



## ***Linux Ubuntu 26.04 Manual Pages on command 'gai\_strerror.3'***

### ***\$ man gai\_strerror.3***

getaddrinfo(3)                      Library Functions Manual                      getaddrinfo(3)

#### NAME

getaddrinfo, freeaddrinfo, gai\_strerror - network address and service translation

#### LIBRARY

Standard C library (libc, -lc)

#### SYNOPSIS

```
#include <sys/types.h>
```

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

```
#include <netdb.h>
```

```
int getaddrinfo(const char *restrict node,  
               const char *restrict service,  
               const struct addrinfo *restrict hints,  
               struct addrinfo **restrict res);
```

```
void freeaddrinfo(struct addrinfo *res);
```

```
const char *gai_strerror(int errcode);
```

Feature Test Macro Requirements for glibc (see feature\_test\_macros(7)):

getaddrinfo(), freeaddrinfo(), gai\_strerror():

Since glibc 2.22:

```
_POSIX_C_SOURCE >= 200112L
```

glibc 2.21 and earlier:

```
_POSIX_C_SOURCE
```

#### DESCRIPTION

Given node and service, which identify an Internet host and a service, getaddrinfo() returns

one or more `addrinfo` structures, each of which contains an Internet address that can be specified in a call to `bind(2)` or `connect(2)`. The `getaddrinfo()` function combines the functionality provided by the `gethostbyname(3)` and `getservbyname(3)` functions into a single interface, but unlike the latter functions, `getaddrinfo()` is reentrant and allows programs to eliminate IPv4-versus-IPv6 dependencies.

The `addrinfo` structure used by `getaddrinfo()` contains the following fields:

```
struct addrinfo {
    int      ai_flags;
    int      ai_family;
    int      ai_socktype;
    int      ai_protocol;
    socklen_t ai_addrlen;
    struct sockaddr *ai_addr;
    char      *ai_canonname;
    struct addrinfo *ai_next;
};
```

The `hints` argument points to an `addrinfo` structure that specifies criteria for selecting the socket address structures returned in the list pointed to by `res`. If `hints` is not `NULL` it points to an `addrinfo` structure whose `ai_family`, `ai_socktype`, and `ai_protocol` specify criteria that limit the set of socket addresses returned by `getaddrinfo()`, as follows:

#### `ai_family`

This field specifies the desired address family for the returned addresses. Valid values for this field include `AF_INET` and `AF_INET6`. The value `AF_UNSPEC` indicates that `getaddrinfo()` should return socket addresses for any address family (either IPv4 or IPv6, for example) that can be used with `node` and `service`.

#### `ai_socktype`

This field specifies the preferred socket type, for example `SOCK_STREAM` or `SOCK_DGRAM`. Specifying 0 in this field indicates that socket addresses of any type can be returned by `getaddrinfo()`.

#### `ai_protocol`

This field specifies the protocol for the returned socket addresses. Specifying 0 in this field indicates that socket addresses with any protocol can be returned by `getaddrinfo()`.

ai\_flags

This field specifies additional options, described below. Multiple flags are specified by bitwise OR-ing them together.

All the other fields in the structure pointed to by hints must contain either 0 or a null pointer, as appropriate.

Specifying hints as NULL is equivalent to setting ai\_socktype and ai\_protocol to 0; ai\_family to AF\_UNSPEC; and ai\_flags to (AI\_V4MAPPED | AI\_ADDRCONFIG). (POSIX specifies different defaults for ai\_flags; see NOTES.) node specifies either a numerical network address (for IPv4, numbers-and-dots notation as supported by inet\_aton(3); for IPv6, hexadecimal string format as supported by inet\_pton(3)), or a network hostname, whose network addresses are looked up and resolved. If hints.ai\_flags contains the AI\_NUMERICHOST flag, then node must be a numerical network address. The AI\_NUMERICHOST flag suppresses any potentially lengthy network host address lookups.

If the AI\_PASSIVE flag is specified in hints.ai\_flags, and node is NULL, then the returned socket addresses will be suitable for bind(2)ing a socket that will accept(2) connections.

The returned socket address will contain the "wildcard address" (INADDR\_ANY for IPv4 addresses, IN6ADDR\_ANY\_INIT for IPv6 address). The wildcard address is used by applications (typically servers) that intend to accept connections on any of the host's network addresses. If node is not NULL, then the AI\_PASSIVE flag is ignored.

If the AI\_PASSIVE flag is not set in hints.ai\_flags, then the returned socket addresses will be suitable for use with connect(2), sendto(2), or sendmsg(2). If node is NULL, then the network address will be set to the loopback interface address (INADDR\_LOOPBACK for IPv4 addresses, IN6ADDR\_LOOPBACK\_INIT for IPv6 address); this is used by applications that intend to communicate with peers running on the same host.

service sets the port in each returned address structure. If this argument is a service name (see services(5)), it is translated to the corresponding port number. This argument can also be specified as a decimal number, which is simply converted to binary. If service is NULL, then the port number of the returned socket addresses will be left uninitialized.

