Data Communication

Data Communication

Basic Elements of a Communication System

The following are the basic requirements for working of a communication system.

1. The sender (source) who creates the message to be transmitted

2. A medium that carries the message

3. The receiver (sink) who receives the message

In data communication **four basic terms** are frequently used. They are:

Data : A collection of facts in raw forms that become information after
processing.

Signals : Electric or electromagnetic encoding of data.

Signaling : Propagation of signals across a communication medium.

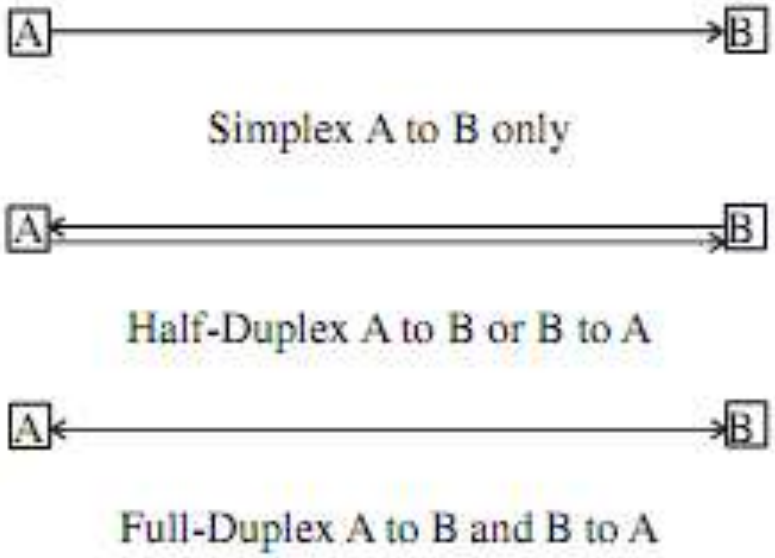
Transmission : Communication of data achieved by the processing of signals.

Data Transmission Modes

1. Simplex :

2. Half-duplex :

3. Full-duplex :



Communication Protocols

The data transmission software or protocols perform the following functions for the efficient and error free transmission of data.

1. **Data sequencing :** A long message to be transmitted is broken into smaller packets of fixed size for error free data transmission.

2. Data Routing : It is the process of finding the most efficient route between source and destination before sending the data.

3. Flow control : All machines are not equally efficient in terms of speed. Hence the flow control regulates the process of sending data between fast sender and slow receiver.

4. Error Control : Error detecting and recovering is the one of the main functions of communication software. It ensures that data are transmitted without any error.

Types of Communication Services

A term used to describe the data-handling capacity of a communication service is bandwidth.

Bandwidth is the range of frequencies that is available for the transmission of data.

Communication companies such as American Telephone and Telegraph (AT&T) and Western Union are called common carriers, and they provide **three general classes of service** for both voice and data communication:

1. Narrowband handles low data volumes. Data transmission rates are from 45 to 300 baud. The low-speed devices might use narrow band communications.

2. Voiceband handles moderate data transmission volumes between 300 and 9600 baud. They are used for applications ranging from operating a CRT to running a line printer. Their major application is for telephone voice communication hence, the term voiceband.

3. Broadband handles very large volumes of data. These systems provide data transmission rates of 1 million baud or more. High-speed data analysis and satellite communications are examples of broadband communication systems.

Communication Media

Following are the major communication devices which are frequently used :

