Lecture 6.h
In Class Test 1 Review

Sockets

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Sockets and Socket Programming

Message Passing: Sockets (1)

Socket

- is an interface between an application and network that is created by the application
- is a construct (file descriptor) defined at OS level that supports read/write data from/to network
- initiates and accepts, and terminates connection

Message Passing: Sockets (1)

Socket

- **acts as an endpoint in the communication where message destinations are specified as socket addresses where each socket address is a communication identifier defined by an Internet address and a port number (the port number distinguishes between services running on the same machine)**

  end point determined by

    Host address: *IP address - Network Layer ID*

    Port number: *Transport Layer ID*

  two end-points determine a connection: socket pair

    ex: 206.62.226.35,p21 + 198.69.10.2,p1500

    ex: 206.62.226.35,p21 + 198.69.10.2,p1499

Message Passing: Sockets (2)

Socket

- **Example:**
  - **206.62.226.35:80 – Unsecured HTTP Server**
  - **206.62.226.35:443 – Secured HTTPS Server**
  - **206.62.226.35:21 – Unsecured FTP Server**

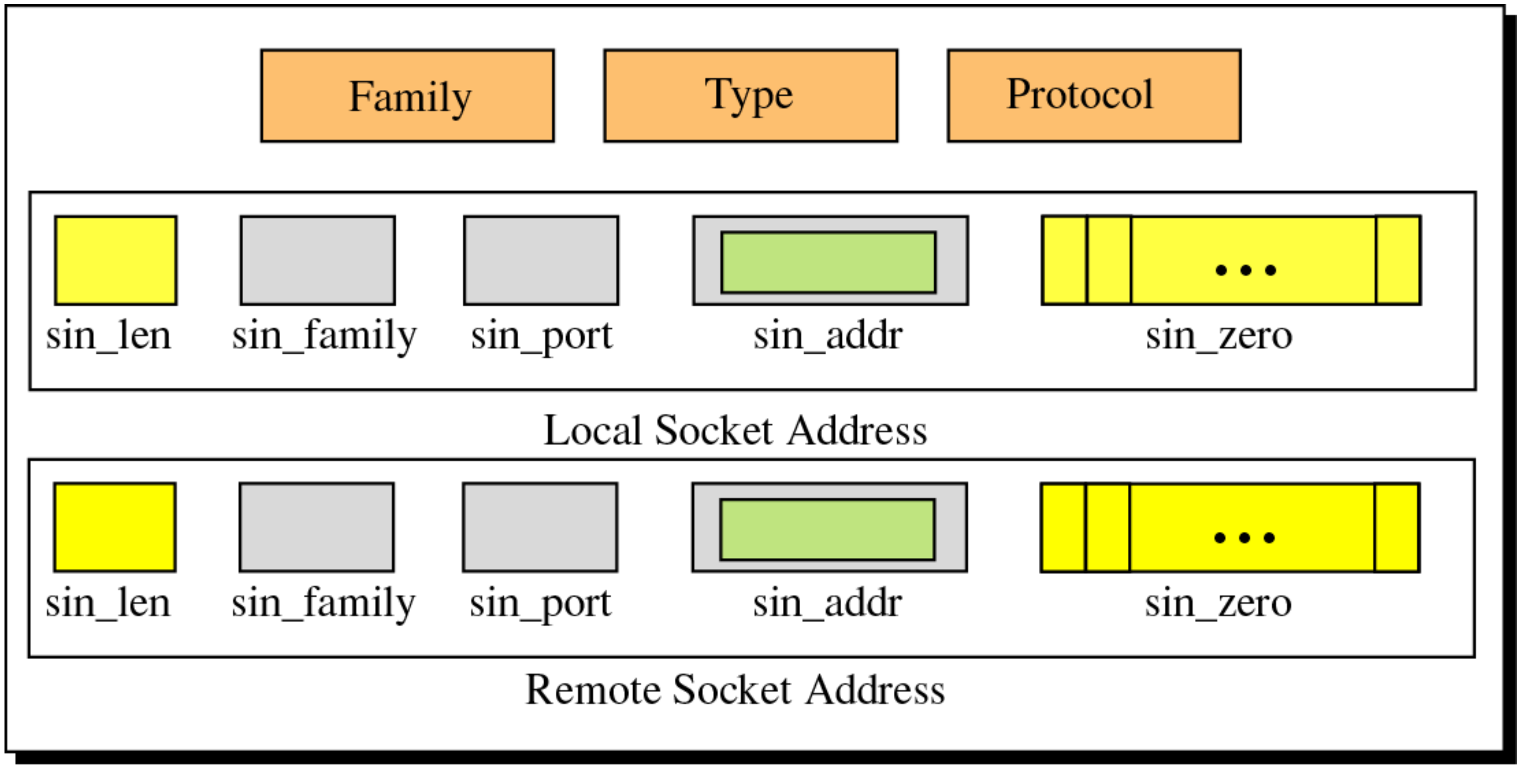
Standard Ports

- http: 80
- https: 443
- ftp: 20/21
- smtp: 25

Message Passing: Sockets (2)

Socket structure

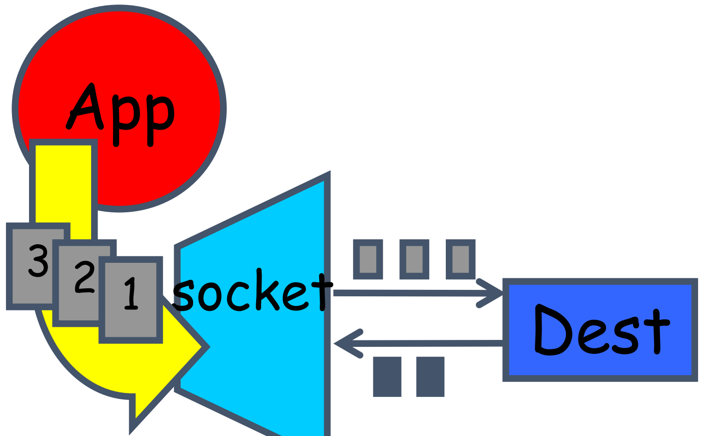
- Family:	defines the protocol group (IPv4, IPv6, UNIX domain protocols)
- Type:	defines the exchange-type (stream, packet, raw)
- Protocol:	TCP/UDP (or IP)
- Local address:	combination of remote IP and application port address
- Remote address:	combination of remote IP and application port address



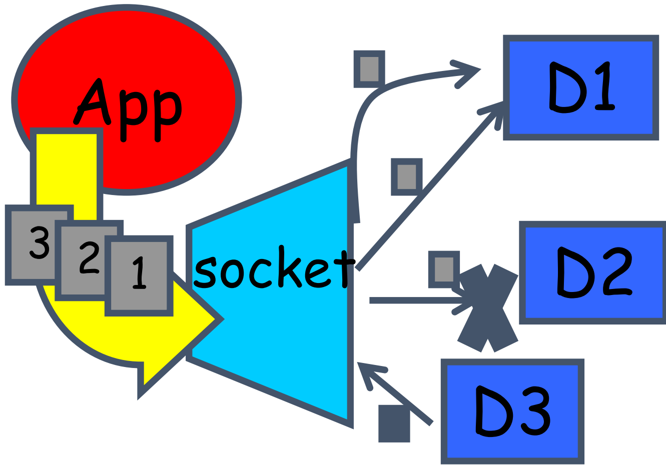
Message Passing: Sockets (3)

Socket types:

- **stream socket: SOCK_STREAM**
  - connection oriented bi-directional communication
  - uses the TCP protocol
  - error free (reliable) delivery;
  - no out- of- order packets
  - <u>applications</u>: telnet/ssh, http, …