If AI\_NUMERICSERV is specified in hints.ai\_flags and service is not NULL, then service must point to a string containing a numeric port number. This flag is used to inhibit the invocation of a name resolution service in cases where it is known not to be required.

Either node or service, but not both, may be NULL.

The getaddrinfo() function allocates and initializes a linked list of addrinfo structures,

one for each network address that matches node and service, subject to any restrictions imposed by hints, and returns a pointer to the start of the list in `res`. The items in the linked list are linked by the `ai_next` field.

There are several reasons why the linked list may have more than one `addrinfo` structure, including: the network host is multihomed, accessible over multiple protocols (e.g., both `AF_INET` and `AF_INET6`); or the same service is available from multiple socket types (one `SOCK_STREAM` address and another `SOCK_DGRAM` address, for example). Normally, the application should try using the addresses in the order in which they are returned. The sorting function used within `getaddrinfo()` is defined in RFC 3484; the order can be tweaked for a particular system by editing `/etc/gai.conf` (available since glibc 2.5).

If `hints.ai_flags` includes the `AI_CANONNAME` flag, then the `ai_canonname` field of the first of the `addrinfo` structures in the returned list is set to point to the official name of the host.

The remaining fields of each returned `addrinfo` structure are initialized as follows:

- The `ai_family`, `ai_socktype`, and `ai_protocol` fields return the socket creation parameters (i.e., these fields have the same meaning as the corresponding arguments of `socket(2)`).

For example, `ai_family` might return `AF_INET` or `AF_INET6`; `ai_socktype` might return `SOCK_DGRAM` or `SOCK_STREAM`; and `ai_protocol` returns the protocol for the socket.

- A pointer to the socket address is placed in the `ai_addr` field, and the size of the socket address, in bytes, is placed in the `ai_addrlen` field.

If `hints.ai_flags` includes the `AI_ADDRCONFIG` flag, then IPv4 addresses are returned in the list pointed to by `res` only if the local system has at least one IPv4 address configured, and IPv6 addresses are returned only if the local system has at least one IPv6 address configured. The loopback address is not considered for this case as valid as a configured address. This flag is useful on, for example, IPv4-only systems, to ensure that `getaddrinfo()` does not return IPv6 socket addresses that would always fail in `connect(2)` or `bind(2)`.

If `hints.ai_flags` specifies the `AI_V4MAPPED` flag, and `hints.ai_family` was specified as `AF_INET6`, and no matching IPv6 addresses could be found, then return IPv4-mapped IPv6 addresses in the list pointed to by `res`. If both `AI_V4MAPPED` and `AI_ALL` are specified in `hints.ai_flags`, then return both IPv6 and IPv4-mapped IPv6 addresses in the list pointed to by `res`. `AI_ALL` is ignored if `AI_V4MAPPED` is not also specified.

The `freeaddrinfo()` function frees the memory that was allocated for the dynamically allocated linked list `res`.

## Extensions to getaddrinfo() for Internationalized Domain Names

Starting with glibc 2.3.4, getaddrinfo() has been extended to selectively allow the incoming and outgoing hostnames to be transparently converted to and from the Internationalized Domain Name (IDN) format (see RFC 3490, Internationalizing Domain Names in Applications (IDNA)). Four new flags are defined:

**AI\_IDN** If this flag is specified, then the node name given in node is converted to IDN for?

mat if necessary. The source encoding is that of the current locale.

If the input name contains non-ASCII characters, then the IDN encoding is used.

Those parts of the node name (delimited by dots) that contain non-ASCII characters are encoded using ASCII Compatible Encoding (ACE) before being passed to the name resolution functions.

**AI\_CANONIDN**

After a successful name lookup, and if the AI\_CANONNAME flag was specified, getad?drinfo() will return the canonical name of the node corresponding to the addrinfo structure value passed back. The return value is an exact copy of the value returned by the name resolution function.

If the name is encoded using ACE, then it will contain the xn-- prefix for one or more components of the name. To convert these components into a readable form the AI\_CANONIDN flag can be passed in addition to AI\_CANONNAME. The resulting string is encoded using the current locale's encoding.

**AI\_IDN\_ALLOW\_UNASSIGNED**

**AI\_IDN\_USE\_STD3\_ASCII\_RULES**

Setting these flags will enable the IDNA\_ALLOW\_UNASSIGNED (allow unassigned Unicode code points) and IDNA\_USE\_STD3\_ASCII\_RULES (check output to make sure it is a STD3 conforming hostname) flags respectively to be used in the IDNA handling.