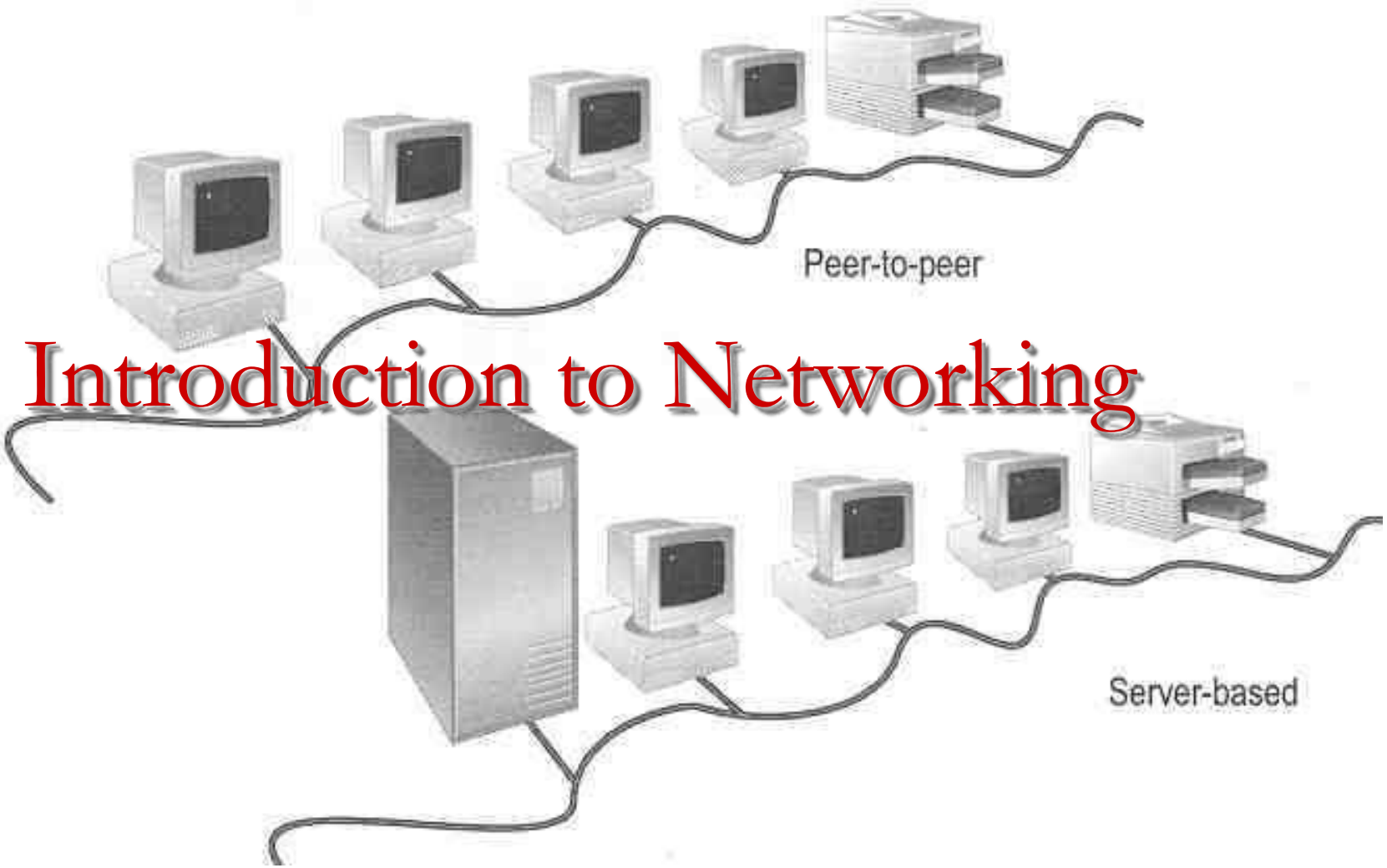
1. Wire Pairs : Wire pairs are commonly used in local telephone communication and for short distance digital data communication. They are usually made up of copper and the pair of wires is twisted together. Data transmission speed is normally 9600 bits per second in a distance of 100 meter.

2. Coaxial Cables : Coaxial cable is groups of specially wrapped and insulated wires that are able to transfer data at higher rate. They consist of a central copper wire surrounded by an insulation over which copper mesh is placed. They are used for long distance telephone lines and local area network for their noise immunity and faster data transfer.

