frees the resources associated with it.

Return Values

The `sdp_new_session()` function returns the newly allocated SDP session structure on success and `NULL` on failure.

Attributes

See `attributes(5)` for descriptions of the following attributes:

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</tbody>
</table>

See Also

`libcommputil(3LIB), attributes(5)`
The `sdp_parse()` function parses the SDP description present in `sdp_info` and populates the `sdp_session_t` structure. The `len` argument specifies the length of the character buffer `sdp_info`. The `flags` argument is not used, but must be set to 0, otherwise the call fails with the error value of `EINVAL` and `*session` set to `NULL`. The function allocates the memory required for the `sdp_session_t` structure and hence the caller is responsible for freeing the parsed session structure (`sdp_session_t`) using `sdp_free_session()`, described on the `sdp_new_session(3COMMPUTIL)` manual page.

The `p_error` argument identifies any field that had a parsing error. It cannot be `NULL` and can take any of the following values:

- `SDP_VERSION_ERROR`          0x00000001
- `SDP_ORIGIN_ERROR`           0x00000002
- `SDP_NAME_ERROR`             0x00000004
- `SDP_INFO_ERROR`             0x00000008
- `SDP_URI_ERROR`              0x00000010
- `SDP_EMAIL_ERROR`            0x00000020
- `SDP_PHONE_ERROR`            0x00000040
- `SDP_CONNECTION_ERROR`       0x00000080
- `SDP_BANDWIDTH_ERROR`        0x00000100
- `SDP_TIME_ERROR`             0x00000200
- `SDP_REPEAT_TIME_ERROR`      0x00000400
- `SDP_ZONE_ERROR`             0x00000800
- `SDP_KEY_ERROR`              0x00001000
- `SDP_ATTRIBUTE_ERROR`        0x00002000
- `SDP_MEDIA_ERROR`            0x00004000
- `SDP_FIELDS_ORDER_ERROR`     0x00008000
- `SDP_MISSING_FIELDS`         0x00010000
RFC 4566 states that the fields in the SDP description need to be in a strict order. If the fields are not in the order specified in the RFC, SDP_FIELDS_ORDER_ERROR will be set.

RFC 4566 mandates certain fields to be present in SDP description. If those fields are missing then SDP_MISSING_FIELDS will be set.

Applications can check for presence of parsing error using the bit-wise operators.

If there was an error on a particular field, that field information will not be in the sdp_session_t structure. Also, parsing continues even if there was a field with a parsing error.

The sdp_session_t structure is defined in the header file <sdp.h> and contains the following members:

```c
typedef struct sdp_session {
    int sdp_session_version; /* SDP session version */
    int s_version; /* SDP version field */
    sdp_origin_t *s_origin; /* SDP origin field */
    char *s_name; /* SDP name field */
    char *s_info; /* SDP info field */
    char *s_uri; /* SDP uri field */
    sdp_list_t *s_email; /* SDP email field */
    sdp_list_t *s_phone; /* SDP phone field */
    sdp_conn_t *s_conn; /* SDP connection field */
    sdp_bandwidth_t *s_bw; /* SDP bandwidth field */
    sdp_time_t *s_time; /* SDP time field */
    sdp_zone_t *s_zone; /* SDP zone field */
    sdp_key_t *s_key; /* SDP key field */
    sdp_attr_t *s_attr; /* SDP attribute field */
    sdp_media_t *s_media; /* SDP media field */
} sdp_session_t;
```

The sdp_session_version member is used to track the version of the structure. Initially it is set to SDP_SESSION_VERSION_1 (= 1).

The sdp_origin_t structure contains the following members:

```c
typedef struct sdp_origin {
    char *o_username; /* username of the originating host */
    uint64_t o_id; /* session id */
    uint64_t o_version; /* version number of this session */
    /* description */
    char *o_nettype; /* type of network */
    char *o_addrtype; /* type of the address */
    char *o_address; /* address of the machine from which */
    /* session was created */
} sdp_origin_t;
```

The sdp_conn_t structure contains the following members:
typedef struct sdp_conn {
    char *c_nettype; /* type of network */
    char *c_addrtype; /* type of the address */
    char *c_address; /* unicast-address or multicast */
    /* address */
    int c_addrcount; /* number of addresses (case of */
    /* multicast address with layered */
    /* encodings */
    struct sdp_conn *c_next; /* pointer to next connection */
    /* structure; there could be several */
    /* connection fields in SDP description */
    uint8_t c_ttl; /* TTL value for IPV4 multicast address */
} sdp_conn_t;

The sdp_bandwidth_t structure contains the following members:

typedef struct sdp_bandwidth {
    char *b_type; /* info needed to interpret b_value */
    uint64_t b_value; /* bandwidth value */
    struct sdp_bandwidth *b_next; /* pointer to next bandwidth structure*/
    /* (there could be several bandwidth */
    /* fields in SDP description */
} sdp_bandwidth_t;

The sdp_list_t structure is a linked list of void pointers. This structure holds SDP fields like email and phone, in which case the void pointers point to character buffers. It to hold information in cases where the number of elements is not predefined (for example, offset (in repeat field) where void pointer holds integer values or format (in media field) where void pointers point to character buffers). The sdp_list_t structure is defined as:

typedef struct sdp_list {
    void *value; /* string values in case of email, phone and */
    /* format (in media field) or integer values */
    /* in case of offset (in repeat field) */
    struct sdp_list *next; /* pointer to the next node in the list */
} sdp_list_t;

The sdp_repeat_t structure contains the following members:

typedef struct sdp_repeat {
    uint64_t r_interval; /* repeat interval, e.g. 86400 seconds */
    /* (1 day) */
    uint64_t r_duration; /* duration of session, e.g. 3600 */
    /* seconds (1 hour) */
    sdp_list_t *r_offset; /* linked list of offset values; each */
    /* represents offset from start-time */
    /* in SDP time field */
    struct sdp_repeat *r_next; /* pointer to next repeat structure; */
    /* there could be several repeat */
    /* fields in SDP description */
}
The `sdp_repeat_t` structure will always be part of the time structure `sdp_time_t`, since the repeat field does not appear alone in SDP description and is always associated with the time field.

The `sdp_time_t` structure contains the following members:

```c
typedef struct sdp_time {
    uint64_t t_start; /* start-time for a session */
    uint64_t t_stop; /* end-time for a session */
    sdp_repeat_t *t_repeat; /* points to the SDP repeat field */
    struct sdp_time *t_next; /* pointer to next time field; there */
        /* could be several time */
        /* fields in SDP description */
} sdp_time_t;
```

The `sdp_zone_t` structure contains the following members:

```c
typedef struct sdp_zone {
    uint64_t z_time; /* base time */
    char *z_offset; /* offset added to z_time to determine */
        /* session time; mainly used for daylight */
        /* saving time conversions */
    struct sdp_zone *z_next; /* pointer to next zone field; there */
        /* could be several <adjustment-time> */
        /* <offset> pairs within a zone field */
} sdp_zone_t;
```

The `sdp_key_t` structure contains the following members:

```c
typedef struct sdp_key {
    char *k_method; /* key type */
    char *k_enckey; /* encryption key */
} sdp_key_t;
```

The `sdp_attr_t` structure contains the following members:

```c
typedef struct sdp_attr {
    char *a_name; /* name of the attribute */
    char *a_value; /* value of the attribute */
    struct sdp_attr *a_next; /* pointer to the next attribute */
        /* structure; there could be several */
        /* attribute fields within SDP description */
} sdp_attr_t;
```

The `sdp_media_t` structure contains the following members:

```c
typedef struct sdp_media {
    char *m_name; /* name of the media such as "audio", */
        /* "video", "message" */
    uint_t m_port; /* transport layer port information */
    int m_portcount; /* number of ports in case of */
```
/* hierarchically encoded streams */
char *m_proto; /* transport protocol */
sdp_list_t *m_format; /* media format description */
char *m_info; /* media info field */
sdp_conn_t *m_conn; /* media connection field */
sdp_bandwidth_t *m_bw; /* media bandwidth field */
sdp_key_t *m_key; /* media key field */
sdp_attr_t *m_attr; /* media attribute field */
struct sdp_media *m_next; /* pointer to next media structure */
sdp_session_t *m_session; /* pointer to the session structure */
} sdp_media_t;

Return Values  The sdp_parse() function returns 0 on success and the appropriate error value on failure. The value of errno is not changed by these calls in the event of an error.

Errors  The sdp_parse() function will fail if:

EINVAL   Arguments to the function were invalid.
ENOMEM    Memory allocation failed while parsing sdp_info.

Examples  EXAMPLE1  sdp_parse() example

If the SDP description was

v=0
o=jdoe 23423423 234234234 IN IP4 192.168.1.1
s=SDP seminar
i=A seminar on the session description protocol
n=test@host.com
c=IN IP4 156.78.90.1
n=t=2873397496 2873404696

then after call to sdp_parse() function the sdp_session_t structure would be

sdp_session_t

session {
  s_version = 1
  s_version = 0
  s_origin {
    o_username = "jdoe"
    o_id = 23423423ULL
    o_version = 234234234ULL
    o_nettype = "IN"
    o_addrtype = "IP4"
    o_address = "192.168.1.1"
  }
  s_name = "SDP seminar"
  s_info = "A seminar on the session description protocol"
**EXAMPLE 1  sdp_parse() example  (Continued)**

```c
s_uri = (nil)
s_email {
    value = "test@host.com"
    next = (nil)
}
s_phone = (nil)
s_conn {
    c_nettype = "IN"
    c_addrtype = "IP4"
    c_address = "156.78.90.1"
    c_addrcount = 0
    c_ttl = 0
    c_next = (nil)
}
s_bw = (nil)
s_time {
    t_start = 2873397496ULL
    t_stop = 2873404696ULL
    t_repeat = (nil)
    t_next = (nil)
}
s_zone = (nil)
s_key = (nil)
s_attr = (nil)
s_media = (nil)
```

**Attributes**  See attributes(5) for descriptions of the following attributes:

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</tbody>
</table>

**See Also**  libcommputil(3LIB), sdp_new_session(3COMMPUTIL), attributes(5)
**Name**  
`sdp_session_to_str` - return a string representation of a session structure

**Synopsis**  
```c
cc [ flag...] file... -lcommputil [ library...]
#include <sdp.h>

char *sdp_session_to_str(const sdp_session_t *session,
                        int *error);
```

**Description**  
The `sdp_session_to_str()` function returns the string representation of the SDP session structure `session`. The caller is responsible for freeing the returned string.

The function adds a CRLF at the end of each SDP field before appending that field to the string.

**Return Values**  
The `sdp_session_to_str()` function returns the relevant string on success and `NULL` otherwise.

If `error` is non-null, the location pointed by `error` is set to 0 on success or the error value on failure. The value of `errno` is not changed by these calls in the event of an error.

**Errors**  
The `sdp_session_to_str()` function will fail if:

- `EINVAL` The input is null.
- `ENOMEM` A memory allocation failure occurred.

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

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</tbody>
</table>

**See Also**  
`libcommputil(3LIB), attributes(5)`
secure_rpc(3NSL)

Name  secure_rpc, authdes_getucred, authdes_seccreate, getnetname, host2netname, key_decryptsession, key_encryptsession, key_gendes, key_setsecret, key_secretkey_is_set, netname2host, netname2user, user2netname – library routines for secure remote procedure calls

Synopsis  cc [ flag... ] file... -lnsl [ library...]
#include <rpc/rpc.h>
#include <sys/types.h>

int authdes_getucred(const struct authdes_cred *adc, uid_t *uidp, gid_t *gidp, short *gidlenp, gid_t *gidlist);

AUTH *authdes_seccreate(const char *name, const uint_t window, const char *timehost, ckey);

int getnetname(char name[MAXNETNAMELEN+1]);

int host2netname(char name[MAXNETNAMELEN+1], const char *host, const char *domain);

int key_decryptsession(const char *remotename, des_block *deskey);

int key_encryptsession(const char *remotename, des_block *deskey);

int key_gendes(des_block *deskey);

int key_setsecret(const char *key);

int key_secretkey_is_set(void)

int netname2host(const char *name, char *host, const int hostlen);

int netname2user(const char *name, uid_t *uidp, gid_t *gidp, int *gidlenp, gid_t *gidlist [NGRPS]);

int user2netname(char name[MAXNETNAMELEN+1], const uid_t uid, const char *domain);

Description  The RPC library functions allow C programs to make procedure calls on other machines across the network.

RPC supports various authentication flavors. Among them are:

AUTH_NONE  No authentication (none).
AUTH_SYS  Traditional UNIX-style authentication.
AUTH_DES  DES encryption-based authentication.

The authdes_getucred() and authdes_seccreate() functions implement the AUTH_DES authentication style. The keyserver daemon keyserv(1M) must be running for the AUTH_DES authentication system to work and keylogin(1) must have been run. The AUTH_DES style of
authentication is discussed here. For information about the AUTH_NONE and AUTH_SYS flavors of authentication, refer to rpc_clnt_auth(3NSL). See rpc(3NSL) for the definition of the AUTH data structure.

The following functions documented on this page are MT-Safe. For the MT-levels of other authentication styles, see relevant man pages.

authdes_getucred() This is the first of two functions that interface to the RPC secure authentication system AUTH_DES. The second is the authdes_seccreate() function. The authdes_getucred() function is used on the server side to convert an AUTH_DES credential, which is operating system independent, to an AUTH_SYS credential. The authdes_getucred() function returns 1 if it succeeds, 0 if it fails.

The *uidp parameter is set to the user's numerical ID associated with adc. The *gidp parameter is set to the numerical ID of the user's group. The *gidlist parameter contains the numerical IDs of the other groups to which the user belongs. The *gidlenp parameter is set to the number of valid group ID entries specified by the *gidlist parameter.

The authdes_getucred() function fails if the authdes_cred structure was created with the netname of a host. In such a case, netname2host() should be used to get the host name from the host netname in the authdes_cred structure.

authdes_seccreate() The second of two AUTH_DES authentication functions, the authdes_seccreate() function is used on the client side to return an authentication handle that enables the use of the secure authentication system. The first field, name, specifies the network name netname of the owner of the server process. The field usually represents a hostname derived from the host2netname() utility, but the field might also represent a user name converted with the user2netname() utility.

The second field, window, specifies the validity of the client credential in seconds. If the difference in time between the client's clock and the server's clock exceeds window, the server rejects the client's credentials and the clock will have to be resynchronized. A small window is more secure than a large one, but choosing too small a window increases the frequency of resynchronization due to clock drift.

The third parameter, timehost, is the host's name and is optional. If timehost is NULL, the authentication system
assumes that the local clock is always in sync with the `timehost` clock and does not attempt resynchronization. If a timehost is supplied, the system consults the remote time service whenever resynchronization is required. The `timehost` parameter is usually the name of the host on which the server is running.

The final parameter, `ckey`, is also optional. If `ckey` is NULL, the authentication system generates a random DES key to be used for the encryption of credentials. If `ckey` is supplied, it is used for encryption.

If `authdes_seccreate()` fails, it returns NULL.

`getnetname()` This function returns the unique, operating system independent netname of the caller in the fixed-length array `name`. The function returns 1 if it succeeds and 0 if it fails.

`host2netname()` This function converts a domain-specific hostname `host` to an operating system independent netname. The function returns 1 if it succeeds and 0 if it fails. The `host2netname()` function is the inverse of the `netname2host()` function. If the `domain` is NULL, `host2netname()` uses the default domain name of the machine. If `host` is NULL, it defaults to that machine itself. If `domain` is NULL and `host` is an NIS name such as `myhost.sun.example.com`, the `host2netname()` function uses the domain `sun.example.com` rather than the default domain name of the machine.

`key_decryptsession()` This function is an interface to the keyserver daemon, which is associated with RPC's secure authentication system (AUTH_DES authentication). User programs rarely need to call `key_decryptsession()` or the associated functions `key_encryptsession()`, `key_gendes()`, and `key_setsecret()`.

The `key_decryptsession()` function takes a server netname `remotename` and a DES key `deskey`, and decrypts the key by using the the public key of the server and the secret key associated with the effective UID of the calling process. The `key_decryptsession()` function is the inverse of `key_encryptsession()` function.

`key_encryptsession()` This function is a keyserver interface that takes a server netname `remotename` and a DES key `deskey`, and encrypts the key using the public key of the the server and the secret key
associated with the effective UID of the calling process. If the
keyserver does not have a key registered for the UID, it falls
back to using the secret key for the netname nobody unless this
feature has been disabled. See keyserv(1M). The
\texttt{key\_encryptsession()} function is the inverse of
\texttt{key\_decryptsession()} function. The
\texttt{key\_encryptsession()} function returns 0 if it succeeds, \texttt{-1} if it fails.

\texttt{key\_gendes()}

This is a keyserver interface function used to ask the keyserver
for a secure conversation key. Selecting a conversion key at
random is generally not secure because the common ways of
choosing random numbers are too easy to guess. The
\texttt{key\_gendes()} function returns 0 if it succeeds, \texttt{-1} if it fails.

\texttt{key\_setsecret()}

This is a keyserver interface function used to set the key for the
effective UID of the calling process. This function returns 0 if it
succeeds, \texttt{-1} if it fails.

\texttt{key\_secretkey\_is\_set()}

This is a keyserver interface function used to determine if a key
has been set for the effective UID of the calling process. If the
keyserver has a key stored for the effective UID of the calling
process, the \texttt{key\_secretkey\_is\_set()} function returns 1.
Otherwise it returns 0.

\texttt{netname2host()}

This function converts an operating system independent
netname \texttt{name} to a domain-specific hostname \texttt{host}. The
\texttt{hostlen} parameter is the maximum size of \texttt{host}. The
\texttt{netname2host()} function returns 1 if it succeeds and 0 if it
fails. The function is the inverse of the \texttt{host2netname()} function.

\texttt{netname2user()}

This function converts an operating system independent
netname to a domain-specific user ID. The \texttt{netname2user()} function returns 1 if it succeeds and 0 if it fails. The function is
the inverse of the \texttt{user2netname()} function.

The \texttt{*uidp} parameter is set to the user’s numerical ID
associated with \texttt{name}. The \texttt{*gidp} parameter is set to the
numerical ID of the user’s group. The \texttt{gidlist} parameter
contains the numerical IDs of the other groups to which the
user belongs. The \texttt{*gidlenp} parameter is set to the number of
valid group ID entries specified by the \texttt{gidlist} parameter.

\texttt{user2netname()}

This function converts a domain-specific username to an
operating system independent netname. The \texttt{user2netname()} function returns 1 if it succeeds and 0 if it fails. The function is
the inverse of `netname2user()` function.

**Attributes**  
See attributes(5) for descriptions of the following attributes:

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</table>

**See Also**  
chkey(1), keylogin(1), keyserv(1M), newkey(1M), rpc(3NSL), rpc_clnt_auth(3NSL), attributes(5)
The `send()`, `sendto()`, and `sendmsg()` functions are used to transmit a message to another transport end-point. The `send()` function can be used only when the socket is in a connected state. See `connect(3SOCKET)`. The `sendto()` and `sendmsg()` functions can be used at any time. The socket is created with `socket(3SOCKET)`.

The address of the target is supplied by `to` with a `tolen` parameter used to specify the size. The length of the message is supplied by the `len` parameter. For socket types such as `SOCK_DGRAM` and `SOCK_RAW` that require atomic messages, the error `EMSGSIZE` is returned and the message is not transmitted when it is too long to pass atomically through the underlying protocol. The same restrictions do not apply to `SOCK_STREAM` sockets.

A return value `−1` indicates locally detected errors. It does not imply a delivery failure.

If the socket does not have enough buffer space available to hold a message, the `send()` function blocks the message, unless the socket has been placed in non-blocking I/O mode (see `fcntl(2)`). The `select(3C)` or `poll(2)` call can be used to determine when it is possible to send more data.

The `flags` parameter is formed from the bitwise OR of zero or more of the following:

- **MSG_OOB** Send out-of-band data on sockets that support this notion. The underlying protocol must also support out-of-band data. Only `SOCK_STREAM` sockets created in the `AF_INET` or the `AF_INET6` address family support out-of-band data.

- **MSG_DONTROUTE** The `SO_DONTROUTE` option is turned on for the duration of the operation. It is used only by diagnostic or routing programs.

See `recv(3SOCKET)` for a description of the `msghdr` structure.

Upon successful completion, these functions return the number of bytes sent. Otherwise, they return `−1` and set `errno` to indicate the error.

The `send()`, `sendto()`, and `sendmsg()` functions return errors under the following conditions:

- **EBADF** `s` is not a valid file descriptor.
The operation was interrupted by delivery of a signal before any data could be buffered to be sent.

The message is too large to be sent all at once (as the socket requires), or the `msg_iovlen` member of the `msghdr` structure pointed to by `message` is less than or equal to 0 or is greater than `IOV_MAX`.

Insufficient memory is available to complete the operation.

Insufficient STREAMS resources are available for the operation to complete.

`s` is not a socket.

The socket is marked non-blocking and the requested operation would block. `EWOULDBLOCK` is also returned when sufficient memory is not immediately available to allocate a suitable buffer. In such a case, the operation can be retried later.

The requested connection was refused by the peer. For connected IPv4 and IPv6 datagram sockets, this indicates that the system received an ICMP Destination Port Unreachable message from the peer in response to some prior transmission.

The `send()` and `sendto()` functions return errors under the following conditions:

- **EINVAL** The `len` argument overflows a `ssize_t`.
  
  Inconsistent port attributes for system call.

The `sendto()` function returns errors under the following conditions:

- **EINVAL** The value specified for the `tolen` parameter is not the size of a valid address for the specified address family.

- **EISCON** A destination address was specified and the socket is already connected.

The `sendmsg()` function returns errors under the following conditions:

- **EINVAL** The `msg_iovlen` member of the `msghdr` structure pointed to by `msg` is less than or equal to 0, or the sum of the `iov_len` values in the `msg_iov` array overflows a `ssize_t`.

  One of the `iov_len` values in the `msg_iov` array member of the `msghdr` structure pointed to by `msg` is negative, or the sum of the `iov_len` values in the `msg_iov` array overflows a `ssize_t`.

  `msg_iov` contents are inconsistent with port attributes.

The `send()` function returns errors under the following conditions:
The socket is shut down for writing, or the socket is connection–mode and is no longer connected. In the latter case, if the socket is of type SOCK_STREAM, the SIGPIPE signal is generated to the calling thread.

Attributes

See attributes(5) for descriptions of the following attributes:

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See Also

fcntl(2), poll(2), write(2), connect(3SOCKET), getsockopt(3SOCKET), recv(3SOCKET), select(3C), socket(3SOCKET), socket(3HEAD), attributes(5)
send – send a message on a socket

Synopsis

```
cc [ flag ... ] file ... -lxnet [ library ... ]
#include <sys/socket.h>
ssize_t send(int socket, const void *buffer, size_t length, int flags);
```

Parameters

- `socket` Specifies the socket file descriptor.
- `buffer` Points to the buffer containing the message to send.
- `length` Specifies the length of the message in bytes.
- `flags` Specifies the type of message transmission. Values of this argument are formed by logically OR'ing zero or more of the following flags:
  - `MSG_EOR` Terminates a record (if supported by the protocol)
  - `MSG_OOB` Sends out-of-band data on sockets that support out-of-band communications. The significance and semantics of out-of-band data are protocol-specific.

Description

The `send()` function initiates transmission of a message from the specified socket to its peer. The `send()` function sends a message only when the socket is connected (including when the peer of a connectionless socket has been set via `connect(3XNET)`).

The length of the message to be sent is specified by the `length` argument. If the message is too long to pass through the underlying protocol, `send()` fails and no data is transmitted.

Successful completion of a call to `send()` does not guarantee delivery of the message. A return value of -1 indicates only locally-detected errors.

If space is not available at the sending socket to hold the message to be transmitted and the socket file descriptor does not have `O_NONBLOCK` set, `send()` blocks until space is available. If space is not available at the sending socket to hold the message to be transmitted and the socket file descriptor does have `O_NONBLOCK` set, `send()` will fail. The `select(3C)` and `poll(2)` functions can be used to determine when it is possible to send more data.

The socket in use may require the process to have appropriate privileges to use the `send()` function.

Usage

The `send()` function is identical to `sendto(3XNET)` with a null pointer `dest_len` argument, and to `write()` if no flags are used.

Return Values

Upon successful completion, `send()` returns the number of bytes sent. Otherwise, -1 is returned and `errno` is set to indicate the error.

Errors

The `send()` function will fail if:
The send() function may fail if:
EACCES The calling process does not have the appropriate privileges.
EIO An I/O error occurred while reading from or writing to the file system.
ENETDOWN The local interface used to reach the destination is down.
ENETUNREACH No route to the network is present.
ENOBUSFS Insufficient resources were available in the system to perform the operation.
ENOSR There were insufficient STREAMS resources available for the operation to complete.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  connect(3XNET), getsockopt(3XNET), poll(2), recv(3XNET), recvfrom(3XNET), recvmsg(3XNET), select(3C), sendmsg(3XNET), sendto(3XNET), setsockopt(3XNET), shutdown(3XNET), socket(3XNET), attributes(5), standards(5)
The `sendmsg()` function sends a message through a connection-mode or connectionless-mode socket. If the socket is connectionless-mode, the message will be sent to the address specified by `msghdr`. If the socket is connection-mode, the destination address in `msghdr` is ignored.

The `msg_iov` and `msg_iovlen` fields of `msghdr` specify zero or more buffers containing the data to be sent. `msg_iov` points to an array of `iovec` structures; `msg_iovlen` must be set to the dimension of this array. In each `iovec` structure, the `iov_base` field specifies a storage area and the `iov_len` field gives its size in bytes. Some of these sizes can be zero. The data from each storage area indicated by `msg_iov` is sent in turn.

Successful completion of a call to `sendmsg()` does not guarantee delivery of the message. A return value of −1 indicates only locally-detected errors.

If space is not available at the sending socket to hold the message to be transmitted and the socket file descriptor does not have O_NONBLOCK set, `sendmsg()` function blocks until space is available. If space is not available at the sending socket to hold the message to be transmitted and the socket file descriptor does have O_NONBLOCK set, `sendmsg()` function will fail.

If the socket protocol supports broadcast and the specified address is a broadcast address for the socket protocol, `sendmsg()` will fail if the SO_BROADCAST option is not set for the socket.

The socket in use may require the process to have appropriate privileges to use the `sendmsg()` function.
**Usage**
The `select(3C)` and `poll(2)` functions can be used to determine when it is possible to send more data.

**Return Values**
Upon successful completion, `sendmsg()` function returns the number of bytes sent. Otherwise, −1 is returned and `errno` is set to indicate the error.

**Errors**
The `sendmsg()` function will fail if:

- **EAGAIN**
  - The socket's file descriptor is marked `O_NONBLOCK` and the requested operation would block.

- **EWOULDBLOCK**
  - Addresses in the specified address family cannot be used with this socket.

- **EAFNOSUPPORT**
  - The `socket` argument is not a valid file descriptor.

- **EWOULDBLOCK**
  - A connection was forcibly closed by a peer.

- **EFAULT**
  - The message parameter, or storage pointed to by the `msg_name`, `msg_control` or `msg_iov` fields of the `message` parameter, or storage pointed to by the `iovec` structures pointed to by the `msg_iov` field can not be accessed.

- **EINTR**
  - A signal interrupted `sendmsg()` before any data was transmitted.

- **EINVAL**
  - The sum of the `iov_len` values overflows an `ssize_t`.

- **EMSGSIZE**
  - The message is too large to be sent all at once (as the socket requires), or the `msg_iov` member of the `msghdr` structure pointed to by `message` is less than or equal to 0 or is greater than `IOV_MAX`.

- **ENOTCONN**
  - The socket is connection-mode but is not connected.

- **ENOTSOCK**
  - The `socket` argument does not refer 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**
  - The socket is shut down for writing, or the socket is connection-mode and is no longer connected. In the latter case, and if the socket is of type `SOCK_STREAM`, the SIGPIPE signal is generated to the calling thread.

If the address family of the socket is `AF_UNIX`, then `sendmsg()` will fail if:

- **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.

The sendmsg() function may fail if:
EACCES  Search permission is denied for a component of the path prefix; or write access to the named socket is denied.
EDESTADDRREQ  The socket is not connection-mode and does not have its peer address set, and no destination address was specified.
EHOSTUNREACH  The destination host cannot be reached (probably because the host is down or a remote router cannot reach it).
EIO  An I/O error occurred while reading from or writing to the file system.
EISCONN  A destination address was specified and the socket is already connected.
ENETDOWN  The local interface used to reach the destination is down.
ENETUNREACH  No route to the network is present.
ENOBUFFS  Insufficient resources were available in the system to perform the operation.
ENOMEM  Insufficient memory was available to fulfill the request.
ENOSR  There were insufficient STREAMS resources available for the operation to complete.

If the address family of the socket is AF_UNIX, then sendmsg() may fail if:
ENAMETOOLONG  Pathname resolution of a symbolic link produced an intermediate result whose length exceeds PATH_MAX.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  poll(2), getsockopt(3XNET), recv(3XNET), recvfrom(3XNET), recvmsg(3XNET), select(3C), send(3XNET), sendto(3XNET), setsockopt(3XNET), shutdown(3XNET), socket(3XNET), attributes(5), standards(5)
**sendto**

**Synopsis**
```c
#include <sys/socket.h>

ssize_t sendto(int socket, const void *message, size_t length, int flags, const struct sockaddr *dest_addr, socklen_t dest_len);
```

**Description**
The `sendto()` function sends a message through a connection-mode or connectionless-mode socket. If the socket is connectionless-mode, the message will be sent to the address specified by `dest_addr`. If the socket is connection-mode, `dest_addr` is ignored.

If the socket protocol supports broadcast and the specified address is a broadcast address for the socket protocol, `sendto()` will fail if the `SO_BROADCAST` option is not set for the socket.

The `dest_addr` argument specifies the address of the target. The `length` argument specifies the length of the message.

Successful completion of a call to `sendto()` does not guarantee delivery of the message. A return value of −1 indicates only locally-detected errors.

If space is not available at the sending socket to hold the message to be transmitted and the socket file descriptor does not have `O_NONBLOCK` set, `sendto()` blocks until space is available. If space is not available at the sending socket to hold the message to be transmitted and the socket file descriptor does have `O_NONBLOCK` set, `sendto()` will fail.

The socket in use may require the process to have appropriate privileges to use the `sendto()` function.

**Parameters**
The function takes the following arguments:

- **socket**
  Specifies the socket file descriptor.

- **message**
  Points to a buffer containing the message to be sent.

- **length**
  Specifies the size of the message in bytes.

- **flags**
  Specifies the type of message transmission. Values of this argument are formed by logically OR'ing zero or more of the following flags:

  - MSG_EOR  Terminates a record (if supported by the protocol)
  - MSG_OOB  Sends out-of-band data on sockets that support out-of-band data. The significance and semantics of out-of-band data are protocol-specific.

- **dest_addr**
  Points to a `sockaddr` structure containing the destination address. The length and format of the address depend on the address family of the socket.

- **dest_len**
  Specifies the length of the `sockaddr` structure pointed to by the `dest_addr` argument.
The `select(3)` and `poll(2)` functions can be used to determine when it is possible to send more data.

Upon successful completion, `sendto()` returns the number of bytes sent. Otherwise, –1 is returned and `errno` is set to indicate the error.

The `sendto()` function will fail if:

- `EAFNOSUPPORT`: Addresses in the specified address family cannot be used with this socket.
- `EAGAIN`: The socket's file descriptor is marked `O_NONBLOCK` and the requested operation would block.
- `EBAADF`: The `socket` argument is not a valid file descriptor.
- `ECONNRESET`: A connection was forcibly closed by a peer.
- `EFAULT`: The `message` or `destaddr` parameter cannot be accessed.
- `EINTR`: A signal interrupted `sendto()` before any data was transmitted.
- `EMSGSIZE`: The message is too large to be sent all at once, as the socket requires.
- `ENOTCONN`: The socket is connection-mode but is not connected.
- `ENOTSOCK`: The `socket` argument does not refer to 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`: The socket is shut down for writing, or the socket is connection-mode and is no longer connected. In the latter case, and if the socket is of type `SOCK_STREAM`, the SIGPIPE signal is generated to the calling thread.

If the address family of the socket is `AF_UNIX`, then `sendto()` will fail if:

- `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.

The `sendto()` function may fail if:
EACCES     Search permission is denied for a component of the path prefix; or write access to the named socket is denied.
EDESTADDRREQ The socket is not connection-mode and does not have its peer address set, and no destination address was specified.
EHOSTUNREACH The destination host cannot be reached (probably because the host is down or a remote router cannot reach it).
EINVAL     The dest_len argument is not a valid length for the address family.
EIO         An I/O error occurred while reading from or writing to the file system.
EISCONN     A destination address was specified and the socket is already connected.
ENETDOWN    The local interface used to reach the destination is down.
ENETUNREACH No route to the network is present.
ENOBFS      Insufficient resources were available in the system to perform the operation.
ENOMEM      Insufficient memory was available to fulfill the request.
ENOSR       There were insufficient STREAMS resources available for the operation to complete.

If the address family of the socket is AF_UNIX, then sendto() may fail if:
ENAMETOOLONG Pathname resolution of a symbolic link produced an intermediate result whose length exceeds PATH_MAX.

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See Also  poll(2), getsockopt(3XNET), recv(3XNET), recvfrom(3XNET), recvmsg(3XNET), select(3C), send(3XNET), sendmsg(3XNET), setsockopt(3XNET), shutdown(3XNET), socket(3XNET), attributes(5), standards(5)
#setsockopt()

The `setsockopt()` function sets the option specified by the `option_name` argument, at the protocol level specified by the `level` argument, to the value pointed to by the `option_value` argument for the socket associated with the file descriptor specified by the `socket` argument.

The `level` argument specifies the protocol level at which the option resides. To set options at the socket level, specify the `level` argument as `SOL_SOCKET`. To set options at other levels, supply the appropriate protocol number for the protocol controlling the option. For example, to indicate that an option will be interpreted by the TCP (Transport Control Protocol), set `level` to the protocol number of TCP, as defined in the `<netinet/in.h>` header, or as determined by using `getprotobyname(3XNET)`.

The `option_name` argument specifies a single option to set. The `option_name` argument and any specified options are passed uninterpreted to the appropriate protocol module for interpretations. The `<sys/socket.h>` header defines the socket level options. The options are as follow:

- **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. This is a boolean option.
- **SO_BROADCAST**: Permits sending of broadcast messages, if this is supported by the protocol. This option takes an `int` value. This is a boolean option.
- **SO_REUSEADDR**: Specifies that the rules used in validating addresses supplied to `bind(3XNET)` should allow reuse of local addresses, if this is supported by the protocol. This option takes an `int` value. This is a boolean option.
- **SO_KEEPALIVE**: Keeps connections active by enabling the periodic transmission of messages, if this is supported by the protocol. This option takes an `int` value.
  
  If the connected socket fails to respond to these messages, the connection is broken and threads writing to that socket are notified with a SIGPIPE signal.

  This is a boolean option.

- **SO_LINGER**: Lingers on a `close(2)` if data is present. This option controls the action taken when unsent messages queue on a socket and `close(2)` is performed. If `SO_LINGER` is set, the system blocks the process during `close(2)` until it can transmit the data or until the time expires. If
SO_LINGER is not specified, and close(2) is issued, the system handles the call in a way that allows the process to continue as quickly as possible. This option takes a linger structure, as defined in the <sys/socket.h> header, to specify the state of the option and linger interval.

SO_OOBINLINE Leaves received out-of-band data (data marked urgent) in line. This option takes an int value. This is a boolean option.

SO_SNDBUF Sets send buffer size. This option takes an int value.

SO_RCVBUF Sets receive buffer size. This option takes an int value.

SO_DONTROUTE Requests that outgoing messages bypass the standard routing facilities. The destination must be on a directly-connected network, and messages are directed to the appropriate network interface according to the destination address. The effect, if any, of this option depends on what protocol is in use. This option takes an int value. This is a boolean option.

SO_MAC_EXEMPT Sets the mandatory access control on the socket. A socket that has this option enabled can communicate with an unlabeled peer if the socket is in the global zone or has a label that dominates the default label of the peer. Otherwise, the socket must have a label that is equal to the default label of the unlabeled peer. SO_MAC_EXEMPT is a boolean option that is available only when the system is configured with Trusted Extensions.

SO_ALLZONES Bypasses zone boundaries (privileged). This option stores an int value. This is a boolean option.

The SO_ALLZONES option can be used to bypass zone boundaries between shared-IP zones. Normally, the system prevents a socket from being bound to an address that is not assigned to the current zone. It also prevents a socket that is bound to a wildcard address from receiving traffic for other zones. However, some daemons which run in the global zone might need to send and receive traffic using addresses that belong to other shared-IP zones. If set before a socket is bound, SO_ALLZONES causes the socket to ignore zone boundaries between shared-IP zones and permits the socket to be bound to any address assigned to the shared-IP zones. If the socket is bound to a wildcard address, it receives traffic intended for all shared-IP zones and behaves as if an equivalent socket were bound in each active shared-IP zone. Applications that use the SO_ALLZONES option to initiate connections or send datagram traffic should specify the source address for outbound traffic by binding to a specific address. There is no effect from setting this option in an exclusive-IP zone. Setting this option requires the sys_net_config privilege. See zones(5).
For boolean options, 0 indicates that the option is disabled and 1 indicates that the option is enabled.

Options at other protocol levels vary in format and name.

**Usage** The `setsockopt()` function provides an application program with the means to control socket behavior. An application program can use `setsockopt()` to allocate buffer space, control timeouts, or permit socket data broadcasts. The `<sys/socket.h>` header defines the socket-level options available to `setsockopt()`.

Options may exist at multiple protocol levels. The `SO_` options are always present at the uppermost socket level.

**Return Values** Upon successful completion, `setsockopt()` returns 0. Otherwise, –1 is returned and `errno` is set to indicate the error.

**Errors** The `setsockopt()` function will fail if:

- **EBADF** The `socket` argument is not a valid file descriptor.
- **EDOM** The send and receive timeout values are too big to fit into the timeout fields in the socket structure.
- **EFAULT** The `option_value` parameter cannot be accessed or written.
- **EINVAL** The specified option is invalid at the specified socket level or the socket has been shut down.
- **EISCONN** The socket is already connected, and a specified option cannot be set while the socket is connected.
- **ENOPROTOOPT** The option is not supported by the protocol.
- **ENOTSOCK** The `socket` argument does not refer to a socket.

The `setsockopt()` function may fail if:

- **ENOMEM** There was insufficient memory available for the operation to complete.
- **ENOBUFS** Insufficient resources are available in the system to complete the call.
- **ENOSR** There were insufficient STREAMS resources available for the operation to complete.

**Attributes** See attributes(5) for descriptions of the following attributes:

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</table>

See Also  bind(3XNET), endprotoent(3XNET), getsockopt(3XNET), socket(3XNET), attributes(5), standards(5)
The `shutdown()` call shuts down all or part of a full-duplex connection on the socket associated with `s`. If `how` is `SHUT_RD`, further receives are disallowed. If `how` is `SHUT_WR`, further sends are disallowed. If `how` is `SHUT_RDWR`, further sends and receives are disallowed.

The `how` values should be defined constants.

Return Values

0 is returned if the call succeeds.

−1 is returned if the call fails.

Errors

The call succeeds unless one of the following conditions exists:

- `EBADF`: The `s` value is not a valid file descriptor.
- `ENOMEM`: Insufficient user memory is available for the operation to complete.
- `ENOSR`: Insufficient STREAMS resources are available for the operation to complete.
- `ENOTCONN`: The specified socket is not connected.
- `ENOTSOCK`: The `s` value is not a socket.

Attributes

See `attributes(5)` for descriptions of the following attributes:

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See Also `connect(3SOCKET), socket(3SOCKET), socket.h(3HEAD), attributes(5)`
The `shutdown()` function disables subsequent `send()` and `receive()` operations on a socket, depending on the value of the `how` argument.

**Parameters**
- `how` Specifies the type of shutdown. The values are as follows:
  - `SHUT_RD` Disables further receive operations.
  - `SHUT_WR` Disables further send operations.
  - `SHUT_RDWR` Disables further send and receive operations.
- `socket` Specifies the file descriptor of the socket.

**Return Values**
Upon successful completion, `shutdown()` returns 0. Otherwise, −1 is returned and `errno` is set to indicate the error.

**Errors**
The `shutdown()` function will fail if:
- `EBADF` The `socket` argument is not a valid file descriptor.
- `EINVAL` The `how` argument is invalid.
- `ENOTCONN` The socket is not connected.
- `ENOTSOCK` The `socket` argument does not refer to a socket.

The `shutdown()` function may fail if:
- `ENOBUFFS` Insufficient resources were available in the system to perform the operation.
- `ENOSR` There were insufficient STREAMS resources available for the operation to complete.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>
See Also  
getsockopt(3XNET), recv(3XNET), recvfrom(3XNET), recvmsg(3XNET), select(3C), 
send(3XNET), sendto(3XNET), setsockopt(3XNET), socket(3XNET), attributes(5), 
standards(5)
Name  sip_add_branchid_to_via – add a branch parameter to the topmost VIA header in the SIP message

Synopsis  
```c
#include <sip.h>

int sip_add_branchid_to_via(sip_msg_t sip_msg, char *branchid);
```

Description  The `sip_add_branchid_to_via()` function adds a branch param to the topmost VIA header in the SIP message `sip_msg`. Note that a new header is created as a result of adding the branch parameter and the old header is marked deleted. Applications with multiple threads working on the same VIA header need to take note of this.

Return Values  These functions return 0 on success and the appropriate error value on failure.

Errors  On failure, functions that return an error value may return one of the following:

- **EINVAL**  Mandatory parameters are not provided or are NULL.
  
  For `sip_add_branchid_to_via()`, the topmost VIA header already has a branch param or the SIP message does not have a VIA header.

- **EPERM**  The message cannot be modified.

- **ENOMEM**  There is an error allocating memory for creating headers/parameters.

