**Exercise I.a.1** The listening socket is bound to a specific address. What address is this? (Give both the symbolic name used in the code, and the corresponding IPv4 address in numeric or dotted notation).

Ans. The listening socket is bound to the INADDR\_ANY (the symbolic name of the address used in the code). When **INADDR\_ANY** is specified in the bind call, the socket will be bound to all local interfaces. The IPv4 address it refers to is 0.0.0.0 but that is not the routable IP address.

**Exercise I.a.2** In the code, there is a call to **recv**() as follows:  
ret = **recv**( cd.sock, cd.buffer, kTransferBufferSize, 0 );

The return value will be one of the following:

1. ret = −1 : -1 is returned when an error has occurred.
2. ret = 0 : For TCP sockets, the return value 0 means the peer has closed its half side of the connection.

(c) 0 < ret < kTransferBufferSize : The return value indicates the number of bytes received.

(d) ret = kTransferBufferSize : The return value indicates the number of bytes received. Since number of bytes is equal to buffer size, it indicates that the buffer is full.

Describe the implications of each case! Additionally, why is cd.buffer (see ConnectionData declaration) defined to be of size kTransferBufferSize+1 rather than just plain kTransferBufferSize?

And: The incoming data is zero terminated by the server to indicate the end of the request, therefore an extra byte is needed in the buffer.

**Exercise I.a.3** Sending is performed using the **send**() method as follows: ret = **send**( cd.sock,

cd.buffer+cd.bufferOffset, cd.bufferSize-cd.bufferOffset, **MSG\_NOSIGNAL**

);  
How does the **send**() method indicate that the connection in question has been closed/reset? How does **MSG\_NOSIGNAL** relate to this (on linux machines)?

On failure, -1 is returned by send and the global variable errno is set to indicate the error. EPIPE errno indicates socket has been shutdown and ECONNRESET errno indicates connection has been reset. MSG\_NOSIGNAL requests not to send SIGPIPE (signal to terminate) to the calling thread.

Discuss the reasons for this behaviour with your partner. Why are these two strategies used?

Also, quickly look through the error codes (values of **errno**) possible after **accept**(), **send**(), and **recv**() (check the *man*-pages!). Under which conditions attempting to continue execution might be unreasonable?

Ans: A server must fail fast during it’s startup to ensure that the system admins know there is a problem quickly. But once the server is running fine, errors relating to specific connections must not affect other connections and not cause the server to shutdown. Therefore the server should just indicate the error to the client and continue to be available for other clients.

Errors relating to send() should not stop the execution of the server since these are problems relating to sending a message to a specific client. Errors on accept and recv that make the server useless and unusable should stop execution and fail fast to notify system admins.

**Exercise I.b.1** Discuss with your partner: How is the program notified that a connection attempt has failed or succeeded?

Hint: the process is described in the course book!

ANS: The program attempts a TCP connection towards a host. If the TCP handshake is successful then the connection attempt has succeeded. If handshake has failed due to some reason then the program is notified that the connection attempt has failed.

**Exercise I.c.1** Try to send messages with each of the clients. Describe the results – do you receive a response immediately?.

Check with *netstat* and document the status of the connection from each client.

When both the clients were connected, only the data sent by the first client was processed immediately whilst the second client was blocked and waiting for the first client to finish. When the first client finished, the server started processing the second client so the response for the second client wasn’t immediate.

madhumitha@madhumitha-VirtualBox:~/Downloads$ netstat --inet -p

Proto Recv-Q Send-Q Local Address Foreign Address State PID/Program name

tcp 7 0 localhost:5703 localhost:49488 ESTABLISHED -

tcp 0 0 localhost:5703 localhost:37328 ESTABLISHED 11968/./server-iter

tcp 0 0 localhost:37328 localhost:5703 ESTABLISHED 12039/./client-simp

tcp 0 0 localhost:49488 localhost:5703 ESTABLISHED 12043/./client-simp

**Exercise I.c.2** When you disconnected the first client, what happened? Explain why.

When the first client disconnected, the server started handling the second client’s request. This is because by default TCP sockets are blocking by nature. There is a flag in the server code that set the socket to NONBLOCKING but NONBLOCKING is set to 0 therefore making it blocking.

**Exercise I.c.3** Measure the round trip time when the client and server are running on the same machine. Also measure the round trip time when they are on different machines.

