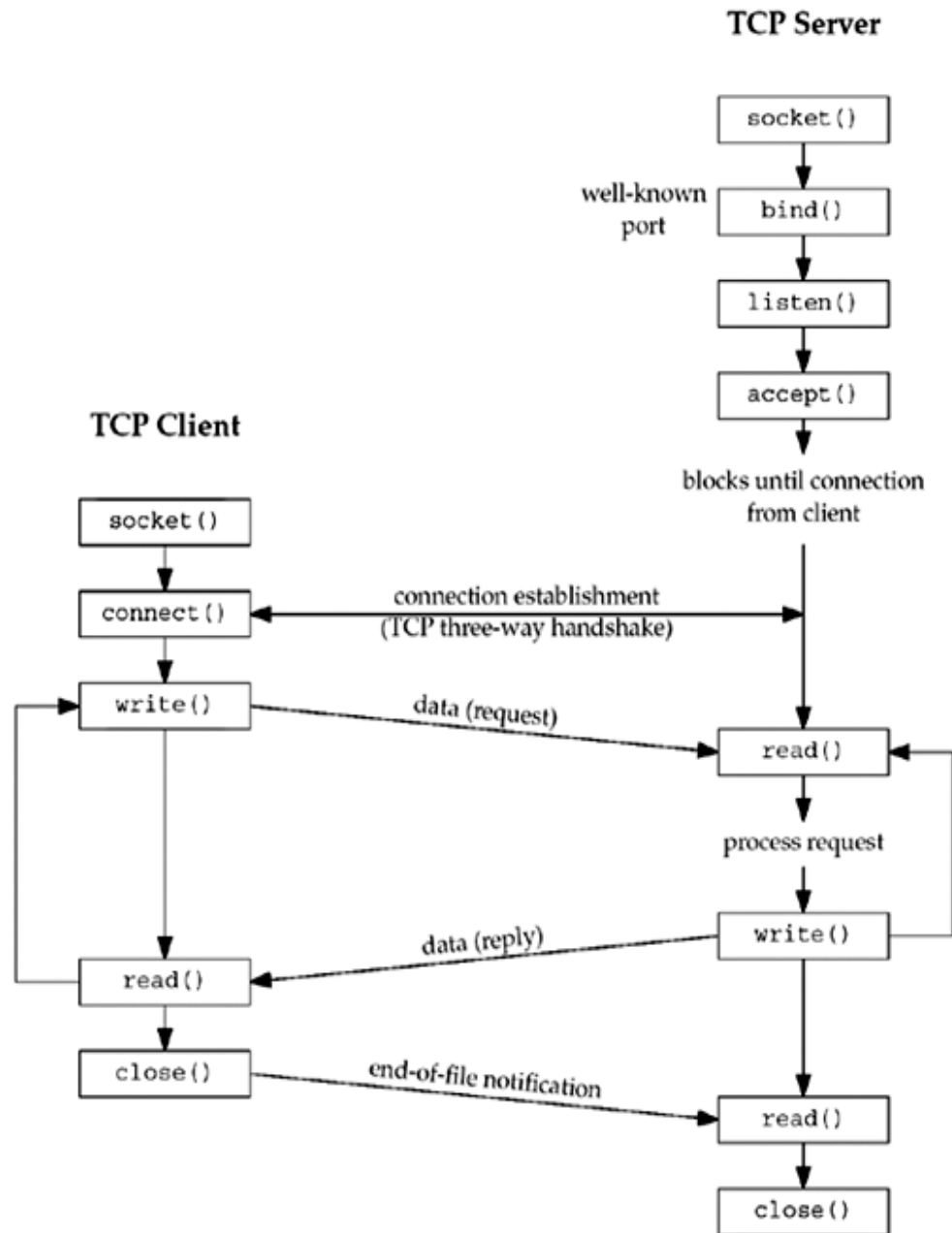


Introduction to Client – Server Programming Using Java

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The socket functions for the elementary TCP client/server



Simple commands

- `Natstat -a -p tcp`
- `Javac file-name.java`
- `Java filename`

socket Function

- To open a socket for performing network I/O.