Attributes  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  `libsip(3LIB)`
Name
sip_add_from, sip_add_to, sip_add_contact, sip_add_via, sip_add_maxforward,
sip_add_callid, sip_add_cseq, sip_add_content_type, sip_add_content, sip_add_accept,
sip_add_accept_enc, sip_add_accept_lang, sip_add_alert_info, sip_add_allow,
sip_add_call_info, sip_add_content_disp, sip_add_content_enc, sip_add_content_lang,
sip_add_date, sip_add_error_info, sip_addExpires, sip_add_in_reply_to,
sip_add_mimetype_version, sip_add_min_expires, sip_add_org, sip_add_priority,
sip_add_reply_to, sip_add_passertedid, sip_add_preferedid, sip_add_require,
sip_add_retry_after, sip_add_route, sip_add_record_route, sip_add_server, sip_add_subject,
sip_add_supported, sip_add_tstamp, sip_add_unsupported, sip_add_user_agent,
sip_add_warning, sip_add_rseq, sip_add_privacy, sip_add_ack, sip_add_author,
sip_add_authen_info, sip_add_proxy_authen, sip_add_proxy_author,
sip_add_proxy_require, sip_add_world_authen, sip_add_allow_events, sip_add_event,
sip_add_substate – add specific SIP headers to the SIP message

Synopsis
cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

int sip_add_from(sip_msg_t sip_msg, char *display_name, char *from_uri,    
    char *from_tag, boolean_t add_aquot, char *from_params);
int sip_add_to(sip_msg_t sip_msg, char *display_name, char *to_uri,        
    char *to_tag, boolean_t add_aquot, char *to_params);
int sip_add_contact(sip_msg_t sip_msg, char *display_name,                
    char *contact_uri, boolean_t add_aquot, char *contact_params);
int sip_add_via(sip_msg_t sip_msg, char *sent_protocol_transport,        
    char *sent_by_host, int sent_by_port, char *via_params);
int sip_add_maxforward(sip_msg_t sip_msg, uint_t maxforward);
int sip_add_callid(sip_msg_t sip_msg, char *callid);
int sip_add_cseq(sip_msg_t sip_msg, sip_method_t method, uint32_t cseq);
int sip_add_content_type(sip_msg_t sip_msg, char *type, char *subtype);
int sip_add_content(sip_msg_t sip_msg, char *content);
int sip_add_accept(sip_msg_t sip_msg, char *type, char *subtype,       
    char *media_param, char *accept_param);
int sip_add_accept_enc(sip_msg_t sip_msg, char *code,                    
    char *param);
int sip_add_accept_lang(sip_msg_t sip_msg, char *lang,                  
    char *param);
int sip_add_alert_info(sip_msg_t sip_msg, char *alert,                 
    char *param);
int sip_add_allow(sip_msg_t sip_msg, sip_method_t method_name);
int sip_add_call_info(sip_msg_t sip_msg, char *uri, 
    char *param);
int sip_add_content_disp(sip_msg_t sip_msg, char *dis_type, char *param);
int sip_add_content_enc(sip_msg_t sip_msg, char *code);
int sip_add_content_lang(sip_msg_t sip_msg, char *lang);
int sip_add_date(sip_msg_t sip_msg, char *date);
int sip_add_error_info(sip_msg_t sip_msg, char *uri, char *param);
int sip_add_expires(sip_msg_t sip_msg, int secs);
int sip_add_in_reply_to(sip_msg_t sip_msg, char *reply_id);
int sip_add_mime_version(sip_msg_t sip_msg, char *version);
int sip_add_min Expires(sip_msg_t sip_msg, int secs);
int sip_add_org(sip_msg_t sip_msg, char *org);
int sip_add_priority(sip_msg_t sip_msg, char *prio);
int sip_add_reply_to(sip_msg_t sip_msg, char *display_name, 
    char *addr, char *param, boolean_t add_aquot);
int sip_add_passertedid(sip_msg_t sip_msg, char *display_name, 
    char *addr, boolean_t add_aquot);
int sip_add_ppreferredid(sip_msg_t sip_msg, char *display_name, 
    char *addr, boolean_t add_aquot);
int sip_add_require(sip_msg_t sip_msg, char *req);
int sip_add_retry_after(sip_msg_t sip_msg, int secs, char *cnt, 
    char *param);
int sip_add_route(sip_msg_t sip_msg, char *display_name, char *uri, 
    char *route_params);
int sip_add_record_route(sip_msg_t sip_msg, char *display_name, 
    char *uri, char *route_params);
int sip_add_server(sip_msg_t sip_msg, char *svr);
int sip_add_subject(sip_msg_t sip_msg, char *subject);
int sip_add_supported(sip_msg_t sip_msg, char *support);
int sip_add_tstamp(sip_msg_t sip_msg, char *time, char *delay);
int sip_add_unsupported(sip_msg_t sip_msg, char *unsupport);
int sip_add_user_agent(sip_msg_t sip_msg, char *usr);
int sip_add_warning(sip_msg_t sip_msg, int code, char *addr, char *msg);
int sip_add_privacy(sip_msg_t sip_msg, char *priv_val);
int sip_add_rseq(sip_msg_t sip_msg, int resp_num);
int sip_add_rack(sip_msg_t sip_msg, int resp_num, int cseq,
    sip_method_t method);

int sip_add_author(sip_msg_t sip_msg, char *scheme, char *param);
int sip_add_authen_info(sip_msg_t sip_msg, char *ainfo);
int sip_add_proxy_author(sip_msg_t sip_msg, char *pascheme,
    char *param);
int sip_add_proxy_author(sip_msg_t sip_msg, char *pascheme,
    char *param);
int sip_add_proxyRequire(sip_msg_t sip_msg, char *opt);
int sip_add_www_authen(sip_msg_t sip_msg, char *wascheme,
    char *param);
int sip_add_allow_events(sip_msg_t sip_msg, char *events);
int sip_add_event(sip_msg_t sip_msg, char *event, char *param);
int sip_add_substate(sip_msg_t sip_msg, char *sub, char *param);

Description

For each of the following functions that add a header to a SIP message, the function adds a
CRLF before appending the header to the SIP message.

The sip_add_from() and sip_add_to() functions appends a FROM and TO header respectively
to the SIP message sip_msg. The header is created using the display_name, if non-null, and the
uri values. The add_aquot parameter is used to specify whether the uri should be enclosed
within ‘<’>. If a display_name is provided then add_aquot cannot be B_FALSE. The
display_name parameter, if provided, is enclosed within quotes before creating to the SIP
header. Tag value for the FROM/TO header can be specified which will be added to the SIP
header by prefixing it with “TAG=”. Any generic parameters can be specified as the last
argument, which will be added, as is, to the SIP header.

Either the tag or the generic parameter can be specified not both, if both are specified, the
resulting header contains only the tag parameter.

The sip_add_contact() function appends a CONTACT header to the SIP message sip_msg
using the display_name and contact_uri. The add_aquot parameter has the same semantics as
in sip_add_from()/sip_add_to(). Any contact parameters specified in contact_param is
added to the CONTACT header before appending the header to the message.

The sip_add_via() function appends a VIA header to the SIP message sip_msg. The VIA
header is constructed using sent_protocol_transport, sent_by_host and sent_by_port. A
value of 0 for sent_by_port means that the port information is not present in the resulting VIA
header. The VIA header that is created has the protocol set to “SIP” and version set to “2.0”.
Any parameters specific in via_params is added to the VIA header before appending the
header to the SIP message.
The `sip_add_maxforward()` function appends a `MAX-FORWARDS` header to the SIP message `sip_msg` using the value in `maxforward`. The `maxforward` value is a positive integer.

The `sip_add_callid()` function appends a `CALL-ID` header to the SIP message `sip_msg` using the value in `callid`, if non-null. If `callid` is null, this function creates a `CALL-ID` header using a randomly generated value.

The `sip_add_cseq()` function appends a `CSEQ` header to the SIP message using the values in `method` and `cseq`. Permissible values for `method` include:

INVITE
ACK
OPTIONS
BYE
CANCEL
REGISTER
REFER
SUBSCRIBE
NOTIFY
PRACK
INFO

The `cseq` value is a positive integer.

The `sip_add_content_type()` function appends a `CONTENT-TYPE` to the SIP message `sip_msg`. The `CONTENT-TYPE` is created using the type and subtype, both should be non-null.

The `sip_add_content()` function adds a message body to the SIP message `sip_msg`. The message body is given by the null terminated string contents. Once the function returns, the caller may reuse or delete contents as `sip_add_content()` creates a new buffer and copies over contents for its use.

The `sip_add_accept()` function appends an `ACCEPT` header to the SIP message `sip_msg`. The `ACCEPT` header is created using type and subtype. If both type and subtype are null, then an empty `ACCEPT` header is added to the SIP message. If type is non-null, but subtype is null, then the `ACCEPT` header has the specified type and sets the subtype in the header to '*'. Any `accept_param` or `media_param`, if provided, are added to the `ACCEPT` header before appending the header to the SIP message.

The `sip_add_accept_enc()` function appends an `ACCEPT-ENCODING` header to the SIP message `sip_msg`. The `ACCEPT-ENCODING` is created using code. Any parameter specified in `param` is added to the `ACCEPT-ENCODING` header before appending the header to the SIP message.
The `sip_add_accept_lang()` function appends an ACCEPT-LANGUAGE header to the SIP message `sip_msg`. The ACCEPT-LANGUAGE header is created using `lang`. Any parameter specified in `param` is added to the ACCEPT-LANGUAGE header before appending the header to the SIP message.

The `sip_add_alert_info()` function appends an ALERT-INFO header to the SIP message `sip_msg`. The ALERT-INFO header is created using `alert`. Any parameter specified in `param` is added to the ALERT-INFO header before appending the header to the SIP message.

The `sip_add_allow()` function appends an ALLOW header to the SIP message `sip_msg`. The ALLOW header is created using `alert` and `method`. Permissible values for `method` include:

```
INVITE
ACK
OPTIONS
BYE
CANCEL
REGISTER
REFER
INFO
SUBSCRIBE
NOTIFY
PRACK
```

The `sip_add_call_info()` function appends a CALL-INFO header to the SIP message `sip_msg`. The CALL-INFO header is created using `uri`. Any parameter specified in `param` is added to the CALL-INFO header before appending the header to the SIP message.

The `sip_add_content_disp()` function appends a CONTENT-DISPOSITION header to the SIP message `sip_msg`. The CONTENT-DISPOSITION header is created using `disp_type`. Any parameter specified in `param` is added to the CONTENT-DISPOSITION header before appending the header to the SIP message.

The `sip_add_content_enc()` function appends a CONTENT-ENCODING header to the SIP message `sip_msg`. The CONTENT-ENCODING header is created using `code`.

The `sip_add_content_lang()` function appends a CONTENT-LANGUAGE header to the SIP message `sip_msg`. The CONTENT-LANGUAGE header is created using `lang`.

The `sip_add_date()` appends a DATE header to the SIP message `sip_msg`. The DATE header is created using the date information specified in `date`. The semantics for the date string is given is RFC 3261, section 25.1.

The `sip_add_error_info()` function appends an ERROR-INFO header to the SIP message `sip_msg`. The ERROR-INFO header is created using `uri`. Any parameters specified in `param` is added to the ERROR-INFO header before adding the header to the SIP message.
The `sip_add_expires()` function appends an EXPIRES header to the SIP message `sip_msg`. The EXPIRES header is created using the seconds specified in `secs`.

The `sip_add_in_reply_to()` function appends an IN-REPLY-TO header to the SIP message `sip_msg`. The IN-REPLY-TO header is created using the `call-id` value specified in `reply_id`.

The `sip_add_mime_version()` function appends a MIME-VERSION header to the SIP message `sip_msg`. The MIME-VERSION header is created using `version`.

The `sip_add_min_expires()` function appends a MIN-EXPIRES header to the SIP message `sip_msg`. The MIN-EXPIRES is created using the time in seconds specified in `secs`.

The `sip_add_org()` function appends an ORGANIZATION header to the SIP message `sip_msg`. The ORGANIZATION header is created using the information specified in `org`.

The `sip_add_priority()` function appends a PRIORITY header to the SIP message `sip_msg`. The PRIORITY header is created using the value specified in `prio`.

The `sip_add_reply_to()` function appends a REPLY-TO header to the SIP message `sip_msg`. The REPLY-TO header is created using the `display_name`, if provided, and `addr`. The `add_aquot` parameter has the same semantics as in `sip_add_from()`/`sip_add_to()`. Any parameters specified in `param` is added to the REPLY-TO header before appending the header to the SIP message.

The `sip_add_passertedid()` function appends a P-ASSERTED-IDENTITY header to the SIP message `sip_msg`. The P-ASSERTED-IDENTITY header is created using the `display_name`, if provided, and the `addr`. The `add_aquot` parameter has the same semantics as in `sip_add_from()`/`sip_add_to()`.

The `sip_add_ppreferredid()` function appends a P-PREFERRED-IDENTITY header to the SIP message `sip_msg`. The P-PREFERRED-IDENTITY header is created using the `display_name`, if provided, and the `addr`. The `add_aquot` parameter has the same semantics as in `sip_add_from()`/`sip_add_to()`.

The `sip_add_require()` function appends a REQUIRE header to the SIP message `sip_msg`. The REQUIRE header is created using the information in `req`.

The `sip_add_retry_after()` function appends a RETRY-AFTER header to the SIP message `sip_msg`. The RETRY-AFTER is created using the time in seconds specified in `secs` comments, if any, in `cnt`. Any parameters specified in `param`, if provided, is added to the RETRY-AFTER header before appending the header to the SIP message.

The `sip_add_route()` function appends a ROUTE header to the SIP message `sip_msg`. The ROUTE header is created using the `display_name`, if any, and the `uri`. The uri is enclosed in '<>' before adding to the header. Parameters specified in `route_params` are added to the ROUTE header before appending the header to the SIP message.
The `sip_add_record_route()` function appends a RECORD-ROUTE header to the SIP message `sip_msg`. The RECORD-ROUTE header is created using the `display_name`, if any, and the `uri`. The `uri` parameter is enclosed in '<>' before adding to the header. Any parameters specified in `route_params` is added to the ROUTE header before appending the header to the SIP message.

The `sip_add_server()` function appends a SERVER header to the SIP message `sip_msg`. The SERVER header is created using the information in `srv`.

The `sip_add_subject()` function appends a SUBJECT header to the SIP message `sip_msg`. The SUBJECT header is created using the information in `subject`.

The `sip_add_supported()` function appends a SUPPORTED header to the SIP message `sip_msg`. The SUPPORTED header is created using the information in `support`.

The `sip_add_tstamp()` function appends a TIMESTAMP header to the SIP message `sip_msg`. The TIMESTAMP header is created using the time value in `time` and the delay value, if provided, in `delay`.

The `sip_add_unsupported()` function appends an UNSUPPORTED header to the SIP message `sip_msg`. The UNSUPPORTED header is created using the option-tag value in `unsupport`.

The `sip_add_user_agent()` function appends an USER-AGENT header to the SIP message `sip_msg`. The USER-AGENT header is created using the server-val specified in `usr`.

The `sip_add_warning()` function appends a WARNING header to the SIP message `sip_msg`. The WARNING header is created using the warn-code in `code`, warn-agent in `addr` and warn-test in `msg`.

The `sip_add_privacy()` function appends a PRIVACY header to the SIP message `sip_msg`. The PRIVACY header is created using the privacy value specified in `priv_val`.

The `sip_add_rseq()` function appends a RSEQ header to the SIP message `sip_msg`. The RSEQ header is created using the sequence number specified in `resp_num`.

The `sip_add_rack()` function appends a RACK header to the SIP message `sip_msg`. The RACK header is created using the sequence number in `resp_num`, the SIP method in `method` and the CSEQ number in `cseq`. Permissible values for method include: INVITE, ACK, OPTIONS, BYE, CANCEL, REGISTER, REFER, INFO, SUBSCRIBE, NOTIFY, PRACK.

The `sip_add_author()` function appends an AUTHORIZATION header to the SIP message `sip_msg`. The AUTHORIZATION header is created using scheme. Any parameter specified in `param` is added to the AUTHORIZATION header before the header is appended to the SIP message.

The `sip_add_authen_info()` function appends an AUTHENTICATION-INFO() header to the SIP message `sip_msg`. The AUTHENTICATION-INFO header is created using the authentication information in `ainfo`. 
The sip_add_proxy_authen() function appends a PROXY-AUTHENTICATE header to the SIP message sip_msg. The PROXY-AUTHENTICATE is created using the value specified in psacheme. Any parameter in param is added to the PROXY-AUTHENTICATE header before adding the header to the SIP message.

The sip_add_proxy_author() function appends a PROXY-AUTHORIZATION header to the SIP message sip_msg. The PROXY-AUTHORIZATION header is created using the value specified in pascheme. Any parameter in param is added to the PROXY-AUTHORIZATION header before adding the header to the SIP message.

The sip_add_proxy_require() function appends a PROXY-REQUIRE header to the SIP message sip_msg. The PROXY-REQUIRE header is created using the option-tag in opt.

The sip_add_wwww_authen() function appends a WWW-AUTHENTICATE header to the SIP message sip_msg. The WWW-AUTHENTICATE header is created using the challenge in wascheme. Any parameter in param is added to the WWW-AUTHENTICATE header before adding the header to the SIP message.

The sip_add_allow_events() function appends an ALLOW-EVENTS header to the SIP message sip_msg. The ALLOW-EVENTS header is created using the event specified in events.

The sip_add_event() function appends an EVENT header to the SIP message. The EVENT header is created using the value specified in event. Any parameter in param is added to the EVENT header before appending the header to the SIP message.

The sip_add_substate() function appends a SUBSCRIPTION-STATE header to the SIP message sip_msg. The SUBSCRIPTION-STATE header is created using the state specified in sub. Any parameter in param is added to the SUBSCRIPTION-STATE header before appending the header to the SIP message.

**Return Values**  These functions return 0 on success and the appropriate error value on failure.

**Errors**  On failure, functions that return an error value can return one of the following:

- **EINVAL**  Mandatory parameters are not provided, i.e. null.

  - For sip_add_from(), sip_add_to(), sip_add_contact(), sip_add_reply_to(), sip_add_passertedid(), sip_add_ppreferredid() if display_name is non-null and add_aquot is B_FALSE.

  - For sip_add_branchid_to_via() the topmost VIA header already has a branch param or the SIP message does not have a VIA header.

- **EPERM**  The message cannot be modified.

- **ENOMEM**  There is an error allocating memory for creating headers/parameters.
Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
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<tbody>
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<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also libsip(3LIB)
The `sip_add_header()` function takes the SIP header `header_string`, adds a CRLF (carriage return/line feed) and appends it to the SIP message `sip_msg`. The `sip_add_header()` function is typically used when adding a SIP header with multiple values.

The `sip_add_header()` function returns 0 on success and the appropriate error value on failure.

On failure, the `sip_add_header()` function can return one of the following error values:

- **EINVAL**: Mandatory parameters are not provided, i.e. null.
- **EPERM**: The message cannot be modified.
- **ENOMEM**: Error allocating memory for creating headers/parameters.

See attributes(5) for descriptions of the following attributes:

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<tr>
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</table>

See Also: **libsip(3LIB)**
The `sip_add_param()` function adds the parameter provided in `param` to the SIP header `sip_header`. The function returns the header with the parameter added. A new header is created as a result of adding the parameter and the old header is marked deleted. Applications with multiple threads working on the same SIP header need to take note of this. If `error` is non-null, it (the location pointer by the variable) is set to 0 on success and the appropriate error value on error.

The `sip_add_param()` function returns the new header on success and null on failure. Further, if `error` is non-null, then on success the value in the location pointed by `error` is 0 and the appropriate error value on failure.

**Errors**

On failure, functions that return an error value may return one of the following:

- **EINVAL** Mandatory parameters are not provided, i.e. null.
  - For `sip_add_param()`, the header to be modified is marked deleted.
- **EPERM** The message cannot be modified.
- **ENOMEM** There is an error allocating memory for creating headers/parameters.

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
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<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**

libsip(3LIB)
The `sip_add_request_line()` function adds a request line to the SIP message `sip_request`. The request line is created using the SIP method specified in `method` and the URI in `request_uri`. The SIP method can be one of the following:

- INVITE
- ACK
- OPTIONS
- BYE
- CANCEL
- REGISTER
- REFER
- SUBSCRIBE
- NOTIFY
- PRACK
- INFO

The resulting request line has the SIP-Version of “2.0”.

The `sip_add_response_line()` function adds a response line to the SIP message `sip_response`. The response line is created using the response code `response_code` and the phrase in `response_phrase`. If the `response_code` is one that is listed in RFC 3261, `sip_get_resp_desc()` can be used to get the response phase for the `response_code`. The resulting response line has the SIP-Version of “2.0”.

### Return Values

The `sip_add_response_line()` and `sip_add_request_line()` functions return 0 on success and the appropriate error value in case of failure.

The value of `errno` is not changed by these calls in the event of an error.

### Errors

On failure, the `sip_add_response_line()` and `sip_add_request_line()` functions could return one of the following errors:

- EINVAL If mandatory input is not provided or if the input is invalid.
- ENOTSUP If the input SIP message cannot be modified.
- ENOMEM If memory allocation fails when creating the request/response line or when creating headers in the ACK request.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  libsip(3LIB)
# sip_branchid

## Synopsis

```c
#include <sip.h>

char *sip_branchid(sip_msg_t sip_msg);
```

## Description

The `sip_branchid()` function can be used to generate a value for the branch parameter for a VIA header. The returned string is prefixed with `z9hG4bK` to conform to RFC 3261. If `sip_msg` is null or `sip_msg` does not have a VIA header, a random value is generated. Otherwise, the value is generated using the MD5 hash of the VIA, FROM, CALL-ID, CSEQ headers and the URI from the request line. The caller is responsible for freeing the returned string.

## Return Values

The `sip_branchid()` function returns a string on success and `NULL` on failure.

The value of `errno` is not changed by these calls in the event of an error.

## Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

## See Also

`libsip(3LIB)`
The `sip_clone_msg()` function clones the input SIP message and returns the cloned message. The resulting cloned message has all the SIP headers and message body, if present, from the input message.

The value of `errno` is not changed by these calls in the event of an error.

See Also `libsip(3LIB)`
Name  sip_copy_start_line, sip_copy_header, sip_copy_header_by_name, sip_copy_all_headers –
copy headers from a SIP message

Synopsis  
```c
#include <sip.h>

int sip_copy_start_line(sip_msg_t from_msg, sip_msg_t to_msg);
int sip_copy_header(sip_msg_t sip_msg, sip_header_t sip_header,
    char *param);
int sip_copy_header_by_name(sip_msg_t from_msg, sip_msg_t to_msg,
    char *header_name, char *param);
int sip_copy_all_headers(sip_msg_t from_msg, sip_msg_t to_msg);
```

Description  
The `sip_copy_start_line()` function copies the start line, a request or a response line, from
`from_msg` to `to_msg`.

The `sip_copy_header()` function copies the SIP header specified by `sip_header` to the SIP
message `sip_msg`. A new SIP header is created from `sip_header` and `param`, and is appended to
`sip_msg`. The `param` can be non-null.

The `sip_copy_header_by_name()` function copies the header specified by `header_name` (long
or short form) from `from_msg` to `to_msg`. The new header is created using the header value
from `from_msg` and `param`, if non-null, and appended to `to_msg`.

The `sip_copy_all_headers()` copies all the headers from `from_msg` to `to_msg`.

Return Values  
These functions return 0 on success and the appropriate error on failure.

The value of `errno` is not changed by these calls in the event of an error.

Errors  
These functions can return one of the following errors in case of failure:

- **EINVAL** If the required input parameters are NULL or if the header being copied does not
  exist or is deleted in source SIP message.
- **ENOMEM** Error while allocating memory for creating the new header.
- **EPERM** If the input SIP message cannot be modified.

Attributes  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<tbody>
<tr>
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<td>MT-Safe</td>
</tr>
</tbody>
</table>
See Also  

libsip(3LIB)
**Name**
sip_create_dialog_req, sip_create_dialog_req_nocontact – create an in-dialog request

**Synopsis**
```c
cc { flag ... } file ... -lsip { library ... }
#include <sip.h>
sip_msg_t sip_create_dialog_req(sip_method_t method,
                                sip_dialog_t dialog,
                                char *transport, char *sent_by,
                                int sent_by_port, char *via_param,
                                uint32_t smaxforward,
                                int cseq);
sip_msg_t sip_create_dialog_req_nocontact(sip_method_t method,
                                            sip_dialog_t dialog,
                                            char *transport, char *sent_by,
                                            int sent_by_port, char *via_param,
                                            uint32_t smaxforward,
                                            int cseq);
```

**Description**
The `sip_create_dialog_req()` function creates and returns a SIP request with the state information contained in `dialog`. The method in the resulting request is from `method`. The method can be one of the following:

- INVITE
- ACK
- OPTIONS
- BYE
- CANCEL
- REGISTER
- REFER
- INFO
- SUBSCRIBE
- NOTIFY
- PRACK

The resulting request line in the SIP message has the SIP-Version of "2.0". The URI in the request line is from the remote target in the `dialog` or from the route set in the `dialog`, if present. See RFC 3261 (section 12.2) for details. The `FROM`, `TO`, and `CALL-ID` headers are added from the `dialog`. The `MAX-FORWARDS` header is added using the value in `maxforward`. The `CSEQ` header is added using the SIP method in `method` and the sequence number value in `cseq`. If `cseq` is -1, the sequence number is obtained from the local sequence number in the `dialog`. The local sequence number in the `dialog` is incremented and is used in the `CSEQ` header. The `VIA` header added is created using the `transport`, `sent_by`, `sent_by_port` (if non-zero), and `via_param` (if any). If `dialog` has a non-empty route set, the resulting SIP request has the route set from the `dialog`.

The `sip_create_dialog_req_nocontact()` function is similar to `sip_create_dialog_req()`, except that it does not add the contact header.
The `sip_create_dialog_req()` and `sip_create_dialog_req_nocontact()` functions return the resulting SIP message on success and `NULL` on failure.

The value of `errno` is not changed by these calls in the event of an error.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tbody>
</table>

**See Also**
`libsip(3LIB), attributes(5)`
The `sip_create_OKack()` function constructs an ACK request in `ack_msg` for the final 2XX SIP response. The request line is created using the URI in the CONTACT header from the `response`. The SIP-Version in the request line is "2.0". The VIA header for the ACK request is created using `transport`, `sent_by`, `sent_by_port` (if non-zero), and `via_params` (if non-null). The following headers are copied to `ack_msg` from `response`:

```
FROM
TO
CALL-ID
MAX_FORWARDS
```

The CSEQ header is created using the method as ACK and the sequence number from the CSEQ header in `response`.

**Return Values**
The `sip_create_OKack()` function returns 0 on success and the appropriate error value in case of failure.

The value of `errno` is not changed by these calls in the event of an error.

**Errors**
On failure, the `sip_create_OKack()` function could return one of the following errors:

- EINVAL: If mandatory input is not provided or if the input is invalid.
  
  The `sip_create_OKack()` function can return this error if it does not find a CONTACT header or if it is unable to obtain the URI from the CONTACT header for the request line.

- ENOTSUP: If the input SIP message cannot be modified.

- ENOMEM: If memory allocation fails when creating the request/response line or when creating headers in the ACK request.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

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</table>
### sip_create_OKack(3SIP)

<table>
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</tr>
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<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**  
`libsip(3LIB)`
The `sip_create_response()` function creates and returns a SIP message in response to the SIP request `sip_request`. The response line in the resulting SIP message is created using the response code in `response_code` and the phrase in `response_phrase`. The response line has the SIP-Version of "2.0". If a non-null `totag` is specified, the resulting SIP response has a TO header with a tag value from `totag`. If `totag` is null and the `response_code` is anything other than 100 (TRYING), `sip_create_response()` adds a TO header with a randomly generated tag value. If the `response_code` is 100 and `totag` is null, the SIP response has a TO header without a tag parameter. If `contact_uri` is non-null, a CONTACT header is added to the SIP response with the URI specified in `contact_uri`. The SIP response has the following headers copied from `sip_request`:

- All VIA headers
- FROM header
- TO header (with tag added, if required, as stated above)
- CALL-ID header
- CSEQ header
- All RECORD-ROUTE headers

**Return Values**

The `sip_create_response()` function returns the resulting SIP message on success and NULL on failure.

The value of `errno` is not changed by these calls in the event of an error.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

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</tr>
</tbody>
</table>

**See Also**

`libsip(3LIB)`
#include <sip.h>

void sip_delete_dialog(sip_dialog_t dialog);

For functions that return a pointer of type sip_str_t, sip_str_t is supplied by:

typedef struct sip_str {
    char *sip_str_ptr;
    int sip_str_len;
}sip_str_t;

The sip_str_ptr parameter points to a specified value at the start of an input string. The sip_str_len supplies the length of the returned value starting from sip_str_ptr.

The sip_delete_dialog() function is used to delete the dialog specified in dialog. The dialog is not freed if it has outstanding references on it. When the last reference is released the dialog is freed.

Return Values  The value of errno is not changed by these calls in the event of an error.

Attributes  See attributes(5) for descriptions of the following attributes:

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</table>

See Also  libsip(3LIB)
Name     sip_delete_start_line, sip_delete_header, sip_delete_header_by_name, sip_delete_value – delete a SIP header or a header value

Synopsis  cc [ flag ... ] file ... -lsip [ library ... ]
          #include <sip.h>
          int sip_delete_start_line(sip_msg_t sip_msg);
          int sip_delete_header(sip_msg_t sip_header);
          int sip_delete_header_by_name(sip_msg_t msg,
                                      char *header_name);
          int sip_delete_value(sip_header_t sip_header,
                               sip_header_value_t sip_header_value);

Description The sip_delete_start_line() function deletes the start line, a request or a response line, from the SIP message sip_msg.

The sip_delete_header() function deletes the SIP header specified by sip_header from the associated SIP message sip_msg.

The sip_delete_header_by_name() function deletes the SIP header name specified by header_name (long or compact form) from the SIP message sip_msg.

The sip_delete_value() deletes the SIP header value specified by sip_header_value from the SIP header sip_header.

When a SIP header or value is deleted, the corresponding header or value is marked as deleted. Lookups ignore headers or values that are marked as deleted.

Return Values These functions return 0 on success and the appropriate error on failure.

The value of errno is not changed by these calls in the event of an error.

Errors On failure, the returned error could be one of the following:

EINVAL    If any of the required input is NULL.

          If the header or value to be deleted does not exist.

          If the header or value to be deleted has already been deleted.

EPERM     If the SIP message cannot be modified.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
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</tbody>
</table>

Networking Library Functions
### sip_delete_start_line(3SIP)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**  
[libsip(3LIB)](http://example.com)
### Name
sip_enable_counters, sip_disable_counters, sip_get_counter_value – counter operations

### Synopsis
```c
cc [ flag... ] file... -lsip [ library... ]
#include <sip.h>

int sip_enable_counters(int counter_group);
int sip_disable_counters(int counter_group);
int sip_get_counter_value(int group, int counter, void *counterval,
                           size_t counterlen);
```

### Description
The `sip_enable_counters()` function enables the measurement and counting of the selected counter group. The only allowed value for the `counter_group` is `SIP_TRAFFIC_COUNTERS`, which is defined in `<sip.h>`. Once enabled, the SIP stack starts measuring end-to-end SIP traffic. The SIP stack keeps track of:

- the number of SIP requests sent and received (broken down by methods),
- the number of SIP responses sent and received (broken down by response codes), and
- the number of bytes sent and received.

The following counters are defined in `<sip.h>` for the `SIP_TRAFFIC_COUNTERS` group. These counter values are retrieved using the `sip_get_counter_value()` function.

```
sip_total_bytes_rcvd
sip_total_bytes_sent
sip_total_req_rcvd
sip_total_req_sent
sip_total_resp_rcvd
sip_total_resp_sent
sip_ack_req_rcvd
sip_ack_req_sent
sip_bye_req_rcvd
sip_bye_req_sent
sip_cancel_req_rcvd
sip_cancel_req_sent
sip_info_req_rcvd
sip_info_req_sent
sip_invite_req_rcvd
sip_invite_req_sent
sip_notify_req_rcvd
sip_notify_req_sent
sip_options_req_rcvd
sip_options_req_sent
sip_prack_req_rcvd
sip_prack_req_sent
sip_refer_req_rcvd
sip_refer_req_sent
sip_register_req_rcvd
```
SIP_REGISTER_REQ_SENT
SIP_SUBSCRIBE_REQ_RCVD
SIP_SUBSCRIBE_REQ_SENT
SIP_UPDATE_REQ_RCVD
SIP_UPDATE_REQ_SENT
SIP_1XX_RESP_RCVD
SIP_1XX_RESP_SENT
SIP_2XX_RESP_RCVD
SIP_2XX_RESP_SENT
SIP_3XX_RESP_RCVD
SIP_3XX_RESP_SENT
SIP_4XX_RESP_RCVD
SIP_4XX_RESP_SENT
SIP_5XX_RESP_RCVD
SIP_5XX_RESP_SENT
SIP_6XX_RESP_RCVD
SIP_6XX_RESP_SENT
SIP_COUNTER_START_TIME /* records time when counting was enabled */
SIP_COUNTER_STOP_TIME /* records time when counting was disabled */

All of the above counters are defined to be uint64_t, except for SIP_COUNTER_START_TIME and SIP_COUNTER_STOP_TIME, which are defined to be time_t.

The sip_disable_counters() function disables measurement and counting for the specified counter_group. When disabled, the counter values are not reset and are retained until the measurement is enabled again. Calling sip_enable_counters() again would reset all counter values to zero and counting would start afresh.

The sip_get_counter_value() function retrieves the value of the specified counter within the specified counter group. The value is copied to the user provided buffer, counterval, of length counterlen. For example, after the following call, invite_rcvd would have the correct value.

```c
uint64_t invite_rcvd;

sip_get_counter_value(SIP_TRAFFIC_COUNTERS, SIP_INVITE_REQ_RCVD,
 &invite_rcvd, sizeof (uint64_t));
```

**Return Values** Upon successful completion, sip_enable_counters() and sip_disable_counters() return 0. They will return EINVAL if an incorrect group is specified.

Upon successful completion, sip_get_counter_value() returns 0. It returns EINVAL if an incorrect counter name or counter size is specified, or if counterval is NULL.

**Attributes** See attributes(5) for descriptions of the following attributes:
### Attribute Table

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</table>

**See Also**  
attributes(5)
The `sip_enable_trans_logging()` and `sip_enable_dialog_logging()` functions enable transaction and dialog logging respectively. The `logfile` argument points to a file to which the SIP messages are logged. The `flags` argument controls the amount of logging. The only flag defined in `<sip.h>` is `SIP_DETAIL_LOGGING`. Either transaction or dialog logging, or both, can be enabled at any time. For dialog logging to work, the SIP stack must be enabled to manage dialogs (using `SIP_STACK_DIALOGS`, see `sip_stack_init(3SIP)`) when the stack is initialized.

All the messages exchanged within a transaction/dialog is captured and later dumped to a log file when the transaction or dialog is deleted or terminated. Upon termination, each dialog writes to the file the messages that were processed in its context. Similarly, upon termination each transaction writes to the file the messages that were processed in its context.

The `sip_disable_trans_logging()` and `sip_disable_dialog_logging()` functions disable the transaction or dialog logging. These functions do not close the files. It is the responsibility of the application to close them.

The log contains the state of the transaction or dialog at the time the message was processed.

Upon successful completion, `sip_enable_trans_logging()` and `sip_enable_dialog_logging()` return 0. They return `EINVAL` if `logfile` is `NULL` or `flags` is unrecognized.

**Examples**

**EXAMPLE 1** Dialog logging

The following is an example of dialog logging.

```c
FILE  *logfile;

logfile = fopen("/tmp/ApplicationA", "a");
sip_enable_dialog_logging(logfile, SIP_DETAIL_LOGGING);

/* Application sends INVITE, receives 180 and 200 response and dialog is created. */
/* Application sends ACK request */
/* Application sends BYE and receives 200 response */
```
EXAMPLE 1  Dialog logging  (Continued)

/* Application disables logging */
sip_disable_dialog_logging();

The log file will be of the following format.

************* Begin Dialog *************
Digest : 43854 43825 26120 9475 5415 21595 25658 18538
-----------------------------
Dialog State : SIP_DLG_NEW
Tue Nov 27 15:53:34 2007| Message - 1
INVITE sip:user@example.com SIP/2.0
From: "Me" < sip:me@mydomain.com > ; TAG=tag-from-01
To: "You" < sip:you@yourdomain.com >
Contact: < sip:myhome.host.com >
MAX-FORWARDS: 70
Call-ID: 1261K6A6492KF33549XM
CSeq: 111 INVITE
CONTENT-TYPE: application/sdp
Via: SIP/2.0/UDP 192.0.0.1 ;branch=z9hG4bK-via-EVERYTHINGIDO-05
Record-Route: <sip:server1.com;lr>
Record-Route: <sip:server2.com;lr>
CONTENT-LENGTH : 0

Tue Nov 27 15:53:34 2007| Message - 2
SIP/2.0 180 Ringing
Via: SIP/2.0/UDP 192.0.0.1 ;branch=z9hG4bK-via-EVERYTHINGIDO-05
From: "Me" < sip:me@mydomain.com > ; TAG=tag-from-01
To: "You" < sip:you@yourdomain.com >;tag=1
Call-ID: 1261K6A6492KF33549XM
CSeq: 111 INVITE
Contact: <sip:whitestart2-0.East.Sun.COM:5060;transport=UDP>
Record-Route: <sip:server1.com;lr>
Record-Route: <sip:server2.com;lr>
Content-Length: 0

-----------------------------
Dialog State : SIP_DLG_EARLY
/* Entire 200 OK SIP Response */

-----------------------------
Dialog State : SIP_DLG_CONFIRMED

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EXAMPLE 1    Dialog logging  (Continued)

/* Entire ACK Request */
/* Entire BYE Request */
/* Entire 200 OK Response */
----------------------------
************* End Dialog *************

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  sip_stack_init(3SIP), attributes(5)
Name  sip_get_contact_display_name, sip_get_from_display_name, sip_get_to_display_name,
sip_get_from_tag, sip_get_to_tag, sip_get_callid, sip_get_callseq_num,
sip_get_callseq_method, sip_get_via_sent_by_host, sip_get_via_sent_by_port,
sip_get_via_sent_protocol_version, sip_get_via_sent_protocol_name,
sip_get_via_sent_transport, sip_get_maxforward, sip_get_content_length,
sip_get_content_type, sip_get_content_sub_type, sip_get_content,
sip_get_accept_type, sip_get_accept_sub_type, sip_get_accept_enc,
sip_get_accept_lang, sip_get_alert_info_uri,
sip_get_allow_method, sip_get_min_expires, sip_get_mime_version, sip_get_org,
sip_get_priority, sip_get_replyto_display_name, sip_get_replyto_uri_str, sip_get_date_time,
sip_get_date_day, sip_get_date_month, sip_get_date_wkday, sip_get_date_year,
sip_get_date_timezone, sip_get_content_disp, sip_get_content_enc, sip_get_error_info_uri,
sip_get_expires, sip_get_require, sip_get_subject, sip_get_supported, sip_get_tstamp_delay,
sip_get_unsupported, sip_get_server, sip_get_user_agent, sip_get_warning_code,
sip_get_warning_agent, sip_get_warning_text, sip_get_call_info_uri, sip_get_in_reply_to,
sip_get_retry_after_time, sip_get_retry_after_cmts, sip_get_rack_resp_num,
sip_get_rack_cseq_num, sip_get_rack_method, sip_get_rseq_resp_num, sip_get_priv_value,
sip_get_passertedid_display_name, sip_get_passertedid_uri_str, sip_get_author_scheme,
sip_get_author_param, sip_get_authen_info, sip_get_proxy_authen_scheme,
sip_get_proxy_authen_param, sip_get_proxy_author_scheme,
sip_get_proxy_author_param, sip_get_proxy_require, sip_get_www_authen_scheme,
sip_get_www_authen_param, sip_get_allow_events, sip_get_event, sip_get_substate,
sip_get_content_lang, sip_get_tstamp_value, sip_get_route_uri_str,
sip_get_route_display_name, sip_get_contact_uri_str, sip_get_from_uri_str,
sip_get_to_uri_str - obtain header specific attributes

Synopsis  cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

const sip_str_t *sip_get_contact_display_name(sip_header_value_t value,
int *error);
const sip_str_t *sip_get_from_display_name(sip_msg_t sip_msg,
int *error);
const sip_str_t *sip_get_to_display_name(sip_msg_t sip_msg,
int *error);
const sip_str_t *sip_get_contact_uri_str(sip_header_value_t value,
int *error);
const sip_str_t *sip_get_from_uri_str(sip_msg_t sip_msg,
int *error);
const sip_str_t *sip_get_to_uri_str(sip_msg_t sip_msg,
int *error);
const sip_str_t *sip_get_from_tag(sip_msg_t sip_msg,
int *error);
const sip_str_t *sip_get_to_tag(sip_msg_t sip_msg,
   int *error);

const sip_str_t *sip_get_callid(sip_msg_t sip_msg,
   int *error);

int sip_get_callseq_num(sip_msg_t sip_msg,
   int *error);

sip_method_t sip_get_callseq_method(sip_msg_t sip_msg,
   int *error);

const sip_str_t *sip_get_via_sent_by_host(sip_header_value_t value,
   int *error);

int sip_get_via_sent_by_port(sip_header_value_t value,
   int *error);

const sip_str_t *sip_get_via_sent_protocol_version
   (sip_header_value_t value, int *error);

const sip_str_t *sip_get_via_sent_transport(sip_header_value_t value,
   int *error);

int sip_get_maxforward(sip_msg_t sip_msg,
   int *error);

int sip_get_content_length(sip_msg_t sip_msg,
   int *error);

const sip_str_t *sip_get_content_type(sip_msg_t sip_msg,
   int *error);

const sip_str_t *sip_get_content_sub_type(sip_msg_t sip_msg,
   int *error);

char *sip_get_content(sip_msg_t sip_msg,
   int *error);

const sip_str_t *sip_get_accept_type(sip_header_value_t value,
   int *error);

const sip_str_t *sip_get_accept_sub_type(sip_header_value_t value,
   int *error);

const sip_str_t *sip_get_accept_enc(sip_header_value_t value,
   int *error);

const sip_str_t *sip_get_accept_lang(sip_header_value_t value,
   int *error);

const sip_str_t *sip_get_alert_info_uri(sip_header_value_t value,
   int *error);

sip_method_t sip_get_allow_method(sip_header_value_t value,
   int *error);
int sip_get_min_expire(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_mime_version(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_org(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_priority(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_replyto_display_name(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_replyto_uri_str(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_date_time(sip_msg_t sip_msg,  
    int *error);

int sip_get_date_day(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_date_month(sip_msg_t sip_msg,  
    int *error);

int sip_get_date_year(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_date_wkday(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_date_timezone(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_content_disp(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_content_enc(sip_header_value_t value,  
    int *error);

const sip_str_t *sip_get_error_info_uri(sip_header_value_t value,  
    int *error);

int sip_get_expires(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_require(sip_header_value_t value,  
    int *error);

const sip_str_t *sip_get_subject(sip_msg_t sip_msg,  
    int *error);

const sip_str_t *sip_get_supported(sip_header_value_t value,  
    int *error);
const sip_str_t *sip_get_timestamp_delay(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_unsupported(sip_header_value_t value, int *error);
const sip_str_t *sip_get_server(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_user_agent(sip_msg_t sip_msg, int *error);
int sip_get_warning_code(sip_header_value_t value, int *error);
const sip_str_t *sip_get_warning_agent(sip_header_value_t value, int *error);
const sip_str_t *sip_get_warning_text(sip_header_value_t value, int *error);
const sip_str_t *sip_get_call_info_uri(sip_header_value_t value, int *error);
const sip_str_t *sip_get_in_reply_to(sip_header_value_t value, int *error);
int sip_get_retry_after_time(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_retry_after_cmts(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_passertedid_display_name(sip_header_value_t value, int *error);
const sip_str_t *sip_get_passertedid_uri_str(sip_header_value_t value, int *error);
int sip_get_rack_resp_num(sip_msg_t sip_msg, int *error);
int sip_get_rack_cseq_num(sip_msg_t sip_msg, int *error);
sip_method_t sip_get_rack_method(sip_msg_t sip_msg, int *error);
int sip_get_rseq_resp_num(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_priv_value(sip_header_value_t value, int *error);
const sip_str_t *sip_get_author_scheme(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_author_param(sip_msg_t sip_msg, char *name, int *error);
const sip_str_t *sip_get_authen_info(sip_header_value_t value, int *error);
const sip_str_t *sip_get_proxy_authen_scheme(sip_msg_t msg, int *error);
const sip_str_t *sip_get_proxy_authen_param(sip_msg_t sip_msg, char *name, int *error);
const sip_str_t *sip_get_proxy_author_scheme(sip_msg_t msg, int *error);
const sip_str_t *sip_get_proxy_author_param(sip_msg_t sip_msg, char *name, int *error);
const sip_str_t *sip_get_proxy_require(sip_header_value_t value, int *error);
const sip_str_t *sip_get_www_authen_scheme(sip_msg_t msg, int *error);
const sip_str_t *sip_get_www_authen_param(sip_msg_t sip_msg, char *name, int *error);
const sip_str_t *sip_get_allow_events(sip_header_value_t value, int *error);
const sip_str_t *sip_get_event(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_substate(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_content_lang(sip_header_value_t value, int *error);
const sip_str_t *sip_get_tstamp_value(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_route_uri_str(sip_header_value_t value, int *error);
const sip_str_t *sip_get_route_display_name(sip_header_value_t value, int *error);

Description  For functions that return a pointer of type sip_str_t, sip_str_t is supplied by:

typedef struct sip_str {
    char *sip_str_ptr;
    int sip_str_len;
} sip_str_t;

The sip_str_ptr parameter points to the start of the returned value and sip_str_len supplies the length of the returned value.