The average round trip is the following:

1. same machines: 0.356041 ms
2. different machines: 88.797333 ms

**Exercise I.c.4** Measure the round trip times for two concurrently connected simple clients (similar to exercise I.c.1 ).

Discuss with your partner: What is the largest factor in the measured round trip time of the second client?

ANS : The round trip time for the first client that connected to the server is 0.291667 ms and the round trip time for the second client is 8072.869458 ms. The largest factor for the second client is the waiting time due the socket being blocked by the first client.

**Exercise I.d.1** Run the above command (make sure that the server is still running), and note the results.

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % ./client-multi localhost 5703 7 255

Simulating 7 clients.

Establishing 7 connections...

successfully initiated 7 connection attempts!

Connect timing results for 7 successful connections

- min time: 0.322375 ms

- max time: 0.530375 ms

- average time: 0.385464 ms

(0 connections failed!)

Roundtrip timing results for 7 connections for 255 round trips

- min time: 24.554167 ms

- max time: 62.156084 ms

- average time: 44.351738 ms

**Exercise I.d.2** Take note of the timing results. You will want to compare them to results in the next Lab/Exercise.

**Exercise I.d.3** How long did it take for the connection attempts to time out?

The first connections started to time out in 48 seconds.

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % ./client-multi localhost 5703 100 10000

Simulating 100 clients.

Establishing 100 connections...

successfully initiated 100 connection attempts!