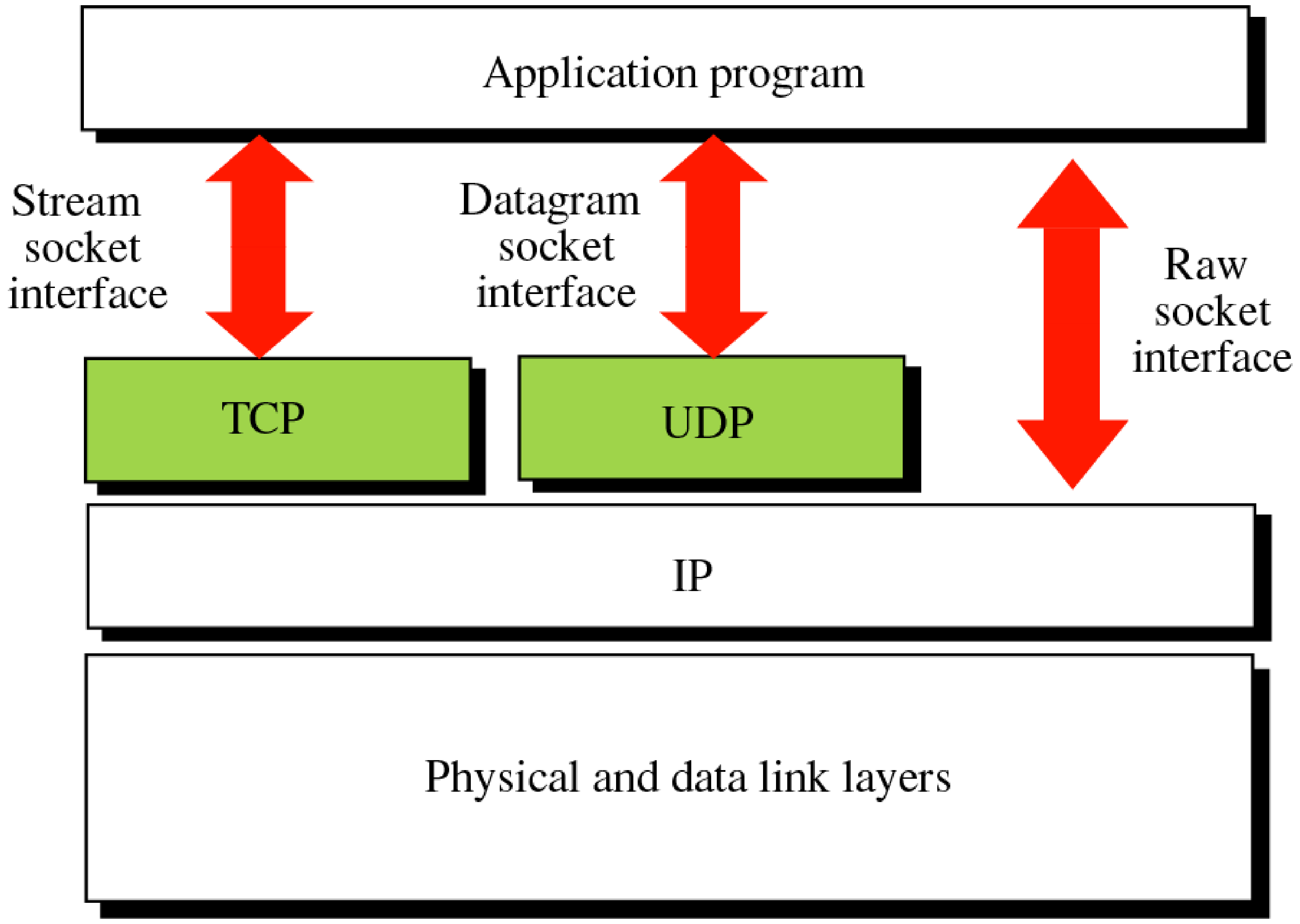


- **datagram socket: SOCK_DGRAM**
  - connectionless communication
  - uses the UDP protocol
  - packets may be lost and may arrive out of order
  - <u>applications</u>: streaming audio/ video (realplayer), …