For example, given the following request line in a SIP message sip_msg that is input to sip_get_request_uri_str():

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the return is a pointer to sip_str_t with the sip_str_ptr member pointing to “A” of Alice and sip_str_len being set to 5, the length of Alice.

Access functions for headers that can have multiple values take the value as the input, while those that can have only one value take the SIP message sip_msg as the input.

The sip_get_contact_display_name(), sip_get_from_display_name(), and sip_get_to_display_name() functions will return the display name, if present, from the CONTACT header value, FROM and TO header respectively.

The sip_get_contact_uri_str(), sip_get_from_uri_str(), and sip_get_to_uri_str() functions will return the URI string from the CONTACT value, FROM and TO header respectively.

The sip_get_from_tag() and sip_get_to_tag() functions will return the TAG parameter value, if present, from the FROM and TO header, respectively, in the provided SIP message sip_msg.

The sip_get_callid() function will return the value from the CALL-ID header in the provided SIP message sip_msg.

The sip_get_callseq_num() function will return the call sequence number from the CSEQ header in the provided SIP message sip_msg.

The sip_get_callseq_method() function will return the method from the CSEQ header in the provided SIP message sip_msg. The method can be one of the following:

INVITE
ACK
OPTIONS
BYE
CANCEL
REGISTER
REFER
INFO
SUBSCRIBE
NOTIFY
PRACK
UNKNOWN

The sip_get_via_sent_by_host(), sip_get_via_sent_by_port(), sip_get_via_sent_protocol_version(), sip_get_via_sent_protocol_name(), and sip_get_via_sent_transport() functions will return the sent-by host, port (if present), protocol version, protocol name and transport information from the provided VIA header
value. Example, if the VIA value is given by SIP/2.0/UDP bobspc.biloxi.com:5060, then the sent-by host is "bobspc.biloxi.com", protocol name is "SIP", protocol version is "2.0", port is 5060 and transport is UDP.

The `sip_get_maxforward()` function will return the value of the MAX-FORWARDS header in the provided SIP message `sip_msg`.

```
INVITE
ACK
OPTIONS
BYE
CANCEL
REGISTER
REFER
INFO
SUBSCRIBE
NOTIFY
PRACK
UNKNOWN
```

The `sip_get_content_length()` function will return the value of the CONTENT-LENGTH header in the provided SIP message `sip_msg`. The method can return one of the following:

The `sip_get_content_type()` and `sip_get_content_sub_type()` functions will return the value of the Type and Sub-Type field, respectively, from the CONTENT-TYPE header in the provided SIP message `sip_msg`.

The `sip_get_content()` function will return the message body from the provided SIP message `sip_msg`. The returned string is a copy of the message body and the caller is responsible for freeing the string after use.

The `sip_get_accept_type()` and `sip_get_accept_sub_type()` functions will return the value of the Type and Sub-Type field, respectively, from the provided ACCEPT header value.

The `sip_get_accept_enc()` function will return the content-coding from the provided ACCEPT-ENCODING header value.

The `sip_get_accept_lang()` function will return the language from the provided ACCEPT-LANGUAGE header value.

The `sip_get_alert_info_uri()` function will return the URI string from the provided ALERT-INFO header value.

The `sip_get_allow_method()` function will return the SIP method from the provided ALLOW header value. The method can return one of the following:

```
INVITE
```
The `sip_get_min_expire()` function will return the time in seconds from the `MIN-EXPIRES` header in the provided SIP message `sip_msg`.

The `sip_get_mime_version()` function will return the MIME version string from the `MIME-VERSION` header in the provided SIP message `sip_msg`.

The `sip_get_org()` function will return the organization string value from the `ORGANIZATION` header in the provided SIP message `sip_msg`.

The `sip_get_priority()` function will return the priority string value from the `PRIORITY` header in the provided SIP message `sip_msg`.

The `sip_get_replyto_display_name()` and `sip_get_replyto_uri_str()` functions will return the display name (if present) and the URI string, respectively, from the `REPLY-TO` header in the provided SIP message `sip_msg`.

The `sip_get_date_time()`, `sip_get_date_day()`, `sip_get_date_month()`, `sip_get_date_wkday()`, `sip_get_date_year()` and `sip_get_date_timezone()` functions will return the time, day, month, weekday, year and timezone value from the `DATE` header in the provided SIP message `sip_msg`. Example, if the `DATE` header has the following value:

```
Sat, 13 Nov 2010 23:29:00 GMT
```

the time is “23:29:00”, week day is “Sat”, day is “13”, month is “Nov”, year is “2010”, timezone is “GMT”.

The `sip_get_content_disp()` function will return the content-disposition type from the `CONTENT-DISPOSITION` header in the provided SIP message `sip_msg`.

The `sip_get_content_enc()` function will return the content-coding value from the `CONTENT-ENCODING` header value.

The `sip_get_error_info_uri()` function will return the URI string from the provided `ERROR-INFO` header value.

The `sip_get_expires()` function will return the time in seconds from the `EXPIRES` header in the provided SIP message `sip_msg`. 
The sip_get_require() function will return the option-tag value from the provided REQUIRE header value.

The sip_get_subject() function will return the value of the SUBJECT header in the provided SIP message sip_msg.

The sip_get_supported() function will return the extension value from the provided SUPPORTED header value.

The sip_get_tstamp_delay() function will return the value from the TIMESTAMP header in the provided SIP message sip_msg.

The sip_get_unsupported() function will return the extension value from the provided UNSUPPORTED header value.

The sip_get_server() function will return the value from the SERVER header in the provided SIP message sip_msg.

The sip_get_user_agent() function will return the value from the USER-AGENT header in the provided SIP message sip_msg.

The sip_get_warning_code(), sip_get_warning_agent(), and sip_get_warning_text() functions will return the value of the warn-code, warn-agent and warn-text, respectively, in the provided WARNING header value.

The sip_get_call_info_uri() function will return the URI string in the provided CALL-INFO header value.

The sip_get_in_reply_to() function will return the Call-Id value in the provided IN-REPLY-TO header value.

The sip_get_retry_after_time(), and sip_get_retry_after_cmts() functions return the time and comments (if any), respectively, from the RETRY-AFTER header in the provided SIP message sip_msg.

The sip_get_passertedid_display_name() and sip_get_passertedid_uri_str() functions will return the display name (if any) and the URI string, respectively, in the provided P-ASSERTED-IDENTITY header value.

The sip_get_ppreferreddid_display_name() and sip_get_ppreferreddid_uri_str() functions will return the display name (if any) and the URI string, respectively, in the provided P-PREFERRED-IDENTITY header value.

The sip_get_rack_resp_num(), sip_get_rack_cseq_num(), and sip_get_rack_method() functions will return the response-number, the CSEQ number and the SIP method from the RACK header in the provided SIP message sip_msg. The method can return one of the following:

INVITE
The `sip_get_rseq_resp_num()` function will return the response-number, the RSEQ header in the provided SIP message `sip_msg`.

The `sip_get_priv_value()` function will return the priv-value in the provided PRIVACY header value.

The `sip_get_route_uri_str()` and `sip_get_route_display_name()` functions will return the URI string, and display name (if present) from the provided ROUTE or RECORD-ROUTE header value.

The `sip_get_author_scheme()` function will return the scheme from the AUTHORIZATION header in the provided SIP message `sip_msg`.

The `sip_get_author_param()` function will return the value of the parameter specified in name from the AUTHORIZATION header in the SIP message `sip_msg`.

The `sip_get_authen_info()` function will return the authentication information from the provided AUTHORIZATION-INFO header value.

The `sip_get_proxy_authen_scheme()` function will return the scheme from the PROXY-AUTHENTICATE header in the SIP message `sip_msg`.

The `sip_get_proxy_authen_param()` function will return the value of the parameter in name from the PROXY-AUTHENTICATE header in the SIP message `sip_msg`.

The `sip_get_proxy_author_scheme()` function will return the value of the scheme from the PROXY-AUTHORIZATION header in the SIP message `sip_msg`.

The `sip_get_proxy_author_param()` function will return the value of the parameter specified in name from the PROXY-AUTHORIZATION header in the SIP message `sip_msg`.

The `sip_get_proxy_require()` function will return the option-tag from the provided PROXY-REQUIRE header value.

The `sip_get_www_authen_scheme()` function will return the challenge from the WWW-AUTHENTICATE header in the SIP message `sip_msg`. 
The `sip_get_www_authen_param()` function will return the value of the parameter specified in name from the WWW-AUTHENTICATE header in the SIP message `sip_msg`.

The `sip_get_allow_events()` function returns the value of the allowed event from the provided ALLOW-EVENTS header value.

The `sip_get_event()` function returns the event in the EVENT header in the SIP message `sip_msg`.

The `sip_get_substate()` function returns the subscription state from the SUBSCRIPTION-STATE header in the provided SIP message `sip_msg`.

The `sip_get_content_lang()` function will return the language from the provided CONTENT-LANGUAGE value.

The `sip_get_tstamp_value()` function will return the timestamp value from the TIMESTAMP header in the SIP message `sip_msg`.

Return Values: For functions that return a pointer to `sip_str_t`, the return value is the specified value on success or NULL in case of error. For functions that return an integer, the return value is the specified value on success and -1 on error.

The value of `errno` is not changed by these calls in the event of an error.

Errors: These functions take a pointer to an integer `error` as an argument. If the error is non-null, one of the following values is set:

- EINVAL: The input SIP message `sip_msg` or the header value is null; or the specified header/header value is deleted.
- EPROTO: The header value is not present or invalid. The parser could not parse it correctly.
- ENOMEM: There is an error allocating memory for the return value.

On success, the value of the location pointed to by `error` is set to 0.

Attributes: See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also: `libsip(3LIB)`
The `sip_get_cseq()` and `sip_get_rseq()` functions can be used to generate an initial sequence number for the CSEQ and RSEQ headers.

The value of `errno` is not changed by these calls in the event of an error.

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
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</tr>
</tbody>
</table>

**See Also**

`libsip(3LIB)`
Name  sip_get_dialog_state, sip_get_dialog_callid, sip_get_dialog_local_tag,
sip_get_dialog_remote_tag, sip_get_dialog_local_uri, sip_get_dialog_remote_uri,
sip_get_dialog_local_contact_uri, sip_get_dialog_remote_target_uri,
sip_get_dialog_route_set, sip_get_dialog_local_cseq, sip_get_dialog_remote_cseq,
sip_get_dialog_type, sip_get_dialog_method, sip_is_dialog_secure, sip_get_dialog_msgcnt —
get dialog attributes

Synopsis  
cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

int sip_get_dialog_state(sip_dialog_t dialog, int *error);

const sip_str_t *sip_get_dialog_callid(sip_dialog_t dialog,
int *error);

const sip_str_t *sip_get_dialog_local_tag(sip_dialog_t dialog,
int *error);

const sip_str_t *sip_get_dialog_remote_tag(sip_dialog_t dialog,
int *error);

const struct sip_uri *sip_get_dialog_local_uri(sip_dialog_t dialog,
int *error);

const struct sip_uri *sip_get_dialog_remote_uri(sip_dialog_t dialog,
int *error);

const struct sip_uri *sip_get_dialog_local_contact_uri(sip_dialog_t dialog,
int *error);

const struct sip_uri *sip_get_dialog_remote_target_uri(sip_dialog_t dialog,
int *error);

const sip_str_t *sip_get_dialog_route_set(sip_dialog_t dialog,
int *error);

boolean_t sip_is_dialog_secure(sip_dialog_t dialog,
int *error);

uint32_t sip_get_dialog_local_cseq(sip_dialog_t dialog,
int *error);

uint32_t sip_get_dialog_remote_cseq(sip_dialog_t dialog,
int *error);

int sip_get_dialog_type(sip_dialog_t dialog, int *error);

int sip_get_dialog_method(sip_dialog_t dialog, int *error);

int sip_get_dialog_msgcnt(sip_dialog_t dialog, int *error);

Description  For functions that return a pointer of type sip_str_t, sip_str_t is supplied by:

typedef struct sip_str {
    char    *sip_str_ptr;

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The *sip_str_ptr* parameter points to the start of the returned value and *sip_str_len* supplies the length of the returned value.

The *sip_get_dialog_state()* returns the state of the *dialog*. A *dialog* can be in one of the following states:

- **SIP_DLG_NEW**
- **SIP_DLG_EARLY**
- **SIP_DLG_CONFIRMED**
- **SIP_DLG_DESTROYED**

The *sip_get_dialog_callid()* function returns the call ID value maintained in the *dialog*.

The *sip_get_dialog_local_tag()* and *sip_get_dialog_remote_tag()* functions return the local and remote tag values, maintained in the *dialog*.

The *sip_get_dialog_local_uri()*, *sip_get_dialog_remote_uri()*,
*sip_get_dialog_local_contact_uri()* and *sip_get_dialog_remote_target_uri()* functions return the local, remote, local contract, and the remote target URIs, maintained in the *dialog*.

The *sip_get_dialog_route_set()* function returns the route set, if any, maintained in the *dialog*.

The *sip_get_dialog_local_cseq()* and *sip_get_dialog_remote_cseq()* functions return the local and remote CSEQ numbers maintained in the *dialog*.

The *sip_get_dialog_type()* function returns one of the following dialog types, depending on whether it is created by the client or the server.

- **SIP_UAC_DIALOG** created by client
- **SIP_UAS_DIALOG** created by server

The *sip_get_dialog_method()* function returns the SIP method, INVITE or SUBSCRIBE, of the request that created the dialog.

The *sip_is_dialog_secure()* function returns **B_TRUE** if the *dialog* is secure and **B_FALSE** otherwise.

The *sip_get_dialog_msgcnt()* function returns the number of SIP messages (requests and responses) that were sent and received within the context of the given dialog.
Return Values

The `sip_get_dialog_state()`, `sip_get_dialog_local_cseq()`, `sip_get_dialog_remote_cseq()`, `sip_get_dialog_type()`, `sip_get_dialog_method()`, and `sip_get_dialog_msgcnt()` functions return the required value on success and -1 on failure.

The `sip_get_dialog_callid()`, `sip_get_dialog_local_tag()`, `sip_get_dialog_remote_tag()`, `sip_get_dialog_local_uri()`, `sip_get_dialog_remote_uri()`, `sip_get_dialog_local_contact_uri()`, `sip_get_dialog_remote_target_uri()`, and `sip_get_dialog_route_set()` functions return the required value on success and NULL on failure.

The value of `errno` is not changed by these calls in the event of an error.

Errors

These functions take an `error` argument.

If the error is non-null, one of the following values is set:

- **EINVAL**
  - The dialog is NULL or the stack is not configured to manage dialogs.

- **ENOTSUP**
  - The input SIP message cannot be modified.

- **ENOMEM**
  - The memory allocation fails when the request/response line or the headers in the ACK request are created.

On success, the value of the location pointed to by `error` is set to 0.

Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
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</tr>
</tbody>
</table>

See Also

`libsip(3LIB)`
The `sip_get_header()` function returns the header specified by `header_name` (long or compact form) from the SIP message `sip_msg`. If `header_name` is `NULL`, the first header in the SIP message is returned. The `old_header`, if non-null, specifies the starting position in `sip_msg` from which the search is started. Otherwise, the search begins at the start of the SIP message. For example, to get the first VIA header from the SIP message `sip_msg`:

```c
via_hdr = sip_get_header(sip_msg, "VIA", NULL, &error);
```

To get the next VIA header from `sip_msg`:

```c
via_hdr = sip_get_header(sip_msg, "VIA", via_hdr, &error);
```

The `sip_get_header()` function ignores any header that is marked as deleted.

Return Values

On success, the `sip_get_header()` function returns the queried header. On failure, it returns `NULL`.

The value of `errno` is not changed by these calls in the event of an error.

Errors

The following value may be returned:

- **EINVAL**  The `header_name` specified in the SIP message is not present or has been deleted; or, the `header_name` is not specified and there are no "un-deleted" headers in the SIP message.

Attributes

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also `libsip(3LIB)`
The `sip_get_header_value()` function returns the first valid value from a SIP header `sip_header`.

The `sip_get_next_value()` function returns the next valid value following the SIP value `old_value`.

These functions return the queried value on success and NULL on failure. The value of `errno` is not changed by these calls in the event of an error.

If the error is non-null, one of the following values is set:

- **EINVAL**: If any of the required input is NULL or if the specified SIP header value is marked deleted.
- **EPROTO**: If the returned SIP header value is invalid (i.e. the parser encountered errors when parsing the value).

On success, the value of the location pointed to by `error` is set to 0.

### Attributes
See `attributes(5)` for descriptions of the following attributes:

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</tr>
</tbody>
</table>

### See Also
`libsip(3LIB)`
Name  
sip_get_msg_len – returns the length of the SIP message

Synopsis  
cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

int sip_get_msg_len(sip_msg_t sip_msg,
int *error);

Description  
The sip_get_msg_len() function will return the length of the SIP message sip_msg.

Return Values  
For functions that return an integer, the return value is the specified value on success and -1 on error.

The value of errno is not changed by these calls in the event of an error.

Errors  
This function takes a pointer to an integer error as an argument. If the error is non-null, one of the following values is set:

EINVAL   The input SIP message sip_msg or the header value is null; or the specified header/header value is deleted.
EPROTO   The header value is not present or invalid. The parser could not parse it correctly.
ENOMEM   There is an error allocating memory for the return value.

On success, the value of the location pointed to by error is set to 0.

Attributes  
See attributes(5) for descriptions of the following attributes:

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</table>

See Also  
libsip(3LIB)
The **sip_get_num_via()** function returns the number of VIA headers in the SIP message `sip_msg`.

The **sip_get_branchid()** function returns the branch ID value from the topmost VIA header. The caller is responsible for freeing the returned string.

**Return Values**

The **sip_get_num_via()** function returns the number of VIA headers on success.

The **sip_get_branchid()** function returns the branch ID on success and NULL on failure.

The value of `errno` is not changed by these calls in the event of an error.

**Errors**

If the error is non-null, one of the following values is set:

- **EINVAL** The `sip_msg` is NULL.
- **ENOENT** For the `sip_get_branchid` function, there is no VIA header or the VIA header has no branch parameter.
- **EPROTO** For the `sip_get_num_via()` function, the VIA value is invalid. The parser encountered an error or errors while parsing the VIA header.
- **ENOMEM** For the `sip_get_branchid` function, there is an error in allocating memory for the branch ID.

On success, the value of the location pointed to by `error` is set to 0.

**Attributes**

See **attributes(5)** for descriptions of the following attributes:

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</table>

**See Also**

**libsip(3LIB)**
Name  sip_get_param_value, sip_get_params, sip_is_param_present – get parameter information for a SIP header value

Synopsis  cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

const sip_str_t *sip_get_param_value
  (sip_header_value_t header_value, char *param_name, int *error);

const sip_param_t *sip_get_params
  (sip_header_value_t header_value, int *error);

boolean_t sip_is_param_present
  (const sip_param_t *param_list, char *param_name, int param_len);

Description  The sip_get_param_value() function returns the value for the parameter name specified by param_name from the SIP header value header_value.

For functions that return a pointer of type sip_str_t, sip_str_t is supplied by:

typedef struct sip_str {
  char  *sip_str_ptr;
  int    sip_str_len;
}sip_str_t;

The sip_str_ptr parameter points to the start of the returned value and sip_str_len supplies the length of the returned value.

The sip_get_params() function returns the parameter list, if any, for the SIP header value header_value.

The sip_is_param_present() function returns B_TRUE if the parameter specified by param_name of length supplied in param_len is present in the parameter list, param_list. Otherwise, it returns B_FALSE.

Return Values  With the exception of sip_is_param_present(), these functions return the queried value on success and NULL on failure.

The value of errno is not changed by these calls in the event of an error.

Errors  If the error is non-null, one of the following values is set:

EINVAL  If any of the required input is NULL or if the specified SIP header value is marked deleted.

EPROTO  If the returned SIP header value is invalid (i.e. the parser encountered errors when parsing the value).

On success, the value of the location pointed to by error is set to 0.
Attributes  See attributes(5) for descriptions of the following attributes:

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</table>

See Also  libsip(3LIB)
**Name**  
sip_get_request_method, sip_get_response_code, sip_get_response_phrase, sip_get_sip_version – obtain attributes from the start line in a SIP message

**Synopsis**  
cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>
sip_method_t sip_get_request_method(const sip_msg_t sip_msg, int *error);
int sip_get_response_code(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_response_phrase(sip_msg_t sip_msg, int *error);
const sip_str_t *sip_get_sip_version(sip_msg_t sip_msg, int *error);

**Description**  
For functions that return a pointer of type sip_str_t, sip_str_t is supplied by:

typedef struct sip_str {
    char *sip_str_ptr;
    int sip_str_len;
}sip_str_t;

The sip_str_ptr parameter points to the start of the returned value and sip_str_len supplies the length of the returned value.

For example, given the following request line in a SIP message sip_msg that is input to sip_get_request_uri_str():

FROM : <Alice sip:alice@atlanta.com>;tag=1928301774

the return is a pointer to sip_str_t with the sip_str_ptr member pointing to “A” of Alice and sip_str_len being set to 5, the length of Alice.

Access functions for headers that can have multiple values take the value as the input, while those that can have only one value take the SIP message sip_msg as the input.

The sip_get_request_method() function will return the SIP method from the request line in the SIP message sip_msg. The method can be one of the following:

INVITE
ACK
OPTIONS
BYE
CANCEL
REGISTER
REFER
INFO
The `sip_get_response_code()` function will return the response code \textit{response} from the request line in the SIP message \textit{sip_msg}.

The `sip_get_response_phrase()` function will return the response phrase \textit{response} from the request line in the SIP message \textit{sip_msg}.

The `sip_get_sip_version()` function will return the version of the SIP protocol from the request or the response line in the SIP message \textit{sip_msg}.

**Return Values** For functions that return a pointer to \textit{sip_str_t}, the return value is the specified value on success or \texttt{NULL} in case of error. For functions that return an integer, the return value is the specified value on success and \texttt{-1} on error.

The value of \texttt{errno} is not changed by these calls in the event of an error.

**Errors** These functions take a pointer to an integer \textit{error} as an argument. If the \textit{error} is non-null, one of the following values is set:

- \texttt{EINVAL} The input SIP message \textit{sip_msg} or the header value is null; or the specified header/header value is deleted.
- \texttt{EPROTO} The header value is not present or invalid. The parser could not parse it correctly.
- \texttt{ENOMEM} There is an error allocating memory for the return value.

On success, the value of the location pointed to by \textit{error} is set to 0.

**Attributes** See \texttt{attributes(5)} for descriptions of the following attributes:

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</table>

**See Also** \texttt{libsip(3LIB)}
**Name**

sip_get_request_uri_str – return request URI

**Synopsis**

```c
cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

const sip_str_t *sip_get_request_uri_str(sip_msg_t sip_msg,
                      int *error);
```

**Description**

For functions that return a pointer of type `sip_str_t`, `sip_str_t` is supplied by:

```c
typedef struct sip_str {
    char *sip_str_ptr;
    int sip_str_len;
}sip_str_t;
```

The `sip_str_ptr` parameter points to the start of the returned value and `sip_str_len` supplies the length of the returned value.

For example, given the following request line in a SIP message input to `sip_get_request_uri_str()`:

```plaintext
INVITE sip:marconi@radio.org SIP/2.0
```

the return is a pointer to `sip_str_t` with the `sip_str_ptr` member pointing to "s" of `sip:marconi@radio.org` and `sip_str_len` being set to 21, the length of `sip:marconi@radio.org`.

The `sip_get_request_uri_str()` function returns the URI string from the request line in the SIP message `sip_msg`.

**Return Values**

The `sip_get_request_uri_str()` function returns the URI string. The function returns NULL on failure.

The value of `errno` is not changed by these calls in the event of an error.

**Errors**

If the error is non-null, one of the following values is set:

- **EINVAL** For the `sip_get_request_uri_str()` function, there is no request line in the SIP message.
- **EPROTO** For `sip_get_request_uri_str`, the request URI is invalid.

On success, the value of the location pointed to by `error` is set to 0.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

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</table>
See Also  libsip(3LIB)
The `sip_get_resp_desc()` function returns the response phrase for the given response code in `resp_code`. The response code is not one that is listed in RFC 3261 (Section 21). The returned string is "UNKNOWN".

The value of `errno` is not changed by these calls in the event of an error.

### Attributes

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</table>

### See Also

`libsip(3LIB)`
#include <sip.h>

const struct sip_xaction *
sip_get_trans(sip_msg_t sip_msg, int which, int *error);

The *sip_get_trans()* function matches a transaction to a message as specified in RFC 3261, sections 17.1.3 and 17.2.3. The *sip_get_trans()* function holds a reference to the returned transaction. The caller must release this reference after use.

Return Values
The *sip_get_trans()* function returns the required value on success or NULL on failure.

The value of *errno* is not changed by these calls in the event of an error.

Errors
On success, the value of the location pointed to by *error* is set to 0.

Attributes
See attributes(5) for descriptions of the following attributes:

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</table>

See Also
libsip(3LIB)
The `sip_get_trans_method()` function returns the method the SIP message that created the transaction `sip_trans`.

The `sip_get_trans_state()` function returns the state of the transaction `sip_trans`.

A newly created transaction is in the state:

**SIP_NEW_TRANSACTION**

A client transaction could be in one of the following states:

- **SIP_CLNT_CALLING**
- **SIP_CLNT_INV_PROCEEDING**
- **SIP_CLNT_INV_TERMINATED**
- **SIP_CLNT_INV_COMPLETED**
- **SIP_CLNT_TRYING**
- **SIP_CLNT_NONINV_PROCEEDING**
- **SIP_CLNT_NONINV_TERMINATED**
- **SIP_CLNT_NONINV_COMPLETED**

A server transaction could be in one of the following states:

- **SIP_SRV_INV_PROCEEDING**
- **SIP_SRV_INV_COMPLETED**
- **SIP_SRV_CONFIRMED**
SIP_SRV_INV_TERMINATED
SIP_SRV_TRYING
SIP_SRV_NONINV_PROCEEDING
SIP_SRV_NONINV_COMPLETED
SIP_SRV_NONINV_TERMINATED

The `sip_get_trans_orig_msg()` function returns the message that created the transaction `sip_trans`. This could be a request on the client or a response on the server.

The `sip_get_transResp_msg()` function returns the last response that was sent on the transaction `sip_trans`. Typically, this response is used by the transaction layer for retransmissions for unreliable transports or for responding to retransmitted requests. A response that terminates a transaction is not returned.

The `sip_get_trans_conn_obj()` function returns the cached connection object, if any, in the transaction `sip_trans`.

The `sip_get_trans_branchid()` function returns the branch ID for the message that created the transaction `sip_trans`. The caller is responsible for freeing the returned string.

**Return Values**

The `sip_get_trans_orig_msg()`, `sip_get_trans_resp_msg()`, `sip_get_trans_conn_obj()`, and `sip_get_trans_branchid()` functions return the required value on success or `NULL` on failure.

The `sip_get_trans_state()` and `sip_get_trans_method()` functions return the required value on success and `-1` on failure.

The value of `errno` is not changed by these calls in the event of an error.

**Errors**

If the error is non-null, one of the following values is set:

- **EINVAL** The input transaction `sip_trans` is `NULL`.
- **ENOMEM** For `sip_get_trans_branchid()` there is an error allocating memory for the branch ID string.

On success, the value of the location pointed to by `error` is set to `0`.

**Attributes**

See `attributes(5)` for descriptions of the following attributes:

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</table>
See Also  \texttt{libsip(3LIB)}
The `sip_get_uri_parsed()` function returns the parsed URI `sip_uri` from the SIP header value specified in `value`.

On success, the value of `error` is set to 0.

See also `libsip(3LIB)`
The `sip_guid()` function can be used to generate a random string. The caller is responsible for freeing the returned string.

The `sip_guid()` function returns a string on success and `NULL` on failure. The value of `errno` is not changed by these calls in the event of an error.

See `attributes(5)` for descriptions of the following attributes:

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See Also `libsip(3LIB)`
### Name
sip_hold_dialog, sip_release_dialog – hold/release reference on a dialog

### Synopsis
```c
cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

void sip_hold_dialog(sip_dialog_t dialog);
void sip_release_dialog(sip_dialog_t dialog);
```

### Description
For functions that return a pointer of type `sip_str_t`, `sip_str_t` is supplied by:

```c
typedef struct sip_str {
    char *sip_str_ptr;
    int sip_str_len;
}sip_str_t;
```

The `sip_str_ptr` parameter points to the start of the returned value and `sip_str_len` supplies the length of the returned value.

The `sip_hold_dialog()` function is used to hold a reference on the `dialog`. A dialog is not freed if there are any references on it.

The `sip_release_dialog()` function is used to release a reference in the `dialog`. If the reference in a dialog drops to 0 and it is in SIP_DLG_DESTROYED state, it is freed.

### Return Values
The value of `errno` is not changed by these calls in the event of an error.

### Attributes
See attributes(5) for descriptions of the following attributes:

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</table>

### See Also
libsip(3LIB)
Name  sip_hold_msg, sip_free_msg – adds and removes a reference from a SIP message

Synopsis  
cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

    void sip_hold_msg(sip_msg_t sip_msg);
    void sip_free_msg(sip_msg_t sip_msg);

Description  The sip_hold_msg() function adds a reference to the SIP message passed as the argument. The reference is used to prevent the SIP message from being freed when in use.

The sip_free_msg() function is used to remove an added reference on the SIP message passed as the argument. If this is the last reference on the SIP message (i.e. the number of references on the SIP message is 0), the SIP message is destroyed and associated resources freed. Freeing a SIP message does not set the sip_msg pointer to NULL. Applications should not expect the pointer to a freed SIP message to be NULL.

Return Values  The value of errno is not changed by these calls in the event of an error.

Attributes  See attributes(5) for descriptions of the following attributes:

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</table>

See Also  libsip(3LIB)
The `sip_hold_trans()` function is used to hold a reference on the transaction `sip_trans`. A transaction is not freed if there are any references on it.

The `sip_release_trans()` function is used to release a reference on the transaction `sip_trans`. If the reference falls to 0 and the transaction is in a terminated state, the transaction is freed.

The value of `errno` is not changed by these calls in the event of an error.

See also `libsip(3LIB)`
Name  sip_init_conn_object, sip_clear_stale_data, sip_conn_destroyed – connection object related functions

Synopsis  
cc [ flag ... ] file ... -lsip [ library ... ] 
#include <sip.h>

int sip_init_conn_object(sip_conn_object_t obj);

void sip_clear_stale_data(sip_conn_object_t obj);

void sip_conn_destroyed(sip_conn_object_t obj);

Description  The sip_init_conn_object() function initializes the connection object obj for use by the stack. The first member of the connection object (a `void *`) is used by the stack to store connection object specific stack-private data.

The sip_clear_stale_data() function is used to clear any stack-private data in the connection object obj.

The sip_conn_destroyed() function is used to intimate the stack of the pending destruction of the connection object obj. The stack clean up any stack-private data in obj and also removes obj from any caches the stack maintains.

Return Values  The sip_init_conn_object() function returns 0 on success and the appropriate error value on failure.

The value of errno is not changed by these calls in the event of an error.

Attributes  See attributes(5) for descriptions of the following attributes:

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See Also  libsip(3LIB)
Name  sip_is_sip_uri, sip_get_uri_scheme, sip_get_uri_host, sip_get_uri_user, sip_get_uri_password, sip_get_uri_port, sip_get_uri_params, sip_get_uri_headers, sip_get_uri_opaque, sip_get_uri_query, sip_get_uri_path, sip_get_uri_regname, sip_is_uri_teluser, sip_get_uri_errflags, sip_uri_errflags_to_str – get URI related attributes

Synopsis  cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

    boolean_t sip_is_sip_uri(const struct sip_uri *sip_uri);
    const sip_str_t *sip_get_uri_scheme(const struct sip_uri *sip_uri,
                                        int *error);
    const sip_str_t *sip_get_uri_user(const struct sip_uri *sip_uri,
                                       int *error);
    const sip_str_t *sip_get_uri_password(const struct sip_uri *sip_uri,
                                           int *error);
    const sip_str_t *sip_get_uri_host(const struct sip_uri *sip_uri,
                                       int *error);
    int sip_get_uri_port(const struct sip_uri *sip_uri,
                           int *error);
    const sip_str_t *sip_get_uri_params(const struct sip_uri *sip_uri,
                                         int *error);
    const sip_str_t *sip_get_uri_headers(const struct sip_uri *sip_uri,
                                          int *error);
    const sip_str_t *sip_get_uri_opaque(const struct sip_uri *sip_uri,
                                         int *error);
    const sip_str_t *sip_get_uri_query(const struct sip_uri *sip_uri,
                                         int *error);
    const sip_str_t *sip_get_uri_path(const struct sip_uri *sip_uri,
                                       int *error);
    const sip_str_t *sip_get_uri_regname(const struct sip_uri *sip_uri,
                                          int *error);
    boolean_t sip_is_uri_teluser(const struct sip_uri *sip_uri);
    int sip_get_uri_errflags(const struct sip_uri *sip_uri,
                              int *error);
    char *sip_uri_errflags_to_str(int uri_errflags);

Description  For functions that return a pointer of type sip_str_t, sip_str_t is supplied by:

    typedef struct sip_str {
        char *sip_str_ptr;
        int sip_str_len;
    }sip_str_t;
The `sip_str_ptr` parameter points to the start of the returned value and `sip_str_len` supplies the length of the returned value.

For example, given the following request line in a SIP message input to `sip_get_request_uri_str()`:
```
INVITE sip:marconi@radio.org SIP/2.0
```

the return is a pointer to `sip_str_t` with the `sip_str_ptr` member pointing to “s” of `sip:marconi@radio.org` and `sip_str_len` being set to 21, the length of `sip:marconi@radio.org`.

The `sip_is_sip_uri()` function takes a parsed URI `sip_uri` and returns `B_TRUE` if it is a SIP[S] URI and `B_FALSE` if it is not. A URI is a SIP[S] URI if the scheme in the URI is either “sip” or “sips”.

The `sip_get_uri_user()` function takes a parsed URI `sip_uri` and returns the value of the “user” component, if present.

The `sip_get_uri_password()` function takes a parsed URI `sip_uri` and returns the value of the “password” component, if present.

The `sip_get_uri_host()` function takes a parsed URI `sip_uri` and returns the value of the “host” component, if present.

The `sip_get_uri_port()` function takes a parsed URI `sip_uri` and returns the value of the “port” component, if present.

The `sip_get_uri_params()` function takes a parsed URI `sip_uri` and returns the list of URI parameters, if present, from a SIP[S] URI.

The `sip_get_uri_headers()` function takes a parsed URI `sip_uri` and returns ‘headers’ from a SIP[S] URI.

The `sip_get_uri_query()` function takes a parsed URI `sip_uri` and returns the value of the ‘query’ component, if present.

The `sip_get_uri_path()` function takes a parsed URI `sip_uri` and returns the value of the ‘path’ component, if present.

The `sip_get_uri_regname()` function takes a parsed URI `sip_uri` and returns the value of the ‘regname’ component, if present.

The `sip_is_uri_teluser()` function returns `B_TRUE` if the user component is a telephone-subscriber. Otherwise, `B_FALSE` is returned.

The `sip_get_uri_errflags()` function returns the error flags from a parsed URI `sip_uri`. The returned value is a bitmask with the appropriate bit set when the parser, `sip_parse_uri()`, encounters an error. The following are the possible error values that could be set:
The `sip_uri_errflags_to_str()` function takes the error flags from a parsed URI `sip_uri` and forms a string with all the error bits that are set. For example, if `SIP_URIERR_PASS` and `SIP_URIERR_PORT` are set in a parsed URI `sip_uri`, the `sip_uri_errflags_to_str()` function returns a string such as:

"Error(s) in PASSWORD, PORT part(s)"

The caller is responsible for freeing the returned string.

**Return Values**

The `sip_get_uri_scheme()`, `sip_get_uri_user()`, `sip_get_uri_password()`, `sip_get_uri_host()`, `sip_get_uri_params()`, `sip_get_uri_headers()`, `sip_get_uri_opaque()`, `sip_get_uri_query()`, `sip_get_uri_path()`, `sip_get_uri_regname()`, and `sip_uri_errflags_to_str()` functions return the requested value on success and NULL on failure.

The `sip_get_uri_port()` function returns `port` from the URI or 0 if the port is not present. The returned port is in host byte order.

The value of `errno` is not changed by these calls in the event of an error.

**Errors**

If the error is non-null, the following value is set:

<table>
<thead>
<tr>
<th>Error</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>EINVAL</td>
<td>The SIP header value of the SIP message is NULL or there is no URI.</td>
</tr>
</tbody>
</table>

The input URI is null or the requested URI component is invalid. The error flag is set for the requested component.

The URI parameters or headers are requested from a non-SIP[S] URI; or the 'opaque', 'query', 'path', 'reg-name' components are requested from a SIP[S] URI.

On success, the value of the location pointed to by `error` is set to 0.
Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTETYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also libsip(3LIB)
**Name**  
sip_msg_is_request, sip_message_is_response – determine if the SIP message is a request or a response

**Synopsis**  
```
cc [ flag ... ] file ... -lsip [ library ... ]  
#include <sip.h>

boolean_t sip_msg_is_request(const sip_msg_t sip_msg,  
    int *error);

boolean_t sip_msg_is_response(const sip_msg_t sip_msg,  
    int *error);
```

**Description**  
The `sip_msg_is_request()` function returns `B_TRUE` if `sip_msg` is a request and `B_FALSE` otherwise.

The `sip_msg_is_response()` function returns `B_TRUE` if `sip_msg` is a response and `B_FALSE` otherwise.

**Return Values**  
For functions that return an integer, the return value is the specified value on success and `-1` on error.

The value of `errno` is not changed by these calls in the event of an error.

**Errors**  
These functions take a pointer to an integer `error` as an argument. If the `error` is non-null, one of the following values is set:

- **EINVAL** The input SIP message `sip_msg` or the header value is null; or the specified header/Header value is deleted.
- **EPROTO** The header value is not present or invalid. The parser could not parse it correctly.
- **ENOMEM** There is an error allocating memory for the return value.