- conn 3 : async connect() error: Connection reset by peer

- conn 5 : async connect() error: Connection reset by peer

- conn 6 : async connect() error: Connection reset by peer

- conn 7 : async connect() error: Connection reset by peer

- conn 10 : async connect() error: Connection reset by peer

- conn 12 : async connect() error: Connection reset by peer

- conn 13 : async connect() error: Connection reset by peer

- conn 14 : async connect() error: Connection reset by peer

- conn 15 : async connect() error: Connection reset by peer

- conn 18 : async connect() error: Connection reset by peer

- conn 19 : async connect() error: Connection reset by peer

- conn 21 : async connect() error: Connection reset by peer

- conn 27 : async connect() error: Connection reset by peer

- conn 29 : async connect() error: Connection reset by peer

- conn 30 : async connect() error: Connection reset by peer

- conn 33 : async connect() error: Connection reset by peer

- conn 39 : async connect() error: Connection reset by peer

- conn 40 : async connect() error: Connection reset by peer

- conn 41 : async connect() error: Connection reset by peer

- conn 42 : async connect() error: Connection reset by peer

- conn 43 : error in recv() : Connection reset by peer

- conn 44 : error in recv() : Connection reset by peer

- conn 45 : error in recv() : Connection reset by peer

- conn 48 : error in recv() : Connection reset by peer

- conn 50 : error in recv() : Connection reset by peer

- conn 53 : error in recv() : Connection reset by peer

- conn 58 : error in recv() : Connection reset by peer

- conn 60 : error in recv() : Connection reset by peer

- conn 63 : error in recv() : Connection reset by peer

- conn 65 : error in recv() : Connection reset by peer

- conn 68 : error in recv() : Connection reset by peer

- conn 70 : error in recv() : Connection reset by peer

- conn 71 : error in recv() : Connection reset by peer

- conn 72 : error in recv() : Connection reset by peer

- conn 73 : error in recv() : Connection reset by peer

- conn 75 : error in recv() : Connection reset by peer

- conn 79 : error in recv() : Connection reset by peer

- conn 80 : error in recv() : Connection reset by peer

- conn 81 : error in recv() : Connection reset by peer

- conn 82 : error in recv() : Connection reset by peer

- conn 86 : error in recv() : Connection reset by peer

- conn 87 : error in recv() : Connection reset by peer

- conn 88 : error in recv() : Connection reset by peer

- conn 93 : error in recv() : Connection reset by peer

- conn 38 : error in recv() : Connection reset by peer

- conn 28 : error in recv() : Connection reset by peer

- conn 31 : error in recv() : Connection reset by peer

- conn 34 : error in recv() : Connection reset by peer

- conn 36 : error in recv() : Connection reset by peer

- conn 37 : error in recv() : Connection reset by peer

- conn 23 : error in recv() : Connection reset by peer

- conn 25 : async connect() error: Connection reset by peer

- conn 35 : error in recv() : Connection reset by peer

- conn 22 : error in recv() : Connection reset by peer

- conn 26 : error in recv() : Connection reset by peer

- conn 32 : error in recv() : Connection reset by peer

- conn 98 : error in recv() : Connection reset by peer

- conn 84 : error in recv() : Connection reset by peer

- conn 85 : error in recv() : Connection reset by peer

- conn 89 : error in recv() : Connection reset by peer

- conn 91 : error in recv() : Connection reset by peer

- conn 95 : error in recv() : Connection reset by peer

- conn 66 : error in recv() : Connection reset by peer

- conn 67 : error in recv() : Connection reset by peer

- conn 76 : error in recv() : Connection reset by peer

- conn 77 : error in recv() : Connection reset by peer

- conn 54 : error in recv() : Connection reset by peer

- conn 55 : error in recv() : Connection reset by peer

- conn 57 : error in recv() : Connection reset by peer

- conn 59 : error in recv() : Connection reset by peer

- conn 61 : error in recv() : Connection reset by peer

- conn 64 : error in recv() : Connection reset by peer

- conn 47 : error in recv() : Connection reset by peer

- conn 49 : error in recv() : Connection reset by peer

- conn 52 : error in recv() : Connection reset by peer

- conn 97 : error in recv() : Connection reset by peer

- conn 74 : error in recv() : Connection reset by peer

- conn 78 : error in recv() : Connection reset by peer

- conn 83 : error in recv() : Connection reset by peer

- conn 90 : error in recv() : Connection reset by peer

- conn 92 : error in recv() : Connection reset by peer

- conn 94 : error in recv() : Connection reset by peer

- conn 96 : error in recv() : Connection reset by peer

- conn 69 : error in recv() : Connection reset by peer

Connect timing results for 79 successful connections

- min time: 0.918708 ms

- max time: 3506.027416 ms

- average time: 698.524211 ms

(21 connections failed!)

Roundtrip timing results for 16 connections for 10000 round trips

- min time: 313.721875 ms

- max time: 2524.665584 ms

- average time: 1637.365893 ms

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % ./client-multi localhost 5703 100 10000

Simulating 100 clients.

Establishing 100 connections...

successfully initiated 100 connection attempts!