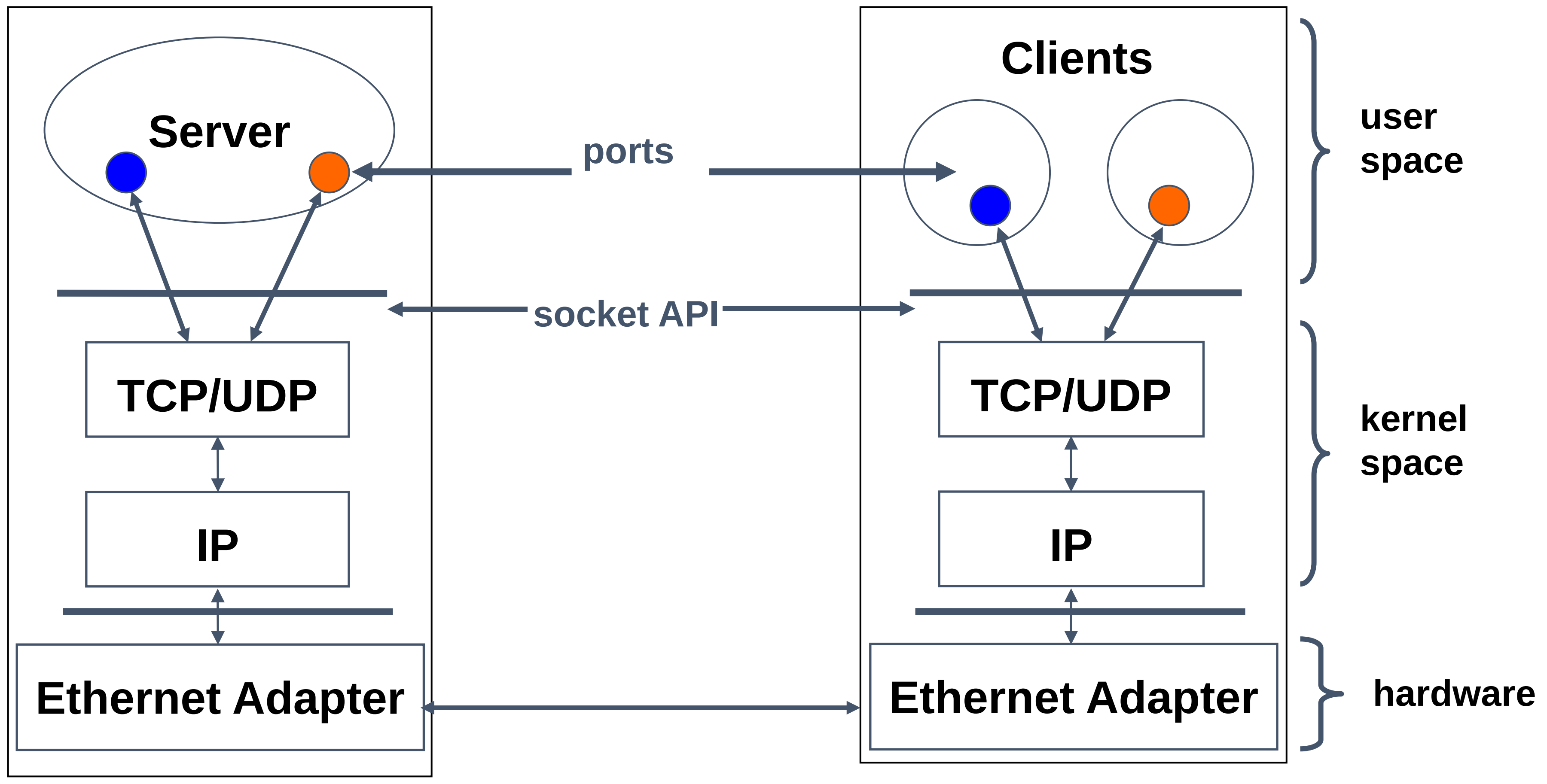


- **raw socket:**
  - some protocols (ICMP) directly use the service of IP
  - raw sockets are used in some applications for performance reasons.

Message Passing: Sockets (4)