On success, the value of the location pointed to by `error` is set to `0`.

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Committed</td>
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<tr>
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<td>MT-Safe</td>
</tr>
</tbody>
</table>

**See Also**  
`libsip(3LIB)`
The `sip_msg_to_str()` function returns the string representation of the SIP message `sip_msg`. Deleted headers are not included in the returned string. The caller is responsible for freeing the returned string.

The `sip_hdr_to_str()` function returns the string representation of the SIP header `sip_header`. The caller is responsible for freeing the returned string.

The `sip_reqline_to_str()` function returns the string representation of the request line from the SIP message `sip_msg`. The caller is responsible for freeing the returned string.

The `sip_respline_to_str()` function returns the string representation of the response line from the SIP message `sip_msg`. The caller is responsible for freeing the returned string.

The `sip_sent_by_to_str()` function can be used to retrieve the list of sent-by values registered with the stack. The returned string is a comma separated list of sent-by values. The caller is responsible for freeing the returned string.

The value of `errno` is not changed by these calls in the event of an error.

For the `sip_msg_to_str()`, `sip_hdr_to_str()`, `sip_reqline_to_str()`, `sip_respline_to_str()`, and `sip_sent_by_to_str()` functions return the relevant string on success and `NULL` on failure.

On success, the value of the location pointed to by `error` is set to 0.
Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<tbody>
<tr>
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</tr>
</tbody>
</table>

See Also libsip(3LIB)
sib_new_msg()—allocates a new SIP message

Synopsis

cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

sip_msg_t sip_new_msg();

Description

The sip_new_msg() function allocates and returns a new SIP message.

Return Values

The sip_new_msg() function returns the newly allocated SIP message on success and NULL on failure.

The value of errno is not changed by these calls in the event of an error.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also

libsip(3LIB)
Name  sip_parse_uri, sip_free_parsed_uri – parse a URI and free a parsed URI

Synopsis  cc { flag ... } file ... -lsip { library ... }
#include <sip.h>

sip_uri_t sip_parse_uri(sip_str_t *uri_str,
   int *error);
void sip_free_parsed_uri(sip_uri_t sip_uri);

Description  For functions that return a pointer of type sip_str_t, sip_str_t is supplied by:

typedef struct sip_str {
   char *sip_str_ptr;
   int sip_str_len;
}sip_str_t;

The sip_str_ptr parameter points to the start of the returned value and sip_str_len supplies the
length of the returned value.

For example, given the following request line in a SIP message input to
sip_get_request_uri_str():
INVITE sip:marconi@radio.org SIP/2.0

the return is a pointer to sip_str_t with the sip_str_ptr member pointing to “s” of
sip:marconi@radio.org and sip_str_len being set to 21, the length of
sip:marconi@radio.org.

The sip_parse_uri() function takes a URI string in the form sip_str_t and returns a parsed
URI sip_uri. The syntax of the URI is as specified in RFC 3261, section 25.1. If the parser
encounters an error when parsing a component, it sets the appropriate error bit in the error
flags and proceeds to the next component, if present.

The sip_free_parsed_uri() function takes a parsed URI sip_uri, obtained from
sip_parse_uri(), and frees any associated memory.

Return Values  The sip_parse_uri() function returns the parsed URI sip_uri on success. It returns a NULL if
memory cannot be allocated for the parsed URI.

The value of errno is not changed by these calls in the event of an error.

Errors  If the error is non-null, the following values is set:

EINVAL  The SIP header value of the SIP message is NULL or there is no URI.

The input URI is null or the requested URI component is invalid. The error flag is
set for the requested component.

The URI parameters or headers are requested from a non-SIP[S] URI; or the
‘opaque’, ‘query’, ‘path’, ‘reg-name’ components are requested from a SIP[S] URI.
On success, the value of the location pointed to by `error` is set to 0.

**Attributes**  
See attributes(5) for descriptions of the following attributes:

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<tr>
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</tbody>
</table>

**See Also**  
libsip(3LIB)
Name  sip_process_new_packet – send an inbound message to the SIP stack for processing

Synopsis  cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

    void sip_process_new_packet(sip_conn_object_t conn_object,
    void *msgstr, size_t msgstr);

Description  The sip_process_new_packet() function receives incoming message, creates a SIP message, processes it and passes it on to the application. For a byte-stream protocol like TCP, sip_process_new_packet() also takes care of breaking the byte stream into message boundaries using the CONTENT-LENGTH header in the SIP message. If the SIP message arriving on TCP does not contain a CONTENT-LENGTH header, the behavior is unspecified.

    sip_process_new_packet() deletes the SIP message on return from the application’s receive function, thus if the application wishes to retain the SIP message for future use, it must use sip_hod_msg() so that the message is not freed by sip_process_new_packet().

Return Values  The value of errno is not changed by these calls in the event of an error.

Attributes  See attributes(5) for descriptions of the following attributes:

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<tr>
<th>ATTRIBUTE TYPE</th>
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</tr>
</tbody>
</table>

See Also  libsip(3LIB)
Name  
sip_register_sent_by, sip_unregister_sent_by, sip_unregister_all_sent_by – allows registering and un-registering sent-by values

Synopsis  
cc [ flag ... ] file ... -lsip [ library ... ]
#include <sip.h>

int sip_register_sent_by(char *val);
void sip_unregister_sent_by(char *val);
void sip_unregister_all_sent_by(int *error);

Description  
The sip_register_sent_by() function can be used to register a list of hostnames or IP addresses that the application may add to the VIA headers. The val is a comma separated list of such sent-by values. If any value is registered using sip_register_sent_by(), the SIP stack validates incoming responses to check if the sent-by parameter in the topmost VIA header is part of the registered list. If the check fails, the response is dropped. If there are no sent-by values registered, there is no check done on incoming responses.

The sip_unregister_sent_by() and sip_unregister_all_sent_by() functions are used to un-register sent-by values. The val for sip_unregister_sent_by() is a comma separated list of sent-by values that need to be un-registered. sip_unregister_all_sent_by() un-registers all the values that have been registered.

Return Values  
The sip_register_sent_by() function returns 0 on success and the appropriate error value on failure.

The value of errno is not changed by these calls in the event of an error.

Attributes  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
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<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  
libsip(3LIB)
**Name**  
sip_sendmsg – send an outbound SIP message to the SIP stack for processing

**Synopsis**  
c{ flag ... } file ... -lsip [ library ... ]  
#include <sip.h>

```c
int sip_sendmsg(sip_conn_object_t obj, sip_msg_t sip_msg,
    sip_dialog_t dialog, uint32_t flags);
```

**Description**  
The `sip_sendmsg()` function is used to send an outbound SIP message `sip_msg` to the SIP stack on its way to the peer. The connection object for the SIP message is passed as `obj`. The caller also provides the dialog associated with the message, if one exists. The value of flags is the result of ORing the following, as required:

- **SIP_SEND_STATEFUL**: Send the request or response statefully. This results in the stack creating and maintaining a transaction for this request/response. If this flag is not set transactions are not created for the request/response.
- **SIP_DIALOG_ON_FORK**: When this flag is set, the stack may create multiple dialogs for a dialog completing response. This may result due to forking of the dialog creating request. If this flag is not set, the first response to a dialog creating request creates a dialog, but subsequent ones do not. It is only meaningful if the stack is configured to maintain dialogs.

**Return Values**  
The `sip_sendmsg()` function returns 0 on success and the appropriate error on failure. The value of `errno` is not changed by these calls in the event of an error.

**Errors**  
The `sip_sendmsg()` function can return one of the following errors on failure:

- **EINVAL**: If a message is being statefully sent and the `branchid` in the VIA header does not conform to RFC 3261 or when accessing CSEQ header while creating a transaction.
- **ENOENT**: If a message is being statefully sent, error getting the CSEQ header while creating a transaction.
- **EPROTO**: If a message is being statefully sent, error getting the CSEQ value while creating a transaction.
- **ENOMEM**: If the message is being statefully sent, error allocating memory for creating or adding a transaction or during transaction related processing.

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
</tbody>
</table>
## sip_sendmsg(3SIP)

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

### See Also

libsip(3LIB)
The `sip_stack_init()` function is used to initialize the SIP stack. The stack can be initialized by a process only once. Any shared library that is linked with a main program or another library that has already initialized the stack will encounter a failure when trying to initialize the stack.

The initialization structure is given by:

```c
typedef struct sip_stack_init_s {
    int sip_version;
    uint32_t sip_stack_flags;
    sip_io_pointers_t *sip_io_pointers;
    sip_ulp_pointers_t *sip_ulp_pointers;
    sip_header_function_t *sip_function_table;
} sip_stack_init_t;
```

- `sip_version` This must be set to `SIP_STACK_VERSION`.
- `sip_stack_flags` If the application wants the SIP stack to maintain dialogs, this flag must be set to `SIP_STACK_DIALOGS`. Otherwise, it must be set to 0. If `SIP_STACK_DIALOGS` is not set, the stack does not deal with dialogs at all.

Upper Layer Registrations

These include callbacks that are invoked to deliver incoming messages or error notification.

The callback functions should not create a thread and invoke a function that could recursively invoke the callback. For example, the callback function for a transition state change notification should not create a thread to send a SIP message that results in a change in the state of the transaction, which would again invoke the callback function.

The registration structure is supplied by:

```c
typedef struct sip_ulp_pointers_s {
    void (*sip_ulp_recv)(const sip_conn_object_t, sip_msg_t, const sip_dialog_t);
    uint_t (*sip_ulp_timeout)(void *,
       void (*func)(void *),
       struct timeval *);
    boolean_t (*sip_ulp_untimeout)(uint_t);
    int (*sip_ulp_trans_error)(sip_transaction_t, int, void *);
    void (*sip_ulp_dlg_del)(sip_dialog_t, sip_msg_t, void *);
    void (*sip_ulp_trans_state_cb)(sip_transaction_t, sip_msg_t,
       void (*func)(void *),
       struct timeval *);
} sip_ulp_pointers_t;
```
This is a mandatory routine that the application registers for the stack to deliver an inbound SIP message. The SIP stack invokes the function with the connection object on which the message arrived, the SIP message, and any associated dialog.

The SIP message is freed once the function returns. If the application wishes to use the message beyond that, it has to hold a reference on the message using `sip_hold_msg()`. Similarly, if the application wishes to cache the dialog, it must hold a reference on the dialog using `sip_hold_msg()`.

An application can register these two routines to implement its own routines for the stack timers. Typically, an application should allow the stack to use its own built-in timer routines. The built-in timer routines are used only by the stack and are not available to applications. If the application registers one routine, it must also register the other.

These functions must be registered for single-threaded application. Otherwise, the timer thread provided by the stack could result in invoking a registered callback function.

The application can register this routine to be notified of a transaction error. An error can occur when the transaction layer tries to send a message using a cached connection object which results in a failure. If this routine is not registered the transaction is terminated on such a failure. The final argument is for future use. It is always set to `NULL`.

An application can register this routine to be notified when a dialog is deleted. The dialog to be deleted is passed along with the SIP message which caused the dialog to be deleted. The final argument is for future use. It is always set to `NULL`.

If these callback routines are registered, the stack invokes `sip_ulp_trans_state_cb` when a transaction changes states and `sip_ulp_dlg_state_cb` when a dialog changes states.
The connection manager interfaces must be registered by the application to provide I/O related functionality to the stack. These interfaces act on a connection object that is defined by the application. The application registers the interfaces for the stack to work with the connection object. The connection object is application defined, but the stack requires that the first member of the connection object is a void *, used by the stack to store connection object specific information which is private to the stack.

The connection manager structure is supplied by:

```
typedef struct sip_io_pointers_s {
    int (*sip_conn_send)(const sip_conn_object_t, char *, int);
    void (*sip_hold_conn_object)(sip_conn_object_t);
    void (*sip_rel_conn_object)(sip_conn_object_t);
    boolean_t (*sip_conn_is_stream)(sip_conn_object_t);
    boolean_t (*sip_conn_is_reliable)(sip_conn_object_t);
    int (*sip_conn_remote_address)(sip_conn_object_t, struct sockaddr *,
                                  socklen_t *);
    int (*sip_conn_local_address)(sip_conn_object_t, struct sockaddr *,
                                  socklen_t *);
    int (*sip_conn_transport)(sip_conn_object_t);
    int (*sip_conn_timer1)(sip_conn_object_t);
    int (*sip_conn_timer2)(sip_conn_object_t);
    int (*sip_conn_timer4)(sip_conn_object_t);
    int (*sip_conn_timerd)(sip_conn_object_t);
}sip_io_pointers_t;
```

**sip_conn_send**

This function is invoked by the stack after processing an outbound SIP message. This function is responsible for sending the SIP message to the peer. A return of 0 indicates success. The SIP message is passed to the function as a string, along with the length information and the associated connection object.

**sip_hold_conn_object**

**sip_rel_conn_object**

The application provides a mechanism for the stack to indicate that a connection object is in use by the stack and must not be freed. The stack uses sip_hold_conn_object to indicate that the connection object is in use and sip_rel_conn_object to indicate that it has been released. The connection object is passed as the argument to these functions. The stack expects that the application will not free the connection object if it is in use by the stack.

**sip_conn_is_stream**

The stack uses this to determine whether the connection object, passed as the argument, is byte-stream oriented. Byte-stream protocols include TCP while message-based protocols include SCTP and UDP.
The stack uses this to determine whether the connection object, passed as the argument, is reliable. Reliable protocols include TCP and SCTP. Unreliable protocols include UDP.

These two interfaces are used by the stack to obtain endpoint information for a connection object. The sip_conn_local_address provides the local address/port information. The sip_conn_remote_address provides the address/port information of the peer. The caller allocates the buffer and passes its associated length along with it. On return, the length is updated to reflect the actual length.

The stack uses this to determine the transport used by the connection object, passed as the argument. The transport could be TCP, UDP, SCTP.

These four interfaces may be registered by an application to provide connection object specific timer information. If these are not registered the stack uses default values.

The interfaces provide the timer values for Timer 1 (RTT estimate - default 500 msec), Timer 2 (maximum retransmit interval for non-INVITE request and INVITE response - default 4 secs), Timer 4 (maximum duration a message will remain in the network - default 5 secs) and Timer D (wait time for response retransmit interval - default 32 secs).

In addition to the SIP headers supported by the stack, an application can optionally provide a table of custom headers and associated parsing functions. The table is an array with an entry for each header. If the table includes headers supported by the stack, parsing functions or other application-specific table entries take precedence over libsip supported headers. The header table structure is supplied by:

typedef struct header_function_table {
    char *header_name;
    char *header_short_name;
    int (*header_parse_func)(struct sip_header *, struct sip_parsed_header **);
    boolean_t (*header_check_compliance)(struct sip_parsed_header *);
    boolean_t (*header_is_equal)(struct sip_parsed_header *, struct sip_parsed_header *),
} custom_sip_headers;
struct sip_parsed_header *);
void (*header_free)(struct sip_parsed_header *);
}

header_name The full name of the header. The application must ensure that the name does not conflict with existing headers. If it does, the one registered by the application takes precedence.

header_short_name Compact name, if any, for the header.

header_parse_func The parsing function for the header. The parser will set the second argument to the resulting parsed structure. A return value of 0 indicates success.

header_free The function that frees the parsed header.

header_check_compliance An application can optionally provide this function that will check if the header is compliant or not. The compliance for a custom header will be defined by the application.

header_is_equal An application can optionally provide this function to determine whether two input headers are equivalent. The equivalence criteria is defined by the application.

Return Values On success sip_stack_init() returns 0. Otherwise, the function returns the error value. The value of errno is not changed by these calls in the event of an error.

Errors On failure, the sip_stack_init() function returns the following error value:
EINVAL If the stack version is incorrect, or if any of the mandatory functions is missing.

Attributes See attributes(5) for descriptions of the following attributes:

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</tbody>
</table>

See Also libsip(3LIB)
The `slp_api` is a C language binding that maps directly into the Service Location Protocol ("SLP") defined by RFC 2614. This implementation requires minimal overhead. With the exception of the `SLPDereg()` and `SLPDelAttrs()` functions, which map into different uses of the SLP deregister request, there is one C language function per protocol request. Parameters are for the most part character buffers. Memory management is kept simple because the client allocates most memory and client callback functions are required to copy incoming parameters into memory allocated by the client code. Any memory returned directly from the API functions is deallocated using the `SLPFree()` function.

To conform with standard C practice, all character strings passed to and returned through the API are null-terminated, even though the SLP protocol does not use null-terminated strings. Strings passed as parameters are UTF-8 but may still be passed as a C string (a null-terminated sequence of bytes.) Escaped characters must be encoded by the API client as UTF-8. In the common case of US-ASCII, the usual one byte per character works. API functions assist in escaping and unescaping strings.

Unless otherwise noted, parameters to API functions and callbacks are non-NULL. Some parameters may have other restrictions. If any parameter fails to satisfy the restrictions on its value, the operation returns a `PARAMETER_BAD` error.

Query strings, attribute registration lists, attribute deregistration lists, scope lists, and attribute selection lists follow the syntax described in RFC 2608. The API reflects the strings passed from clients directly into protocol requests, and reflects out strings returned from protocol replies directly to clients. As a consequence, clients are responsible for formatting request strings, including escaping and converting opaque values to escaped byte-encoded strings. Similarly, on output, clients are required to unescape strings and convert escaped string-encoded opaque to binary. The `SLPUnescape()` functions can be used for escaping SLP reserved characters, but they perform no opaque processing.

Opaque values consist of a character buffer that contains a UTF-8-encoded string, the first characters of which are the non UTF-8 encoding \"\ff\". Subsequent characters are the escaped values for the original bytes in the opaque. The escape convention is relatively simple. An escape consists of a backslash followed by the two hexadecimal digits encoding the byte. An example is \"\2c\" for the byte 0x2c. Clients handle opaque processing themselves, since the algorithm is relatively simple and uniform.

The system properties established in `slp.conf(4)`, the configuration file, are accessible through the `SLPGetProperty()` and `SLPSetProperty()` functions. The `SLPSetProperty()` function modifies properties only in the running process, not in the configuration file. Errors are checked when the property is used and, as with parsing the configuration file, are logged at the `LOG_INFO` priority. Program execution continues without interruption by substituting the default for the erroneous parameter. In general, individual agents should rarely be required to
override these properties, since they reflect properties of the SLP network that are not of concern to individual agents. If changes are required, system administrators should modify the configuration file.

Properties are global to the process, affecting all threads and all handles created with SLPOpen().

### Memory Management

The only API functions that return memory specifically requiring deallocation on the part of the client are SLPParseServerURL(), SLPFindScope(), SLPEscape(), and SLPUnescape(). Free this memory with SLPFree() when it is no longer needed. Do not free character strings returned by means of the SLPGetProperty() function.

Any memory passed to callbacks belongs to the library, and it must not be retained by the client code. Otherwise, crashes are possible. Clients must copy data out of the callback parameters. No other use of the memory in callback parameters is allowed.

If a handle parameter to an API function is opened asynchronously, the API function calls on the handle to check the other parameters, opens the appropriate operation, and returns immediately. If an error occurs in the process of starting the operation, the error code is returned. If the handle parameter is opened synchronously, the function call is blocked until all results are available, and it returns only after the results are reported through the callback function. The return code indicates whether any errors occurred during the operation.

The callback function is called whenever the API library has results to report. The callback code is required to check the error code parameter before looking at the other parameters. If the error code is not SLP_OK, the other parameters may be NULL or otherwise invalid. The API library can terminate any outstanding operation on which an error occurs. The callback code can similarly indicate that the operation should be terminated by passing back SLP_FALSE to indicate that it is not interested in receiving more results. Callback functions are not permitted to recursively call into the API on the same SLPHandle. If an attempt is made to call into the API, the API function returns SLP_HANDLE_IN_USE. Prohibiting recursive callbacks on the same handle simplifies implementation of thread safe code, since locks held on the handle will not be in place during a second outcall on the handle.

The total number of results received can be controlled by setting the net.slp.maxResults parameter.

On the last call to a callback, whether asynchronous or synchronous, the status code passed to the callback has value SLP_LAST_CALL. There are four reasons why the call can terminate:

- **DA reply received** A reply from a DA has been received and therefore nothing more is expected.
- **Multicast terminated** The multicast convergence time has elapsed and the API library multicast code is giving up.
- **Multicast null results** Nothing new has been received during multicast for awhile and the API library multicast code is giving up on that (as an optimization).
Maximum results  The user has set the `net.slp.maxResults` property and that number of replies has been collected and returned.

Configuration Files  The API library reads `slp.conf(4)`, the default configuration file, to obtain the operating parameters. You can specify the location of this file with the `SLP_CONF_FILE` environment variable. If you do not set this variable, or the file it refers to is invalid, the API will use the default configuration file at `/etc/inet/slp.conf` instead.

Data Structures  The data structures used by the SLP API are as follows:

The URL Lifetime Type

```c
typedef enum {
    SLP_LIFETIME_DEFAULT = 10800,
    SLP_LIFETIME_MAXIMUM = 65535
} SLPURLLifetime;
```

The enumeration `SLPURLLifetime` contains URL lifetime values, in seconds, that are frequently used. `SLP_LIFETIME_DEFAULT` is 3 hours, while `SLP_LIFETIME_MAXIMUM` is 18 hours, which corresponds to the maximum size of the lifetime field in SLP messages. Note that on registration `SLP_LIFETIME_MAXIMUM` causes the advertisement to be continually reregistered until the process exits.

The SLPBoolean Type

```c
typedef enum {
    SLP_FALSE = 0,
    SLP_TRUE = 1
} SLPBoolean;
```

The enumeration `SLPBoolean` is used as a Boolean flag.

The Service URL Structure

```c
typedef struct srvurl {
    char *s_pcsrvType;
    char *s_pcHost;
    int   s_iPort;
    char *s_pcNetFamily;
    char *s_pcsrvPart;
} SLPSrvURL;
```

The `SLPSrvURL` structure is filled in by the `SLPParseSrvURL()` function with information parsed from a character buffer containing a service URL. The fields correspond to different parts of the URL, as follows:

- `s_pcsrvType`  A pointer to a character string containing the service type name, including naming authority.
s_pcHost  A pointer to a character string containing the host identification information.

s_iPort  The port number, or zero, if none. The port is only available if the transport is IP.

s_pcNetFamily  A pointer to a character string containing the network address family identifier. Possible values are "ipx" for the IPX family, "at" for the Appletalk family, and "", the empty string, for the IP address family.

s_pcSrvPart  The remainder of the URL, after the host identification.

The host and port should be sufficient to open a socket to the machine hosting the service; the remainder of the URL should allow further differentiation of the service.

The SLPHandle

typedef void* SLPHandle;

The SLPHandle type is returned by SLPOpen() and is a parameter to all SLP functions. It serves as a handle for all resources allocated on behalf of the process by the SLP library. The type is opaque.

Callbacks  Include a function pointer to a callback function specific to a particular API operation in the parameter list when the API function is invoked. The callback function is called with the results of the operation in both the synchronous and asynchronous cases. When the callback function is invoked, the memory included in the callback parameters is owned by the API library, and the client code in the callback must copy out the contents if it wants to maintain the information longer than the duration of the current callback call.

Each callback parameter list contains parameters for reporting the results of the operation, as well as an error code parameter and a cookie parameter. The error code parameter reports the error status of the ongoing (for asynchronous) or completed (for synchronous) operation. The cookie parameter allows the client code that starts the operation by invoking the API function to pass information down to the callback without using global variables. The callback returns an SLPBoolean to indicate whether the API library should continue processing the operation. If the value returned from the callback is SLP_TRUE, asynchronous operations are terminated. Synchronous operations ignore the return since the operation is already complete.

SLPRegReport()

typedef void SLPRegReport(SLPHandle hSLP,  
    SLPError errCode,  
    void *pvCookie);

SLPRegReport() is the callback function to the SLPReg(), SLPDereg(), and SLPDelAttrs() functions. The SLPRegReport() callback has the following parameters:
The `SLPHandle()` used to initiate the operation.

An error code indicating if an error occurred during the operation.

Memory passed down from the client code that called the original API function, starting the operation. It may be NULL.

**SLPSrvTypeCallback()**

```c
typedef SLPBoolean SLPSrvTypeCallback(SLPHandle hSLP,
                                      const char* pcSrvTypes,
                                      SLPError errCode,
                                      void *pvCookie);
```

The `SLPSrvTypeCallback()` type is the type of the callback function parameter to the `SLPFindSrvTypes()` function. The results are collated when the `hSLP` handle is opened either synchronously or asynchronously. The `SLPSrvTypeCallback()` callback has the following parameters:

- **hSLP** The `SLPHandle` used to initiate the operation.
- **pcSrvTypes** A character buffer containing a comma-separated, null-terminated list of service types.
- **errCode** An error code indicating if an error occurred during the operation. The callback should check this error code before processing the parameters. If the error code is other than `SLP_OK`, then the API library may choose to terminate the outstanding operation.
- **pvCookie** Memory passed down from the client code that called the original API function, starting the operation. It can be NULL.

**SLPSrvURLCallback**

```c
typedef SLPBoolean SLPSrvURLCallback(SLPHandle hSLP,
                                      const char* pcSrvURL,
                                      unsigned short usLifetime,
                                      SLPError errCode,
                                      void *pvCookie);
```

The `SLPSrvURLCallback()` type is the type of the callback function parameter to the `SLPFindSrvs()` function. The results are collated, regardless of whether the `hSLP` was opened collated or uncollated. The `SLPSrvURLCallback()` callback has the following parameters:

- **hSLP** The `SLPHandle` used to initiate the operation.
- **pcSrvURL** A character buffer containing the returned service URL.
- **usLifetime** An unsigned short giving the life time of the service advertisement. The value must be an unsigned integer less than or equal to `SLP_LIFETIME_MAXIMUM`. 
**errCode**  
An error code indicating if an error occurred during the operation. The callback should check this error code before processing the parameters. If the error code is other than SLP_OK, then the API library may choose to terminate the outstanding operation.

**pvCookie**  
Memory passed down from the client code that called the original API function, starting the operation. It can be NULL.

### SLPAttrCallback

typedef SLPBoolean SLPAttrCallback(SLPHandle hSLP,
const char* pcAttrList,
SLPError errCode,
void *pvCookie);

The SLPAttrCallback() type is the type of the callback function parameter to the SLPFindAttrs() function.

The behavior of the callback differs depending upon whether the attribute request was by URL or by service type. If the SLPFindAttrs() operation was originally called with a URL, the callback is called once, in addition to the last call, regardless of whether the handle was opened asynchronously or synchronously. The pcAttrList parameter contains the requested attributes as a comma-separated list. It is empty if no attributes match the original tag list.

If the SLPFindAttrs() operation was originally called with a service type, the value of pcAttrList and the calling behavior depend upon whether the handle was opened asynchronously or synchronously. If the handle was opened asynchronously, the callback is called every time the API library has results from a remote agent. The pcAttrList parameter is collated between calls, and contains a comma-separated list of the results from the agent that immediately returned. If the handle was opened synchronously, the results are collated from all returning agents, the callback is called once, and the pcAttrList parameter is set to the collated result.

SLPAttrCallback() callback has the following parameters:

- **hSLP**  
The SLPHandle used to initiate the operation.

- **pcAttrList**  
A character buffer containing a comma-separated and null-terminated list of attribute id/value assignments, in SLP wire format.

- **errCode**  
An error code indicating if an error occurred during the operation. The callback should check this error code before processing the parameters. If the error code is other than SLP_OK, then the API library may choose to terminate the outstanding operation.

- **pvCookie**  
Memory passed down from the client code that called the original API function, starting the operation. It can be NULL.
Errors  An interface that is part of the SLP API may return one of the following values.

SLP_LAST_CALL  The SLP_LAST_CALL code is passed to callback functions when the API library has no more data for them and therefore no further calls will be made to the callback on the currently outstanding operation. The callback uses this to signal the main body of the client code that no more data will be forthcoming on the operation, so that the main body of the client code can break out of data collection loops. On the last call of a callback during both a synchronous and asynchronous call, the error code parameter has value SLP_LAST_CALL, and the other parameters are all NULL. If no results are returned by an API operation, then only one call is made, with the error parameter set to SLP_LAST_CALL.

SLP_OK  The SLP_OK code indicates that no error occurred during the operation.

SLP_LANGUAGE_NOT_SUPPORTED  No DA or SA has service advertisement information in the language requested, but at least one DA or SA might have information for that service in another language.

SLPPARSE_ERROR  The SLP message was rejected by a remote SLP agent. The API returns this error only when no information was retrieved, and at least one SA or DA indicated a protocol error. The data supplied through the API may be malformed or damaged in transit.

SLP_INVALID_REGISTRATION  The API may return this error if an attempt to register a service was rejected by all DAs because of a malformed URL or attributes. SLP does not return the error if at least one DA accepts the registration.

SLP_SCOPE_NOT_SUPPORTED  The API returns this error if the UA or SA has been configured with the net.slp.useScopes list of scopes and the SA request did not specify one or more of these allowable scopes, and no others. It may also be returned by a DA if the scope included in a request is not supported by a DA.

SLP_AUTHENTICATION_ABSENT  This error arises when the UA or SA failed to send an authenticator for requests or registrations when security is enabled and thus required.

SLP_AUTHENTICATION_FAILED  This error arises when a authentication on an SLP message received from a remote SLP agent failed.
<table>
<thead>
<tr>
<th>Error Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SLP_INVALID_UPDATE</td>
<td>An update for a nonexisting registration was issued, or the update includes a service type or scope different than that in the initial registration.</td>
</tr>
<tr>
<td>SLP_REFRESH_REJECTED</td>
<td>The SA attempted to refresh a registration more frequently than the minimum refresh interval. The SA should call the appropriate API function to obtain the minimum refresh interval to use.</td>
</tr>
<tr>
<td>SLP_NOT_IMPLEMENTED</td>
<td>An outgoing request overflowed the maximum network MTU size. The request should be reduced in size or broken into pieces and tried again.</td>
</tr>
<tr>
<td>SLP_BUFFER_OVERFLOW</td>
<td>An outgoing request overflowed the maximum network MTU size. The request should be reduced in size or broken into pieces and tried again.</td>
</tr>
<tr>
<td>SLP_NETWORK_TIMED_OUT</td>
<td>When no reply can be obtained in the time specified by the configured timeout interval, this error is returned.</td>
</tr>
<tr>
<td>SLP_NETWORK_INIT_FAILED</td>
<td>If the network cannot initialize properly, this error is returned.</td>
</tr>
<tr>
<td>SLP_MEMORY_ALLOC_FAILED</td>
<td>If the API fails to allocate memory, the operation is aborted and returns this.</td>
</tr>
<tr>
<td>SLP_PARAMETER_BAD</td>
<td>If a parameter passed into an interface is bad, this error is returned.</td>
</tr>
<tr>
<td>SLP_NETWORK_ERROR</td>
<td>The failure of networking during normal operations causes this error to be returned.</td>
</tr>
<tr>
<td>SLP_INTERNAL_SYSTEM_ERROR</td>
<td>A basic failure of the API causes this error to be returned. This occurs when a system call or library fails. The operation could not recover.</td>
</tr>
<tr>
<td>SLP_HANDLE_IN_USE</td>
<td>In the C API, callback functions are not permitted to recursively call into the API on the same SLPHandle, either directly or indirectly. If an attempt is made to do so, this error is returned from the called API function.</td>
</tr>
</tbody>
</table>

**List Of Routines**

- `SLPOpen()`  open an SLP handle
- `SLPClose()` close an open SLP handle
- `SLPReg()` register a service advertisement
- `SLPDereg()` deregister a service advertisement
- `SLPDelAttrs()` delete attributes
SLPFindSrvTypes()  return service types
SLPFindSrvs()    return service URLs
SLPFindAttrs()  return service attributes
SLPGetRefreshInterval() return the maximum allowed refresh interval for SAs
SLPFindScopes() return list of configured and discovered scopes
SLPParseSrvURL() parse service URL
SLPEscape() escape special characters
SLPUnecape() translate escaped characters into UTF-8
SLGetProperty() return SLP configuration property
SLPSetProperty() set an SLP configuration property
slp_strerror() map SLP error code to message
SLPFree() free memory

Environment Variables

When SLP_CONF_FILE is set, use this file for configuration.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
<tr>
<td>CSI</td>
<td>CSI-enabled</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  slpd(1M), slp.conf(4), slpd.reg(4), attributes(5)

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Name  SLPClose – close an open SLP handle

Synopsis  
```
cc [ flag... ] file... -lslp [ library... ]
#include <slp.h>
```

```
void SLPClose(SLPHandle phSLP);
```

Description  The SLPClose() function frees all resources associated with the handle. If the handle is invalid, the function returns silently. Any outstanding synchronous or asynchronous operations are cancelled, so that their callback functions will not be called any further.

Parameters  
```
phSLP    An SLPHandle handle returned from a call to SPLopen().
```

Errors  This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

Examples  
```
EXAMPLE 1  Using SLPClose()
```

The following example will free all resources associated the handle:

```
SLPHandle hslp
SLPClose(hslp);
```

Environment Variables  SLP_CONF_FILE    When set, use this file for configuration.

Attributes  See attributes(5) for descriptions of the following attributes:

```
<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>
```

See Also  slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

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SLPDelAttrs – delete attributes

Synopsis

cc [ flag... ] file... -tslp [ library... ]
#include <slp.h>

SLPError SLPDelAttrs(SLPHandle hSLP, const char *pcURL,
                      const char *pcAttrs, SLPRegReport *callback, void *pvCookie);

Description

The SLPDelAttrs() function deletes the selected attributes in the locale of the
SLPHandle. If no error occurs, the return value is 0. Otherwise, one of the
SLPError codes is returned.

Parameters

hSLP The language specific SLPHandle to use to delete attributes. It cannot be NULL.

pcURL The URL of the advertisement from which the attributes should be deleted. It
cannot be NULL.

pcAttrs A comma-separated list of attribute ids for the attributes to deregister.

callback A callback to report the operation’s completion status. It cannot be NULL.

pvCookie Memory passed to the callback code from the client. It cannot be NULL.

Errors

This function or its callback may return any SLP error code. See the ERRORS section in
slp_api(3SLP).

Examples

EXAMPLE 1  Deleting Attributes

Use the following example to delete the location and dpi attributes for the URL
service:printer:lp://serv/queue1

SLPHandle hSLP;
SLPError err;
SLPRegReport report;

err = SLPDelAttrs(hSLP, "service:printer:lp://serv/queue1",
                  "location,dpi", report, NULL);

Environment Variables

SLP_CONF_FILE When set, use this file for configuration.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also  slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

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SPDereg - deregister the SLP advertisement

**Synopsis**

cc [ flag... ] file... -lslp [ library... ]
#include <slp.h>

SLPError SPDereg(SLPHandle hSLP, const char *pcURL, SLPRegReport callback, void *pvCookie);

**Description**
The SPDereg() function deregisters the advertisement for URL pcURL in all scopes where the service is registered and in all language locales, not just the locale of the SLPHandle. If no error occurs, the return value is 0. Otherwise, one of the SLPError codes is returned.

**Parameters**
- **hSLP** The language specific SLPHandle to use for deregistering. hSLP cannot be NULL.
- **pcURL** The URL to deregister. The value of pcURL cannot be NULL.
- **callback** A callback to report the operation completion status. callback cannot be NULL.
- **pvCookie** Memory passed to the callback code from the client. pvCookie can be NULL.

**Errors**
This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

**Examples**

**EXAMPLE 1** Using SPDereg()

Use the following example to deregister the advertisement for the URL "service:ftp://csserver":

```c
SLPerror err;
SLPHandle hSLP;
SLPRegReport regreport;

err = SPDereg(hSLP, "service:ftp://csserver", regreport, NULL);
```

**Environment Variables**
- **SLP_CONF_FILE** When set, use this file for configuration.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

**See Also**
- slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)
- *Oracle Solaris Administration: Network Services*
SLPEscape (3SLP)

**Name**
SLPEscape – escapes SLP reserved characters

**Synopsis**
```
cc [ flag... ] file... -tslp [ library... ]
#include <slp.h>
SLPError SLPEscape(const char * pcInBuf, char ** ppcOutBuf,
                    SLPBoolean isTag);
```

**Description**
The SLPEscape() function processes the input string in `pcInBuf` and escapes any SLP reserved characters. If the `isTag` parameter is `SLP_TRUE`, it then looks for bad tag characters and signals an error if any are found by returning the SLP_PARSE_ERROR code. The results are put into a buffer allocated by the API library and returned in the `ppcOutBuf` parameter. This buffer should be deallocated using `SLPFree(3SLP)` when the memory is no longer needed.

**Parameters**
- `pcInBuf` Pointer to the input buffer to process for escape characters.
- `ppcOutBuf` Pointer to a pointer for the output buffer with the SLP reserved characters escaped. It must be freed using `SLPFree()` when the memory is no longer needed.
- `isTag` When true, checks the input buffer for bad tag characters.

**Errors**
This function or its callback may return any SLP error code. See the ERRORS section in `slp_api(3SLP)`.

**Examples**
**EXAMPLE 1** Converting Attribute Tags
The following example shows how to convert the attribute tag, `tag-example`, to on the wire format:

```c
SLPError err;
char* escapedChars;
err = SLPEscape("", "tag-example", &escapedChars, SLP_TRUE);
```

**Environment Variables**
- `SLP_CONF_FILE` When set, use this file for configuration.

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slpa</td>
</tr>
</tbody>
</table>

**See Also**
`slpd(1M), slp_api(3SLP), SLPFree(3SLP), slp.conf(4), slpd.reg(4), attributes(5)`

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The SLPFindAttrs() function returns service attributes matching the attribute tags for the indicated full or partial URL. If pcURL is a complete URL, the attribute information returned is for that particular service in the language locale of the SLPHandle. If pcURL is a service type, then all attributes for the service type are returned, regardless of the language of registration. Results are returned through the callback parameter.

The result is filtered with an SLP attribute request filter string parameter, the syntax of which is described in RFC 2608. If the filter string is the empty string, "", all attributes are returned. If an error occurs in starting the operation, one of the SLPError codes is returned.

**Parameters**
- **hSLP**  
The language-specific SLPHandle on which to search for attributes. It cannot be NULL.
- **pcURL**  
The full or partial URL. See RFC 2608 for partial URL syntax. It cannot be NULL.
- **pcScopeList**  
A pointer to a char containing a comma-separated list of scope names. It cannot be NULL or an empty string, "".
- **pcAttrIds**  
The filter string indicating which attribute values to return. Use empty string "" to indicate all values. Wildcards matching all attribute ids having a particular prefix or suffix are also possible. It cannot be NULL.
- **callback**  
A callback function through which the results of the operation are reported. It cannot be NULL.
- **pvCookie**  
Memory passed to the callback code from the client. It may be NULL.

**Errors**  
This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

**Examples**

**EXAMPLE 1  Returning Service Attributes for a Specific URL**

Use the following example to return the attributes “location” and “dpi” for the URL “service:printer:lpr://serv/queue1” through the callback attrReturn:

```c
SLPHandle hSLP;
SLPAttrCallback attrReturn;
SLPError err;

err = SLPFindAttrs(hSLP, "service:printer:lpr://serv/queue1", 
const char *pcURL, 
const char *pcScopeList, const char *pcAttrIds, 
SLPAttrCallback *callback, void *pvCookie);
```
EXAMPLE 1 Returning Service Attributes for a Specific URL (Continued)

    "default", "location,dpi", attrReturn, err);

EXAMPLE 2 Returning Service Attributes for All URLs of a Specific Type

Use the following example to return the attributes "location" and "dpi" for all service URLs having type "service:printer:lpr":

    err = SLPFindAttrs(hSLP, "service:printer:lpr",
                      "default", "location, pi",
                      attrReturn, NULL);

Environment
Variables

SLP_CONF_FILE When set, use this file for configuration.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services

SLPFindScopes(3SLP)

Name
SLPFindScopes – return list of configured and discovered scopes

Synopsis
c [ flag... ] file... -lslp [ library... ]
#include <slp.h>

SLPError SLPFindScopes(SLPHandle hSLP, char** ppcScopes);

Description
The SLPFindScopes() function sets the ppcScopes parameter to a pointer to a comma-separated list including all available scope names. The list of scopes comes from a variety of sources: the configuration file, the net.slp.useScopes property and the net.slp.DAAddresses property, DHCP, or through the DA discovery process. If there is any order to the scopes, preferred scopes are listed before less desirable scopes. There is always at least one string in the array, the default scope, DEFAULT.

If no error occurs, SLPFindScopes() returns SLP_OK, otherwise, it returns the appropriate error code.

Parameters
hSLP
The SLPHandle on which to search for scopes. hSLP cannot be NULL.
ppcScopes
A pointer to a char pointer into which the buffer pointer is placed upon return. The buffer is null-terminated. The memory should be freed by calling SLPFree(). See SLPFree(3SLP).

Errors
This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

Examples
EXAMPLE 1 Finding Configured or Discovered Scopes
Use the following example to find configured or discovered scopes:

SLPHandle hSLP;
char *ppcScopes;
SLPError err;

err = SLPFindScopes(hSLP, & ppcScopes);

Environment
Variables
SLP_CONF_FILE When set, use this file for configuration.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also
slpd(1M), slp_api(3SLP), SLPFree(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services

Name  SLPFindSrvs – return service URLs

Synopsis  cc [ flag... ] file... -tslp [ library... ]
#include <slp.h>

SLPError SLPFindSrvs(SLPHandle hSLP, const char *pcServiceType,
const char *pcScopeList, const char *pcSearchFilter,
SLPSrvURLCallback *callback, void *pvCookie);

Description  The SLPFindSrvs() function issues a request for SLP services. The query is for services on a
language-specific SLPHandle. It returns the results through the callback. The parameters will
determine the results.

If an error occurs in starting the operation, one of the SLPError codes is returned.