3. Microwave : Microwave system uses very high frequency radio signals to transmit data through space. The transmitter and receiver of a

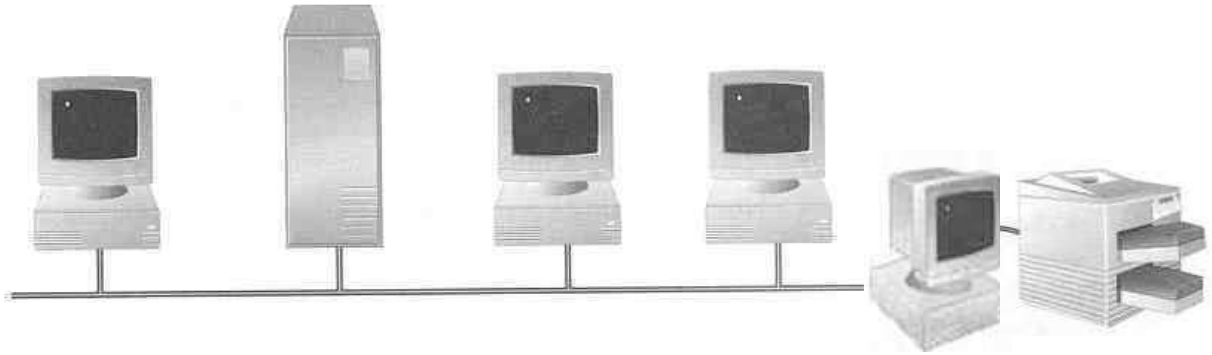
4. Communication Satellite : The problem of line-sight and repeaters are overcome by using satellites which are the most widely used data transmission media in modern days. A communication satellite is a microwave relay station placed in outer space.

Introduction to Networking



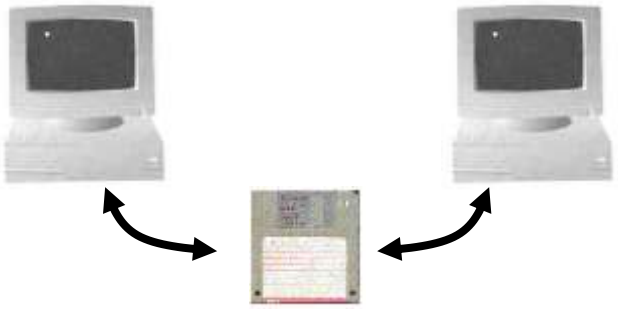
What is a Network?

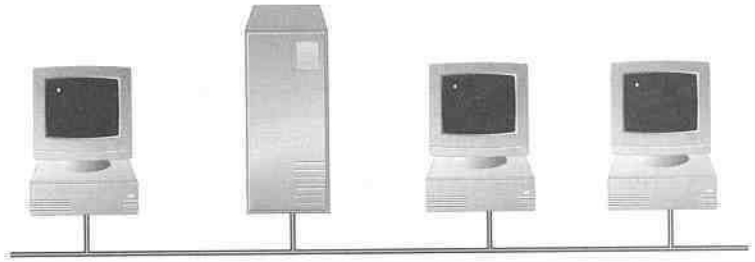
A network consists of 2 or more computers connected together, and they can communicate and share resources (e.g. information)



Why Networking?

- **Sharing information — i.e. data communication**
  - **Do you prefer these?**
  - **Or this?**