Message Passing: Socket: Client-Server Communication



Message Passing: Socket Operations

Client operations

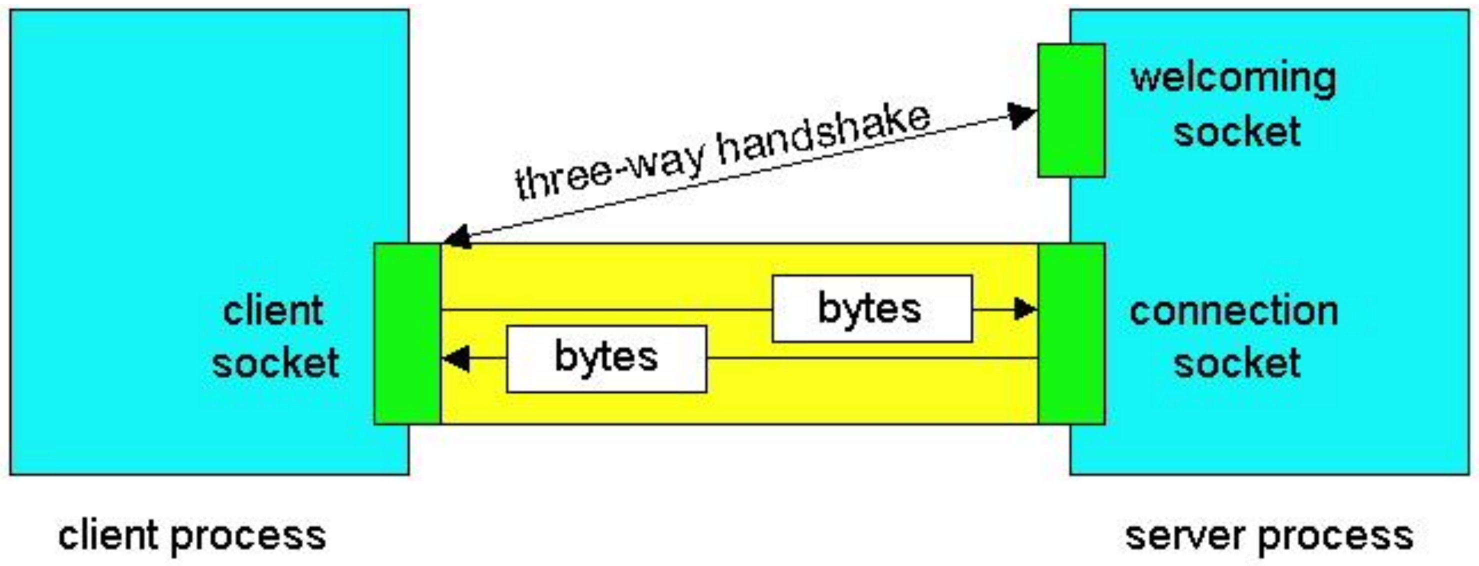
- Create a socket
- Setup the server address
- Connect to the server
- Read/write data
- Shutdown connection

Server operations

- Create a socket
- Bind the socket
- Listen for connections
- Accept new client connections
- Read/write to client connections
- Shutdown connection

Message Passing: Berkeley Socket API

socket ():	**create a socket**
bind():	**bind a socket to a local IP address and port #**
listen():	**passively waiting for connections**
connect():	**initiating connection to another socket**
accept():	**accept a new connection**
write():	**write data to a socket**
read():	**read data from a socket**
sendto():	**send a datagram to another UDP socket**
recvfrom():	**read a datagram from a UDP socket**
close():	**close a socket (tear down the connection)**



Message Passing: Berkeley Socket API

socket() creates a new socket of a certain socket type, identified by an integer number, and allocates system resources to it.

bind() is typically used on the server side, and associates a socket with a socket address structure, i.e. a specified local port number and IP address.

listen() is used on the server side, and causes a bound TCP socket to enter listening state.

connect() is used on the client side, and assigns a free local port number to a socket. In case of a TCP socket, it causes an attempt to establish a new TCP connection.

Message Passing: Berkeley Socket API

accept() is used on the server side. It accepts a received incoming attempt to create a new TCP connection from the remote client, and creates a new socket associated with the socket address pair of this connection.

send() and **recv()**, or **write()** and **read()**, or **sendto()** and **recvfrom()**, are used for sending and receiving data to/from a remote socket.

close() causes the system to release resources allocated to a socket. In case of TCP, the connection is terminated.

Message Passing: Berkeley Socket API

gethostbyname() and **gethostbyaddr()** are used to resolve host names and addresses. IPv4 only.