Parameters  hSLP         The language-specific SLPHandle on which to search for services. It cannot
            be NULL.

            pcServiceType  The service type string for the request. The pcServiceType can be discovered
            by a call to SLPSrvTypes(). Examples of service type strings include
            "service:printer:lpr"
            or
            "service:nfs"
            pcServiceType cannot be NULL.

            pcScopeList    A pointer to a char containing a comma-separated list of scope names. It
            cannot be NULL or an empty string, "".

            pcSearchFilter A query formulated of attribute pattern matching expressions in the form
            of a LDAPv3 search filter. See RFC 2254. If this filter is empty, """, all services
            of the requested type in the specified scopes are returned. It cannot be NULL.

            callback      A callback through which the results of the operation are reported. It
            cannot be NULL.

            pvCookie      Memory passed to the callback code from the client. It can be NULL.

Errors  This function or its callback may return any SLP error code. See the ERRORS section in
slp_api(3SLP).

Examples  EXAMPLE 1  Using SLPFindSrvs()

The following example finds all advertisements for printers supporting the LPR protocol with
the dpi attribute 300 in the default scope:

SLPError err;
SLPHandle hSLP;
SLPSrvURLCallback srvngst;
EXAMPLE 1 Using SLPFindSrvs() (Continued)

```c
err = SLPFindSrvs(hSLP,
    "service:printer:lpr",
    "default",
    "(dpi=300)",
    srvngst,
    NULL);
```

SLP_CONF_FILE When set, use this file for configuration.

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also sld(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services


# SLPFindSrvTypes

**Synopsis**

```bash
c { flag... } file... -tslp { library... }
#include <slp.h>
```

```c
SLPError SLPFindSrvTypes(SLPHandle hSLP, const char *pcNamingAuthority,
                        const char *pcScopeList, SLPSrvTypeCallback *callback, void *pvCookie);
```

The `SLPFindSrvTypes()` function issues an SLP service type request for service types in the scopes indicated by the `pcScopeList`. The results are returned through the `callback` parameter. The service types are independent of language locale, but only for services registered in one of the scopes and for the indicated naming authority.

If the naming authority is "*", then results are returned for all naming authorities. If the naming authority is the empty string, "", then the default naming authority, IANA, is used. IANA is not a valid naming authority name. The SLP_PARAMETER_BAD error code will be returned if you include it explicitly.

The service type names are returned with the naming authority included in the following format:

```
service-type "," naming-authority
```

unless the naming authority is the default, in which case, just the service type name is returned.

If an error occurs in starting the operation, one of the SLPError codes is returned.

**Parameters**

- **hSLP**  
The SLPHandle on which to search for types. It cannot be NULL.

- **pcNamingAuthority**  
The naming authority to search. Use "*" to search all naming authorities; use the empty string "" to search the default naming authority. It cannot be NULL.

- **pcScopeList**  
A pointer to a char containing a comma-separated list of scope names to search for service types. It cannot be NULL or an empty string, "".

- **callback**  
A callback through which the results of the operation are reported. It cannot be NULL.

- **pvCookie**  
Memory passed to the callback code from the client. It can be NULL.

**Errors**  
This function or its callback may return any SLP error code. See the ERRORS section in `slp_api(3SLP)`.

**Examples**

**EXAMPLE 1**  
Using `SLPFindSrvTypes()`

The following example finds all service type names in the default scope and default naming authority:
EXAMPLE 1  Using SLPFindSrvTypes()  (Continued)

SLLError err;
SLPHandle hSLP;
SLPSrvTypeCallback findsrvtypes;

err = SLPFindSrvTypes(hSLP, "", "default", findsrvtypes, NULL);

Environment
Variables

SLP_CONF_FILE  When set, use this file for configuration.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also  slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services


Name  SLPFree – frees memory

Synopsis  cc [flag...] file... -tslp [ library... ]
           #include <slp.h>
           SLPError SLPFree(void *pvMem);

Description  The SLPFree() function frees memory returned from SLPParseSrvURL(), SLPFindScopes(), SLPEscape(), and SLPUnescape().

Parameters  pvMem  A pointer to the storage allocated by the SLPParseSrvURL(), SLPFindScopes(), SLPEscape(), and SLPUnescape() functions. pvMem is ignored if its value is NULL.

Errors  This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

Examples  EXAMPLE 1  Using SLPFree()
           The following example illustrates how to call SLPFree(). It assumes that SrvURL contains previously allocated memory.
           SLPError err;
           err = SLPFree((void*) SrvURL);

Environment Variables

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also  slpd(1M), SLPFindScopes(3SLP), SLPUnescape(3SLP), SLPParseSrvURL(3SLP),
           attributes(5), slp_api(3SLP), slp.conf(4), slpd.reg(4)

Oracle Solaris Administration: Network Services


Name  SLPGetProperty – return SLP configuration property

Synopsis  
```
cc [ flag... ] file... -lslp [ library... ]
#include <slp.h>
const char* SLPGetProperty(const char* pcName);
```

Description  The SLPGetProperty() function returns the value of the corresponding SLP property name, or NULL, if none. If there is no error, SLPGetProperty() returns a pointer to the property value. If the property was not set, it returns the empty string, "". If an error occurs, SLPGetProperty() returns NULL. The returned string should not be freed.

Parameters  pcName  A null-terminated string with the property name. pcName cannot be NULL.

Errors  This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

Examples  EXAMPLE1  Using SLPGetProperty()

Use the following example to return a list of configured scopes:
```
const char* useScopes

useScopes = SLPGetProperty("net.slp.useScopes");
```

Environment Variables

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also  slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services

Name  
SLPGetRefreshInterval – return the maximum allowed refresh interval

Synopsis  
```
cc [ flag... ] file... -lslp [ library... ] include <slp.h>
int SLPGetRefreshInterval(void)
```

Description  
The SLPGetRefreshInterval() function returns the maximum across all DAs of the
`min-refresh-interval` attribute. This value satisfies the advertised refresh interval bounds
for all DAs. If this value is used by the SA, it assures that no refresh registration will be rejected.
If no DA advertises a `min-refresh-interval` attribute, a value of 0 is returned. If an error
occurs, an SLP error code is returned.

Errors  
This function or its callback may return any SLP error code. See the ERRORS section in
`slp_api(3SLP)`.

Examples  
**EXAMPLE 1**  
Using SLPGetRefreshInterval()

Use the following example to return the maximum valid refresh interval for SA:

```
int minrefresh

minrefresh = SLPGetRefreshInterval();
```

Environment Variables
SLP_CONF_FILE  
When set, use this file for configuration.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also  
`slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)`

*Oracle Solaris Administration: Network Services*

# SLPOpen(3SLP)

**Name**
SLPOpen – open an SLP handle

**Synopsis**
cc { flag... } file... -lslp { library... }
#include <slp.h>

SLPError SLPOpen(const char *pcLang, SLPBoolean isAsync, SLPHandle *phSLP);

**Description**
The SLPOpen() function returns a SLPHandle handle in the phSLP parameter for the language locale passed in as the pcLang parameter. The client indicates if operations on the handle are to be synchronous or asynchronous through the isAsync parameter. The handle encapsulates the language locale for SLP requests issued through the handle, and any other resources required by the implementation. SLP properties are not encapsulated by the handle, they are global. The return value of the function is an SLPError code indicating the status of the operation. Upon failure, the phSLP parameter is NULL.

An SLPHandle can only be used for one SLP API operation at a time. If the original operation was started asynchronously, any attempt to start an additional operation on the handle while the original operation is pending results in the return of an SLP_HANDLE_IN_USE error from the API function. The SLPClose() function terminates any outstanding calls on the handle.

**Parameters**
- **pcLang**
  A pointer to an array of characters containing the language tag set forth in RFC 1766 for the natural language locale of requests issued on the handle. This parameter cannot be NULL.
- **isAsync**
  An SLPBoolean indicating whether or not the SLPHandle should be opened for an asynchronous operation.
- **phSLP**
  A pointer to an SLPHandle in which the open SLPHandle is returned. If an error occurs, the value upon return is NULL.

**Errors**
This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

**Examples**
EXAMPLE 1 Using SLPOpen()

Use the following example to open a synchronous handle for the German ("de") locale:

```c
SLPHandle HSLP; SLPError err; err = SLPOpen("de", SLP_FALSE, &HSLP)
```

**Environment Variables**
- **SLP_CONF_FILE**
  When set, use this file for configuration.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>
See Also  slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services


The `SLPParseSrvURL()` routine parses the URL passed in as the argument into a service URL structure and returns it in the `ppSrvURL` pointer. If a parser error occurs, returns `SLP_PARSE_ERROR`. The structure returned in `ppSrvURL` should be freed with `SLPFree()`. If the URL has no service part, the `s_pcSrvPart` string is the empty string, "", that is, it is not `NULL`. If `pcSrvURL` is not a service:URL, then the `s_pcSrvType` field in the returned data structure is the URL's scheme, which might not be the same as the service type under which the URL was registered. If the transport is IP, the `s_pcNetFamily` field is the empty string.

If no error occurs, the return value is the `SLP_OK`. Otherwise, if an error occurs, one of the `SLPError` codes is returned.

**Parameters**
- `pcSrvURL` A pointer to a character buffer containing the null terminated URL string to parse. It is destructively modified to produce the output structure. It may not be `NULL`.
- `ppSrvURL` A pointer to a pointer for the `SLPSrvURL` structure to receive the parsed URL. It may not be `NULL`.

**Errors**
This function or its callback may return any SLP error code. See the ERRORS section in `slp_api(3SLP)`.

**Examples**
**EXAMPLE 1** Using `SLPParseSrvURL()`

The following example uses the `SLPParseSrvURL()` function to parse the service URL

```c
service:printer:lpr://serv/queue1:
```

```c
SLPSrvURL* surl;
SLPError err;

err = SLPParseSrvURL("service:printer:lpr://serv/queue1", &surl);
```

**Environment Variables**
- `SLP_CONF_FILE` When set, use this file for configuration.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

**See Also**
- `slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)`

*Oracle Solaris Administration: Network Services*

Name  SLPReg – register an SLP advertisement

Synopsis  cc [ flag... ] file... -lslp [ library... ]
#include <slp.h>

SLPError SLPReg(SLPHandle hSLP, const char * pcSrvURL,
const unsigned short usLifetime, const char * pcSrvType,
const char * pcAttrs, SLPBoolean fresh,
SLPRegReport callback, void * pvCookie);

Description  The SLPReg() function registers the URL in pcSrvURL having the lifetime usLifetime with the
attribute list in pcAttrs. The pcAttrs list is a comma-separated list of attribute assignments in
on-the-wire format (including escaping of reserved characters). The sLifetime parameter must
be nonzero and less than or equal to SLP_LIFETIME_MAXIMUM. If the fresh flag is SLP_TRUE,
then the registration is new, the SLP protocol fresh flag is set, and the registration replaces any
existing registrations.

The pcSrvType parameter is a service type name and can be included for service URLs that are
not in the service: scheme. If the URL is in the service: scheme, the pcSrvType parameter is
ignored. If the fresh flag is SLP_FALSE, then an existing registration is updated. Rules for new
and updated registrations, and the format for pcAttrs and pcScopeList, can be found in RFC
2608. Registrations and updates take place in the language locale of the hSLP handle.

The API library is required to perform the operation in all scopes obtained through
configuration.

Parameters  hSLP  The language specific SLPHandle on which to register the advertisement. hSLP
cannot be NULL.

pcSrvURL  The URL to register. The value of pcSrvURL cannot be NULL or the empty
string.

usLifetime  An unsigned short giving the life time of the service advertisement, in
seconds. The value must be an unsigned integer less than or equal to
SLP_LIFETIME_MAXIMUM.

pcSrvType  The service type. If pURL is a service: URL, then this parameter is ignored.
pcSrvType cannot be NULL.

pcAttrs  A comma-separated list of attribute assignment expressions for the attributes
of the advertisement. pcAttrs cannot be NULL. Use the empty string, "", to
indicate no attributes.

fresh  An SLPBoolean that is SLP_TRUE if the registration is new or SLP_FALSE if it is a
reregistration.

callback  A callback to report the operation completion status. callback cannot be NULL.

pvCookie  Memory passed to the callback code from the client. pvCookie can be NULL.
This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

Examples

**EXAMPLE 1  An Initial Registration**

The following example shows an initial registration for the "service:video://bldg15" camera service for three hours:

```c
SLPError err;
SLPHandle hSLP;
SLPRegReport regreport;
err = SLPReg(hSLP, "service:video://bldg15",
10800, "", "(location=B15-corridor),
(scan-rate=100)", SLP_TRUE,
regRpt, NULL);
```

Attributes

SLP_CONF_FILE When set, use this file for configuration.

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also

slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services


Name  SLPSetProperty – set an SLP configuration property

Synopsis  cc { flag... } file... -lslp [ library... ]
  #include <slp.h>

  void SLPSetProperty(const char *pcName, const char *pcValue);

Description  The SLPSetProperty() function sets the value of the SLP property
to the new value. The pcValue parameter contains the property value as a string.

Parameters  pcName    A null-terminated string with the property name. pcName cannot be NULL.

            pcValue   A null-terminated string with the property value. pcValue cannot be NULL

Errors     This function or its callback may return any SLP error code. See the ERRORS section in
            slp_api(3SLP).

Examples     EXAMPLE 1  Setting a Configuration Property

            The following example shows to set the property net.slp.typeHint to service:ftp:
            SLPSetProperty("net.slp.typeHint" "service:ftp");

Environment   SLP_CONF_FILE    When set, use this file for configuration.
Variables

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also  slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services

slp_strerror(3SLP)

Name  slp_strerror – map SLP error codes to messages

Synopsis  #include <slp.h>

const char* slp_strerror(SLPError err_code);

Description  The slp_strerror() function maps err_code to a string explanation of the error. The
returned string is owned by the library and must not be freed.

Parameters  err_code   An SLP error code.

Errors  This function or its callback may return any SLP error code. See the ERRORS section in
slp_api(3SLP).

Examples  EXAMPLE 1  Using slp_strerror()

The following example returns the message that corresponds to the error code:

SLPError error;
const char* msg;
msg = slp_strerror(err);

Environment Variables  SLP_CONF_FILE   When set, use this file for configuration.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also  slpd(1M), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services

Name: SLPUnescape – translate escaped characters into UTF-8

Synopsis: cc [ flag... ] file... -lslp [ library... ]
#include <slp.h>

SLPError SLPUnescape(const char *pcInBuf, char **ppcOutBuf,
SLPBoolean isTag);

Description: The SLPUnescape() function processes the input string in pcInbuf and unescapes any SLP reserved characters. If the isTag parameter is SLPTrue, then look for bad tag characters and signal an error if any are found with the SLP_PARSE_ERROR code. No transformation is performed if the input string is an opaque. The results are put into a buffer allocated by the API library and returned in the ppcOutBuf parameter. This buffer should be deallocated using SLPFree(3SLP) when the memory is no longer needed.

Parameters:
- pcInBuf: Pointer to the input buffer to process for escape characters.
- ppcOutBuf: Pointer to a pointer for the output buffer with the SLP reserved characters escaped. Must be freed using SLPFree(3SLP) when the memory is no longer needed.
- isTag: When true, the input buffer is checked for bad tag characters.

Errors: This function or its callback may return any SLP error code. See the ERRORS section in slp_api(3SLP).

Examples:
Example 1: Using SLPUnescape()
The following example decodes the representation for ", tag,":

```c
char* pcOutBuf;
SLPError err;
err = SLPUnescape("\2c tag\2c", &pcOutBuf, SLP_TRUE);
```

Environment Variables:
- SLP_CONF_FILE: When set, use this file for configuration.

Attributes:
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Availability</td>
<td>service/network/slp</td>
</tr>
</tbody>
</table>

See Also: slpd(1M), SLPFree(3SLP), slp_api(3SLP), slp.conf(4), slpd.reg(4), attributes(5)

Oracle Solaris Administration: Network Services

sockatmark() 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 sockatmark() 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 sockatmark() function does not remove the mark from the
stream.

Upon successful completion, the sockatmark() 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 sockatmark() function returns 0. Otherwise, it
returns −1 and sets errno to indicate the error.

The sockatmark() function will fail if:

- EBAFD The s argument is not a valid file descriptor.
- ENOTTY The s argument does not specify a descriptor for a socket.

The use of this function between receive operations allows an application to determine which
received data precedes the out-of-band data and which follows the out-of-band data.

There is an inherent race condition in the use of this function. On an empty receive queue, the
current read of the location might well be at the “mark”, but the system has no way of knowing
that the next data segment that will arrive from the network will carry the mark, and sockatmark() will return false, and the next read operation will silently consume the mark.

Hence, this function can only be used reliably when the application already knows that the
out-of-band data has been seen by the system or that it is known that there is data waiting to be
read at the socket, either by SIGURG or select(3C).

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>
See Also  recv(3XNET), recvmsg(3XNET), select(3C), attributes(5), standards(5)
socket(3SOCKET)

Name  
socket – create an endpoint for communication

Synopsis  
cc [ flag ... ] file ... -lsocket -lssl [ library ... ]
#include <sys/types.h>
#include <sys/socket.h>

int socket(int domain, int type, int protocol);

Description  
The socket() function creates an endpoint for communication and returns a descriptor.

The domain argument specifies the protocol family within which communication takes place.
The protocol family is generally the same as the address family for the addresses supplied in
later operations on the socket. These families are defined in <sys/socket.h>.

The currently supported protocol families are:

<table>
<thead>
<tr>
<th>Protocol Family</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PF_UNIX</td>
<td>UNIX system internal protocols</td>
</tr>
<tr>
<td>PF_INET</td>
<td>Internet Protocol Version 4 (IPv4)</td>
</tr>
<tr>
<td>PF_INET6</td>
<td>Internet Protocol Version 6 (IPv6)</td>
</tr>
<tr>
<td>PF_NCA</td>
<td>Network Cache and Accelerator (NCA) protocols</td>
</tr>
</tbody>
</table>

The socket has the indicated type, which specifies the communication semantics. Currently
defined types are:

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SOCK_STREAM</td>
<td>sequenced, reliable, two-way connection-based byte streams.</td>
</tr>
<tr>
<td>SOCK_DGRAM</td>
<td>supports datagrams (connectionless, unreliable messages of a fixed (typically small) maximum length).</td>
</tr>
<tr>
<td>SOCK_RAW</td>
<td>provides access to internal network interfaces. The types SOCK_RAW, which is available only to a user with the net_rawaccess privilege, and SOCK_RDM, for which no implementation currently exists, are not described here.</td>
</tr>
<tr>
<td>SOCK_SEQPACKET</td>
<td>a consumer may be required to read an entire packet with each read system call. This facility is protocol specific, and presently not implemented for any protocol family.</td>
</tr>
<tr>
<td>SOCK_RDM</td>
<td>protocol is found, then the first entry containing the specified family and type with a protocol value of zero will be used.</td>
</tr>
</tbody>
</table>

There must be an entry in the netconfig(4) file for at least each protocol family and type
required. If a non-zero protocol has been specified but no exact match for the protocol family,
type, and protocol is found, then the first entry containing the specified family and type with a
protocol value of zero will be used.

A SOCK_STREAM type provides sequenced, reliable, two-way connection-based byte streams.
An out-of-band data transmission mechanism may be supported. A SOCK_DGRAM socket
supports datagrams (connectionless, unreliable messages of a fixed (typically small) maximum length). A SOCK_SEQPACKET socket may provide a sequenced, reliable, two-way
connection-based data transmission path for datagrams of fixed maximum length; a
consumer may be required to read an entire packet with each read system call. This facility is
protocol specific, and presently not implemented for any protocol family. SOCK_RAW sockets
provide access to internal network interfaces. The types SOCK_RAW, which is available only to a
user with the net_rawaccess privilege, and SOCK_RDM, for which no implementation currently exists, are not described here.
The *protocol* parameter is a protocol-family-specific value which specifies a particular protocol to be used with the socket. Normally this value is zero, as commonly only a single protocol exists to support a particular socket type within a given protocol family. However, multiple protocols may exist, in which case a particular protocol may be specified in this manner.

Sockets of type `SOCK_STREAM` are full-duplex byte streams, similar to pipes. A stream socket must be in a *connected* state before any data may be sent or received on it. A connection to another socket is created with a `connect(3SOCKET)` call. Once connected, data may be transferred using `read(2)` and `write(2)` calls or some variant of the `send(3SOCKET)` and `recv(3SOCKET)` calls. When a session has been completed, a `close(2)` may be performed. Out-of-band data may also be transmitted as described on the `send(3SOCKET)` manual page and received as described on the `recv(3SOCKET)` manual page.

The communications protocols used to implement a `SOCK_STREAM` insure that data is not lost or duplicated. If a piece of data for which the peer protocol has buffer space cannot be successfully transmitted within a reasonable length of time, then the connection is considered broken and calls will indicate an error with −1 returns and with `ETIMEDOUT` as the specific code in the global variable `errno`. The protocols optionally keep sockets “warm” by forcing transmissions roughly every minute in the absence of other activity. An error is then indicated if no response can be elicited on an otherwise idle connection for an extended period (for instance 5 minutes). A `SIGPIPE` signal is raised if a thread sends on a broken stream; this causes naive processes, which do not handle the signal, to exit.

`SOCK_SEQPACKET` sockets employ the same system calls as `SOCK_STREAM` sockets. The only difference is that `read(2)` calls will return only the amount of data requested, and any remaining in the arriving packet will be discarded.

`SOCK_DGRAM` and `SOCK_RAW` sockets allow datagrams to be sent to correspondents named in `sendto(3SOCKET)` calls. Datagrams are generally received with `recvfrom(3SOCKET)`, which returns the next datagram with its return address.

An `fcntl(2)` call can be used to specify a process group to receive a `SIGURG` signal when the out-of-band data arrives. It can also enable non-blocking I/O.

The operation of sockets is controlled by socket level options. These options are defined in the file `<sys/socket.h>`. `setsockopt(3SOCKET)` and `getsockopt(3SOCKET)` are used to set and get options, respectively.

**Return Values**  Upon successful completion, a descriptor referencing the socket is returned. Otherwise, -1 is returned and `errno` is set to indicate the error.

**Errors**  The `socket( )` function will fail if:

- `EACCES`  Permission to create a socket of the specified type or protocol is denied.
EAGAIN
There were insufficient resources available to complete the operation.

EAFNOSUPPORT
The specified address family is not supported by the protocol family.

EMFILE
The per-process descriptor table is full.

ENOMEM
Insufficient user memory is available.

ENOSR
There were insufficient STREAMS resources available to complete the operation.

EPFNOSUPPORT
The specified protocol family is not supported.

EPROTONOSUPPORT
The protocol type is not supported by the address family.

EPROTOTYPE
The socket type is not supported by the protocol.

Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also
close(2), fcntl(2), ioctl(2), read(2), write(2), accept(3SOCKET), bind(3SOCKET), connect(3SOCKET), getsockname(3SOCKET), getsockopt(3SOCKET), in.h(3HEAD), listen(3SOCKET), recv(3SOCKET), setsockopt(3SOCKET), send(3SOCKET), shutdown(3SOCKET), socket.h(3HEAD), socketpair(3SOCKET), attributes(5), nca(7d)

Notes
Historically, AF_* was commonly used in places where PF_* was meant. New code should be careful to use PF_* as necessary.
socket – create an endpoint for communication

cc [ flag ... ] file ... -lxnet [ library ... ]
#include <sys/socket.h>

int socket(int domain, int type, int protocol);

The `socket()` function creates an unbound socket in a communications domain, and returns a file descriptor that can be used in later function calls that operate on sockets.

The `<sys/socket.h>` header defines at least the following values for the `domain` argument:

- **AF_UNIX** File system pathnames.
- **AF_INET** Internet Protocol version 4 (IPv4) address.
- **AF_INET6** Internet Protocol version 6 (IPv6) address.

The `type` argument specifies the socket type, which determines the semantics of communication over the socket. The socket types supported by the system are implementation-dependent. Possible socket types include:

- **SOCK_STREAM** Provides sequenced, reliable, bidirectional, connection-mode byte streams, and may provide a transmission mechanism for out-of-band data.
- **SOCK_DGRAM** Provides datagrams, which are connectionless-mode, unreliable messages of fixed maximum length.
- **SOCK_SEQPACKET** Provides sequenced, reliable, bidirectional, connection-mode transmission path for records. A record can be sent using one or more output operations and received using one or more input operations, but a single operation never transfers part of more than one record. Record boundaries are visible to the receiver via the MSG_EOR flag.

If the `protocol` argument is non-zero, it must specify a protocol that is supported by the address family. The protocols supported by the system are implementation-dependent.

The process may need to have appropriate privileges to use the `socket()` function or to create some sockets.

The function takes the following arguments:

- **domain** Specifies the communications domain in which a socket is to be created.
- **type** Specifies the type of socket to be created.
- **protocol** Specifies a particular protocol to be used with the socket. Specifying a `protocol` of 0 causes `socket()` to use an unspecified default protocol appropriate for the requested socket type.
The domain argument specifies the address family used in the communications domain. The address families supported by the system are implementation-dependent.

Usage

The documentation for specific address families specify which protocols each address family supports. The documentation for specific protocols specify which socket types each protocol supports.

The application can determine if an address family is supported by trying to create a socket with domain set to the protocol in question.

Return Values

Upon successful completion, socket() returns a nonnegative integer, the socket file descriptor. Otherwise a value of -1 is returned and errno is set to indicate the error.

Errors

The socket() function will fail if:

- EAFNOSUPPORT: The implementation does not support the specified address family.
- EMFILE: No more file descriptors are available for this process.
- ENFILE: No more file descriptors are available for the system.
- EPROTONOSUPPORT: The protocol is not supported by the address family, or the protocol is not supported by the implementation.
- EPROTOTYPE: The socket type is not supported by the protocol.

The socket() function may fail if:

- EACCES: The process does not have appropriate privileges.
- ENOBUFS: Insufficient resources were available in the system to perform the operation.
- ENOMEM: Insufficient memory was available to fulfill the request.
- ENOSR: There were insufficient STREAMS resources available for the operation to complete.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also

accept(3XNET), bind(3XNET), connect(3XNET), getsockname(3XNET), getsockopt(3XNET), listen(3XNET), recv(3XNET), recvfrom(3XNET), recvmsg(3XNET), send(3XNET), sendmsg(3XNET), setsockopt(3XNET), shutdown(3XNET), socketpair(3XNET), attributes(5), standards(5)
socketpair (3SOCKET)

Name  socketpair – create a pair of connected sockets

Synopsis  cc [ flag . . . ] file ... -lsocket -lnsl [ library ... ]
          #include <sys/types.h>
          #include <sys/socket.h>

          int socketpair(int domain, int type, int protocol, int sv[2]);

Description  The socketpair() library call creates an unnamed pair of connected sockets in the specified address family domain, of the specified type, that uses the optionally specified protocol. The descriptors that are used in referencing the new sockets are returned in sv[0] and sv[1]. The two sockets are indistinguishable.

Return Values  socketpair() returns −1 on failure and 0 on success.

Errors  The call succeeds unless:

- EAFNOSUPPORT  The specified address family is not supported on this machine.
- EMFILE  Too many descriptors are in use by this process.
- ENOMEM  There was insufficient user memory for the operation to complete.
- ENOSR  There were insufficient STREAMS resources for the operation to complete.
- EOPNOTSUPP  The specified protocol does not support creation of socket pairs.
- EPROTONOSUPPORT  The specified protocol is not supported on this machine.
- EACCES  The process does not have appropriate privileges.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  pipe(2), read(2), write(2), socket.h(3HEAD), attributes(5)

Notes  This call is currently implemented only for the AF_UNIX address family.
The `socketpair()` function creates an unbound pair of connected sockets in a specified domain, of a specified type, under the protocol optionally specified by the `protocol` argument. The two sockets are identical. The file descriptors used in referencing the created sockets are returned in `socket_vector[0]` and `socket_vector[1]`.

The `type` argument specifies the socket type, which determines the semantics of communications over the socket. The socket types supported by the system are implementation-dependent. Possible socket types include:

- **SOCK_STREAM**: Provides sequenced, reliable, bidirectional, connection-mode byte streams, and may provide a transmission mechanism for out-of-band data.

- **SOCK_DGRAM**: Provides datagrams, which are connectionless-mode, unreliable messages of fixed maximum length.

- **SOCK_SEQPACKET**: Provides sequenced, reliable, bidirectional, connection-mode transmission path for records. A record can be sent using one or more output operations and received using one or more input operations, but a single operation never transfers part of more than one record. Record boundaries are visible to the receiver via the MSG_EOR flag.

If the `protocol` argument is non-zero, it must specify a protocol that is supported by the address family. The protocols supported by the system are implementation-dependent.

The process may need to have appropriate privileges to use the `socketpair()` function or to create some sockets.

**Parameters**

- `domain` Specifies the communications domain in which the sockets are to be created.
- `type` Specifies the type of sockets to be created.
- `protocol` Specifies a particular protocol to be used with the sockets. Specifying a `protocol` of 0 causes `socketpair()` to use an unspecified default protocol appropriate for the requested socket type.
- `socket_vector` Specifies a 2-integer array to hold the file descriptors of the created socket pair.

**Usage**

The documentation for specific address families specifies which protocols each address family supports. The documentation for specific protocols specifies which socket types each protocol supports.
The `socketpair()` function is used primarily with UNIX domain sockets and need not be supported for other domains.

**Return Values**  
Upon successful completion, this function returns 0. Otherwise, −1 is returned and `errno` is set to indicate the error.

**Errors**  
The `socketpair()` function will fail if:

- **EAFNOSUPPORT**  
The implementation does not support the specified address family.
- **EMFILE**  
No more file descriptors are available for this process.
- **ENFILE**  
No more file descriptors are available for the system.
- **EOPNOTSUPP**  
The specified protocol does not permit creation of socket pairs.
- **EPROTONOSUPPORT**  
The protocol is not supported by the address family, or the protocol is not supported by the implementation.
- **EPROTOTYPE**  
The socket type is not supported by the protocol.

The `socketpair()` function may fail if:

- **EACCES**  
The process does not have appropriate privileges.
- **ENOBUFS**  
Insufficient resources were available in the system to perform the operation.
- **ENOMEM**  
Insufficient memory was available to fulfill the request.
- **ENOSR**  
There were insufficient STREAMS resources available for the operation to complete.

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
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</tr>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See <code>standards(5)</code></td>
</tr>
</tbody>
</table>

**See Also**  
`socket(3XNET), attributes(5), standards(5)`
The spray program sends packets to a given machine to test communications with that machine.

The spray program is not a C function interface, per se, but it can be accessed using the generic remote procedure calling interface clnt_call(). See rpc_clnt_calls(3NSL). The program sends a packet to the called host. The host acknowledges receipt of the packet. The program counts the number of acknowledgments and can return that count.

The spray program currently supports the following procedures, which should be called in the order given:

- **SPRAYPROC_CLEAR**
  This procedure clears the counter.
- **SPRAYPROC_SPRAY**
  This procedure sends the packet.
- **SPRAYPROC_GET**
  This procedure returns the count and the amount of time since the last SPRAYPROC_CLEAR.

### Examples

**Example 1 Using spray()**

The following code fragment demonstrates how the spray program is used:

```c
#include <rpc/rpc.h>
#include <rpcsvc/spray.h>

spraycumul spray_result;
sprayarr spray_data;
char buf[100]; /* arbitrary data */
int loop = 1000;
CLIENT *clnt;
struct timeval timeout0 = {0, 0};
struct timeval timeout25 = {25, 0};
spray_data.sprayarr_len = (uint_t)100;
spray_data.sprayarr_val = buf;
clnt = clnt_create("somehost", SPRAYPROG, SPRAYVERS, "netpath");
if (clnt == (CLIENT *)NULL) {
    /* handle this error */
}
if (clnt_call(clnt, SPRAYPROC_CLEAR,
xdr_void, NULL, xdr_void, NULL, timeout25)) {
    /* handle this error */
}
```
EXAMPLE 1 Using spray()  (Continued)

while (loop--) {
    if (clnt_call(clnt, SPRAYPROC_SPRAY,
        xdr_sprayarr, &spray_data, xdr_void, NULL, timeout0)) {
        /* handle this error */
    }
}
if (clnt_call(clnt, SPRAYPROC_GET,
    xdr_void, NULL, xdr_spraycumul, &spray_result, timeout25)) {
    /* handle this error */
}
printf("Acknowledged %ld of 1000 packets in %d secs %d usecs\n",
    spray_result.counter,
    spray_result.clock.sec,
    spray_result.clock.usec);

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Unsafe</td>
</tr>
</tbody>
</table>

See Also  spray(1M), rpc_clnt_calls(3NSL), attributes(5)

Notes  This interface is unsafe in multithreaded applications. Unsafe interfaces should be called only from the main thread.

A spray program is not useful as a networking benchmark as it uses unreliable connectionless transports, for example, udp. It can report a large number of packets dropped, when the drops were caused by the program sending packets faster than they can be buffered locally, that is, before the packets get to the network medium.
Name  
t_accept — accept a connection request

Synopsis  
#include <xti.h>

int t_accept(int fd, int resfd, const struct t_call *call);

Description  
This routine is part of the XTI interfaces that evolved from the TLI interfaces. XTI represents
the future evolution of these interfaces. However, TLI interfaces are supported for
compatibility. When using a TLI routine that has the same name as an XTI routine, a different
header file, tiuserr.h, must be used. Refer to the TLI COMPATIBILITY section for a description
of differences between the two interfaces.

This function is issued by a transport user to accept a connection request. The parameter fd
identifies the local transport endpoint where the connection 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(3NSL) that uniquely associates the response with a
previously received connection 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 connection indication arrived. Before the connection can
be accepted on the same endpoint (resfd==fd), the user must have responded to any previous
connection indications received on that transport endpoint by means of t_accept() or
t_snddis(3NSL). Otherwise, t_accept() will fail and set 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 prior to the
t_accept(), the endpoint must be in the T_UNBND state before the t_accept() is issued, and
the transport provider will automatically bind it to an address that is appropriate for the
protocol concerned. 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.

Responding endpoints should be supplied to t_accept() in the state T_UNBND.

The call to t_accept() may fail with t_errno set to TLOOK if there are indications (for example
connect or disconnect) waiting to be received on endpoint fd. Applications should be
prepared for such a failure.
The \textit{udata} argument enables the called transport user to send user data to the caller and the amount of user data must not exceed the limits supported by the transport provider as returned in the \textit{connect} field of the \textit{info} argument of \texttt{t_open(3NSL)} or \texttt{t_getinfo(3NSL)}. If the \textit{len} field of \textit{udata} is zero, no data will be sent to the caller. All the \textit{maxlen} fields are meaningless.

When the user does not indicate any option \((\text{call} \rightarrow \text{opt}. \text{len} = 0)\) the connection shall be accepted with the option values currently set for the responding endpoint \texttt{resfd}.

**Return Values**

Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and \texttt{t_errno} is set to indicate an error.

**Valid States**

\texttt{fd: T_INCON}

\texttt{resfd (fd != resfd): T_IDLE, T_UNBND}

**Errors**

On failure, \texttt{t_errno} is set to one of the following:

\begin{itemize}
  \item \textbf{TACCESS} \quad The user does not have permission to accept a connection on the responding transport endpoint or to use the specified options.
  \item \textbf{TBADADDR} \quad The specified protocol address was in an incorrect format or contained illegal information.
  \item \textbf{TBADDATA} \quad The amount of user data specified was not within the bounds allowed by the transport provider.
  \item \textbf{TBADF} \quad The file descriptor \texttt{fd} or \texttt{resfd} does not refer to a transport endpoint.
  \item \textbf{TBADOPT} \quad The specified options were in an incorrect format or contained illegal information.
  \item \textbf{TBADSEQ} \quad Either an invalid sequence number was specified, or a valid sequence number was specified but the connection request was aborted by the peer. In the latter case, its \texttt{T_DISCONNECT} event will be received on the listening endpoint.
  \item \textbf{TINDOUT} \quad The function was called with \texttt{fd == resfd} but there are outstanding connection indications on the endpoint. Those other connection indications must be handled either by rejecting them by means of \texttt{t_snddis(3NSL)} or accepting them on a different endpoint by means of \texttt{t_accept}.
  \item \textbf{TLOOK} \quad An asynchronous event has occurred on the transport endpoint referenced by \texttt{fd} and requires immediate attention.
  \item \textbf{TNOTSUPPORT} \quad This function is not supported by the underlying transport provider.
  \item \textbf{TOUTSTATE} \quad The communications endpoint referenced by \texttt{fd} or \texttt{resfd} is not in one of the states in which a call to this function is valid.
\end{itemize}
This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI error (t_errno).

The file descriptors fd and resfd do not refer to the same transport provider.

This transport provider requires both fd and resfd to be bound to the same address. This error results if they are not.

The endpoint referenced by resfd (where resfd != fd) was bound to a protocol address with a qlen that is greater than zero.

A system error has occurred during execution of this function.

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

#include <tiuser.h>

The t_errno values that can be set by the XTI interface and cannot be set by the TLI interface are:

TPROTO
TINDOUT
TPROVMISMATCH
TRESADDR
TRESQLEN

The format of the options in an opt buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not specify the buffer format.

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  
t_connect(3NSL), t_getinfo(3NSL), t_getstate(3NSL), t_listen(3NSL), t_open(3NSL), t_optmgmt(3NSL), t_rcvconnect(3NSL), t_snddis(3NSL), attributes(5)
There may be transport provider-specific restrictions on address binding.

Some transport providers do not differentiate between a connection indication and the connection itself. If the connection has already been established after a successful return of `t_listen(3NSL)`, `t_accept()` will assign the existing connection to the transport endpoint specified by `resfd`. 
t_alloc – allocate a library structure

Synopsis

```c
#include <xti.h>

void *t_alloc(int fd, int struct_type, int fields);
```

Description

This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, a different header file, tiuser.h, must be used. Refer to the section, TLI COMPATIBILITY, for a description of differences between the two interfaces.

The `t_alloc()` function dynamically allocates memory for the various transport function argument structures as specified below. This function will allocate memory for the specified structure, and will also allocate 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(3NSL)` or `t_getinfo(3NSL)`. 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()` will allocate memory for the buffer associated with the field, and initialize 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(3NSL)` and `t_getinfo(3NSL)`, `fd` must refer to the transport endpoint through...
which the newly allocated structure will be passed. In the case where a T_INFO structure is to be allocated, \( fd \) may be set to any value. In this way the appropriate size information can be accessed. If the size value associated with any specified field is T_INVALID, \( t\_alloc() \) will be unable to determine the size of the buffer to allocate and will fail, setting \( t\_errno \) to TSYSERR and \( errno \) to EINVAL. See \( t\_open(3NSL) \) or \( t\_getinfo(3NSL) \). If the size value associated with any specified field is T_INFINITE, then the behavior of \( t\_alloc() \) is implementation-defined. For any field not specified in \( fields \), \( buf \) will be set to the null pointer and \( len \) and \( maxlen \) will be set to zero. See \( t\_open(3NSL) \) or \( t\_getinfo(3NSL) \).

The pointer returned if the allocation succeeds is suitably aligned so that it can be assigned to a pointer to any type of object and then used to access such an object or array of such objects in the space allocated.

Use of \( t\_alloc() \) to allocate structures will help ensure the compatibility of user programs with future releases of the transport interface functions.

**Return Values**

On successful completion, \( t\_alloc() \) returns a pointer to the newly allocated structure. On failure, a null pointer is returned.

**Valid States**

ALL - apart from T_UNINIT

**Errors**

On failure, \( t\_errno \) is set to one of the following:

- **TBADF**
  
  struct_type is other than T_INFO and 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-mode or connectionless-mode.

- **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 error (t_errno).

- **TSYSERR**
  
  A system error has occurred during execution of this function.

**Tli Compatibility**

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

**Interface Header**

The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```
#include <tiuser.h>
```

**Error Description Values**

The t_errno values that can be set by the XTI interface and cannot be set by the TLI interface are:
Assume that the value associated with any field of struct t_info (argument returned by t_open() or t_getinfo()) that describes buffer limits is –1. Then the underlying service provider can support a buffer of unlimited size. If this is the case, t_alloc() will allocate a buffer with the default size 1024 bytes, which may be handled as described in the next paragraph.

If the underlying service provider supports a buffer of unlimited size in the netbuf structure (see t_connect(3NSL)), t_alloc() will return a buffer of size 1024 bytes. If a larger size buffer is required, it will need to be allocated separately using a memory allocation routine such as malloc(3C). The buf and maxlen fields of the netbuf data structure can then be updated with the address of the new buffer and the 1024 byte buffer originally allocated by t_alloc() can be freed using free(3C).

Assume that the value associated with any field of struct t_info (argument returned by t_open() or t_getinfo()) that describes nbuffer limits is –2. Then t_alloc() will set the buffer pointer to NULL and the buffer maximum size to 0, and then will return success (see t_open(3NSL) or t_getinfo(3NSL)).

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also free(3C), malloc(3C), t_connect(3NSL), t_free(3NSL), t_getinfo(3NSL), t_open(3NSL), attributes(5)
**t_bind** (3NSL)

**Name**
`t_bind` – bind an address to a transport endpoint

**Synopsis**
```
#include <xti.h>

int t_bind(int fd, const struct t_bind *req, struct t_bind *ret);
```

**Description**
This routine is part of the XTI interfaces that evolved from the TLI interfaces. XTI represents
the future evolution of these interfaces. However, TLI interfaces are supported for
compatibility. When using a TLI routine that has the same name as an XTI routine, the
t_user.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of
differences between the two interfaces.

This function associates a protocol address with the transport endpoint specified by `fd` and
activates that transport endpoint. In connection mode, the transport provider may begin
enqueuing 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:
```c
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 connection 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 an encoding for the address that the transport provider
actually bound to the transport endpoint; if an address was specified in `req`, this will be an
encoding of the same address. 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` equals zero, no address is returned. If `maxlen` is greater than zero and less
than the length of the address, `t_bind()` fails with `t_errno` set to TBUFOVFLW.