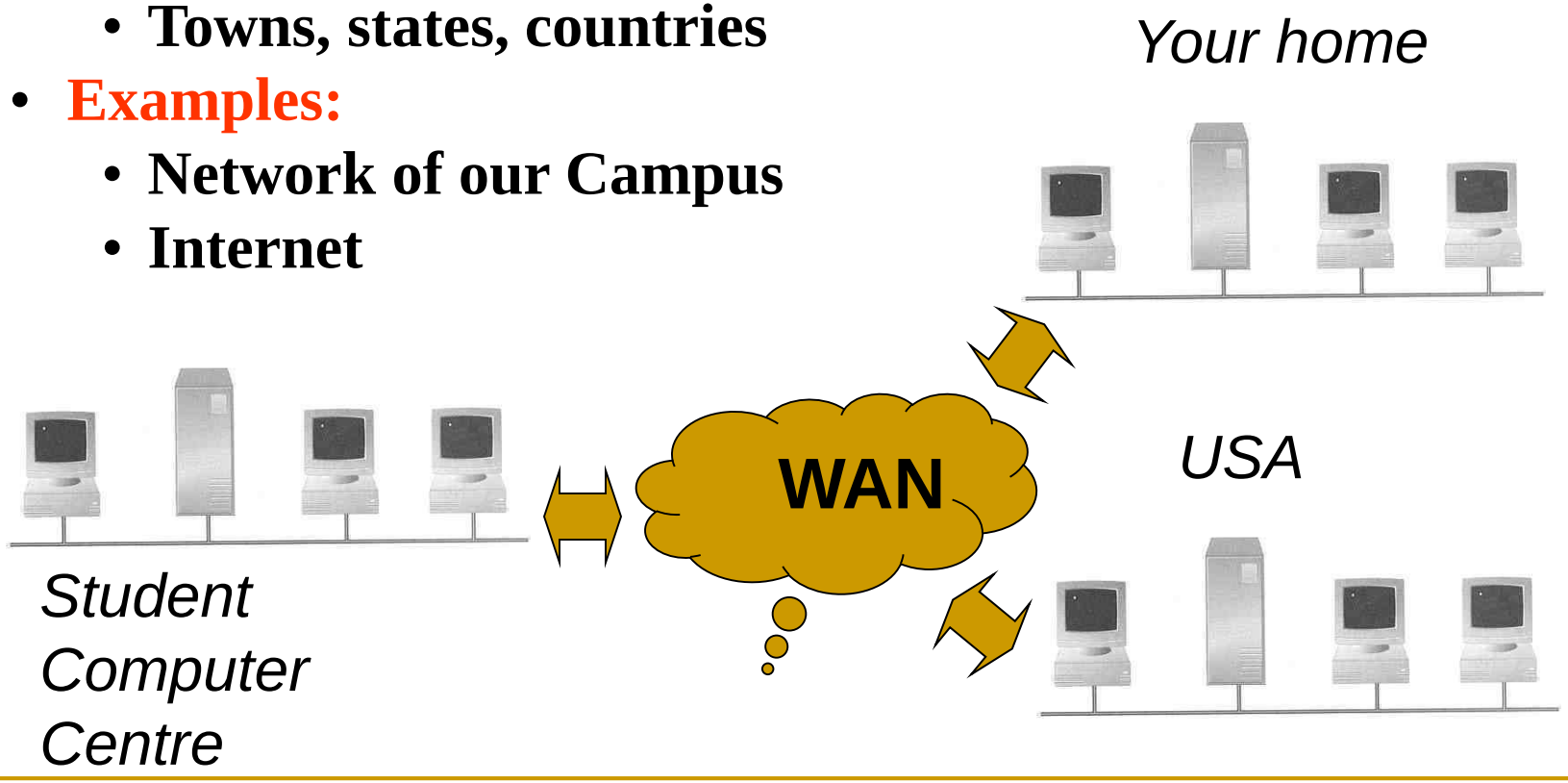
How many kinds of Networks?

- **Depending on one's perspective, we can classify networks in different ways**
  - **Based on transmission media: Wired (UTP, coaxial cables, fiber-optic cables) and Wireless**
  - **Based on network size: LAN and WAN (and MAN)**
  - **Based on management method: Peer-to-peer and Client/Server**
  - **Based on topology (connectivity): Bus, Star, Ring …**