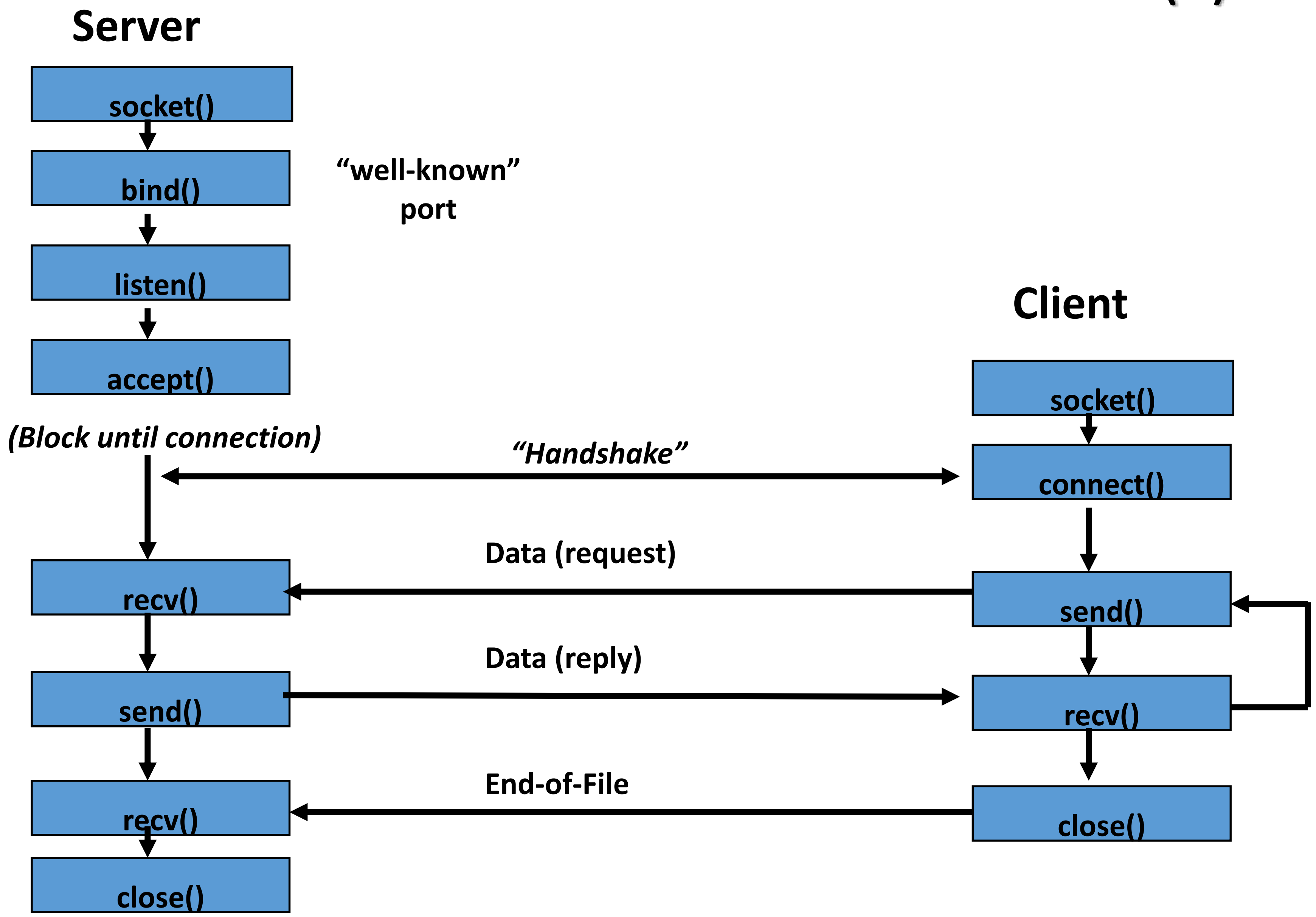
select() is used to suspend, waiting for one or more of a provided list of sockets to be ready to read, ready to write, or that have errors.

poll() is used to check on the state of a socket in a set of sockets. The set can be tested to see if any socket can be written to, read from or if an error occurred.

**getsockopt(**) is used to retrieve the current value of a particular socket option for the specified socket.

setsockopt() is used to set a particular socket option for the specified socket.

Message Passing: TCP Client-Server Communication (2)


Server
socket()
bind()
"well-known" port
listen()
accept()
(Block until connection)
Client
socket()
connect()
"Handshake"
Data (request)
recv()
send()
Data (reply)
send()
recv()
End-of-File
recv()
close()
close()