If the requested address is not available, `t_bind()` will return −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()` will fail 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 will assign 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 `glen` field has meaning only when initializing a connection-mode service. It specifies the number of outstanding connection indications that the transport provider should support for the given transport endpoint. An outstanding connection 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 `glen` greater than zero is only meaningful when issued by a passive transport user that expects other users to call it. The value of `glen` will be negotiated by the transport provider and may be changed if the transport provider cannot support the specified number of outstanding connection indications. However, this value of `glen` will never be negotiated from a requested value greater than zero to zero. This is a requirement on transport providers; see WARNINGS below. On return, the `glen` field in `ret` will contain the negotiated value.

If `fd` refers to a connection-mode service, this function allows more than one transport endpoint to be bound to the same protocol address. However, the transport provider must also support this capability. If a user binds more than one transport endpoint to the same protocol address, only one endpoint can be used to listen for connection indications associated with that protocol address. In other words, only one `t_bind()` for a given protocol address may specify a value of `glen` greater than zero. In this way, the transport provider can identify which transport endpoint should be notified of an incoming connection indication. If a user attempts to bind a protocol address to a second transport endpoint with a value of `glen` greater than zero, `t_bind()` will return −1 and set `t_errno` 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(3NSL)` or `t_close(3NSL)` 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 will prevent more than one transport endpoint bound to the same protocol address from accepting connection indications.

If `fd` refers to connectionless mode service, this function allows for more than one transport endpoint to be associated with a protocol address, where the underlying transport provider supports this capability (often in conjunction with value of a protocol-specific option). If a user attempts to bind a second transport endpoint to an already bound protocol address when such capability is not supported for a transport provider, `t_bind()` will return −1 and set `t_errno` to `TADDRBUSY`.

**Return Values** Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and `t_errno` is set to indicate an error.
Valid States  T_UNBND

Errors  On failure, t_errno is set to one of the following:

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.
TOUTSTATE  The communications endpoint referenced by fd is not in one of the states in which a call to this function is valid.
TNOADDR  The transport provider could not allocate an address.
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 error (t_errno).
TSYSERR  A system error has occurred during execution of this function.

Tli Compatibility  The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header  The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

#include <tiuser.h>

Address Bound  The user can compare the addresses in req and ret to determine whether the transport provider bound the transport endpoint to a different address than that requested.

Error Description Values  The t_errno values TPROTO and TADDRBUSY can be set by the XTI interface but cannot be set by the TLI interface.

A t_errno value that this routine can return under different circumstances than its XTI counterpart is TBUFOVFLW. It can be returned even when the maxlen field of the corresponding buffer has been set to zero.
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  t_accept(3NSL), t_alloc(3NSL), t_close(3NSL), t_connect(3NSL), t_unbind(3NSL), attributes(5)

Warnings  The requirement that the value of qlen never be negotiated from a requested value greater than zero to zero implies that transport providers, rather than the XTI implementation itself, accept this restriction.

An implementation need not allow an application explicitly to bind more than one communications endpoint to a single protocol address, while permitting more than one connection to be accepted to the same protocol address. That means that although an attempt to bind a communications endpoint to some address with qlen=0 might be rejected with TADDRBUSY, the user may nevertheless use this (unbound) endpoint as a responding endpoint in a call to t_accept(3NSL). To become independent of such implementation differences, the user should supply unbound responding endpoints to t_accept(3NSL).

The local address bound to an endpoint may change as result of a t_accept(3NSL) or t_connect(3NSL) call. Such changes are not necessarily reversed when the connection is released.
The `t_close()` function informs 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. In addition, `t_close()` closes the file associated with the transport endpoint.

The function `t_close()` should be called from the T_UNBND state. See `t_getstate(3NSL)`. However, this function 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 will be freed automatically. In addition, `close(2)` will be issued for that file descriptor; if there are no other descriptors in this process or in another process which references the communication endpoint, any connection that may be associated with that endpoint is broken. The connection may be terminated in an orderly or abortive manner.

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.

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `t_errno` is set to indicate an error.

On failure, `t_errno` is set to the following:

- **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 error (`t_errno`).
- **TSYSERR**: A system error has occurred during execution of this function.

The `t_close()` function is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the `tiuser.h` header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.
The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```
#include <tiuser.h>
```

The `t_errno` value that can be set by the XTI interface and cannot be set by the TLI interface is:

TPROTO

**Attributes**  
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  
close(2), t_getstate(3NSL), t_open(3NSL), t_unbind(3NSL), attributes(5)
Name  t_connect – establish a connection with another transport user

Synopsis  #include <xti.h>

    int t_connect(int fd, const struct t_call *sndcall,
                  struct t_call *rcvcall);

Description  This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI
representsthefutureevolutionofthesetermines. However,TLIinterfacesaresupportedfor
compatibility. When using a TLI routine that has the same name as an XTI routine, the
tuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description
of differences between the two interfaces. This function 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, and 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, and sequence has no meaning for this
function.

The opt argument permits users to define the options that may be passed to the transport
provider. The user may choose not to negotiate protocol options by setting the len field of opt
to zero. In this case, the provider uses the option values currently set for the communications
endpoint.

If used, sndcall->opt.buf must point to a buffer with the corresponding options, and
sndcall->opt.len must specify its length. The maxlen and buf fields of the netbuf structure
pointed by rcvcall->addr and rcvcall->opt must be set before the call.
The \texttt{udata} argument enables the caller to pass user data to the destination transport user and receive user data from the destination user during connection establishment. However, the amount of user data must not exceed the limits supported by the transport provider as returned in the \texttt{connect} field of the \texttt{info} argument of \texttt{t_open(3NSL)} or \texttt{t_getinfo(3NSL)}. If the \texttt{len} of \texttt{udata} is zero in \texttt{sndcall}, no data will be sent to the destination transport user.

On return, the \texttt{addr}, \texttt{opt} and \texttt{udata} fields of \texttt{rcvcall} will be updated to reflect values associated with the connection. Thus, the \texttt{maxlen} field of each argument must be set before issuing this function to indicate the maximum size of the buffer for each. However, \texttt{maxlen} can be set to zero, in which case no information to this specific argument is given to the user on the return from \texttt{t_connect()}. If \texttt{maxlen} is greater than zero and less than the length of the value, \texttt{t_connect()} fails with \texttt{t_errno} set to \texttt{TBUFOVFLW}. If \texttt{rcvcall} is set to \texttt{NULL}, no information at all is returned.

By default, \texttt{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 \texttt{O_NONBLOCK} is set by means of \texttt{t_open(3NSL)} or \texttt{fcntl(2)}, \texttt{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 \texttt{-1} with \texttt{t_errno} set to \texttt{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 connection request to the destination transport user. The \texttt{t_rcvconnect(3NSL)} function is used in conjunction with \texttt{t_connect()} to determine the status of the requested connection.

When a synchronous \texttt{t_connect()} call is interrupted by the arrival of a signal, the state of the corresponding transport endpoint is \texttt{T\_OUTCON}, allowing a further call to either \texttt{t_rcvconnect(3NSL)}, \texttt{t_rcvdis(3NSL)} or \texttt{t_snddis(3NSL)}. When an asynchronous \texttt{t_connect()} call is interrupted by the arrival of a signal, the state of the corresponding transport endpoint is \texttt{T\_IDLE}.

\begin{description}
\item[Return Values] Upon successful completion, a value of 0 is returned. Otherwise, a value of \texttt{-1} is returned and \texttt{t_errno} is set to indicate an error.
\item[Valid States] \texttt{T\_IDLE}
\item[Errors] On failure, \texttt{t_errno} is set to one of the following:
\begin{itemize}
\item[TACCES] The user does not have permission to use the specified address or options.
\item[TADDRBUSY] This transport provider does not support multiple connections with the same local and remote addresses. This error indicates that a connection already exists.
\item[TBADADDR] The specified protocol address was in an incorrect format or contained illegal information.
\end{itemize}
\end{description}
<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBADDA</td>
<td>The amount of user data specified was not within the bounds allowed by the transport provider.</td>
</tr>
<tr>
<td>TBADF</td>
<td>The specified file descriptor does not refer to a transport endpoint.</td>
</tr>
<tr>
<td>TBADOPT</td>
<td>The specified protocol options were in an incorrect format or contained illegal information.</td>
</tr>
<tr>
<td>TBUFOVFLW</td>
<td>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_DATA XFER, and the information to be returned in rcvcall is discarded.</td>
</tr>
<tr>
<td>TLOOK</td>
<td>An asynchronous event has occurred on this transport endpoint and requires immediate attention.</td>
</tr>
<tr>
<td>TNODATA</td>
<td>O_NONBLOCK was set, so the function successfully initiated the connection establishment procedure, but did not wait for a response from the remote user.</td>
</tr>
<tr>
<td>TNOTSUPPORT</td>
<td>This function is not supported by the underlying transport provider.</td>
</tr>
<tr>
<td>TOUTSTATE</td>
<td>The communications endpoint referenced by fd is not in one of the states in which a call to this function is valid.</td>
</tr>
<tr>
<td>TPROTO</td>
<td>This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI error (t_errno).</td>
</tr>
<tr>
<td>TSYSERR</td>
<td>A system error has occurred during execution of this function.</td>
</tr>
</tbody>
</table>

**Tli Compatibility**

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

**Interface Header**

The XTI interfaces use the header file, xti.h. TLI interfaces should *not* use this header. They should use the header:

```c
#include <tiuser.h>
```

**Error Description Values**

The TPROTO and TADDBUSY t_errno values can be set by the XTI interface but not by the TLI interface.

A t_errno value that this routine can return under different circumstances than its XTI counterpart is TBUFOVFLW. It can be returned even when the maxlen field of the corresponding buffer has been set to zero.
Option Buffers  The format of the options in an opt buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not fix the buffer format.

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  fcntl(2), t_accept(3NSL), t_alloc(3NSL), t_getinfo(3NSL), t_listen(3NSL), t_open(3NSL), t_optmgmt(3NSL), t_rcvconnect(3NSL), t_rcvdis(3NSL), t_snddis(3NSL), attributes
t_errno

**Name**

`t_errno` – XTI error return value

**Synopsis**

```c
#include <xti.h>
```

**Description**

This error return value is part of the XTI interfaces that evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI interface that has the same name as an XTI interfaces, a different header file, `<tiuser.h>`, must be used. Refer the the TLI COMPATIBILITY section for a description of differences between the two interfaces.

`t_errno` is used by XTI functions to return error values.

XTI functions provide an error number in `t_errno` which has type `int` and is defined in `<xti.h>`. The value of `t_errno` will be defined only after a call to a XTI function for which it is explicitly stated to be set and until it is changed by the next XTI function call. The value of `t_errno` should only be examined when it is indicated to be valid by a function's return value.

Programs should obtain the definition of `t_errno` by the inclusion of `<xti.h>`. The practice of defining `t_errno` in program as `extern int t_errno` is obsolescent. No XTI function sets `t_errno` to 0 to indicate an error.

It is unspecified whether `t_errno` is a macro or an identifier with external linkage. It represents a modifiable lvalue of type `int`. If a macro definition is suppressed in order to access an actual object or a program defines an identifier with name `t_errno`, the behavior is undefined.

The symbolic values stored in `t_errno` by an XTI function are defined in the `ERRORS` sections in all relevant XTI function definition pages.

**Tli Compatibility**

`t_errno` is also used by TLI functions to return error values.

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

**Interface Header**

The XTI interfaces use the header file, `<xti.h>`. TLI interfaces should *not* use this header. They should use the header:

```c
#include <tiuser.h>
```

**Error Description Values**

The `t_errno` values that can be set by the XTI interface but cannot be set by the TLI interface are:

- `TNOSTRUCTYPE`
- `TBADNAME`
- `TBADQLEN`
- `TADDRBUSY`
TINDOUT
TPROVMISMATCH
TRESADDR
TQFULL
TPROTO

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also  attributes(5)
Name

**t_error** – produce error message

Synopsis

```c
#include <xti.h>

int t_error(const char *errmsg);
```

Description

This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the `tiuser.h` header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

The **t_error()** function produces a 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 be **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.

The language for error message strings written by **t_error()** is that of the current locale. If it is English, the error message string describing the value in **t_errno** may be derived from the comments following the **t_errno** codes defined in **xti.h**. 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.

Examples

If a **t_connect(3NSL)** function fails on transport endpoint **fd2** because a bad address was given, the following call might follow the failure:

```c
t_error("t_connect failed on fd2");
```

The diagnostic message to be printed would look like:

```c
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.

Return Values

Upon completion, a value of 0 is returned.
All apart from T_UNINIT

No errors are defined for the t_error() function.

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```c
#include <tiuser.h>
```

The t_errno value that can be set by the XTI interface and cannot be set by the TLI interface is:

TPROTO

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also t_errno(3NSL),strerror(3C), attributes(5)
#include <xti.h>
int t_free(void *ptr, int struct_type);

This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

The t_free() function frees memory previously allocated by t_alloc(3NSL). This function will free memory for the specified structure, and will also free memory for buffers referenced by the structure.

The argument ptr points to one of the seven structure types described for t_alloc(3NSL), 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.

The function t_free() will check the addr, opt and udata fields of the given structure, as appropriate, and free the buffers pointed to by the buf field of the netbuf structure. If buf is a null pointer, t_free() will not attempt to free memory. After all buffers are freed, t_free() will free the memory associated with the structure pointed to by ptr.

Undefined results will occur if ptr or any of the buf pointers points to a block of memory that was not previously allocated by t_alloc(3NSL).

Return Values Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and t_errno is set to indicate an error.

Valid States ALL - apart from T_UNINIT.

Errors On failure, t_errno is set to the following:

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 error (t_errno).
TSYSERR A system error has occurred during execution of this function.
The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

The XTI interfaces use the header file, xti.h. TLI interfaces should **not** use this header. They should use the header:

```c
#include <tiuser.h>
```

The `t_errno` value that can be set by the XTI interface and cannot be set by the TLI interface is:

TPROTO

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  
t_alloc(3NSL), attributes(5)
**Name**
t_getinfo – get protocol-specific service information

**Synopsis**
```
#include <xti.h>

int t_getinfo(int fd, struct t_info *info);
```

**Description**
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function 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(3NSL)`, 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:

- `t scalar_t addr; /*max size in octets of the transport protocol address*/`
- `t scalar_t options; /*max number of bytes of protocol-specific options */`
- `t scalar_t tsdu; /*max size in octets of a transport service data unit */`
- `t scalar_t etsdu; /*max size in octets of an expedited transport service*/ /*data unit (ETSDU) */`
- `t scalar_t connect; /*max number of octets allowed on connection */ /*establishment functions */`
- `t scalar_t discon; /*max number of octets of data allowed on t_snddis() */ /*and t_rcvdis() functions */`
- `t scalar_t servtype; /*service type supported by the transport provider */`
- `t scalar_t flags; /*other info about the transport provider */`

The values of the fields have the following meanings:

- **addr** A value greater than zero indicates the maximum size of a transport protocol address and a value of `T_INVALID (-2)` specifies that the transport provider does not provide user access to transport protocol addresses.

- **options** A value greater than zero indicates the maximum number of bytes of protocol-specific options supported by the provider, and a value of `T_INVALID (-2)` specifies that the transport provider does not support user-settable options.

- **tsdu** A value greater than zero specifies the maximum size in octets of a transport service data unit (TSDU); a value of `T_NULL (zero)` specifies that the transport provider does not support the concept of TSDU, although it does support the sending of a datastream with no logical boundaries preserved across a connection; a value of `T_INFINITE (-1)` specifies that there is no limit on the size in octets of a TSDU; and a value of `T_INVALID (-2)` specifies that the transfer of normal data is not supported by the transport provider.
etsdu  A value greater than zero specifies the maximum size in octets of an expedited transport service data unit (ETSDU); a value of T_NULL (zero) specifies that the transport provider does not support the concept of ETSDU, although it does support the sending of an expedited data stream with no logical boundaries preserved across a connection; a value of T_INFINITE (-1) specifies that there is no limit on the size (in octets) of an ETSDU; and a value of T_INVALID (-2) specifies that the transfer of expedited data is not supported by the transport provider. Note that the semantics of expedited data may be quite different for different transport providers.

connect A value greater than zero specifies the maximum number of octets that may be associated with connection establishment functions and a value of T_INVALID (-2) specifies that the transport provider does not allow data to be sent with connection establishment functions.

discon If the T_ORDRELDATA bit in flags is clear, a value greater than zero specifies the maximum number of octets that may be associated with the t_snddis(3NSL) and t_rcvdis(3NSL) functions, and a value of T_INVALID (-2) specifies that the transport provider does not allow data to be sent with the abortive release functions. If the T_ORDRELDATA bit is set in flags, a value greater than zero specifies the maximum number of octets that may be associated with the t_sndreldata(), t_rcvreldata(), t_snddis(3NSL) and t_rcvdis(3NSL) functions.

servtype This field specifies the service type supported by the transport provider, as described below.

flags This is a bit field used to specify other information about the communications provider. If the T_ORDRELDATA bit is set, the communications provider supports sending user data with an orderly release. If the T_SENDZERO bit is set in flags, this indicates that the underlying 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(3NSL) function may be used to allocate these buffers. An error will result 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(3NSL) call has no effect on the values returned by t_getinfo( )). These values will only change from the values presented to t_open(3NSL) after the endpoint enters the T_DATAEXFER state.

The servtype field of info specifies one of the following values on return:

T_COTS The transport provider supports a connection-mode service but does not support the optional orderly release facility.
T_COTS_ORD  The transport provider supports a connection-mode service with the optional orderly release facility.

T_CLTS  The transport provider supports a connectionless-mode service. For this service type, t_open(3NSL) will return T_INVALID (–1) for etsdu, connect and discon.

Return Values  Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and t_errno is set to indicate an error.

Valid States  ALL - apart from T_UNINIT.

Errors  On failure, t_errno is set to one of the following:

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 error (t_errno).

TSYSERR  A system error has occurred during execution of this function.

Tli Compatibility  The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header  The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```
#include <tiuser.h>
```

Error Description Values  The t_errno value TPROTO can be set by the XTI interface but not by the TLI interface.

The t_info Structure  For TLI, the t_info structure referenced by info lacks the following structure member:

```
t_scalar_t flags;  /* other info about the transport provider */
```

This member was added to struct t_info in the XTI interfaces.

When a value of –1 is observed as the return value in various t_info structure members, it signifies that the transport provider can handle an infinite length buffer for a corresponding attribute, such as address data, option data, TSDU (octet size), ETSDU (octet size), connection data, and disconnection data. The corresponding structure members are addr, options, tsdu, estdu, connect, and discon, respectively.

Attributes  See attributes(5) for descriptions of the following attributes:
### See Also

t_alloc(3NSL), t_open(3NSL), t_optmgmt(3NSL), t_rcvdis(3NSL), t_snddis(3NSL), attributes(5)
t_getprotaddr(3NSL)

**Name**  
t_getprotaddr – get the protocol addresses

**Synopsis**  
#include <xti.h>

    int t_getprotaddr(int fd, struct t_bind *boundaddr,  \n                        struct t_bind *peeraddr);

**Description**  
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

The t_getprotaddr() function 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 (in bytes) 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_UNBIND 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, T_INREL, T_OUTCON or T_OUTREL states, zero is returned in the len field of peeraddr. If the maxlen field of boundaddr or peeraddr is set to zero, no address is returned.

**Return Values**  
Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and t_errno is set to indicate the error.

**Valid States**  
ALL - apart from T_UNINIT.

**Errors**  
On failure, t_errno is set to one of the following:

TBAFD  
The specified file descriptor does not refer to a transport endpoint.

TBUFFOVFLW  
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 error (t_errno).

TSYSERR  
A system error has occurred during execution of this function.

**TI Compatibility**  
In the TLI interface definition, no counterpart of this routine was defined.

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>
See Also  t_bind(3NSL), attributes(5)
t_getstate – get the current state

Synopsis

```c
#include <xti.h>

int t_getstate(int fd);
```

Description

This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

The `t_getstate()` function returns the current state of the provider associated with the transport endpoint specified by `fd`.

Return Values

State is returned upon successful completion. Otherwise, a value of –1 is returned and `t_errno` is set to indicate an error. The current state is one of the following:

- **T_UNBND**: Unbound.
- **T_IDLE**: Idle.
- **T_OUTCON**: Outgoing connection pending.
- **T_INCON**: Incoming connection pending.
- **T_DATAxFER**: Data transfer.
- **T_OUTREL**: Outgoing direction orderly release sent.
- **T_INREL**: Incoming direction orderly release received.

If the provider is undergoing a state transition when `t_getstate()` is called, the function will fail.

Errors

On failure, `t_errno` is set to one of the following:

- **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 error (`t_errno`).
- **TSTATECHNG**: The transport provider is undergoing a transient state change.
- **TSYSERR**: A system error has occurred during execution of this function.

Tli Compatibility

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.
The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```c
#include <tiuser.h>
```

The `t_errno` value that can be set by the XTI interface and cannot be set by the TLI interface is:

TPROTO

**Attributes**

See [attributes(5)](attributes(5)) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**

`t_open(3NSL), attributes(5)`
t_listen(3NSL)

Name  t_listen – listen for a connection indication

Synopsis  
```
#include <xti.h>

int t_listen(int fd, struct t_call *call);
```

Description  This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function listens for a connection indication from a calling transport user. The argument `fd` identifies the local transport endpoint where connection indications arrive, and on return, `call` contains information describing the connection 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(3NSL)`. Note, however that `t_connect(3NSL)` may fail for other reasons, for example TADDRBUSY. `opt` returns options associated with the connection indication, `udata` returns any user data sent by the caller on the connection request, and `sequence` is a number that uniquely identifies the returned connection indication. The value of `sequence` enables the user to listen for multiple connection 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. If the `maxlen` field of `call->addr`, `call->opt` or `call->udata` is set to zero, no information is returned for this parameter.

By default, `t_listen()` executes in synchronous mode and waits for a connection indication to arrive before returning to the user. However, if `O_NONBLOCK` is set via `t_open(3NSL)` or `fcntl(2)`, `t_listen()` executes asynchronously, reducing to a poll for existing connection indications. If none are available, it returns −1 and sets `t_errno` to TNODATA.

Return Values  Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and `t_errno` is set to indicate an error.

Valid States  T_IDLE, T_INCON
Errors

On failure, t_errno is set to one of the following:

- **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 connection indication information to be returned in call is discarded. The value of sequence returned can be used to do a t_snddis (3NSL).
- **TLOOK**: An asynchronous event has occurred on this transport endpoint and requires immediate attention.
- **TNODATA**: 0_NONBLOCK was set, but no connection indications had been queued.
- **TNOTSUPPORT**: This function is not supported by the underlying transport provider.
- **TOUTSTATE**: The communications endpoint referenced by fd is not in one of the states in which a call to this function is valid.
- **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 error (t_errno).
- **TQFULL**: The maximum number of outstanding connection indications has been reached for the endpoint referenced by fd. Note that a subsequent call to t_listen() may block until another incoming connection indication is available. This can only occur if at least one of the outstanding connection indications becomes no longer outstanding, for example through a call to t_accept (3NSL).
- **TSYSERR**: A system error has occurred during execution of this function.

Ti Compatibility

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header

The XTI interfaces use the header file, xti.h. TLI interfaces should *not* use this header. They should use the header:

```c
#include <tiuser.h>
```

Error Description Values

The t_errno values TPROT0, TBADQLEN, and TQFULL can be set by the XTI interface but not by the TLI interface.

A t_errno value that this routine can return under different circumstances than its XTI counterpart is TBUFOVFLW. It can be returned even when the maxlen field of the corresponding buffer has been set to zero.
The format of the options in an opt buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not fix the buffer format.

**Attributes**  
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  
fcntl(2), t_accept(3NSL), t_alloc(3NSL), t_bind(3NSL), t_connect(3NSL), t_open(3NSL), t_optmgmt(3NSL), t_rcvconnect(3NSL), t_snddis(3NSL), attributes(5)

**Warnings**  
Some transport providers do not differentiate between a connection indication and the connection itself. If this is the case, a successful return of t_listen() indicates an existing connection.
**Name**  
t_look – look at the current event on a transport endpoint

**Synopsis**  
```c
#include <xti.h>

int t_look(int fd);
```

**Description**  
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the `tiuser.h` header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function 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.

**Return Values**  
Upon success, `t_look()` returns a value that indicates which of the allowable events has occurred, or returns zero if no event exists. One of the following events is returned:

- **T_LISTEN**: Connection indication received.
- **T_CONNECT**: Connect confirmation received.
- **T_DATA**: Normal data received.
- **T_EXDATA**: Expedited data received.
- **T_DISCONNECT**: Disconnection received.
- **T_UDERR**: Datagram error indication.
- **T_ORDREL**: Orderly release indication.
- **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.

On failure, –1 is returned and `t_errno` is set to indicate the error.

**Valid States**  
ALL - apart from T_UNINIT.

**Errors**  
On failure, `t_errno` is set to one of the following:

- **TBADF**: The specified file descriptor does not refer to a transport endpoint.
This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI error (`t_errno`).

A system error has occurred during execution of this function.

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

The XTI interfaces use the header file, `xti.h`. TLI interfaces should not use this header. They should use the header:

```c
#include <tiuser.h>
```

The return values that are defined by the XTI interface and cannot be returned by the TLI interface are:

- `T_GODATA`
- `T_GOEXDATA`

The `t_errno` value that can be set by the XTI interface and cannot be set by the TLI interface is:

- `TPROTO`

See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also `t_open(3NSL), t_snd(3NSL), t_sndudata(3NSL), attributes(5)`
The `t_open()` function 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.

The argument `name` points to a transport provider identifier and `oflag` identifies any open flags, as in `open(2)`. The argument `oflag` 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 `t_info` structure. This argument points to a `t_info` which contains the following members:

- `t_scalar_t addr; /* max size of the transport protocol address */`
- `t_scalar_t options; /* max number of bytes of */
  * protocol-specific options */`
- `t_scalar_t tsdu; /* max size of a transport service data */
  * unit (TSDU) */`
- `t_scalar_t etsdu; /* max size of an expedited transport */
  * service data unit (ETSDU) */`
- `t_scalar_t connect; /* max amount of data allowed on */
  * connection establishment functions */`
- `t_scalar_t discon; /* max amount of data allowed on */
  * t_snddis() and t_rcvdis() functions */`
- `t_scalar_t servtype; /* service type supported by the */
  * transport provider */`
- `t_scalar_t flags; /* other info about the transport provider */`

The values of the fields have the following meanings:

- `addr` A value greater than zero (T_NULL) indicates the maximum size of a transport protocol address and a value of -2 (T_INVALID) specifies that the transport provider does not provide user access to transport protocol addresses.
options
A value greater than zero (T_NULL) indicates the maximum number of bytes of protocol-specific options supported by the provider, and a value of –2 (T_INVALID) specifies that the transport provider does not support user-settable options.

tsdu
A value greater than zero (T_NULL specifies the maximum size of a transport service data unit (TSDU); a value of zero (T_NULL) specifies that the transport provider does not support the concept of TSDU, although it does support the sending of a data stream with no logical boundaries preserved across a connection; a value of –1 (T_INFINITE) specifies that there is no limit to the size of a TSDU; and a value of –2 (T_INVALID) specifies that the transfer of normal data is not supported by the transport provider.

etsdu
A value greater than zero (T_NULL specifies the maximum size of an expedited transport service data unit (ETSDU); a value of zero (T_NULL) specifies that the transport provider does not support the concept of ETSDU, although it does support the sending of an expedited data stream with no logical boundaries preserved across a connection; a value of –1 (T_INFINITE) specifies that there is no limit on the size of an ETSDU; and a value of –2 (T_INVALID) specifies that the transfer of expedited data is not supported by the transport provider. Note that the semantics of expedited data may be quite different for different transport providers.

connect
A value greater than zero (T_NULL) specifies the maximum amount of data that may be associated with connection establishment functions, and a value of –2 (T_INVALID) specifies that the transport provider does not allow data to be sent with connection establishment functions.

discon
If the T_ORDRELDATA bit in flags is clear, a value greater than zero (T_NULL) specifies the maximum amount of data that may be associated with the t_snddis(3NSL) and t_rcvdis(3NSL) functions, and a value of –2 (T_INVALID) specifies that the transport provider does not allow data to be sent with the abortive release functions. If the T_ORDRELDATA bit is set in flags, a value greater than zero (T_NULL) specifies the maximum number of octets that may be associated with the t_sndreldata(), t_rcvreldata(), t_snddis(3NSL) and t_rcvdis(3NSL) functions.

servtype
This field specifies the service type supported by the transport provider, as described below.

flags
This is a bit field used to specify other information about the communications provider. If the T_ORDRELDATA bit is set, the communications provider supports user data to be sent with an orderly release. If the T_SENDZERO bit is set in flags, this indicates the underlying 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(3NSL) function may be used to allocate these buffers. An error will result if a transport user exceeds the allowed data size on any function.

The servtype field of info specifies one of the following values on return:

- **T_COTS** The transport provider supports a connection-mode service but does not support the optional orderly release facility.
- **T_COTS_ORD** The transport provider supports a connection-mode service with the optional orderly release facility.
- **T_CLTS** The transport provider supports a connectionless-mode service. For this service type, t_open() will return -2 (T_INVALID) for etsdu, connect and discon.

A single transport endpoint may support only one of the above services at one time.

If info is set to a null pointer by the transport user, no protocol information is returned by t_open().

**Return Values** A valid file descriptor is returned upon successful completion. Otherwise, a value of -1 is returned and t_errno is set to indicate an error.

**Valid States** T_UNINIT.

**Errors** On failure, t_errno is set to the following:

- **T BADFLAG** An invalid flag is specified.
- **T BADNAME** 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 error (t_errno).
- **TSYSERR** A system error has occurred during execution of this function.

**Tli Compatibility** The XTI and TLI interface definitions have common names but use different header files. This and other semantic differences between the two interfaces are described in the subsections below.

**Interface Header** The XTI interfaces use the xt1.h header. TLI interfaces should *not* use this header. They should use the header:

```
#include <tiuser.h>
```
The `t_errno` values `TPROTO` and `TBADNAME` can be set by the XTI interface but cannot be set by the TLI interface.

For TLI, the `t_info` structure referenced by `info` lacks the following structure member:

```c
    t_scalar_t flags; /* other info about the transport provider */
```

This member was added to `struct t_info` in the XTI interfaces.

When a value of −1 is observed as the return value in various `t_info` structure members, it signifies that the transport provider can handle an infinite length buffer for a corresponding attribute, such as address data, option data, TSDU (octet size), ETSDU (octet size), connection data, and disconnection data. The corresponding structure members are `addr`, `options`, `tsdu`, `estdu`, `connect`, and `discon`, respectively.

### Attributes
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

### See Also
open(2), attributes(5)
Name  

t_optmgmt – manage options for a transport endpoint

Synopsis

#include <xti.h>

int t_optmgmt(int fd, const struct t_optmgmt *req, struct t_optmgmt *ret);

Description

This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

The t_optmgmt() function 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;
t_scalar_t 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(3NSL). 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. If maxlen in ret is set to zero, no options values are returned. 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 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; that 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.

Several options can be concatenated. The option user has, however to ensure that each options header and value part starts at a boundary appropriate for the architecture-specific alignment rules. The macros T_OPT_FIRSTHDR(nbp), T_OPT_NEXTHDR(nbp,tohp), T_OPT_DATA(tohp) are provided for that purpose.
T_OPT_DATA(nhp)  If argument is a pointer to a t_opthdr structure, this macro returns an unsigned character pointer to the data associated with the t_opthdr.

T_OPT_NEXTHDR(nbp, tohp)  If the first argument is a pointer to a netbuf structure associated with an option buffer and second argument is a pointer to a t_opthdr structure within that option buffer, this macro returns a pointer to the next t_opthdr structure or a null pointer if this t_opthdr is the last t_opthdr in the option buffer.

T_OPT_FIRSTHDR(tohp)  If the argument is a pointer to a netbuf structure associated with an option buffer, this macro returns the pointer to the first t_opthdr structure in the associated option buffer, or a null pointer if there is no option buffer associated with this netbuf or if it is not possible or the associated option buffer is too small to accommodate even the first aligned option header.

T_OPT_FIRSTHDR is useful for finding an appropriately aligned start of the option buffer. T_OPT_NEXTHDR is useful for moving to the start of the next appropriately aligned option in the option buffer. Note that OPT_NEXTHDR is also available for backward compatibility requirements. T_OPT_DATA is useful for finding the start of the data part in the option buffer where the contents of its values start on an appropriately aligned boundary.

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.

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 \texttt{req}→\texttt{opt.buf} and \texttt{req}→\texttt{opt.len}. The negotiated option values are returned in the buffer pointed to by \texttt{ret}→\texttt{opt.buf}. The \texttt{status} field of each returned option is set to indicate the result of the negotiation. The value \texttt{T_SUCCESS} if the proposed value was negotiated, \texttt{T_PARSUCCESS} if a degraded value was negotiated, \texttt{T_FAILURE} if the negotiation failed (according to the negotiation rules), \texttt{T_NOTSUPPORT} if the transport provider does not support this option or illegally requests negotiation of a privileged option, and \texttt{T_READONLY} if modification of a read-only option was requested. If the status is \texttt{T_SUCCESS}, \texttt{T_FAILURE}, \texttt{T_NOTSUPPORT} or \texttt{T_READONLY}, the returned option value is the same as the one requested on input.

The overall result of the negotiation is returned in \texttt{ret}→\texttt{flags}.

This field contains the worst single result, whereby the rating is done according to the order \texttt{T_NOTSUPPORT}, \texttt{T_READONLY}, \texttt{T_FAILURE}, \texttt{T_PARSUCCESS}, \texttt{T_SUCCESS}. The value \texttt{T_NOTSUPPORT} is the worst result and \texttt{T_SUCCESS} is the best.

For each level, the option \texttt{T_ALLOPT} can be requested on input. No value is given with this option; only the \texttt{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 \texttt{ret}→\texttt{opt.buf}. Note that depending on the state of the transport endpoint, not all requests to negotiate the default value may be successful.

This action enables the user to verify whether the options specified in \texttt{req} are supported by the transport provider. If an option is specified with no option value (it consists only of a \texttt{t_opthdr} structure), the option is returned with its \texttt{status} field set to \texttt{T_SUCCESS} if it is supported, \texttt{T_NOTSUPPORT} if it is not or needs additional user privileges, and \texttt{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 \texttt{status} field of the returned option has the same value, as if the user had tried to negotiate this value with \texttt{T_NEGOTIATE}. If the status is \texttt{T_SUCCESS}, \texttt{T_FAILURE}, \texttt{T_NOTSUPPORT} or \texttt{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` 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` before the call. See `t_getinfo(3NSL)` and `t_open(3NSL)`.

**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 `req->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 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.

Transport providers may not be able to provide an interface capable of supporting T_NEGOTIATE and/or T_CHECK functionalities. When this is the case, the error TNOTSUPPORT is returned.

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; that is, 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.

**Return Values**

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and t_errno is set to indicate an error.

**Valid States**

ALL - apart from T_UNINIT.

**Errors**

On failure, t_errno is set to one of the following:

- **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.
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.

This action is not supported by the transport provider.

The communications endpoint referenced by *fd* is not in one of the states in which a call to this function is valid.

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI error (*t_errno*).

A system error has occurred during execution of this function.

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

The XTI interfaces use the header file, *xti.h*. TLI interfaces should *not* use this header. They should use the header:

```
#include <tiuser.h>
```

The *t_errno* value *TPROTO* can be set by the XTI interface but not by the TLI interface.

The *t_errno* values that this routine can return under different circumstances than its XTI counterpart are *TACCES* and *TBUFOMVLW*.

*TACCES* can be returned to indicate that the user does not have permission to negotiate the specified options.

*TBUFOMVLW* can be returned even when the *maxlen* field of the corresponding buffer has been set to zero.

The format of the options in an *opt* buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not fix the buffer format. The macros *T_OPT_DATA*, *T_OPT_NEXTHDR*, and *T_OPT_FIRSTHDR* described for XTI are not available for use by TLI interfaces.

The semantic meaning of various action values for the *flags* field of *req* differs between the TLI and XTI interfaces. TLI interface users should heed the following descriptions of the actions:

This action enables the user to negotiate the values of the options specified in *req* with the transport provider. The provider will evaluate the requested options and negotiate the values, returning the negotiated values through *ret*. 

---

**TLI Compatibility**

**Interface Header**

The XTI interfaces use the header file, *xti.h*. TLI interfaces should *not* use this header. They should use the header:

```
#include <tiuser.h>
```

**Error Description Values**

The *t_errno* value *TPROTO* can be set by the XTI interface but not by the TLI interface.

The *t_errno* values that this routine can return under different circumstances than its XTI counterpart are *TACCES* and *TBUFOMVLW*.

*TACCES* can be returned to indicate that the user does not have permission to negotiate the specified options.

*TBUFOMVLW* can be returned even when the *maxlen* field of the corresponding buffer has been set to zero.

**Option Buffers**

The format of the options in an *opt* buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not fix the buffer format. The macros *T_OPT_DATA*, *T_OPT_NEXTHDR*, and *T_OPT_FIRSTHDR* described for XTI are not available for use by TLI interfaces.

**Actions**

The semantic meaning of various action values for the *flags* field of *req* differs between the TLI and XTI interfaces. TLI interface users should heed the following descriptions of the actions:

*This action enables the user to negotiate the values of the options specified in *req* with the transport provider. The provider will evaluate the requested options and negotiate the values, returning the negotiated values through *ret*.**
This action enables the user to verify whether the options specified in `req` are supported by the transport provider. On return, the `flags` field of `ret` will have either `T_SUCCESS` or `T_FAILURE` set to indicate to the user whether the options are supported. These flags are only meaningful for the `T_CHECK` request.

This action enables a user to retrieve the default options supported by the transport provider into the `opt` field of `ret`. In `req`, the `len` field of `opt` must be zero and the `buf` field may be NULL.

Connectionless Mode If issued as part of the connectionless mode service, `t_optmgmt()` may block due to flow control constraints. The function will not complete until the transport provider has processed all previously sent data units.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also `close(2), poll(2), select(3C), t_accept(3NSL), t_alloc(3NSL), t_bind(3NSL), t_close(3NSL), t_connect(3NSL), t_getinfo(3NSL), t_getsockname(3NSL), t_getsockopt(3NSL), t_getpeername(3NSL), t_getproto(3NSL), t_getsockname(3NSL), t_getsockopt(3NSL), t_getpeername(3NSL), t_getproto(3NSL), t_setopt(3NSL), t_setoptsockopt(3NSL), t_getsockopt(3NSL), t_setopt(3NSL), attributes(5)`
Name  
t_rcv – receive data or expedited data sent over a connection

Synopsis  
#include <xti.h>

    int t_rcv(int fd, void *buf, unsigned int nbytes, int *flags);

Description  
This function is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI function that has the same name as an XTI function, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function 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 will be placed, and 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 by means of t_open(3NSL) or fcntl(2), t_rcv() will execute in asynchronous mode and will fail if no data is available. See T_NODATA below.

On return from the call, if T_MORE is set in flags, this indicates that there is more data, and the current transport service data unit (TSDU) or expedited transport service data unit (ETSDU) must be received in multiple t_rcv() calls. In the asynchronous mode, or under unusual conditions (for example, the arrival of a signal or T_EXDATA event), 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 TSDU. The end of the TSDU is identified by the return of a t_rcv() call with the T_MORE flag not set. If the transport provider does not support the concept of a TSDU as indicated in the info argument on return from t_open(3NSL) or t_getinfo(3NSL), the T_MORE flag is not meaningful 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 is expedited if T_EXPEDITED is set in flags. If T_MORE is also set, it indicates that the number of expedited bytes exceeded nbytes, a signal has interrupted the call, or that an entire ETSDU was not available (only for transport protocols that support fragmentation of ETSDUs). The rest of the ETSDU will be returned by subsequent calls to t_rcv() which will return with T_EXPEDITED set in flags. The end of the ETSDU is identified by the return of a t_rcv() call with T_EXPEDITED set and T_MORE cleared. If the entire ETSDU is not available it is possible for normal data fragments to be returned between the initial and final fragments of an ETSDU.

If a signal arrives, t_rcv() returns, giving the user any data currently available. If no data is available, t_rcv() returns –1, sets t_errno to TSYSERR and errno to EINTR. If some data is available, t_rcv() returns the number of bytes received and T_MORE is set in flags.
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 \texttt{t\_look(3NSL)} function. Additionally, the process can arrange to be notified by means of the EM interface.

### Return Values
On successful completion, \texttt{t\_rcv()} returns the number of bytes received. Otherwise, it returns $-1$ on failure and \texttt{t\_errno} is set to indicate the error.

### Valid States
- T\_DATAFER, T\_OUTREL.

### Errors
On failure, \texttt{t\_errno} is set to one of the following:

<table>
<thead>
<tr>
<th>Error</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TBADF</td>
<td>The specified file descriptor does not refer to a transport endpoint.</td>
</tr>
<tr>
<td>TLOOK</td>
<td>An asynchronous event has occurred on this transport endpoint and requires immediate attention.</td>
</tr>
<tr>
<td>TNODATA</td>
<td>0_NONBLOCK was set, but no data is currently available from the transport provider.</td>
</tr>
<tr>
<td>TNOTSUPPORT</td>
<td>This function is not supported by the underlying transport provider.</td>
</tr>
<tr>
<td>TOUTSTATE</td>
<td>The communications endpoint referenced by \texttt{fd} is not in one of the states in which a call to this function is valid.</td>
</tr>
<tr>
<td>TPROTO</td>
<td>This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI error (\texttt{t_errno}).</td>
</tr>
<tr>
<td>TSYSERR</td>
<td>A system error has occurred during execution of this function.</td>
</tr>
</tbody>
</table>

### TLI Compatibility
The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

#### Interface Header
The XTI interfaces use the header file, \texttt{xti.h}. TLI interfaces should \texttt{not} use this header. They should use the header:

```c
#include <tiuser.h>
```

#### Error Description Values
The \texttt{t\_errno} value that can be set by the XTI interface and cannot be set by the TLI interface is:

- TPROTO
Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
<tr>
<td>Standard</td>
<td>See standards(5).</td>
</tr>
</tbody>
</table>

See Also  fcntl(2), t_getinfo(3NSL), t_look(3NSL), t_open(3NSL), t_snd(3NSL), attributes(5), standards(5)
**Name**
t_rcvconnect – receive the confirmation from a connection request

**Synopsis**
```
#include <xti.h>

int t_rcvconnect(int fd, struct t_call *call);
```

**Description**
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tliuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function enables a calling transport user to determine the status of a previously sent connection request and is used in conjunction with t_connect(3NSL) to establish a connection in asynchronous mode, and to complete a synchronous t_connect(3NSL) call that was interrupted by a signal. 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:

```c
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* points to optional user data that may be returned by the destination transport user during connection establishment, and *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, *maxlen* can be set to zero, in which case no information to this specific argument is given to the user on the return from t_rcvconnect(). If *call* is set to NULL, no information at all is returned. By default, t_rcvconnect() executes in synchronous mode and waits for the connection to be established before returning. On return, the *addr*, *opt* and *udata* fields reflect values associated with the connection.