LAN and WAN

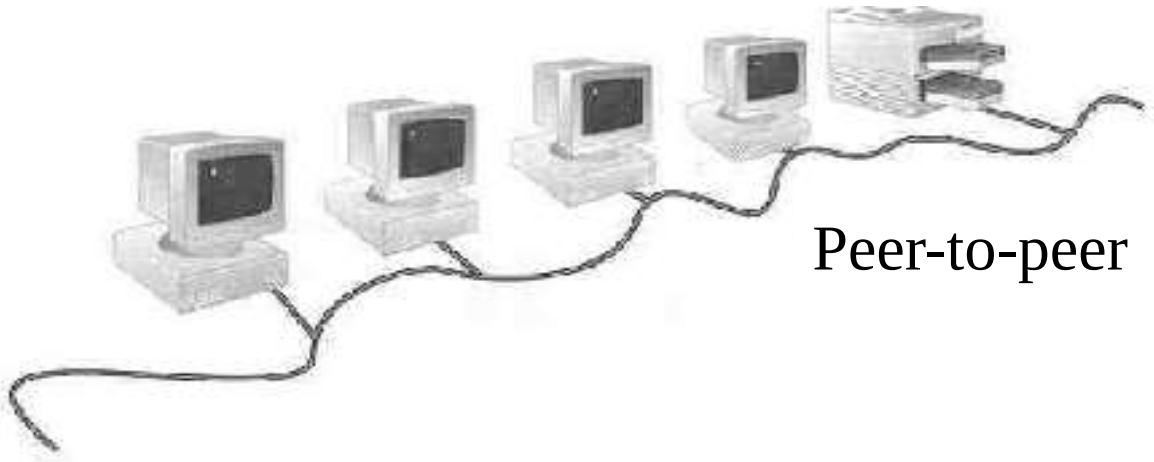
- **Local Area Network (LAN)**
  - **Small network, short distance**
    - **A room, a floor, a building**
    - **Limited by no. of computers and distance covered**
    - **Usually one kind of technology throughout the LAN**
    - **Serve a department within an organization**
  - **Examples:**
    - **Network inside the Student Computer Room**
    - **Network inside your home**

- **Wide Area Network (WAN)**
  - **A network that uses long-range telecommunication links to connect 2 or more LANs/computers housed in different places far apart.**
    - **Towns, states, countries**
  - **Examples:**
    - **Network of our Campus**
    - **Internet**



Peer-to-Peer Networks

- **Peer-to-peer network is also called workgroup**
- **No hierarchy among computers ⇒ all are equal**
- **No administrator responsible for the network**



Peer-to-peer

- **Advantages of peer-to-peer networks:**
  - **Low cost**
  - **Simple to configure**
  - **User has full accessibility of the computer**
- **Disadvantages of peer-to-peer networks:**
  - **May have duplication in resources**
  - **Difficult to uphold security policy**
  - **Difficult to handle uneven loading**
- **Where peer-to-peer network is appropriate:**
  - **10 or less users**
  - **No specialized services required**
  - **Security is not an issue**
  - **Only limited growth in the foreseeable future**