- conn 1 : async connect() error: Connection reset by peer

- conn 2 : async connect() error: Connection reset by peer

- conn 3 : async connect() error: Connection reset by peer

- conn 4 : async connect() error: Connection reset by peer

- conn 5 : async connect() error: Connection reset by peer

- conn 6 : async connect() error: Connection reset by peer

- conn 7 : error in recv() : Connection reset by peer

- conn 8 : error in recv() : Connection reset by peer

- conn 9 : error in recv() : Connection reset by peer

- conn 10 : error in recv() : Connection reset by peer

- conn 11 : error in recv() : Connection reset by peer

- conn 12 : error in recv() : Connection reset by peer

- conn 13 : error in recv() : Connection reset by peer

- conn 14 : error in recv() : Connection reset by peer

- conn 15 : error in recv() : Connection reset by peer

- conn 16 : error in recv() : Connection reset by peer

- conn 17 : error in recv() : Connection reset by peer

- conn 18 : error in recv() : Connection reset by peer

- conn 19 : error in recv() : Connection reset by peer

- conn 20 : error in recv() : Connection reset by peer

- conn 21 : error in recv() : Connection reset by peer

- conn 22 : error in recv() : Connection reset by peer

- conn 23 : error in recv() : Connection reset by peer

- conn 24 : error in recv() : Connection reset by peer

- conn 25 : error in recv() : Connection reset by peer

- conn 26 : error in recv() : Connection reset by peer

- conn 28 : error in recv() : Connection reset by peer

- conn 29 : error in recv() : Connection reset by peer

- conn 30 : error in recv() : Connection reset by peer

- conn 31 : error in recv() : Connection reset by peer

- conn 32 : error in recv() : Connection reset by peer

- conn 33 : error in recv() : Connection reset by peer

- conn 34 : error in recv() : Connection reset by peer

- conn 35 : error in recv() : Connection reset by peer

- conn 36 : error in recv() : Connection reset by peer

- conn 37 : error in recv() : Connection reset by peer

- conn 39 : error in recv() : Connection reset by peer

- conn 40 : error in recv() : Connection reset by peer

- conn 41 : error in recv() : Connection reset by peer

- conn 42 : error in recv() : Connection reset by peer

- conn 43 : error in recv() : Connection reset by peer

- conn 44 : error in recv() : Connection reset by peer

- conn 45 : error in recv() : Connection reset by peer

- conn 46 : error in recv() : Connection reset by peer

- conn 47 : error in recv() : Connection reset by peer

- conn 49 : error in recv() : Connection reset by peer

- conn 50 : error in recv() : Connection reset by peer

- conn 51 : error in recv() : Connection reset by peer

- conn 52 : error in recv() : Connection reset by peer

- conn 54 : error in recv() : Connection reset by peer

- conn 56 : error in recv() : Connection reset by peer

- conn 57 : error in recv() : Connection reset by peer

- conn 58 : error in recv() : Connection reset by peer

- conn 59 : error in recv() : Connection reset by peer

- conn 60 : error in recv() : Connection reset by peer

- conn 61 : error in recv() : Connection reset by peer

- conn 63 : error in recv() : Connection reset by peer

- conn 64 : error in recv() : Connection reset by peer

- conn 65 : error in recv() : Connection reset by peer

- conn 66 : error in recv() : Connection reset by peer

- conn 67 : error in recv() : Connection reset by peer

- conn 68 : error in recv() : Connection reset by peer

- conn 69 : error in recv() : Connection reset by peer

- conn 70 : error in recv() : Connection reset by peer

- conn 71 : error in recv() : Connection reset by peer

- conn 73 : error in recv() : Connection reset by peer

- conn 75 : error in recv() : Connection reset by peer

- conn 76 : error in recv() : Connection reset by peer

- conn 78 : error in recv() : Connection reset by peer

- conn 79 : error in recv() : Connection reset by peer

- conn 80 : error in recv() : Connection reset by peer

- conn 81 : error in recv() : Connection reset by peer

- conn 82 : error in recv() : Connection reset by peer

- conn 84 : error in recv() : Connection reset by peer

- conn 86 : error in recv() : Connection reset by peer

- conn 87 : error in recv() : Connection reset by peer

- conn 92 : error in recv() : Connection reset by peer

- conn 95 : error in recv() : Connection reset by peer

- conn 96 : error in recv() : Connection reset by peer

Connect timing results for 94 successful connections

- min time: 2.703417 ms

- max time: 101.181959 ms

- average time: 15.682963 ms

(6 connections failed!)

Roundtrip timing results for 21 connections for 10000 round trips

- min time: 1155.215417 ms

- max time: 1450.989416 ms

- average time: 1362.377476 ms

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % netstat -f inet | grep 5703

tcp4 0 0 localhost.5703 localhost.59976 ESTABLISHED

tcp4 0 0 localhost.59976 localhost.5703 ESTABLISHED

tcp4 0 0 localhost.5703 localhost.59975 ESTABLISHED

tcp4 0 0 localhost.59975 localhost.5703 ESTABLISHED

**What happens if the sender send more data than can fit the buffer?**

Even if the message is larger than the buffer, the receiver is still able to receive the full message. By adding a printf statement to print the number of bytes received, I am seeing that the message is split into parts of size of the buffer and being received by the server. This is since we’re using SOCK\_STREAM/TCP which is a reliable message transfer protocol.

The following is from the man pages of recv()

If a message is too long to fit in the supplied buffer, excess bytes may be discarded depending on the type of socket the message is received from (see socket(2)).

The following is from the man pages of socket(2)

The communications protocols used to implement a SOCK\_STREAM insure that data is not lost or duplicated.

**Can you please provide a listing of relevant errno values here?**

The following errnos are ones where continuing execution is not a good idea.

**accept()**

**EBADF** *sockfd* is not an open file descriptor.

**EFAULT** The *addr* argument is not in a writable part of the user

address space.

**EINVAL** Socket is not listening for connections, or *addrlen* is

invalid (e.g., is negative).

**EINVAL** (**accept4**()) invalid value in *flags*.

**ENOTSOCK**

The file descriptor *sockfd* does not refer to a socket.

**EOPNOTSUPP**

The referenced socket is not of type **SOCK\_STREAM**.