If `O_NONBLOCK` is set by means of `t_open(3NSL)` or `fcntl(2)`, t_rcvconnect() executes in asynchronous mode, and reduces to a poll for existing connection 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*. 

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Return Values  Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and \texttt{t_errno} is set to indicate an error.

Valid States  \texttt{T\_OUTCON}.

Errors  On failure, \texttt{t_errno} is set to one of the following:

- \texttt{TBADF}  The specified file descriptor does not refer to a transport endpoint.
- \texttt{TBUFOVFLW}  The number of bytes allocated for an incoming argument (\texttt{maxlen}) is greater than 0 but not sufficient to store the value of that argument, and the connection information to be returned in \texttt{call} will be discarded. The provider's state, as seen by the user, will be changed to \texttt{T\_DATAXFER}.
- \texttt{TLOOK}  An asynchronous event has occurred on this transport connection and requires immediate attention.
- \texttt{TNODATA}  \texttt{O\_NONBLOCK} was set, but a connection confirmation has not yet arrived.
- \texttt{TNOTSUPPORT}  This function is not supported by the underlying transport provider.
- \texttt{TOUTSTATE}  The communications endpoint referenced by \texttt{fd} is not in one of the states in which a call to this function is valid.
- \texttt{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 error (\texttt{t_errno}).
- \texttt{TSYSERR}  A system error has occurred during execution of this function.

Tli Compatibility  The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header  The XTI interfaces use the header file, \texttt{xti\_h}. TLI interfaces should not use this header. They should use the header:

\begin{verbatim}
#include&lt;tiuser.h&gt;
\end{verbatim}

Error Description Values  The \texttt{t_errno} value \texttt{TPROTO} can be set by the XTI interface but not by the TLI interface.

A \texttt{t_errno} value that this routine can return under different circumstances than its XTI counterpart is \texttt{TBUFOVFLW}. It can be returned even when the \texttt{maxlen} field of the corresponding buffer has been set to zero.

Attributes  See \texttt{attributes(5)} for descriptions of the following attributes:
See Also  `fcntl(2), t_accept(3NSL), t_alloc(3NSL), t_bind(3NSL), t_connect(3NSL), t_listen(3NSL), t_open(3NSL), t_optmgmt(3NSL), attributes(5)`
t_rcvdis – retrieve information from disconnection

Synopsis
#include <xti.h>

int t_rcvdis(int fd, struct t_discon *discon);

Description
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI
represents the future evolution of these interfaces. However, TLI interfaces are supported for
compatibility. When using a TLI routine that has the same name as an XTI routine, the
t_user.h header file must be used. Refer to the TLI COMPATIBILITY section for a description
of differences between the two interfaces.

This function is used to identify the cause of a disconnection and to retrieve any user data sent
with the disconnection. 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 disconnection through a protocol-dependent
reason code, udata identifies any user data that was sent with the disconnection, and sequence
may identify an outstanding connection indication with which the disconnection 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(3NSL) functions and is processing the
resulting connection indications. If a disconnection indication occurs, sequence can be used to
identify which of the outstanding connection indications is associated with the disconnection.

The maxlen field of udata may be set to zero, if the user does not care about incoming data. If,
in addition, the user does not need to know the value of reason or sequence, discon may be set
to NULL and any user data associated with the disconnection indication shall be discarded.
However, if a user has retrieved more than one outstanding connection indication by means
of t_listen(3NSL), and discon is a null pointer, the user will be unable to identify with which
connection indication the disconnection is associated.

Return Values
Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and
t_errno is set to indicate an error.

Valid States
T_DATAXHR, T_OUTCON, T_OUTREL, T_INREL, T_INCON (ocnt > 0).

Errors
On failure, t_errno is set to one of the following:

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 disconnection indication currently exists on the specified transport endpoint.

TNOTSUPPORT  This function is not supported by the underlying transport provider.

TOUTSTATE  The communications endpoint referenced by *fd* is not in one of the states in which a call to this function is valid.

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 error (*t_errno*).

TSYSERR  A system error has occurred during execution of this function.

**Tli Compatibility**
The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

**Interface Header**
The XTI interfaces use the header file, *xti.h*. TLI interfaces should not use this header. They should use the header:

```
#include <tiuser.h>
```

**Error Description Values**
The *t_errno* values TPROTO and TOUTSTATE can be set by the XTI interface but not by the TLI interface.

A failure return, and a *t_errno* value that this routine can set under different circumstances than its XTI counterpart is TBUFF0VFLW. It can be returned even when the *maxlen* field of the corresponding buffer has been set to zero.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**
t_alloc(3NSL), t_connect(3NSL), t_listen(3NSL), t_open(3NSL), t_snddis(3NSL), attributes(5)
t_rcvrel(3NSL)

**Name**
t_rcvrel – acknowledge receipt of an orderly release indication

**Synopsis**
#include <xti.h>

```c
int t_rcvrel(int fd);
```

**Description**
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the `tiuser.h` header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function is used to receive an orderly release indication for the incoming direction of data transfer. The argument `fd` identifies the local transport endpoint where the connection exists. After receipt of this indication, the user may not attempt to receive more data by means of `t_rcv(3NSL)` or `t_rcvv()`. Such an attempt will fail with `t_errno` set to TOUTSTATE. However, the user may continue to send data over the connection if `t_sndrel(3NSL)` has not been called by the user. This function is an optional service of the transport provider, and is only supported if the transport provider returned service type `T_COTS_ORD` on `t_open(3NSL)` or `t_getinfo(3NSL)`. Any user data that may be associated with the orderly release indication is discarded when `t_rcvrel()` is called.

**Return Values**
Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and `t_errno` is set to indicate an error.

**Valid States**
T_DATAXFER, T_OUTREL.

**Errors**
On failure, `t_errno` is set to one of the following:

- **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.

- **TNOREL**
  No orderly release indication currently exists on the specified transport endpoint.

- **TNOTSUPPORT**
  This function is not supported by the underlying transport provider.

- **TOUTSTATE**
  The communications endpoint referenced by `fd` is not in one of the states in which a call to this function is valid.

- **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 error (`t_errno`).

- **TSYSERR**
  A system error has occurred during execution of this function.
The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

**Interface Header**
The XTI interfaces use the header file, `xti.h`. TLI interfaces should not use this header. They should use the header:

```c
#include <tiuser.h>
```

**Error Description Values**
The `t_errno` values that can be set by the XTI interface and cannot be set by the TLI interface are:

- `TPROTO`
- `TOUTSTATE`

**Attributes**
See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**
`t_getinfo(3NSL), t_open(3NSL), t_sndrel(3NSL), attributes(5)`
### t_rcvreldata(3NSL)

#### Name
`t_rcvreldata` - receive an orderly release indication or confirmation containing user data

#### Synopsis
```c
#include <xti.h>

int t_rcvreldata(int fd, struct t_discon *discon);
```

#### Description
This function is used to receive an orderly release indication for the incoming direction of data transfer and to retrieve any user data sent with the release. The argument `fd` identifies the local transport endpoint where the connection exists, and `discon` points to a `t_discon` structure containing the following members:

- `struct netbuf udata;
- int reason;
- int sequence;

After receipt of this indication, the user may not attempt to receive more data by means of `t_rcv(3NSL)` or `t_rcvv(3NSL)`. Such an attempt will fail with `t_errno` set to `TOUTSTATE`. However, the user may continue to send data over the connection if `t_sndrel(3NSL)` or `t_sndreldata (3N)` has not been called by the user.

The field `reason` specifies the reason for the disconnection through a protocol-dependent reason code, and `udata` identifies any user data that was sent with the disconnection; the field `sequence` is not used.

If a user does not care if there is incoming data and does not need to know the value of `reason`, `discon` may be a null pointer, and any user data associated with the disconnection will be discarded.

If `discon->udata.maxlen` is greater than zero and less than the length of the value, `t_rcvreldata()` fails with `t_errno` set to `TBUFFOVER`.

This function is an optional service of the transport provider, only supported by providers of service type `T_COTS_ORD`. The flag `T_ORDRELDATA` in the `info->flag` field returned by `t_open(3NSL)` or `t_getinfo(3NSL)` indicates that the provider supports orderly release user data; when the flag is not set, this function behaves like `t_rcvrel(3NSL)` and no user data is returned.

This function may not be available on all systems.

#### Return Values
Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and `t_errno` is set to indicate an error.

#### Valid States
`T_DATAXFER, T_OUTREL`

#### Errors
- **TBADF** The specified file descriptor does not refer to a transport endpoint.
The number of bytes allocated for incoming data (maxlen) is greater than 0 but not sufficient to store the data, and the disconnection information to be returned in \texttt{discon} will be discarded. The provider state, as seen by the user, will be changed as if the data was successfully retrieved.

An asynchronous event has occurred on this transport endpoint and requires immediate attention.

No orderly release indication currently exists on the specified transport endpoint.

Orderly release is not supported by the underlying transport provider.

The communications endpoint referenced by \texttt{fd} is not in one of the states in which a call to this function is valid.

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI error \texttt{(t_errno)}.

A system error has occurred during execution of this function.

In the TLI interface definition, no counterpart of this routine was defined.

See \texttt{attributes(5)} for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

\texttt{t_getinfo(3NSL), t_open(3NSL), t_sndreldata(3NSL), t_rcvrel(3NSL), t_sndrel(3NSL), attributes(5)}

The interfaces \texttt{t_sndreldata(3NSL)} and \texttt{t_rcvrel()} are only for use with a specific transport called “minimal OSI,” which is not available on the Solaris platform. These interfaces are not available for use in conjunction with Internet Transports (TCP or UDP).
**t_rcvudata(3NSL)**

**Name**  
t_rcvudata – receive a data unit

**Synopsis**  
#include <xti.h>

```c
int t_rcvudata(int fd, struct t_unitdata *unitdata, int *flags);
```

**Description**  
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function is used in connectionless-mode to receive a data unit from another transport user. The argument `fd` identifies the local transport endpoint through which data will be received, `unitdata` holds information associated with the received data unit, and `flags` is set on return to indicate that the complete data unit was not received. The argument `unitdata` points to a `t_unitdata` structure containing the following members:

```c
define struct netbuf addr;
define struct netbuf opt;
define struct netbuf udata;
```

The `maxlen` field of `addr`, `opt` and `udata` must be set before calling this function to indicate the maximum size of the buffer for each. If the `maxlen` field of `addr` or `opt` is set to zero, no information is returned in the `buf` field of this parameter.

On return from this call, `addr` specifies the protocol address of the sending user, `opt` identifies options that were associated with this data unit, and `udata` specifies the user data that was received.

By default, `t_rcvudata()` operates in synchronous mode and will wait for a data unit to arrive if none is currently available. However, if `O_NONBLOCK` is set by means of `t_open(3NSL)` or `fcntl(2)`, `t_rcvudata()` will execute in asynchronous mode and will fail if no data units are available.

If the buffer defined in the `udata` field of `unitdata` is not large enough to hold the current data unit, the buffer will be filled and `T_MORE` will be set in `flags` on return to indicate that another `t_rcvudata()` should be called to retrieve the rest of the data unit. Subsequent calls to `t_rcvudata()` will return zero for the length of the address and options until the full data unit has been received.

If the call is interrupted, `t_rcvudata()` will return `EINTR` and no datagrams will have been removed from the endpoint.

**Return Values**  
Upon successful completion, a value of 0 is returned. Otherwise, a value of −1 is returned and `t_errno` is set to indicate an error.
Valid States  T_IDLE.

Errors  On failure, t_errno is set to one of the following:

TBADF  The specified file descriptor does not refer to a transport endpoint.

TBUFOVFLW  The number of bytes allocated for the incoming protocol address or options (maxlen) is greater than 0 but not sufficient to store the information. The unit data information to be returned in unitdata will be discarded.

TLOOK  An asynchronous event has occurred on this transport endpoint and requires immediate attention.

TNODATA  0_NONBLOCK was set, but no data units are currently available from the transport provider.

TNOTSUPPORT  This function is not supported by the underlying transport provider.

TOUTSTATE  The communications endpoint referenced by fd is not in one of the states in which a call to this function is valid.

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 error (t_errno).

TSYSErr  A system error has occurred during execution of this function.

Tli Compatibility  The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header  The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

#include<tiuser.h>

Error Description Values  The t_errno values that can be set by the XTI interface and cannot be set by the TLI interface are:

TPROTO
TOUTSTATE

A t_errno value that this routine can return under different circumstances than its XTI counterpart is TBUFOVFLW. It can be returned even when the maxlen field of the corresponding buffer has been set to zero.
The format of the options in an opt buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not fix the buffer format.

**Attributes**  See `attributes(5)` for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**  `fcntl(2), t_alloc(3NSL), t_open(3NSL), t_rcvuderr(3NSL), t_sndudata(3NSL), attributes(5)`
t_rcvuderr – receive a unit data error indication

Synopsis
#include <xti.h>

int t_rcvuderr(int fd, struct t_uderr *uderr);

Description
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function is used in connectionless-mode to receive information concerning an error on a previously sent data unit, and should only be issued following a unit data error indication. It informs the transport user that a data unit with a specific destination address and protocol options produced an error. The argument fd identifies the local transport endpoint through which the error report will be received, and uderr points to a t_uderr structure containing the following members:

struct netbuf addr;
struct netbuf opt;
t_scalar_t error;

The maxlen field of addr and opt must be set before calling this function to indicate the maximum size of the buffer for each. If this field is set to zero for addr or opt, no information is returned in the buf field of this parameter.

On return from this call, the addr structure specifies the destination protocol address of the erroneous data unit, the opt structure identifies options that were associated with the data unit, and error specifies a protocol-dependent error code.

If the user does not care to identify the data unit that produced an error, uderr may be set to a null pointer, and t_rcvuderr() will simply clear the error indication without reporting any information to the user.

Return Values
Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and t_errno is set to indicate an error.

Valid States
T_IDLE.

Errors
On failure, t_errno is set to one of the following:

T_BADF The specified file descriptor does not refer to a transport endpoint.
T_BUFOVFLW The number of bytes allocated for the incoming protocol address or options (maxlen) is greater than 0 but not sufficient to store the information. The unit data error information to be returned in uderr will be discarded.
T_NOTSUPPORT This function is not supported by the underlying transport provider.
TNouderr:  No unit data error indication currently exists on the specified transport endpoint.

TOutstate:  The communications endpoint referenced by fd is not in one of the states in which a call to this function is valid.

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 error (t_errno).

TSyserr:  A system error has occurred during execution of this function.

**Tli Compatibility**

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

**Interface Header**

The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```
#include <tiuser.h>
```

**Error Description Values**

The t_errno values TProto and TOutstate can be set by the XTI interface but not by the TLI interface.

A t_errno value that this routine can return under different circumstances than its XTI counterpart is TBUFOVFLW. It can be returned even when the maxlen field of the corresponding buffer has been set to zero.

**Option Buffers**

The format of the options in an opt buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not fix the buffer format.

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**

t_rcvudata(3NSL), t_sndudata(3NSL), attributes(5)
t_rcvv – receive data or expedited data sent over a connection and put the data into one or more non-contiguous buffers

### Synopsis

```
#include <xti.h>

int t_rcvv(int fd, struct iovec *iov, unsigned int iovcount, int *flags);
```

### Description

This function receives either normal or expedited data. The argument `fd` identifies the local transport endpoint through which data will arrive, `iov` points to an array of buffer address/size pairs (`iov_base, iov_len`). The `t_rcvv()` function receives data into the buffers specified by `iov[0].iov_base, iov[1].iov_base, through iov[iovcount-1].iov_base`, always filling one buffer before proceeding to the next.

Note that the limit on the total number of bytes available in all buffers passed:

```
iov(0).iov_len + \ldots + iov(iovcount-1).iov_len
```

may be constrained by implementation limits. If no other constraint applies, it will be limited by `INT_MAX`. In practice, the availability of memory to an application is likely to impose a lower limit on the amount of data that can be sent or received using scatter/gather functions.

The argument `iovcount` contains the number of buffers which is limited to `T_IOV_MAX`, which is an implementation-defined value of at least 16. If the limit is exceeded, the function will fail with `TNODATA`.

The argument `flags` may be set on return from `t_rcvv()` and specifies optional flags as described below.

By default, `t_rcvv()` operates in synchronous mode and will wait for data to arrive if none is currently available. However, if `O_NONBLOCK` is set by means of `t_open(3NSL)` or `fcntl(2)`, `t_rcvv()` 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 transport service data unit (TSDU) or expedited transport service data unit (ETSDU) must be received in multiple `t_rcvv()` or `t_rcv(3NSL)` calls. In the asynchronous mode, or under unusual conditions (for example, the arrival of a signal or `T_EXDATA` event), the `T_MORE` flag may be set on return from the `t_rcvv()` call even when the number of bytes received is less than the total size of all the receive buffers. Each `t_rcvv()` with the `T_MORE` flag set indicates that another `t_rcvv()` must follow to get more data for the current TSDU. The end of the TSDU is identified by the return of a `t_rcvv()` call with the `T_MORE` flag not set. If the transport provider does not support the concept of a TSDU as indicated in the `info` argument on return from `t_open(3NSL)` or `t_getinfo(3NSL)`, the `T_MORE` flag is not meaningful and should be ignored. If the amount of buffer space passed in `iov` is greater than zero on the call to `t_rcvv()`, then `t_rcvv()` will return `0` only if the end of a TSDU is being returned to the user.

On return, the data is expedited if `T_EXPEDITED` is set in `flags`. If `T_MORE` is also set, it indicates that the number of expedited bytes exceeded `nbytes`, a signal has interrupted the call, or that an entire ETSDU was not available (only for transport protocols that support fragmentation of
The rest of the ETSDU will be returned by subsequent calls to `t_rcvv()` which will return with T_EXPEDITED set in flags. The end of the ETSDU is identified by the return of a `t_rcvv()` call with T_EXPEDITED set and T_MORE cleared. If the entire ETSDU is not available it is possible for normal data fragments to be returned between the initial and final fragments of an ETSDU.

If a signal arrives, `t_rcvv()` returns, giving the user any data currently available. If no data is available, `t_rcvv()` returns -1, sets t_errno to TSYSERR and errno to EINTR. If some data is available, `t_rcvv()` returns the number of bytes received and T_MORE is set in flags.

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 via the EM interface.

**Return Values**

On successful completion, `t_rcvv()` returns the number of bytes received. Otherwise, it returns -1 on failure and t_errno is set to indicate the error.

**Valid States**

T_DATAFER, T_OUTREL.

**Errors**

On failure, t_errno is set to one of the following:

- TBADDATA: `iovcount` is greater than T_IOV_MAX.
- 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 communications endpoint referenced by `fd` is not in one of the states in which a call to this function is valid.
- 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 error (t_errno).
- TSYSERR: A system error has occurred during execution of this function.

**Tli Compatibility**

In the TLI interface definition, no counterpart of this routine was defined.

**Attributes**

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>
See Also  fcntl(2), t_getinfo(3NSL), t_look(3NSL), t_open(3NSL), t_rcv(3NSL), t_snd(3NSL), t_sndv(3NSL), attributes(5)
**t_rcvvudata(3NSL)**

**Name**
t_rcvvudata – receive a data unit into one or more noncontiguous buffers

**Synopsis**
```c
#include <xti.h>

int t_rcvvudata(int fd, struct t_unitdata *unitdata, struct t_iovec *iov,
                 unsigned int iovcount, int *flags);
```

**Description**
This function is used in connectionless mode to receive a data unit from another transport user. The argument *fd* identifies the local transport endpoint through which data will be received, *unitdata* holds information associated with the received data unit, *iovcount* contains the number of non-contiguous udata buffers which is limited to T_IOV_MAX, which is an implementation-defined value of at least 16, and *flags* is set on return to indicate that the complete data unit was not received. If the limit on *iovcount* is exceeded, the function fails with TBADDATA. The argument *unitdata* points to a t_unitdata structure containing the following members:

```c
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
```

The *maxlen* field of *addr* and *opt* must be set before calling this function to indicate the maximum size of the buffer for each. The *udata* field of t_unitdata is not used. The *iov_len* and *iov_base* fields of "iov0" through *iov[iovcount-1]* must be set before calling t_rcvvudata() to define the buffer where the userdata will be placed. If the maxlen field of *addr* or *opt* is set to zero then no information is returned in the *buf* field for this parameter.

On return from this call, *addr* specifies the protocol address of the sending user, *opt* identifies options that were associated with this data unit, and *iov[0].iov_base* through *iov[iovcount-1].iov_base* contains the user data that was received. The return value of t_rcvvudata() is the number of bytes of user data given to the user.

Note that the limit on the total number of bytes available in all buffers passed:

```
iiov(0).iov_len + ... + iiov(iovcount-1).iov_len
```

may be constrained by implementation limits. If no other constraint applies, it will be limited by INT_MAX. In practice, the availability of memory to an application is likely to impose a lower limit on the amount of data that can be sent or received using scatter/gather functions.

By default, t_rcvvudata() operates in synchronous mode and waits for a data unit to arrive if none is currently available. However, if O_NONBLOCK is set by means of t_open(3NSL) or fcntl(2), t_rcvvudata() executes in asynchronous mode and fails if no data units are available.

If the buffers defined in the *iov[]* array are not large enough to hold the current data unit, the buffers will be filled and T_MORE will be set in *flags* on return to indicate that another t_rcvvudata() should be called to retrieve the rest of the data unit. Subsequent calls to t_rcvvudata() will return zero for the length of the address and options, until the full data unit has been received.
Return Values  On successful completion, \texttt{t_rcvvudata()} returns the number of bytes received. Otherwise, it returns \(-1\) on failure and \texttt{t_errno} is set to indicate the error.

Valid States  \texttt{T_IDLE}.

Errors  On failure, \texttt{t_errno} is set to one of the following:

- \textbf{TBADDATA} \textit{iovcount} is greater than \texttt{T_IOV_MAX}.
- \textbf{TBADF} The specified file descriptor does not refer to a transport endpoint.
- \textbf{TBUFOVFLW} The number of bytes allocated for the incoming protocol address or options (maxlen) is greater than 0 but not sufficient to store the information. The unit data information to be returned in \textit{unitdata} will be discarded.
- \textbf{TLOOK} An asynchronous event has occurred on this transport endpoint and requires immediate attention.
- \textbf{TNODATA} \texttt{O_NONBLOCK} was set, but no data units are currently available from the transport provider.
- \textbf{TNOTSUPPORT} This function is not supported by the underlying transport provider.
- \textbf{TOUTSTATE} The communications endpoint referenced by \texttt{fd} is not in one of the states in which a call to this function is valid.
- \textbf{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 error (\texttt{t_errno}).
- \textbf{TSYSERR} A system error has occurred during execution of this function.

Tli Compatibility  In the TLI interface definition, no counterpart of this routine was defined.

Attributes  See \texttt{attributes(5)} for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>Attribute Type</th>
<th>Attribute Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
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</tbody>
</table>

See Also  \texttt{fcntl(2), t_alloc(3NSL), t_open(3NSL), t_rcvvudata(3NSL), t_rcvuderr(3NSL), t_sndudata(3NSL), t_sndvudata(3NSL), attributes(5)}
t_snd(3NSL)

Name  t snd – send data or expedited data over a connection

Synopsis  #include <xti.h>

    int t_snd(int fd, void *buf, unsigned int nbytes, int flags);

Description  This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function is used to send 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  If set in flags, this indicates to the transport provider that the transport service data unit (TSDU) (or expedited transport service data unit - ETSDU) is being sent through multiple t_snd() calls. Each t_snd() with the T_MORE flag set indicates that another t_snd() will follow with more data for the current TSDU (or ETSDU).

The end of the TSDU (or ETSDU) is identified by a t_snd() call with the T_MORE flag not set. Use of T_MORE enables a user to break up large logical data units without losing the boundaries of those units at the other end of the connection. The flag implies nothing about how the data is packaged for transfer below the transport interface. If the transport provider does not support the concept of a TSDU as indicated in the info argument on return from t_open(3NSL) or t_getinfo(3NSL), the T_MORE flag is not meaningful and will be ignored if set.

The sending of a zero-length fragment of a TSDU or ETSDU is only permitted where this is used to indicate the end of a TSDU or ETSDU; that is, when the T_MORE flag is not set. Some transport providers also forbid zero-length TSDUs and ETSDUs.

T_PUSH  If set in flags, requests that the provider transmit all data that it has accumulated but not sent. The request is a local action on the provider and does not affect any similarly named protocol flag (for example, the TCP PUSH flag). This effect of setting this flag is protocol-dependent, and it may be ignored entirely by transport providers which do not support the use of this feature.
Note that the communications provider is free to collect data in a send buffer until it accumulates a sufficient amount for transmission.

By default, \texttt{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 \texttt{\_NONBLOCK} is set by means of \texttt{t\_open(3NSL)} or \texttt{fcntl(2)}, \texttt{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 by means of either \texttt{t\_look(3NSL)} or the EM interface.

On successful completion, \texttt{t\_snd()} returns the number of bytes (octets) accepted by the communications provider. Normally this will equal the number of octets specified in \texttt{nbytes}. However, if \texttt{\_NONBLOCK} is set or the function is interrupted by a signal, it is possible that only part of the data has actually been accepted by the communications provider. In this case, \texttt{t\_snd()} returns a value that is less than the value of \texttt{nbytes}. If \texttt{t\_snd()} is interrupted by a signal before it could transfer data to the communications provider, it returns \texttt{−1} with \texttt{t\_errno} set to \texttt{TSYSERR} and \texttt{errno} set to \texttt{EINVAL}.

If \texttt{nbytes} is zero and sending of zero bytes is not supported by the underlying communications service, \texttt{t\_snd()} returns \texttt{−1} with \texttt{t\_errno} set to \texttt{TBADDATA}.

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 \texttt{info} argument returned by \texttt{t\_getinfo(3NSL)}.

The error \texttt{TLOOK} is returned for asynchronous events. It is required only for an incoming disconnect event but may be returned for other events.

\textbf{Return Values} On successful completion, \texttt{t\_snd()} returns the number of bytes accepted by the transport provider. Otherwise, \texttt{−1} is returned on failure and \texttt{t\_errno} is set to indicate the error.

Note that if the number of bytes accepted by the communications provider is less than the number of bytes requested, this may either indicate that \texttt{\_NONBLOCK} is set and the communications provider is blocked due to flow control, or that \texttt{\_NONBLOCK} is clear and the function was interrupted by a signal.

\textbf{Errors} On failure, \texttt{t\_errno} is set to one of the following:

\begin{itemize}
  \item \texttt{TBADDATA} Illegal amount of data:
    \begin{itemize}
      \item 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 \texttt{info} argument.
      \item A send of a zero byte TSDU (ETSDU) or zero byte fragment of a TSDU (ETSDU) is not supported by the provider.
    \end{itemize}
\end{itemize}
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 – the ability of an XTI implementation to detect such an error case is implementation-dependent. See WARNINGS, below.

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 communications endpoint referenced by fd is not in one of the states in which a call to this function is valid.

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 error (t_errno).

TSYSERR
A system error has occurred during execution of this function.

Tli Compatibility
The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header
The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

#include <tiuser.h>

Error Description Values
The t_errno values that can be set by the XTI interface and cannot be set by the TLI interface are:

TPROTO
TLOOK
TBADFLAG
TOUTSTATE

The t_errno values that this routine can return under different circumstances than its XTI counterpart are:

TBADDATA
In the TBADDATA error cases described above, TBADDATA is returned, only for illegal zero byte TSDU (ETSDU) send attempts.

**Attributes** See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also** fcntl(2), t_getinfo(3NSL), t_look(3NSL), t_open(3NSL), t_rcv(3NSL), attributes(5)

**Warnings** 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.
t_snddis(3NSL)

Name  t_snddis – send user-initiated disconnection request

Synopsis  #include <xti.h>

    int t_snddis(int fd, const struct t_call *call);

Description  This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function is used to initiate an abortive release on an already established connection, or to reject a connection request. The argument \texttt{fd} identifies the local transport endpoint of the connection, and \texttt{call} specifies information associated with the abortive release. The argument \texttt{call} points to a \texttt{t_call} structure which contains the following members:

\begin{verbatim}
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
int sequence;
\end{verbatim}

The values in \texttt{call} have different semantics, depending on the context of the call to \texttt{t_snddis()}. When rejecting a connection request, \texttt{call} must be non-null and contain a valid value of \texttt{sequence} to uniquely identify the rejected connection indication to the transport provider. The \texttt{sequence} field is only meaningful if the transport connection is in the \texttt{T_INCON} state. The \texttt{addr} and \texttt{opt} fields of \texttt{call} are ignored. In all other cases, \texttt{call} need only be used when data is being sent with the disconnection request. The \texttt{addr}, \texttt{opt} and \texttt{sequence} fields of the \texttt{t_call} structure are ignored. If the user does not wish to send data to the remote user, the value of \texttt{call} may be a null pointer.

The \texttt{udata} structure specifies the user data to be sent to the remote user. The amount of user data must not exceed the limits supported by the transport provider, as returned in the \texttt{discon} field, of the \texttt{info} argument of \texttt{t_open(3NSL)} or \texttt{t_getinfo(3NSL)}. If the \texttt{len} field of \texttt{udata} is zero, no data will be sent to the remote user.

Return Values  Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and \texttt{t_errno} is set to indicate an error.

Valid States  \texttt{T_DATAXFER}, \texttt{T_OUTCON}, \texttt{T_OUTREL}, \texttt{T_INREL}, \texttt{T_INCON} (\texttt{ocnt} > 0).

Errors  On failure, \texttt{t_errno} is set to one of the following:

\begin{verbatim}
TBADF    The specified file descriptor does not refer to a transport endpoint.
TBADDATA The amount of user data specified was not within the bounds allowed by the transport provider.
TBADSEQ  An invalid sequence number was specified, or a null \texttt{call} pointer was specified, when rejecting a connection request.
\end{verbatim}
An asynchronous event, which requires attention, has occurred.

This function is not supported by the underlying transport provider.

The communications endpoint referenced by \( fd \) is not in one of the states in which a call to this function is valid.

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI error (\( t\_errno \)).

A system error has occurred during execution of this function.

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

The XTI interfaces use the header file, \( xti.h \). TLI interfaces should not use this header. They should use the header:

```
#include <tiuser.h>
```

The \( t\_errno \) value \( \text{TPROTO} \) can be set by the XTI interface but not by the TLI interface.

The format of the options in an \( opt \) buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not fix the buffer format.

See \( \text{attributes(5)} \) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also \( \text{t_connect(3NSL), t_getinfo(3NSL), t_listen(3NSL), t_open(3NSL), t_snd(3NSL), attributes(5)} \)

\( \text{t_snddis()} \) is an abortive disconnection. Therefore a \( \text{t_snddis()} \) issued on a connection endpoint may cause data previously sent by means of \( \text{t_snd(3NSL)} \), or data not yet received, to be lost, even if an error is returned.
t_sndrel(3NSL)

Name  t_sndrel – initiate an orderly release

Synopsis  

```
#include <xti.h>

int t_sndrel(int fd);
```

Description  This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

For transport providers of type T_COTS_ORD, this function is used to initiate an orderly release of the outgoing direction of data transfer and indicates to the transport provider that the transport user has no more data to send. The argument `fd` identifies the local transport endpoint where the connection exists. After calling `t_sndrel()`, the user may not send any more data over the connection. However, a user may continue to receive data if an orderly release indication has not been received. For transport providers of types other than T_COTS_ORD, this function fails with error TNOTSUPPORT.

Return Values  Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and `t_errno` is set to indicate an error.

Valid States  T_DATAFER, T_INREL.

Errors  On failure, `t_errno` is set to one of the following:

- TBADF: The specified file descriptor does not refer to a transport endpoint.
- TFLOW: 0_NONBLOCK was set, but the flow control mechanism prevented the transport provider from accepting the function at this time.
- TLOOK: An asynchronous event has occurred on this transport endpoint and requires immediate attention.
- TNOTSUPPORT: This function is not supported by the underlying transport provider.
- TOUTSTATE: The communications endpoint referenced by `fd` is not in one of the states in which a call to this function is valid.
- 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 error (`t_errno`).
- TSYSERR: A system error has occurred during execution of this function.

TLI Compatibility  The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.
The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```c
#include <tiuser.h>
```

The `t_errno` values that can be set by the XTI interface and cannot be set by the TLI interface are:

- TPROTO
- TLOOK
- TOUTSTATE

Whenever this function fails with `t_errno` set to TFLOW, `O_NONBLOCK` must have been set.

### Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

### See Also

t_error(3NSL), t_getinfo(3NSL), t_open(3NSL), t_rcvrel(3NSL), attributes(5)
# t_sndreldata(3NSL)

## Name

t_sndreldata – initiate or respond to an orderly release with user data

## Synopsis

```c
#include <xti.h>

int t_sndreldata(int fd, struct t_discon *discon);
```

## Description

This function is used to initiate an orderly release of the outgoing direction of data transfer and to send user data with the release. The argument `fd` identifies the local transport endpoint where the connection exists, and `discon` points to a `t_discon` structure containing the following members:

- `struct netbuf udata;`
- `int reason;`
- `int sequence;`

After calling `t_sndreldata()`, the user may not send any more data over the connection. However, a user may continue to receive data if an orderly release indication has not been received.

The field `reason` specifies the reason for the disconnection through a protocol-dependent reason code, and `udata` identifies any user data that is sent with the disconnection; the field `sequence` is not used.

The `udata` structure specifies the user data to be sent to the remote user. The amount of user data must not exceed the limits supported by the transport provider, as returned in the `discon` field of the `info` argument of `t_open(3NSL)` or `t_getinfo(3NSL)`. If the `len` field of `udata` is zero or if the provider did not return `T_ORDRELDATA` in the `t_open(3NSL)` flags, no data will be sent to the remote user.

If a user does not wish to send data and reason code to the remote user, the value of `discon` may be a null pointer.

This function is an optional service of the transport provider, only supported by providers of service type `T_COTS_ORD`. The flag `T_ORDRELDATA` in the `info->flag` field returned by `t_open(3NSL)` or `t_getinfo(3NSL)` indicates that the provider supports orderly release user data.

This function may not be available on all systems.

## Return Values

Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and `t_errno` is set to indicate an error.

## Valid States

`T_DATAXFER`, `T_INREL`.

## Errors

On failure, `t_errno` is set to one of the following:

- **TBADDATA**
  
The amount of user data specified was not within the bounds allowed by the transport provider, or user data was supplied and the provider did not return `T_ORDRELDATA` in the `t_open(3NSL)` flags.
The specified file descriptor does not refer to a transport endpoint.

0_NONBLOCK was set, but the flow control mechanism prevented the transport provider from accepting the function at this time.

An asynchronous event has occurred on this transport endpoint and requires immediate attention.

Orderly release is not supported by the underlying transport provider.

The communications endpoint referenced by $fd$ is not in one of the states in which a call to this function is valid.

This error indicates that a communication problem has been detected between XTI and the transport provider for which there is no other suitable XTI error ($t_errno$).

A system error has occurred during execution of this function.

**Tli Compatibility**
In the TLI interface definition, no counterpart of this routine was defined.

**Attributes**
See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

**See Also**
`t_getinfo(3NSL), t_open(3NSL), t_rcvrel(3NSL), t_rcvreldata(3NSL), t_sndrel(3NSL), attributes(5)`

**Notes**
The interfaces `t_sndrelata()` and `t_rcvreldata(3NSL)` are only for use with a specific transport called "minimal OSI," which is not available on the Solaris platform. These interfaces are not available for use in conjunction with Internet Transports (TCP or UDP).
Name  t_sndudata – send a data unit

Synopsis  
```
#include <xti.h>

int t_sndudata(int fd, const struct t_unitdata *unitdata);
```

Description  This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

This function is used in connectionless-mode to send a data unit to another transport user. The argument fd identifies the local transport endpoint through which data will be sent, and unitdata points to a t_unitdata structure containing the following members:

```
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
```

In unitdata, addr specifies the protocol address of the destination user, opt identifies options that the user wants associated with this request, and udata specifies the user data to be sent. The user may choose not to specify what protocol options are associated with the transfer by setting the len field of opt to zero. In this case, the provider uses the option values currently set for the communications endpoint.

If the len field of udata is zero, and sending of zero octets is not supported by the underlying transport service, the t_sndudata() will return -1 with t_errno set to TBADDATA.

By default, t_sndudata() 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 by means of t_open(3NSL) or fcntl(2), t_sndudata() will execute in asynchronous mode and will fail under such conditions. The process can arrange to be notified of the clearance of a flow control restriction by means of either t_look(3NSL) or the EM interface.

If the amount of data specified in udata exceeds the TSDU size as returned in the tsdu field of the info argument of t_open(3NSL) or t_getinfo(3NSL), a TBADDATA error will be generated. If t_sndudata() is called before the destination user has activated its transport endpoint (see t_bind(3NSL)), the data unit may be discarded.

If it is not possible for the transport provider to immediately detect the conditions that cause the errors TBADDADDR and TBADOPT, these errors will alternatively be returned by t_rcvuderr. Therefore, an application must be prepared to receive these errors in both of these ways.

If the call is interrupted, t_sndudata() will return EINTR and the datagram will not be sent.
Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and t_errno is set to indicate an error.

Valid States

Errors

On failure, t_errno is set to one of the following:

- TBADADDR: The specified protocol address was in an incorrect format or contained illegal information.
- TBADDATA: Illegal amount of data. A single send was attempted specifying a TSDU greater than that specified in the info argument, or a send of a zero byte TSDU is not supported by the provider.
- TBADF: The specified file descriptor does not refer to a transport endpoint.
- TBADOPT: The specified options were in an incorrect format or contained illegal information.
- 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 communications endpoint referenced by fd is not in one of the states in which a call to this function is valid.
- 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 error (t_errno).
- TSYSERR: A system error has occurred during execution of this function.