Clients and Servers

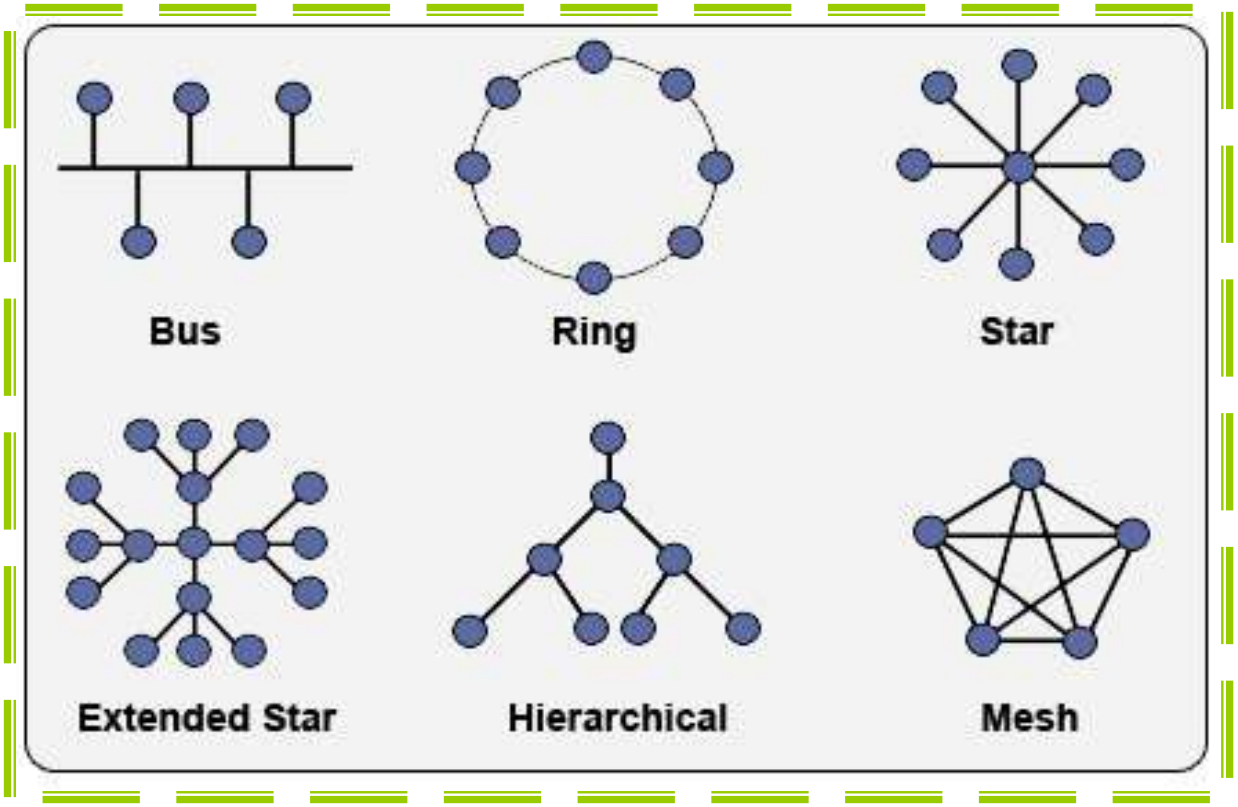
- **Network Clients (Workstation)**
  - **Computers that request network resources or services**
- **Network Servers**
  - **Computers that manage and provide network resources and services to clients**
    - **Usually have more processing power, memory and hard disk space than clients**
    - **Run Network Operating System that can manage not only data, but also users, groups, security, and applications on the network**
    - **Servers often have a more stringent requirement on its performance and reliability**

- **Advantages of client/server networks**
  - **Facilitate resource sharing – centrally administrate and control**
  - **Facilitate system backup and improve fault tolerance**
  - **Enhance security – only administrator can have access to Server**
  - **Support more users – difficult to achieve with peer-to-peer networks**

- **Disadvantages of client/server networks**
  - **High cost for Servers**
  - **Need expert to configure the network**
  - **Introduce a single point of failure to the system**

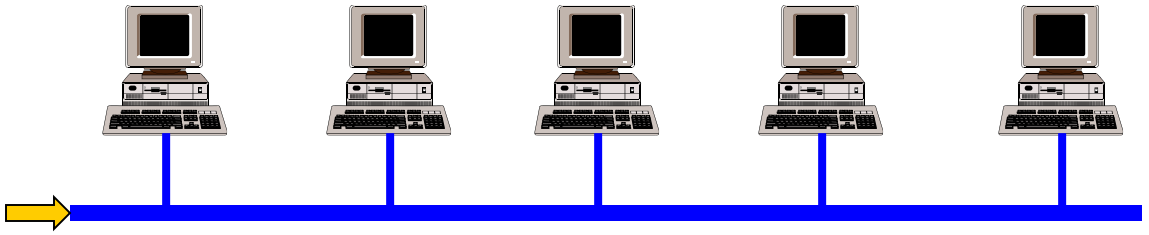
Topology

The physical topology of a network refers to the configuration of cables, computers, and other peripherals.