**EPERM** Firewall rules forbid connection.

**EPROTO** Protocol error.

**send()**

**EINVAL** Invalid argument passed.

**ENOTSOCK**

The file descriptor *sockfd* does not refer to a socket.

**EOPNOTSUPP**

Some bit in the *flags* argument is inappropriate for the

socket type.

**recv()**

**EBADF** The argument *sockfd* is an invalid file descriptor.

**EFAULT** The receive buffer pointer(s) point outside the process's

address space.

**EINVAL** Invalid argument passed.

**ENOTSOCK**

The file descriptor *sockfd* does not refer to a socket.

**How does the program learn that from the API? Think of both the client and the server. Also pick only the most relevant API call for each.**

The return value of send and recv indicates if a connection is successful. The return value indicates the number of bytes read or sent but when it’s -1 then this indicates a failure.

**Do you see anything weird on the netstat results? Hint:Compare both of the server-side connections**

I can see the message size sent by the blocked client is mentioned in Recv-Q column (receiving queue) and is waiting to be read by the application. Once the first client is stopped then when running netstat, I can see no more messages in the queue since the message in the queue got processed.

**You sure about these numbers? How can the same machine take almost 6 minutes but different ones less than a second?**

Sorry, I mistakenly didn’t paste the value properly.

The average round trip is the following:

1. same machines: 0.356041 ms
2. different machines: 88.797333 ms

**Can you provide your full data and a more in depth analysis on the patterns you see from them?**

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % ./client-multi localhost 5703 10 255 Simulating 10 clients.

Establishing 10 connections...

successfully initiated 10 connection attempts!

- conn 0 : error in recv() : Connection reset by peer

- conn 1 : error in recv() : Connection reset by peer

Connect timing results for 10 successful connections

- min time: 0.452042 ms

- max time: 0.634666 ms

- average time: 0.494308 ms

(0 connections failed!)

Roundtrip timing results for 8 connections for 255 round trips

- min time: 26.347458 ms

- max time: 70.535458 ms

- average time: 49.311266 ms

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % ./client-multi localhost 5703 15 255

Simulating 15 clients.

Establishing 15 connections...

successfully initiated 15 connection attempts!

- conn 0 : error in recv() : Connection reset by peer

- conn 1 : error in recv() : Connection reset by peer

- conn 2 : error in recv() : Connection reset by peer

- conn 3 : error in recv() : Connection reset by peer

- conn 4 : error in recv() : Connection reset by peer

- conn 5 : error in recv() : Connection reset by peer

- conn 6 : error in recv() : Connection reset by peer

Connect timing results for 15 successful connections

- min time: 0.485000 ms

- max time: 0.685209 ms

- average time: 0.579492 ms

(0 connections failed!)

Roundtrip timing results for 8 connections for 255 round trips

- min time: 25.708542 ms

- max time: 69.778250 ms

- average time: 48.687745 ms

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % ./client-multi localhost 5703 30 255

Simulating 30 clients.

Establishing 30 connections...

successfully initiated 30 connection attempts!

- conn 2 : error in recv() : Connection reset by peer

- conn 3 : error in recv() : Connection reset by peer

- conn 4 : error in recv() : Connection reset by peer

- conn 5 : error in recv() : Connection reset by peer

- conn 6 : error in recv() : Connection reset by peer

- conn 7 : error in recv() : Connection reset by peer

- conn 8 : error in recv() : Connection reset by peer

- conn 9 : error in recv() : Connection reset by peer

- conn 10 : error in recv() : Connection reset by peer

- conn 11 : error in recv() : Connection reset by peer

- conn 12 : error in recv() : Connection reset by peer

- conn 13 : error in recv() : Connection reset by peer

- conn 15 : error in recv() : Connection reset by peer

- conn 16 : error in recv() : Connection reset by peer

- conn 17 : error in recv() : Connection reset by peer

- conn 18 : error in recv() : Connection reset by peer

- conn 20 : error in recv() : Connection reset by peer

- conn 21 : error in recv() : Connection reset by peer

- conn 26 : error in recv() : Connection reset by peer

Connect timing results for 30 successful connections

- min time: 0.932208 ms

- max time: 100.331791 ms

- average time: 7.712426 ms

(0 connections failed!)