TI Compatibility

The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header

The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```
#include <ti-user.h>
```

Error Description Values

The t_errno values that can be set by the XTI interface and cannot be set by the TLI interface are:

- TPROTO
- TBADADDR
Whenever this function fails with _t_error set to TFLOW, _O_NONBLOCK must have been set.

The format of the options in an opt buffer is dictated by the transport provider. Unlike the XTI interface, the TLI interface does not fix the buffer format.

Attributes: See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also: fcntl(2), t_alloc(3NSL), t_bind(3NSL), t_error(3NSL), t_getinfo(3NSL), t_look(3NSL), t_open(3NSL), t_rcvudata(3NSL), t_rcvuderr(3NSL), attributes(5)
**Synopsis**

```c
#include <xti.h>

int t_sndv(int fd, const struct t_iovec *iov, unsigned int iovcount, int flags);
```

This function is used to send either normal or expedited data. The argument `fd` identifies the local transport endpoint over which data should be sent, `iov` points to an array of buffer address/buffer length pairs. `t_sndv()` sends data contained in buffers `iov[0]`, `iov[1]`, through `iov[iovcount-1]`. `iovcount` contains the number of non-contiguous data buffers which is limited to `T_IOV_MAX`, an implementation-defined value of at least 16. If the limit is exceeded, the function fails with `T_BAD_DATA`.

`iov(0).iov_len + ... + iov(iovcount-1).iov_len`

Note that the limit on the total number of bytes available in all buffers passed:

may be constrained by implementation limits. If no other constraint applies, it will be limited by `INT_MAX`. In practice, the availability of memory to an application is likely to impose a lower limit on the amount of data that can be sent or received using scatter/gather functions.

The argument `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** If set in `flags`, this indicates to the transport provider that the transport service data unit (TSDU) (or expedited transport service data unit–ETSDU) is being sent through multiple `t_sndv()` calls. Each `t_sndv()` with the `T_MORE` flag set indicates that another `t_sndv()` or `t_snd(3NSL)` will follow with more data for the current TSDU (or ETSDU).

The end of the TSDU (or ETSDU) is identified by a `t_sndv()` call with the `T_MORE` flag not set. Use of `T_MORE` enables a user to break up large logical data units without losing the boundaries of those units at the other end of the connection. The flag implies nothing about how the data is packaged for transfer below the transport interface. If the transport provider does not support the concept of a TSDU as indicated in the `info` argument on return from `t_open(3NSL)` or `t_getinfo(3NSL)`, the `T_MORE` flag is not meaningful and will be ignored if set.

The sending of a zero-length fragment of a TSDU or ETSDU is only permitted where this is used to indicate the end of a TSDU or ETSDU, that is, when the `T_MORE` flag is not set. Some transport providers also forbid zero-length TSDUs and ETSDUs.

If set in `flags`, requests that the provider transmit all data that it has accumulated but not sent. The request is a local action on the provider and does not affect any similarly named protocol.
flag (for example, the TCP PUSH flag). This effect of setting this flag is protocol-dependent, and it may be ignored entirely by transport providers which do not support the use of this feature.

The communications provider is free to collect data in a send buffer until it accumulates a sufficient amount for transmission.

By default, t_sndv() 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 by means of t_open(3NSL) or fcntl(2), t_sndv() executes 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 via either t_look(3NSL) or the EM interface.

On successful completion, t_sndv() returns the number of bytes accepted by the transport provider. Normally this will equal the total number of bytes to be sent, that is,

\[ \text{iov0.iov_len} + \ldots + \text{iov[iovcount-1].iov_len} \]

However, the interface is constrained to send at most INT_MAX bytes in a single send. When t_sndv() has submitted INT_MAX (or lower constrained value, see the note above) bytes to the provider for a single call, this value is returned to the user. However, if O_NONBLOCK is set or the function is interrupted by a signal, it is possible that only part of the data has actually been accepted by the communications provider. In this case, t_sndv() returns a value that is less than the value of nbytes. If t_sndv() is interrupted by a signal before it could transfer data to the communications provider, it returns -1 with t_errno set to TSYSERR and errno set to EINTR.

If the number of bytes of data in the iov array is zero and sending of zero octets is not supported by the underlying transport service, t_sndv() returns -1 with t_errno set to TBADDATA.

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(3NSL).

The error TLOOK is returned for asynchronous events. It is required only for an incoming disconnect event but may be returned for other events.

**Return Values**  
On successful completion, t_sndv() returns the number of bytes accepted by the transport provider. Otherwise, -1 is returned on failure and t_errno is set to indicate the error.

Note that in synchronous mode, if more than INT_MAX bytes of data are passed in the iov array, only the first INT_MAX bytes will be passed to the provider.
If the number of bytes accepted by the communications provider is less than the number of bytes requested, this may either indicate that O_NONBLOCK is set and the communications provider is blocked due to flow control, or that O_NONBLOCK is clear and the function was interrupted by a signal.

**Valid States**  
T_DATAxFER, T_INREL.

**Errors**  
On failure, t_errno is set to one of the following:

- **TBADDATA**  
  The specified file descriptor does not refer to a transport endpoint.

- **TBADF**  
  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.

- **TBSDF**  
  A send of a zero byte TSDU (ETSDU) or zero byte fragment of a TSDU (ETSDU) is not supported by the provider.

- **TBSDF+**  
  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 – the ability of an XTI implementation to detect such an error case is implementation-dependent. See WARNINGS, below.

  - **iovcount** is greater than T_IOV_MAX.

- **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.

- **TOTSTATE**  
  The communications endpoint referenced by `fd` is not in one of the states in which a call to this function is valid.

- **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 error (t_errno).

- **TSYSERR**  
  A system error has occurred during execution of this function.

**Tli Compatibility**  
In the TLI interface definition, no counterpart of this routine was defined.

**Attributes**  
See attributes(5) for descriptions of the following attributes:
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_sndv()` or `t_snd(3NSL)` 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_sndv()` fails with TBADDATA.
Name  
t_sndvudata – send a data unit from one or more noncontiguous buffers

Synopsis

```c
#include <xti.h>

int t_sndvudata(int fd, struct t_unitdata *unitdata, struct t_iovec *iov,
                 unsigned int iovcount);
```

Description  
This function is used in connectionless mode to send a data unit to another transport user. The argument `fd` identifies the local transport endpoint through which data will be sent, `iovcount` contains the number of non-contiguous `udata` buffers and is limited to an implementation-defined value given by `T_IOV_MAX` which is at least 16, and `unitdata` points to a `t_unitdata` structure containing the following members:

```c
struct netbuf addr;
struct netbuf opt;
struct netbuf udata;
```

If the limit on `iovcount` is exceeded, the function fails with `TBADDATA`.

In `unitdata`, `addr` specifies the protocol address of the destination user, and `opt` identifies options that the user wants associated with this request. The `udata` field is not used. The user may choose not to specify what protocol options are associated with the transfer by setting the `len` field of `opt` to zero. In this case, the provider may use default options.

The data to be sent is identified by `iov[0]` through `iov[iovcount-1]`.

Note that the limit on the total number of bytes available in all buffers passed:

```
iov(0).iov_len + ... + iov(iovcount-1).iov_len
```

may be constrained by implementation limits. If no other constraint applies, it will be limited by `INT_MAX`. In practice, the availability of memory to an application is likely to impose a lower limit on the amount of data that can be sent or received using scatter/gather functions.

By default, `t_sndvudata()` 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 by means of `t_open(3NSL)` or `fcntl(2)`, `t_sndvudata()` executes in asynchronous mode and will fail under such conditions. The process can arrange to be notified of the clearance of a flow control restriction by means of either `t_look(3NSL)` or the EM interface.

If the amount of data specified in `iov[0]` through `iov[iovcount-1]` exceeds the TSDU size as returned in the `tsdu` field of the `info` argument of `t_open(3NSL)` or `t_getinfo(3NSL)`, or is zero and sending of zero octets is not supported by the underlying transport service, a `TBADDATA` error is generated. If `t_sndvudata()` is called before the destination user has activated its transport endpoint (see `t_bind(3NSL)`), the data unit may be discarded.
If it is not possible for the transport provider to immediately detect the conditions that cause the errors TBADDADDR and TBADOPT, these errors will alternatively be returned by \texttt{t_rcvuderr(3NSL)}. An application must therefore be prepared to receive these errors in both of these ways.

**Return Values**  
Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and \texttt{t_errno} is set to indicate an error.

**Valid States**  
\texttt{T_IDLE}.

**Errors**  
On failure, \texttt{t_errno} is set to one of the following:

- **TBADDADDR**  
The specified protocol address was in an incorrect format or contained illegal information.

- **TBADDATA**  
  Illegal amount of data.
  - A single send was attempted specifying a TSDU greater than that specified in the \texttt{info} argument, or a send of a zero byte TSDU is not supported by the provider.
  - \texttt{iovcount} is greater than \texttt{T_IOV_MAX}.

- **TBADF**  
The specified file descriptor does not refer to a transport endpoint.

- **TBADOPT**  
The specified options were in an incorrect format or contained illegal information.

- **TFLOW**  
  0\_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 communications endpoint referenced by \texttt{fd} is not in one of the states in which a call to this function is valid.

- **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 error (\texttt{t_errno}).

- **TSYSERR**  
  A system error has occurred during execution of this function.

**Tli Compatibility**  
In the TLI interface definition, no counterpart of this routine was defined.

**Attributes**  
See \texttt{attributes(5)} for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>
See Also  
fcntl(2), t_alloc(3NSL), t_open(3NSL), t_rcvudata(3NSL), t_rcvvudata(3NSL)
t_rcvuderr(3NSL), t_sndudata(3NSL), attributes(5)
t_strerror(3NSL)

Name  t_strerror – produce an error message string

Synopsis  #include <xti.h>

   const char *t_strerror(int errnum);

Description  This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

The t_strerror() function 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 will 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. The language for error message strings written by t_strerror() is that of the current locale. If it is English, the error message string describing the value in t_errno may be derived from the comments following the t_errno codes defined in <xti.h>. 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 - apart from T_UNINIT.

Return Values  The function t_strerror() returns a pointer to the generated message string.

Tli Compatibility  The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header  The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

   #include <tiuser.h>

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>


See Also  t_errno(3NSL), t_error(3NSL), attributes(5)
t_sync – synchronize transport library

Synopsis
#include <xti.h>

int t_sync(int fd);

Description
This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

For the transport endpoint specified by fd, t_sync() synchronizes the data structures managed by the transport library with information from the underlying transport provider. In doing so, it can convert an uninitialized file descriptor (obtained by means of a open(2), dup(2) or as a result of a fork(2) and exec(2)) 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(2), 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.

Return Values
On successful completion, the state of the transport endpoint is returned. Otherwise, a value of −1 is returned and t_errno is set to indicate an error. The state returned is one of the following:

- T_UNBND: Unbound.
- T_IDLE: Idle.
- T_OUTCON: Outgoing connection pending.
- T_INCON: Incoming connection pending.
- T_DATAXFER: Data transfer.
- T_OUTREL: Outgoing orderly release (waiting for an orderly release indication).
T_INREL  Incoming orderly release (waiting for an orderly release request).

Errors  On failure, t_errno is set to one of the following:

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 error (t_errno).

TSTATECHNG  The transport endpoint is undergoing a state change.

TSYSERR  A system error has occurred during execution of this function.

Tli Compatibility  The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header  The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```
#include <tiuser.h>
```

Error Description Values  The t_errno value that can be set by the XTI interface and cannot be set by the TLI interface is:

TPROTO

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  dup(2), exec(2), fork(2), open(2), attributes(5)
t_sysconf – get configurable XTI variables

Synopsis

#include <xti.h>

int t_sysconf(int name);

Description

The t_sysconf() function provides a method for the application to determine the current value of configurable and implementation-dependent XTI limits or options.

The name argument represents the XTI system variable to be queried. The following table lists the minimal set of XTI system variables from <xti.h> that can be returned by t_sysconf(), and the symbolic constants, defined in <xti.h> that are the corresponding values used for name.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Value of Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>T_IOV_MAX</td>
<td>_SC_T_IOV_MAX</td>
</tr>
</tbody>
</table>

Return Values

If name is valid, t_sysconf() returns the value of the requested limit/option, which might be –1, and leaves t_errno unchanged. Otherwise, a value of –1 is returned and t_errno is set to indicate an error.

Valid States

All.

Errors

On failure, t_errno is set to the following:

TBADFLAG name has an invalid value.

Tli Compatibility

In the TLI interface definition, no counterpart of this routine was defined.

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also sysconf(3C), t_rcvv(3NSL), t_rcvvudata(3NSL), t_sndv(3NSL), t_sndvudata(3NSL), attributes(5)
t_unbind(3NSL)

Name  t_unbind – disable a transport endpoint

Synopsis  

```c
#include <xti.h>

int t_unbind(int fd);
```

Description  The This routine is part of the XTI interfaces which evolved from the TLI interfaces. XTI represents the future evolution of these interfaces. However, TLI interfaces are supported for compatibility. When using a TLI routine that has the same name as an XTI routine, the tiuser.h header file must be used. Refer to the TLI COMPATIBILITY section for a description of differences between the two interfaces.

t_unbind() function disables the transport endpoint specified by fd which was previously bound by t_bind(3NSL). 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(3NSL).

Return Values  Upon successful completion, a value of 0 is returned. Otherwise, a value of –1 is returned and t_errno is set to indicate an error.

Valid States  T_IDLE.

Errors  On failure, t_errno is set to one of the following:

- TBAFDF: The specified file descriptor does not refer to a transport endpoint.
- TLOOK: An asynchronous event has occurred on this transport endpoint.
- TOUTSTATE: The communications endpoint referenced by fd is not in one of the states in which a call to this function is valid.
- 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 error (t_errno).
- TSYMERR: A system error has occurred during execution of this function.

Tli Compatibility  The XTI and TLI interface definitions have common names but use different header files. This, and other semantic differences between the two interfaces are described in the subsections below.

Interface Header  The XTI interfaces use the header file, xti.h. TLI interfaces should not use this header. They should use the header:

```c
#include <tiuser.h>
```
t_unbind(3NSL)

Error Description Values

The t_errno value that can be set by the XTI interface and cannot be set by the TLI interface is:

TPROTO

Attributes

See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>MT-Safe</td>
</tr>
</tbody>
</table>

See Also t_bind(3NSL), attributes(5)
TXTRecordCreate(3DNS_SD)

**Name**  
TXTRecordCreate, TXTRecordDeallocate, TXTRecordSetValue, TXTRecordRemoveValue, TXTRecordGetLength, TXTRecordGetBytesPtr, TXTRecordContainsKey, TXTRecordGetValuePtr, TXTRecordGetCount, TXTRecordGetItemAtIndex – DNS TXT record manipulation functions

**Synopsis**  
cc [ flag ... ] file ... -ldns_sd [ library ... ]

```c
#include <dns_sd.h>

void TXTRecordCreate(TXTRecordRef *txtRecord, uint16_t bufferLen, void *buffer);
void TXTRecordDeallocate(TXTRecordRef *txtRecord);
DNSServiceErrorType txtRecord(TXTRecordRef *txtRecord, const char *key, uint8_t valueSize, const void *value);
DNSServiceErrorType TXTRecordRemoveValue(TXTRecordRef *txtRecord, const char *key);
uint16_t TXTRecordGetLength(const TXTRecordRef *txtRecord);
const void *TXTRecordGetBytesPtr(const TXTRecordRef *txtRecord, const char *key);
uint16_t *TXTRecordGetCount(const TXTRecordRef *txtRecord);
DNSServiceErrorType TXTRecordGetItemAtIndex(uint16_t *txtLen, const void *txtRecord, uint16_t *index, uint8_t *keyBufLen, char *key, uint8_t *valueLen, const void **value);
```

**Description**  
These functions in the libdns_sd library allow applications to create and to manipulate TXT resource records. TXT resource records enable applications to include service specific information, other than a host name and port number, as part of the service registration.

**Attributes**  
See attributes(5) for description of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interface Stability</td>
<td>Committed</td>
</tr>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

Networking Library Functions 849
See Also attributes(5)
**Name**  
XDR routines allow C programmers to describe arbitrary data structures in a machine-independent fashion. Data for remote procedure calls (RPC) are transmitted using these routines.

**Description**  

<table>
<thead>
<tr>
<th>XDR Routine</th>
<th>Manual Reference Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>xdr_array</td>
<td>xdr_complex(3NSL)</td>
</tr>
<tr>
<td>xdr_bool</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_bytes</td>
<td>xdr_complex(3NSL)</td>
</tr>
<tr>
<td>xdr_char</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_control</td>
<td>xdr_admin(3NSL)</td>
</tr>
<tr>
<td>xdr_destroy</td>
<td>xdr_create(3NSL)</td>
</tr>
<tr>
<td>xdr_double</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_enum</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_float</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_free</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_getpos</td>
<td>xdr_admin(3NSL)</td>
</tr>
<tr>
<td>xdr_hyper</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_inline</td>
<td>xdr_admin(3NSL)</td>
</tr>
<tr>
<td>xdr_int</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_long</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_longlong_t</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdrOpaque</td>
<td>xdr_complex(3NSL)</td>
</tr>
<tr>
<td>xdr_pointer</td>
<td>xdr_complex(3NSL)</td>
</tr>
<tr>
<td>xdr_quadruple</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_reference</td>
<td>xdr_complex(3NSL)</td>
</tr>
<tr>
<td>xdr_setpos</td>
<td>xdr_admin(3NSL)</td>
</tr>
<tr>
<td>xdr_short</td>
<td>xdr_simple(3NSL)</td>
</tr>
<tr>
<td>xdr_sizeof</td>
<td>xdr_admin(3NSL)</td>
</tr>
</tbody>
</table>

Networking Library Functions 851
xdr(3NSL)

xdr_string xdr_complex(3NSL)
xdr_u_char xdr_simple(3NSL)
xdr_u_hyper xdr_simple(3NSL)
xdr_u_int xdr_simple(3NSL)
xdr_u_long xdr_simple(3NSL)
xdr_u_longlong_t xdr_simple(3NSL)
xdr_u_short xdr_simple(3NSL)
xdr_union xdr_complex(3NSL)
xdr_vector xdr_complex(3NSL)
xdr_void xdr_simple(3NSL)
xdr_wrapstring xdr_complex(3NSL)
xdrmem_create xdr_create(3NSL)
xdrrec_create xdr_create(3NSL)
xdrrec_endofrecord xdr_admin(3NSL)
xdrrec_eof xdr_admin(3NSL)
xdrrec_readbytes xdr_admin(3NSL)
xdrrec_skiprecord xdr_admin(3NSL)
xdrstdio_create xdr_create(3NSL)

Attributes  See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also  rpc(3NSL), xdr_admin(3NSL), xdr_complex(3NSL), xdr_create(3NSL), xdr_simple(3NSL), attributes(5)
**Description**

XDR library routines allow C programmers to describe arbitrary data structures in a machine-independent fashion. Protocols such as remote procedure calls (RPC) use these routines to describe the format of the data.

These routines deal specifically with the management of the XDR stream.

**Routines**

See **rpc(3NSL)** for the definition of the XDR data structure. Note that any buffers passed to the XDR routines must be properly aligned. It is suggested either that **malloc(3C)** be used to allocate these buffers, or that the programmer insure that the buffer address is divisible evenly by four.

```c
#include <rpc/xdr.h>

bool_t xdr_control( XDR *xdrs, int req, void *info);
A function macro to change or retrieve various information about an XDR stream. *req* indicates the type of operation and *info* is a pointer to the information. The supported values of *req* is XDR_GET_BYTES_AVAIL and its argument type is xdr_bytesrec *. They return the number of bytes left unconsumed in the stream and a flag indicating whether or not this is the last fragment.

uint_t xdr_getpos(const XDR *xdrs);
A macro that invokes the get-position routine associated with the XDR stream, *xdrs*. The routine returns an unsigned integer, which indicates the position of the XDR byte stream. A desirable feature of XDR streams is that simple arithmetic works with this number, although the XDR stream instances need not guarantee this. Therefore, applications written for portability should not depend on this feature.

long *xdr_inline(XDR *xdrs, const int len);
A macro that invokes the in-line routine associated with the XDR stream, *xdrs*. The routine returns a pointer to a contiguous piece of the stream's buffer; *len* is the byte length of the desired buffer. Note: pointer is cast to `long *`.

**Warning:** `xdr_inline()` may return `NULL` if it cannot allocate a contiguous piece of a buffer. Therefore the behavior may vary among stream instances; it exists for the sake of efficiency, and applications written for portability should not depend on this feature.

bool_t xdrrec_endofrecord(XDR *xdrs, int sendnow);
This routine can be invoked only on streams created by `xdrrec_create()`. See **xdr_create(3NSL)**. The data in the output buffer is marked as a completed record, and the output buffer is optionally written out if *sendnow* is non-zero. This routine returns TRUE if it succeeds, FALSE otherwise.
bool_t xdrrec_eof(XDR *xdrs);
This routine can be invoked only on streams created by xdrrec_create(). After
consuming the rest of the current record in the stream, this routine returns TRUE if there is
no more data in the stream’s input buffer. It returns FALSE if there is additional data in the
stream’s input buffer.

int xdrrec_readbytes(XDR *xdrs, caddr_t addr, uint_t nbytes);
This routine can be invoked only on streams created by xdrrec_create(). It attempts to
read nbytes bytes from the XDR stream into the buffer pointed to by addr. Upon success
this routine returns the number of bytes read. Upon failure, it returns −1. A return value of
0 indicates an end of record.

bool_t xdrrec_skiprecord(XDR *xdrs);
This routine can be invoked only on streams created by xdrrec_create(). See
xdr_create(3NSL). It tells the XDR implementation that the rest of the current record in
the stream’s input buffer should be discarded. This routine returns TRUE if it succeeds,
FALSE otherwise.

bool_t xdr_setpos(XDR *xdrs, const uint_t pos);
A macro that invokes the set position routine associated with the XDR stream xdrs. The
parameter pos is a position value obtained from xdr_getpos(). This routine returns TRUE if
the XDR stream was repositioned, and FALSE otherwise.

Warning: it is difficult to reposition some types of XDR streams, so this routine may fail
with one type of stream and succeed with another. Therefore, applications written for
portability should not depend on this feature.

unsigned long xdr_sizeof(xdrproc_t func, void *data);
This routine returns the number of bytes required to encode data using the XDR filter
function func, excluding potential overhead such as RPC headers or record markers. 0 is
returned on error. This information might be used to select between transport protocols, or
to determine the buffer size for various lower levels of RPC client and server creation
routines, or to allocate storage when XDR is used outside of the RPC subsystem.

Attributes See attributes(5) for descriptions of the following attributes:

<table>
<thead>
<tr>
<th>ATTRIBUTE TYPE</th>
<th>ATTRIBUTE VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MT-Level</td>
<td>Safe</td>
</tr>
</tbody>
</table>

See Also malloc(3C), rpc(3NSL), xdr_complex(3NSL), xdr_create(3NSL), xdr_simple(3NSL),
attributes(5)
XDR library routines allow C programmers to describe complex data structures in a machine-independent fashion. Protocols such as remote procedure calls (RPC) use these routines to describe the format of the data. These routines are the XDR library routines for complex data structures. They require the creation of XDR streams. See `xdr_create(3NSL)`.

See `rpc(3NSL)` for the definition of the XDR data structure. Note that any buffers passed to the XDR routines must be properly aligned. It is suggested either that `malloc()` be used to allocate these buffers, or that the programmer insure that the buffer address is divisible evenly by four.

```c
#include <rpc/xdr.h>

bool txdr_array(XDR *xdrs, caddr_t *arrp, uint_t *sizep, const uint_t maxsize, const uint_t elsize, const xdrproc_t elproc);

xdr_array() translates between variable-length arrays and their corresponding external representations. The parameter `arrp` is the address of the pointer to the array, while `sizep` is the address of the element count of the array; this element count cannot exceed `maxsize`. The parameter `elsize` is the size of each of the array's elements, and `elproc` is an XDR routine that translates between the array elements' C form and their external representation. If `*arrp` is NULL when decoding, `xdr_array()` allocates memory and `*arrp` points to it. This routine returns TRUE if it succeeds, FALSE otherwise.

bool txdr_bytes(XDR *xdrs, char **sp, uint_t *sizep, const uint_t maxsize);

xdr_bytes() translates between counted byte strings and their external representations. The parameter `sp` is the address of the string pointer. The length of the string is located at address `sizep`; strings cannot be longer than `maxsize`. If `*sp` is NULL when decoding, `xdr_bytes()` allocates memory and `*sp` points to it. This routine returns TRUE if it succeeds, FALSE otherwise.

bool txdr_opaque(XDR *xdrs, caddr_t *cp, const uint_t cnt);

xdr_opaque() translates between fixed size opaque data and its external representation. The parameter `cp` is the address of the opaque object, and `cnt` is its size in bytes. This routine returns TRUE if it succeeds, FALSE otherwise.

bool txdr_pointer(XDR *xdrs, char **objpp, uint_t *objsize, const xdrproc_t xdrobj);

Like `xdr_reference()` except that it serializes null pointers, whereas `xdr_reference()` does not. Thus, `xdr_pointer()` can represent recursive data structures, such as binary trees or linked lists. If `*objpp` is NULL when decoding, `xdr_pointer()` allocates memory and `*objpp` points to it.

bool txdr_reference(XDR *xdrs, caddr_t *pp, uint_t *size, const xdrproc_t proc);

xdr_reference() provides pointer chasing within structures. The parameter `pp` is the address of the pointer; `size` is the size of the structure that `*pp` points to; and `proc` is an XDR procedure that translates the structure between its C form and its external representation. If `*pp` is NULL when decoding, `xdr_reference()` allocates memory and `*pp` points to it. This routine returns 1 if it succeeds, 0 otherwise.
Warning: this routine does not understand null pointers. Use \texttt{xdr\_pointer()} instead.

\begin{verbatim}
bool_t xdr_string(XDR *xdrs, char **sp, const uint_t maxsize);
\end{verbatim}
\par
\texttt{xdr\_string()} translates between C strings and their corresponding external representations. Strings cannot be longer than \texttt{maxsize}. Note: \texttt{sp} is the address of the string's pointer. If \texttt{*sp} is NULL when decoding, \texttt{xdr\_string()} allocates memory and \texttt{*sp} points to it. This routine returns \texttt{TRUE} if it succeeds, \texttt{FALSE} otherwise. Note: \texttt{xdr\_string()} can be used to send an empty string but not a null string.

\begin{verbatim}
bool_t xdr_union(XDR *xdrs, enum_t *dscmp, char *unp, const struct xdr_discrim *choices, const xdrproc_t (*defaultarm));
\end{verbatim}
\par
\texttt{xdr\_union()} translates between a discriminated C union and its corresponding external representation. It first translates the discriminant of the union located at \texttt{dscmp}. This discriminant is always an \texttt{enum\_t}. Next the union located at \texttt{unp} is translated. The parameter \texttt{choices} is a pointer to an array of \texttt{xdr\_discrim} structures. Each structure contains an ordered pair of \texttt{[value, proc]}. If the union's discriminant is equal to the associated \texttt{value}, then the \texttt{proc} is called to translate the union. The end of the \texttt{xdr\_discrim} structure array is denoted by a routine of value \texttt{NULL}. If the discriminant is not found in the \texttt{choices} array, then the \texttt{defaultarm} procedure is called (if it is not \texttt{NULL}). It returns \texttt{TRUE} if it succeeds, \texttt{FALSE} otherwise.

\begin{verbatim}
bool_t xdr_vector(XDR *xdrs, char *arrp, const uint_t size, const uint_t elsize, const xdrproc_t elproc);
\end{verbatim}
\par
\texttt{xdr\_vector()} translates between fixed-length arrays and their corresponding external representations. The parameter \texttt{arrp} is the address of the pointer to the array, while \texttt{size} is the element count of the array. The parameter \texttt{elsize} is the size of each of the array's elements, and \texttt{elproc} is an XDR routine that translates between the array elements' C form and their external representation. This routine returns \texttt{TRUE} if it succeeds, \texttt{FALSE} otherwise.

\begin{verbatim}
bool_t xdr_wrapstring(XDR *xdrs, char **sp);
\end{verbatim}
\par
A routine that calls \texttt{xdr\_string(xdrs, sp, maxuint)}; where \texttt{maxuint} is the maximum value of an unsigned integer.

Many routines, such as \texttt{xdr\_array()}, \texttt{xdr\_pointer()}, and \texttt{xdr\_vector()} take a function pointer of type \texttt{xdrproc\_t()}, which takes two arguments. \texttt{xdr\_string()}, one of the most frequently used routines, requires three arguments, while \texttt{xdr\_wrapstring()} only requires two. For these routines, \texttt{xdr\_wrapstring()} is desirable. This routine returns \texttt{TRUE} if it succeeds, \texttt{FALSE} otherwise.

\textbf{Attributes} See attributes(5) for descriptions of the following attributes:

\begin{table}[h]
\begin{tabular}{|l|l|}
\hline
\textbf{ATTRIBUTE TYPE} & \textbf{ATTRIBUTE VALUE} \\
\hline
MT-Level & Safe \\
\hline
\end{tabular}
\end{table}
See Also  malloc(3C), rpc(3NSL), xdr_admin(3NSL), xdr_create(3NSL), xdr_simple(3NSL),
attributes(5)
The XDR library routines allow C programmers to describe arbitrary data structures in a machine-independent fashion. Protocols such as remote procedure calls (RPC) use these routines to describe the format of the data.

These routines deal with the creation of XDR streams, which must be created before any data can be translated into XDR format.

Routines

See rpc(3NSL) for the definition of the XDR CLIENT and SVCXPRT data structures. Any buffers passed to the XDR routines must be properly aligned. Use malloc(3C) to allocate these buffers or be sure that the buffer address is divisible evenly by four.

xdr_destroy() A macro that invokes the destroy routine associated with the XDR stream, xdrs. Private data structures associated with the stream are freed. Using xdrs after xdr_destroy() is invoked is undefined.

xdrmem_create() This routine initializes the XDR stream object pointed to by xdrs. The stream's data is written to or read from a chunk of memory at location addr whose length is no less than size bytes long. The op determines the direction of the XDR stream. The value of op can be either XDR_ENCODE, XDR_DECODE, or XDR_FREE.

xdrrec_create() This routine initializes the read-oriented XDR stream object pointed to by xdrs. The stream's data is written to a buffer of size sendsz. A value of 0 indicates the system should use a suitable default. The stream's data is read from a buffer of size recvsz. It too can be set to a suitable default by passing a 0 value. When a stream's output buffer is full, writeit is called. Similarly, when a stream's input buffer is empty, xdrrec_create() calls readit. The behavior of these two routines is similar to the system calls read() and write(), except that an appropriate handle, read_handle or write_handle, is passed to the
formerroutinesasthefirstparametersinsteadofafiledescriptor. See
read(2)andwrite(2),respectively. The XDR stream's op field must
be set by the caller.

This XDR stream implements an intermediate record stream.
Therefore, additional bytes in the stream are provided for record
boundary information.

xdrstdio_create() This routine initializes the XDR stream object pointed
to by xdrs. The XDR stream data is written to or read from the
standard I/O
stream file. The parameter op determines the direction of the XDR
stream. The value of op can be either XDR_ENCODE, XDR_DECODE,
or
XDR_FREE.

The destroy routine associated with XDR streams calls fflush() on
the file stream, but never fclose(). See fclose(3).

A failure of any of these functions can be detected by first initializing the x_ops field in the
XDR structure (xdrs->x_ops) to NULL before calling the xdr_*create() function. If the x_ops
field is still NULL, after the return from the xdr_*create() function, the call has failed. If the
x_ops field contains some other value, assume that the call has succeeded.

Attributes See attributes(5) for descriptions of the following attributes:

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</table>

See Also read(2), write(2), fclose(3C), malloc(3C), rpc(3NSL), xdr_admin(3NSL),
xdr_complex(3NSL), xdr_simple(3NSL), attributes(5)
The XDR library routines allow C programmers to describe simple data structures in a machine-independent fashion. Protocols such as remote procedure calls (RPC) use these routines to describe the format of the data.

These routines require the creation of XDR streams (see xdr_create(3NSL)).

See rpc(3NSL) for the definition of the XDR data structure. Note that any buffers passed to the XDR routines must be properly aligned. It is suggested that malloc(3C) be used to allocate these buffers or that the programmer insure that the buffer address is divisible evenly by four.
xdr_bool() translates between booleans (C integers) and their external representations. When encoding data, this filter produces values of either 1 or 0. This routine returns TRUE if it succeeds, FALSE otherwise.

xdr_char() translates between C characters and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise. Note: encoded characters are not packed, and occupy 4 bytes each. For arrays of characters, it is worthwhile to consider xdr_bytes(), xdr_opaque(), or xdr_string() (see xdr_complex(3NSL)).

xdr_double() translates between C double precision numbers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

xdr_enum() translates between C enums (actually integers) and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

xdr_float() translates between C floats and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

xdr_free() Generic freeing routine. The first argument is the XDR routine for the object being freed. The second argument is a pointer to the object itself. Note: the pointer passed to this routine is not freed, but what it points to is freed (recursively, depending on the XDR routine).

xdr_hyper() translates between ANSI C long long integers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

xdr_int() translates between C integers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

xdr_long() translates between C long integers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

In a 64-bit environment, this routine returns an error if the value of lp is outside the range [INT32_MIN, INT32_MAX]. The xdr_int() routine is recommended in place of this routine.
**xdr_longlong_t()**

`xdr_longlong_t()` translates between ANSI C `long long` integers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise. This routine is identical to `xdr_hyper()`.

**xdr_quadruple()**

`xdr_quadruple()` translates between IEEE quadruple precision floating point numbers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

**xdr_short()**

`xdr_short()` translates between C `short` integers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

**xdr_u_char()**

`xdr_u_char()` translates between unsigned C characters and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

**xdr_u_hyper()**

`xdr_u_hyper()` translates between unsigned ANSI C `long long` integers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

**xdr_u_int()**

A filter primitive that translates between a C `unsigned` integer and its external representation. This routine returns TRUE if it succeeds, FALSE otherwise.

In a 64-bit environment, this routine returns an error if the value of `ulp` is outside the range `[0, UINT32_MAX]`. The `xdr_u_int()` routine is recommended in place of this routine.

**xdr_u_longlong_t()**

`xdr_u_longlong_t()` translates between unsigned ANSI C `long long` integers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise. This routine is identical to `xdr_u_hyper()`.

**xdr_u_short()**

`xdr_u_short()` translates between C `unsigned short` integers and their external representations. This routine returns TRUE if it succeeds, FALSE otherwise.

**xdr_void()**

This routine always returns TRUE. It may be passed to RPC routines that require a function parameter, where nothing is to be done.

**Attributes**

See attributes(5) for descriptions of the following attributes:
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See Also: `malloc(3C), rpc(3NSL), xdr_admin(3NSL), xdr_complex(3NSL), xdr_create(3NSL), attributes(5)`
### Name
ypclnt, yp_get_default_domain, yp_bind, yp_unbind, yp_match, yp_first, yp_next, yp_all,
yp_order, yp_master, yperr_string, ypprot_err – NIS Version 2 client interface

### Synopsis
```c
#include <rpcsvc/ypclnt.h>
#include <rpcsvc/yp_prot.h>

int yp_bind(char *indomain);
void yp_unbind (char *indomain);
int yp_get_default_domain(char **outdomain);
int yp_match(char *indomain, char *inmap, char *inkey, int inkeylen,
              char *char **outval, int *outvallen);
int yp_first(char *indomain, char *inmap, char **outkey, int *outkeylen,
             char **outval, int *outvallen);
int yp_next(char *indomain, char *inmap, char *inkey, int *inkeylen,
            char **outkey, int *outkeylen, char **outval,
            int *outvallen);
int yp_all(char *indomain, char *inmap, struct ypall_callback *incallback);
int yp_order(char *indomain, char *inmap, unsigned long *outorder);
int yp_master(char *indomain, char *inmap, char **outname);
char *yperr_string(int incode);
int ypprot_err(char *domain);
```

### Description
This package of functions provides an interface to NIS, Network Information Service Version 2, formerly referred to as YP. In this version of SunOS, NIS version 2 is supported only for compatibility with previous versions. The current SunOS supports the client interface to NIS version 2. This client interface will be served by an existing ypserv process running on another machine on the network. For commands used to access NIS from a client machine, see `ypbind(1M)`, `ypwhich(1)`, `ypmatch(1)`, and `ypcat(1)`. The package can be loaded from the standard library, `/usr/lib/libnsl.so.1`.

All input parameter names begin with `in`. Output parameters begin with `out`. Output parameters of type `char **` should be addresses of uninitialized character pointers. Memory is allocated by the NIS client package using `malloc(3C)` and can be freed by the user code if it has no continuing need for it. For each `outkey` and `outval`, two extra bytes of memory are allocated at the end that contain NEWLINE and null, respectively, but these two bytes are not reflected in `outkeylen` or `outvallen`. The `indomain` and `inmap` strings must be non-null and null-terminated. String parameters that are accompanied by a count parameter may not be null, but they may point to null strings, with the count parameter indicating this. Counted strings need not be null-terminated.

All functions in this package of type `int` return 0 if they succeed. Otherwise, they return a failure code (YPERR_xxxx). Failure codes are described in the `ERRORS` section.
To use the NIS name services, the client process must be “bound” to an NIS server that serves the appropriate domain using `yp_bind()`. Binding need not be done explicitly by user code. Binding is done automatically whenever an NIS lookup function is called. The `yp_bind()` function can be called directly for processes that make use of a backup strategy, for example, a local file in cases when NIS services are not available. A process should call `yp_unbind()` when it is finished using NIS in order to free up resources.

Each binding allocates or uses up one client process socket descriptor. Each bound domain costs one socket descriptor. However, multiple requests to the same domain use the same descriptor. The `yp_unbind()` function is available at the client interface for processes that explicitly manage their socket descriptors while accessing multiple domains. The call to `yp_unbind()` makes the domain unbound, and frees all per-process and per-node resources used to bind it.

If an RPC failure results upon use of a binding, that domain will be unbound automatically. At that point, the `ypclnt()` layer will retry a few more times or until the operation succeeds, provided that `rpcbind(1M)` and `ypbind(1M)` are running, and either:

- The client process cannot bind a server for the proper domain; or
- RPC requests to the server fail.

Under the following circumstances, the `ypclnt` layer will return control to the user code, with either an error or success code and the results:

- If an error is not RPC-related.
- If `rpcbind` is not running.
- If `ypbind` is not running.
- If a bound `ypserv` process returns any answer (success or failure).

NIS lookup calls require a map name and a domain name, at minimum. The client process should know the name of the map of interest. Client processes fetch the node’s default domain by calling `yp_get_default_domain()` and use the returned `outdomain` as the `indomain` parameter to successive NIS name service calls. The domain returned is the same as
that returned using the SI_SRPC_DOMAIN command to the sysinfo(2) system call. The value returned in outdomain should not be freed.

**yp_match()**

The yp_match() function returns the value associated with a passed key. This key must be exact because no pattern matching is available. yp_match() requires a full YP map name, such as hosts.byname, instead of the nickname hosts.

**yp_first()**

The yp_first() function returns the first key-value pair from the named map in the named domain.

**yp_next()**

The yp_next() function returns the next key-value pair in a named map. The inkey parameter must be the outkey returned from an initial call to yp_first() (to get the second key-value pair) or the one returned from the nth call to yp_next() (to get the nth + second key-value pair). Similarly, the inkeylen parameter must be the outkeylen returned from the earlier yp_first() or yp_next() call.

The concept of first and next is particular to the structure of the NIS map being processed. Retrieval order is not related to either the lexical order within any original (non-NIS name service) data base, or to any obvious numerical sorting order on the keys, values, or key-value pairs. The only ordering guarantee is that if the yp_first() function is called on a particular map, and then the yp_next() function is repeatedly called on the same map at the same server until the call fails with a reason of YPERR_NOMORE, every entry in the data base is seen exactly once. Further, if the same sequence of operations is performed on the same map at the same server, the entries are seen in the same order.

Under conditions of heavy server load or server failure, the domain can become unbound, then bound once again (perhaps to a different server) while a client is running. This binding can cause a break in one of the enumeration rules. Specific entries may be seen twice by the client, or not at all. This approach protects the client from error messages that would otherwise be returned in the midst of the enumeration. For a better solution to enumerating all entries in a map, see yp_all().

**yp_all()**

The yp_all() function provides a way to transfer an entire map from server to client in a single request using TCP (rather than UDP as with other functions in this package).
The entire transaction takes place as a single RPC request and response. The yp_all() function can be used just like any other NIS name service procedure to identify the map in the normal manner and to supply the name of a function that will be called to process each key-value pair within the map. The call to yp_all() returns only when the transaction is completed (successfully or unsuccessfully), or the foreach() function decides that it does not want to see any more key-value pairs.

The third parameter to yp_all() is:

```c
struct ypall_callback *incallback {
    int (*foreach)();
    char *data;
};
```

The function foreach() is called:

```c
foreach(int instatus, char *inkey,
        int inkeylen, char *inval,
        int invallen, char *indata);
```

The instatus parameter holds one of the return status values defined in `<rpcsvc/yp_prot.h>`, either YP_TRUE or an error code. See ypprot_err(), for a function that converts an NIS name service protocol error code to a ypclnt layer error code.

The key and value parameters are somewhat different than defined in the synopsis section above. First, the memory pointed to by the inkey and inval parameters is private to the yp_all() function, and is overwritten with the arrival of each new key-value pair. The foreach() function must do something useful with the contents of that memory, but it does not own the memory itself. Key and value objects presented to the foreach() function look exactly as they do in the server’s map. If they were not NEWLINE-terminated or null-terminated in the map, they would not be here either.

The indata parameter is the contents of the incallback->data element passed to yp_all(). The data element of the callback structure can be used to share state information between the foreach() function and the mainline code. Its use is optional, and no part of the NIS client package inspects its contents; cast it to something useful, or ignore it. The foreach() function is Boolean. It should return 0 to indicate
that it wants to be called again for further received key-value pairs, or non-zero to stop the flow of key-value pairs. If foreach() returns a non-zero value, it is not called again. The functional value of yp_all() is then 0.

yp_order() The yp_order() function returns the order number for a map.

yp_master() The yp_master() function returns the machine name of the master NIS server for a map.

yperr_string() The yperr_string() function returns a pointer to an error message string that is null-terminated but contains no period or NEWLINE.

ypprot_err() The ypprot_err() function takes an NIS nameservice protocol error code as input, and returns a ypclnt() layer error code, which can be used as an input to yperr_string().

Return Values All integer functions return 0 if the requested operation is successful, or one of the following errors if the operation fails:

YPERR_ACCESS Access violation.
YPERR_BADARGS The arguments to the function are bad.
YPERR_BADDB The YP database is bad.
YPERR_BUSY The database is busy.
YPERR_DOMAIN Cannot bind to server on this domain.
YPERR_KEY No such key in map.
YPERR_MAP No such map in server's domain.
YPERR_NODOM Local domain name not set.
YPERR_NOMORE No more records in map database.
YPERR_PMAP Cannot communicate with rpcbind.
YPERR_RESRC Resource allocation failure.
YPERR_RPC RPC failure; domain has been unbound.
YPERR_YPBIND Cannot communicate with ypbind.
YPERR_YPERR Internal YP server or client error.
YPERR_YPSERV Cannot communicate with ypserve.
YPERR_VERS YP version mismatch.
Attributes

<table>
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<tbody>
<tr>
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</tbody>
</table>

See Also  `ypcat(1), ypmatch(1), ypwhich(1), rpcbind(1M), yppbind(1M), ypserv(1M), sysinfo(2), malloc(3C), ypfiles(4), attributes(5)`
Name  yp_update – change NIS information

Synopsis  
```c
#include <rpcsvc/ypclnt.h>

int yp_update(char *domain, char *map, unsigned ypop, char *key, 
               char *int keylen, char *data, int datalen);
```

Description  yp_update() is used to make changes to the NIS database. The syntax is the same as that of yp_match() except for the extra parameter ypop which may take on one of four values. If it is POP_CHANGE then the data associated with the key will be changed to the new value. If the key is not found in the database, then yp_update() will return YPERR_KEY. If ypop has the value YPOP_INSERT then the key-value pair will be inserted into the database. The error YPERR_KEY is returned if the key already exists in the database. To store an item into the database without concern for whether it exists already or not, pass ypop as YPOP_STORE and no error will be returned if the key already or does not exist. To delete an entry, the value of ypop should be YPOP_DELETE.

This routine depends upon secure RPC, and will not work unless the network is running secure RPC.

Return Values  If the value of ypop is POP_CHANGE, yp_update() returns the error YPERR_KEY if the key is not found in the database.

If the value of ypop is POP_INSERT, yp_update() returns the error YPERR_KEY if the key already exists in the database.

Attributes  See attributes(5) for descriptions of the following attributes:

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<tr>
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<td>Unsafe</td>
</tr>
</tbody>
</table>

See Also  secure_rpc(3NSL), ypclnt(3NSL), attributes(5)

Notes  This interface is unsafe in multithreaded applications. Unsafe interfaces should be called only from the main thread.