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

```
int socket(int family, int type, int protocol);
```

Returns: non-negative descriptor if OK, -1 on error

| <i>family</i> | Description |
|---------------|-----------------------|
| AF_INET | IPv4 protocols |
| AF_INET6 | IPv6 protocols |
| AF_LOCAL | UNIX domain protocols |
| AF_ROUTE | Routing protocols |
| AF_KEY | Key socket |

| <i>type</i> | Description |
|----------------|----------------------------------|
| SOCK_STREAM | stream socket (TCP/SCTP) |
| SOCK_DGRAM | datagram socket (UDP) |
| SOCK_SEQPACKET | sequenced packet socket (SCTP) |
| SOCK_RAW | raw socket (talk to IP directly) |

- For protocol, one may select the system default (0), since not all combinations of family and type are valid.

connect Function (1/3)

- is used by a client to establish a connection with a server via a 3-way handshake.

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

```
int connect(int sockfd, const struct sockaddr *servaddr, socklen_t addrlen);
```

Returns: 0 if OK, -1 on error

- sockfd is a socket descriptor returned by the socket() function.
- servaddr contains the IP address and port number of the server.
- addrlen has the length (in bytes) of the server socket address structure.

connect Function (2/3)

- This function returns only when the connection is established or an error occurs.
- Some possible errors:
 - If the client TCP receives no response to its SYN segment, ETIMEDOUT is returned.
 - The connection-establishment timer expires after 75 seconds (4.4 BSD).
 - The client will resend SYN after 6 seconds later, and again another 24 seconds later. If no response is received after a total of 75 seconds, the error is returned.

connect Function (3/3)

- If a reset (RST) is received from server, **ECONNREFUSED** is returned. This is a **hard error**.
 - This indicates that there is no process running at the server host at the port specified.
- If an ICMP “destination unreachable” is received from an intermediate router, **EHOSTUNREACH** or **ENETUNREACH** is returned. This is a **soft error**.
 - Upon receiving the first ICMP message, the client kernel will keep sending SYNs at the same time intervals as mentioned earlier, until after 75 seconds have elapsed (4.4BSD).

bind Function (1/2)

- Is used primarily by a server to assign a local protocol address to a socket.

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

```
int bind(int sockfd, const struct sockaddr *myaddr, socklen_t addrlen);
```

Returns: 0 if OK, -1 on error

- *sockfd* is a socket descriptor returned by the socket() function.
- *myaddr* is a pointer to a protocol-specific address. With TCP, it has the IP address and port number of the server.
- *addrlen* has the length (in bytes) of the server socket address structure.

bind Function (2/2)

■ IP address/Port number assignment:

| Process specifies | | Results |
|-------------------|---------|---|
| IP address | Port | |
| Wildcard | 0 | Kernel chooses IP address and port |
| Wildcard | Nonzero | Kernel chooses IP address, process specifies port |
| Local IP addr | 0 | Process specifies IP address, kernel chooses port |
| Local IP addr | Nonzero | Process specifies IP address and port |

- *Wildcard address*: INADDR_ANY (IPv4), in6addr_any (IPv6).
- TCP servers typically bind their well-known port, and clients let the kernel choose an ephemeral port.

listen Function (1/2)

- Is used by a server to convert an unconnected socket to a passive socket.

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

```
int listen(int sockfd, int backlog);
```

Returns: 0 if OK, -1 on error

- *sockfd* is a socket descriptor returned by the socket() function.
- *backlog* specifies the maximum number of connections the kernel should queue for this socket.

listen Function (2/2)

- For a given listening socket, the kernel maintains 2 queues.
 - An incomplete connection queue
 - It contains an entry for each SYN received from a client, for which the server is awaiting completion of the TCP 3-way handshake.
 - A completed connection queue
 - It contains an entry for each client with whom the TCP 3-way handshake process has completed.
- backlog is the sum of these two queues
 - backlog has not been well-defined so far.
 - One may select any number other than 0.

Thakn yuo for ryou atteinton...