Roundtrip timing results for 11 connections for 255 round trips

- min time: 6.003291 ms

- max time: 76.740625 ms

- average time: 44.502818 ms

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % ./client-multi localhost 5703 50 255

Simulating 50 clients.

Establishing 50 connections...

successfully initiated 50 connection attempts!

- conn 2 : async connect() error: Connection reset by peer

- conn 3 : async connect() error: Connection reset by peer

- conn 4 : error in recv() : Connection reset by peer

- conn 5 : error in recv() : Connection reset by peer

- conn 6 : error in recv() : Connection reset by peer

- conn 7 : error in recv() : Connection reset by peer

- conn 8 : error in recv() : Connection reset by peer

- conn 9 : error in recv() : Connection reset by peer

- conn 10 : error in recv() : Connection reset by peer

- conn 11 : error in recv() : Connection reset by peer

- conn 12 : error in recv() : Connection reset by peer

- conn 13 : error in recv() : Connection reset by peer

- conn 14 : error in recv() : Connection reset by peer

- conn 15 : error in recv() : Connection reset by peer

- conn 16 : error in recv() : Connection reset by peer

- conn 17 : error in recv() : Connection reset by peer

- conn 20 : error in recv() : Connection reset by peer

- conn 22 : error in recv() : Connection reset by peer

- conn 23 : error in recv() : Connection reset by peer

- conn 24 : error in recv() : Connection reset by peer

- conn 25 : error in recv() : Connection reset by peer

- conn 26 : error in recv() : Connection reset by peer

- conn 27 : error in recv() : Connection reset by peer

- conn 28 : error in recv() : Connection reset by peer

- conn 29 : error in recv() : Connection reset by peer

- conn 30 : error in recv() : Connection reset by peer

- conn 32 : error in recv() : Connection reset by peer

- conn 34 : error in recv() : Connection reset by peer

- conn 35 : error in recv() : Connection reset by peer

- conn 36 : error in recv() : Connection reset by peer

- conn 37 : error in recv() : Connection reset by peer

- conn 38 : error in recv() : Connection reset by peer

- conn 39 : error in recv() : Connection reset by peer

- conn 40 : error in recv() : Connection reset by peer

- conn 41 : error in recv() : Connection reset by peer

Connect timing results for 48 successful connections

- min time: 1.325125 ms

- max time: 100.520208 ms

- average time: 10.901560 ms

(2 connections failed!)

Roundtrip timing results for 15 connections for 255 round trips

- min time: 6.258416 ms

- max time: 78.010958 ms

- average time: 40.123886 ms

shivneshwarvelayutham@Shivneshwars-MacBook-Air lab1 % ./client-multi localhost 5703 100 255

Simulating 100 clients.

Establishing 100 connections...

successfully initiated 100 connection attempts!