## RETURN VALUE

getaddrinfo() returns 0 if it succeeds, or one of the following nonzero error codes:

**EAI\_ADDRFAMILY**

The specified network host does not have any network addresses in the requested address family.

**EAI\_AGAIN**

The name server returned a temporary failure indication. Try again later.

**EAI\_BADFLAGS**

hints.ai\_flags contains invalid flags; or, hints.ai\_flags included AI\_CANONNAME and node was NULL.

#### EAI\_FAIL

The name server returned a permanent failure indication.

#### EAI\_FAMILY

The requested address family is not supported.

#### EAI\_MEMORY

Out of memory.

#### EAI\_NODATA

The specified network host exists, but does not have any network addresses defined.

#### EAI\_NONAME

The node or service is not known; or both node and service are NULL; or AI\_NUMERICSERV was specified in hints.ai\_flags and service was not a numeric port-number string.

#### EAI\_SERVICE

The requested service is not available for the requested socket type. It may be available through another socket type. For example, this error could occur if service was "shell" (a service available only on stream sockets), and either hints.ai\_protocol was IPPROTO\_UDP, or hints.ai\_socktype was SOCK\_DGRAM; or the error could occur if service was not NULL, and hints.ai\_socktype was SOCK\_RAW (a socket type that does not support the concept of services).

#### EAI\_SOCKTYPE

The requested socket type is not supported. This could occur, for example, if hints.ai\_socktype and hints.ai\_protocol are inconsistent (e.g., SOCK\_DGRAM and IPPROTO\_TCP, respectively).

#### EAI\_SYSTEM

Other system error; errno is set to indicate the error.

The gai\_strerror() function translates these error codes to a human readable string, suitable for error reporting.

## FILES

/etc/gai.conf

## ATTRIBUTES

For an explanation of the terms used in this section, see attributes(7).

```

????????????????????????????????????????????????????????????????????????????????????????????????????????????????
? Interface                ? Attribute  ? Value                ?
????????????????????????????????????????????????????????????????????????????????????????????????????????????????
? getaddrinfo()           ? Thread safety ? MT-Safe env locale ?
????????????????????????????????????????????????????????????????????????????????????????????????????????????????
? freeaddrinfo(), gai_strerror()      ? Thread safety ? MT-Safe                ?
????????????????????????????????????????????????????????????????????????????????????????????????????????????????

```

## VERSIONS

According to POSIX.1, specifying hints as NULL should cause ai\_flags to be assumed as 0.

The GNU C library instead assumes a value of (AI\_V4MAPPED | AI\_ADDRCONFIG) for this case, since this value is considered an improvement on the specification.

## STANDARDS

POSIX.1-2008.

getaddrinfo()

RFC 2553.

## HISTORY

POSIX.1-2001.

AI\_ADDRCONFIG

AI\_ALL

AI\_V4MAPPED

glibc 2.3.3.

AI\_NUMERICSERV

glibc 2.3.4.

## NOTES

getaddrinfo() supports the address%scope-id notation for specifying the IPv6 scope-ID.

## EXAMPLES

The following programs demonstrate the use of getaddrinfo(), gai\_strerror(), freeaddrinfo(), and getnameinfo(3). The programs are an echo server and client for UDP datagrams.

Server program

```

#include <netdb.h>
#include <stdio.h>
#include <stdlib.h>
#include <string.h>

```

```

#include <sys/socket.h>

#include <sys/types.h>

#include <unistd.h>

#define BUF_SIZE 500

int

main(int argc, char *argv[])

{
    int            sfd, s;

    char            buf[BUF_SIZE];

    ssize_t        nread;

    socklen_t       peer_addrlen;

    struct addrinfo  hints;

    struct addrinfo  *result, *rp;

    struct sockaddr_storage peer_addr;

    if (argc != 2) {
        fprintf(stderr, "Usage: %s port\n", argv[0]);
        exit(EXIT_FAILURE);
    }

    memset(&hints, 0, sizeof(hints));

    hints.ai_family = AF_UNSPEC; /* Allow IPv4 or IPv6 */

    hints.ai_socktype = SOCK_DGRAM; /* Datagram socket */

    hints.ai_flags = AI_PASSIVE; /* For wildcard IP address */

    hints.ai_protocol = 0; /* Any protocol */

    hints.ai_canonname = NULL;

    hints.ai_addr = NULL;

    hints.ai_next = NULL;

    s = getaddrinfo(NULL, argv[1], &hints, &result);

    if (s != 0) {
        fprintf(stderr, "getaddrinfo: %s\n", gai_strerror(s));
        exit(EXIT_FAILURE);
    }

    /* getaddrinfo() returns a list of address structures.

