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08 Interaction Schemes

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Client-Server Model

- Servers provide services over a network.
  - Usually listen at a particular reserved TCP or UDP port (sometimes a TCP/UDP pair of ports).
  - May participate in more than one TCP connection at the same time.
  - Servers are often called daemons and are then given a name that ends with `d` (e.g., `httpd`).
  - A server may be organized as a group of processes or threads.
- Clients utilize services provided by servers.
  - Clients initiate connections to servers.
  - Usually are assigned an ephemeral port by the OS.
- Servers are usually more complex than clients.
  - The burden of security falls mostly on the server.

Components of a Client-Server Application

1. Communication protocol.
2. Server running a server program.
3. One or more clients running client programs.
4. Communication channels via TCP or UDP.

The Socket Interface

- The socket interface is an interface for application programs to establish communication channels using TCP/IP protocols (as well as other protocols).
- The socket interface can be implemented:
  - Directly in the operating system.
  - By a set of library routines.
  - Within a programming language (e.g., Java).
- A socket is the end point of a communication channel.
  - Is a generalization of a Unix file.
- The socket interface is becoming a de facto standard.

Functions in the Socket Interface

- Socket: Creates a socket.
- Bind: Establishes a local protocol port for a socket.
  - Usually only called by a server process.
- Connect: Connects a socket to a destination IP address and protocol port.
  - For TCP, a TCP connection is established.
  - For UDP, no connection is made, but the destination address and port number are stored.
- Listen: Enables a server process to listen to a socket.
- Accept: Blocks a server process until a connection request arrives and then creates a new socket to handle the request.
- Close: Closes a socket.

Sending and Receiving Data

- Data is sent through a socket using various kinds of write functions.
- Data is received through a socket using various kinds of read functions.

Other Socket Interface Functions

- Functions for getting socket attributes such as:
  - Source and destination IP addresses.
  - Source and destination IP protocol ports.
- Functions for getting and setting socket options such as:
  - Buffer sizes.
  - Timeout parameters.
- Library functions that provide network services such as:
  - DNS queries.
  - Host information.
  - Network information.
  - Protocol information.