- conn 0 : async connect() error: Connection reset by peer

- conn 1 : async connect() error: Connection reset by peer

- conn 2 : async connect() error: Connection reset by peer

- conn 3 : async connect() error: Connection reset by peer

- conn 4 : error in recv() : Connection reset by peer

- conn 5 : error in recv() : Connection reset by peer

- conn 6 : error in recv() : Connection reset by peer

- conn 7 : error in recv() : Connection reset by peer

- conn 9 : error in recv() : Connection reset by peer

- conn 10 : error in recv() : Connection reset by peer

- conn 11 : error in recv() : Connection reset by peer

- conn 12 : error in recv() : Connection reset by peer

- conn 13 : error in recv() : Connection reset by peer

- conn 14 : error in recv() : Connection reset by peer

- conn 15 : error in recv() : Connection reset by peer

- conn 16 : error in recv() : Connection reset by peer

- conn 17 : error in recv() : Connection reset by peer

- conn 18 : error in recv() : Connection reset by peer

- conn 19 : error in recv() : Connection reset by peer

- conn 20 : error in recv() : Connection reset by peer

- conn 21 : error in recv() : Connection reset by peer

- conn 22 : error in recv() : Connection reset by peer

- conn 23 : error in recv() : Connection reset by peer

- conn 24 : error in recv() : Connection reset by peer

- conn 26 : error in recv() : Connection reset by peer

- conn 27 : error in recv() : Connection reset by peer

- conn 28 : error in recv() : Connection reset by peer

- conn 29 : error in recv() : Connection reset by peer

- conn 30 : error in recv() : Connection reset by peer

- conn 31 : error in recv() : Connection reset by peer

- conn 32 : error in recv() : Connection reset by peer

- conn 33 : error in recv() : Connection reset by peer

- conn 34 : error in recv() : Connection reset by peer

- conn 36 : error in recv() : Connection reset by peer

- conn 39 : error in recv() : Connection reset by peer

- conn 40 : error in recv() : Connection reset by peer

- conn 41 : error in recv() : Connection reset by peer

- conn 42 : error in recv() : Connection reset by peer

- conn 43 : error in recv() : Connection reset by peer

- conn 44 : error in recv() : Connection reset by peer

- conn 45 : error in recv() : Connection reset by peer

- conn 47 : error in recv() : Connection reset by peer

- conn 48 : error in recv() : Connection reset by peer

- conn 49 : error in recv() : Connection reset by peer

- conn 50 : error in recv() : Connection reset by peer

- conn 51 : error in recv() : Connection reset by peer

- conn 53 : error in recv() : Connection reset by peer

- conn 54 : error in recv() : Connection reset by peer

- conn 55 : error in recv() : Connection reset by peer

- conn 56 : error in recv() : Connection reset by peer

- conn 57 : error in recv() : Connection reset by peer

- conn 58 : error in recv() : Connection reset by peer

- conn 59 : error in recv() : Connection reset by peer

- conn 60 : error in recv() : Connection reset by peer

- conn 61 : error in recv() : Connection reset by peer

- conn 62 : error in recv() : Connection reset by peer

- conn 63 : error in recv() : Connection reset by peer

- conn 64 : error in recv() : Connection reset by peer

- conn 65 : error in recv() : Connection reset by peer

- conn 67 : error in recv() : Connection reset by peer

- conn 68 : error in recv() : Connection reset by peer

- conn 69 : error in recv() : Connection reset by peer

- conn 70 : error in recv() : Connection reset by peer

- conn 71 : error in recv() : Connection reset by peer

- conn 72 : error in recv() : Connection reset by peer

- conn 73 : error in recv() : Connection reset by peer

- conn 74 : error in recv() : Connection reset by peer

- conn 75 : error in recv() : Connection reset by peer

- conn 76 : error in recv() : Connection reset by peer

- conn 77 : error in recv() : Connection reset by peer

- conn 78 : error in recv() : Connection reset by peer

- conn 79 : error in recv() : Connection reset by peer

- conn 80 : error in recv() : Connection reset by peer

- conn 81 : error in recv() : Connection reset by peer

- conn 82 : error in recv() : Connection reset by peer

- conn 84 : error in recv() : Connection reset by peer

- conn 86 : error in recv() : Connection reset by peer

- conn 89 : error in recv() : Connection reset by peer

- conn 90 : error in recv() : Connection reset by peer

- conn 91 : error in recv() : Connection reset by peer

- conn 92 : error in recv() : Connection reset by peer

- conn 93 : error in recv() : Connection reset by peer

- conn 94 : error in recv() : Connection reset by peer

Connect timing results for 96 successful connections

- min time: 2.795959 ms

- max time: 100.480750 ms

- average time: 11.304072 ms

(4 connections failed!)

Roundtrip timing results for 17 connections for 255 round trips

- min time: 6.711167 ms

- max time: 80.027375 ms

- average time: 41.254863 ms

The min time for connections increased but only gradually. With the max time and average time for connections, there was a huge jump between 15 connections to 30 connections. Before and after, the max time increased gradually as connections grew. The average roundtrip time stayed the same since the server only handles one message at a time. The number of errors grew as the number of clients increased.

Comment: Ths is wrong, recv and send are not involved in establishing the connection but in sending and receiving data. Can you pick two different APIs? (One for server, one for client).

Answer:

The API used by the client to establish connection is connect(). The return value indicates success or failure.

Excerpt from man page:

Upon successful completion, a value of 0 is returned. Otherwise, a value of -1 is returned and the global integer variable errno is set to indicate the error.

The API used by the server to establish connection is accept(). The return value indicates success or failure.

Excerpt from man page:

The call returns -1 on error and the global variable errno is set to indicate the error. If it succeeds, it returns a non-negative integer that is a descriptor for the accepted socket.