```

Try each address until we successfully bind(2).

```

    If socket(2) (or bind(2)) fails, we (close the socket
    and) try the next address. */
for (rp = result; rp != NULL; rp = rp->ai_next) {
    sfd = socket(rp->ai_family, rp->ai_socktype,
                rp->ai_protocol);
    if (sfd == -1)
        continue;
    if (bind(sfd, rp->ai_addr, rp->ai_addrlen) == 0)
        break;          /* Success */
    close(sfd);
}
freeaddrinfo(result);    /* No longer needed */
if (rp == NULL) {        /* No address succeeded */
    fprintf(stderr, "Could not bind\n");
    exit(EXIT_FAILURE);
}

/* Read datagrams and echo them back to sender. */
for (;;) {
    char host[NI_MAXHOST], service[NI_MAXSERV];
    peer_addrlen = sizeof(peer_addr);
    nread = recvfrom(sfd, buf, BUF_SIZE, 0,
                    (struct sockaddr *) &peer_addr, &peer_addrlen);
    if (nread == -1)
        continue;        /* Ignore failed request */
    s = getnameinfo((struct sockaddr *) &peer_addr,
                    peer_addrlen, host, NI_MAXHOST,
                    service, NI_MAXSERV, NI_NUMERICSERV);
    if (s == 0)
        printf("Received %zd bytes from %s:%s\n",
                nread, host, service);
    else
        fprintf(stderr, "getnameinfo: %s\n", gai_strerror(s));
    if (sendto(sfd, buf, nread, 0, (struct sockaddr *) &peer_addr,

```

```

        peer_addrlen) != nread)

    {
        fprintf(stderr, "Error sending response\n");
    }
}
}

```

#### Client program

```

#include <netdb.h>

#include <stdio.h>

#include <stdlib.h>

#include <string.h>

#include <sys/socket.h>

#include <sys/types.h>

#include <unistd.h>

#define BUF_SIZE 500

int

main(int argc, char *argv[])

{
    int      sfd, s;

    char      buf[BUF_SIZE];

    size_t    size;

    ssize_t    nread;

    struct addrinfo  hints;

    struct addrinfo  *result, *rp;

    if (argc < 3) {
        fprintf(stderr, "Usage: %s host port msg...\n", argv[0]);
        exit(EXIT_FAILURE);
    }

    /* Obtain address(es) matching host/port. */

    memset(&hints, 0, sizeof(hints));

    hints.ai_family = AF_UNSPEC; /* Allow IPv4 or IPv6 */

    hints.ai_socktype = SOCK_DGRAM; /* Datagram socket */

    hints.ai_flags = 0;

```

```

hints.ai_protocol = 0;      /* Any protocol */

s = getaddrinfo(argv[1], argv[2], &hints, &result);

if (s != 0) {
    fprintf(stderr, "getaddrinfo: %s\n", gai_strerror(s));
    exit(EXIT_FAILURE);
}

/* getaddrinfo() returns a list of address structures.
   Try each address until we successfully connect(2).
   If socket(2) (or connect(2)) fails, we (close the socket
   and) try the next address. */

for (rp = result; rp != NULL; rp = rp->ai_next) {
    sfd = socket(rp->ai_family, rp->ai_socktype,
                 rp->ai_protocol);

    if (sfd == -1)
        continue;

    if (connect(sfd, rp->ai_addr, rp->ai_addrlen) != -1)
        break;          /* Success */

    close(sfd);
}

freeaddrinfo(result);      /* No longer needed */

if (rp == NULL) {          /* No address succeeded */
    fprintf(stderr, "Could not connect\n");
    exit(EXIT_FAILURE);
}

/* Send remaining command-line arguments as separate
   datagrams, and read responses from server. */

for (size_t j = 3; j < argc; j++) {
    size = strlen(argv[j]) + 1;

    /* +1 for terminating null byte */

    if (size > BUF_SIZE) {
        fprintf(stderr,
            "Ignoring long message in argument %zu\n", j);
        continue;
    }
}

```

```

}
if (write(sfd, argv[j], size) != size) {
    fprintf(stderr, "partial/failed write\n");
    exit(EXIT_FAILURE);
}
nread = read(sfd, buf, BUF_SIZE);
if (nread == -1) {
    perror("read");
    exit(EXIT_FAILURE);
}
printf("Received %zd bytes: %s\n", nread, buf);
}
exit(EXIT_SUCCESS);
}

```

#### SEE ALSO

[getaddrinfo\\_a\(3\)](#), [gethostbyname\(3\)](#), [getnameinfo\(3\)](#), [inet\(3\)](#), [gai.conf\(5\)](#), [hostname\(7\)](#), [ip\(7\)](#)