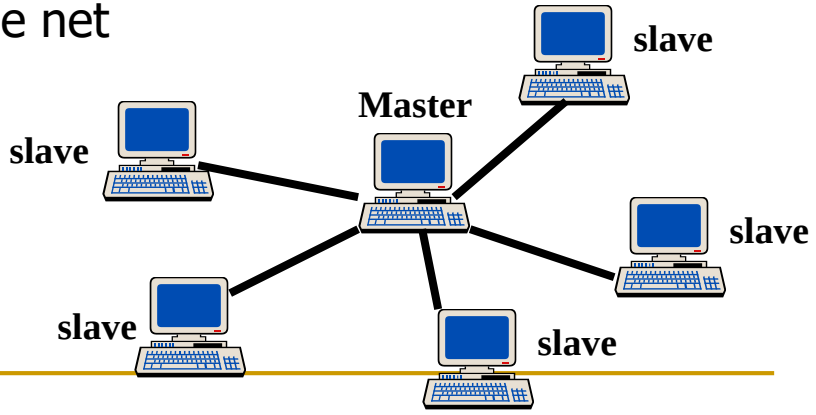
Bus Network Topology

- Every nodes tap into a common medium
- Signals may collide with each other
  - need to arbitrate who will get the bus
  - capable of broadcasting message (one send & many listen)
  - the common medium is the bottleneck
    - single node failure causes no network failure
    - the medium failure brings down the network
  - Example: (old, 10BASE2, 10BASE5) Ethernet



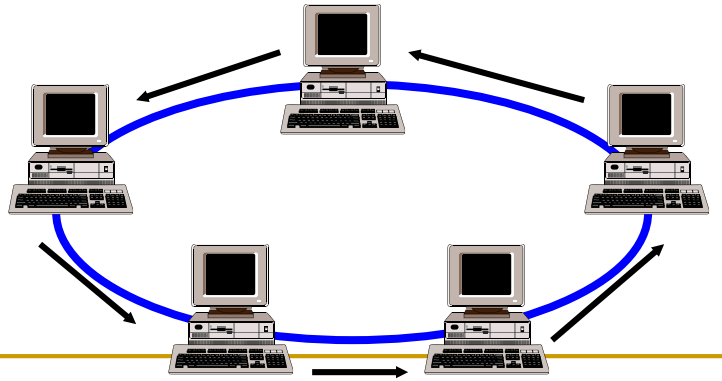
Star Network Topology

- One node at the center as the master node
- Other nodes linked to the master as slaves
  - slaves communicate via master
  - easy to arbitrate among slaves (master decides)
  - not scalable (the master is the bottleneck)
  - normally for small networks or that requires predictable performance
  - master failure shutdowns the whole net
- Example: Ethernet



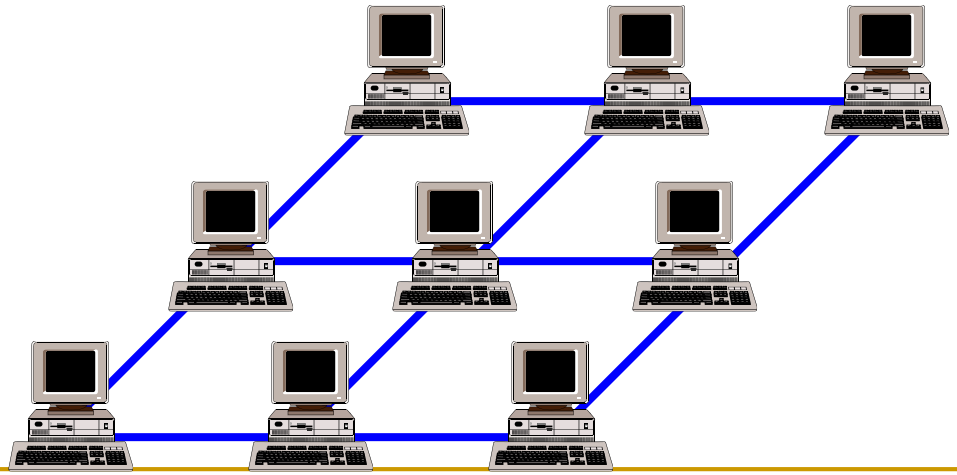
Ring Network Topology

- Nodes are arranged in a ring
- One node receives from its predecessor & sends to its successor
  - arbitrate who can access the ring
  - messages forwarded by each node
  - sender deletes its messages from the ring
  - the common ring is the single point of failure (complicated connectors needed)



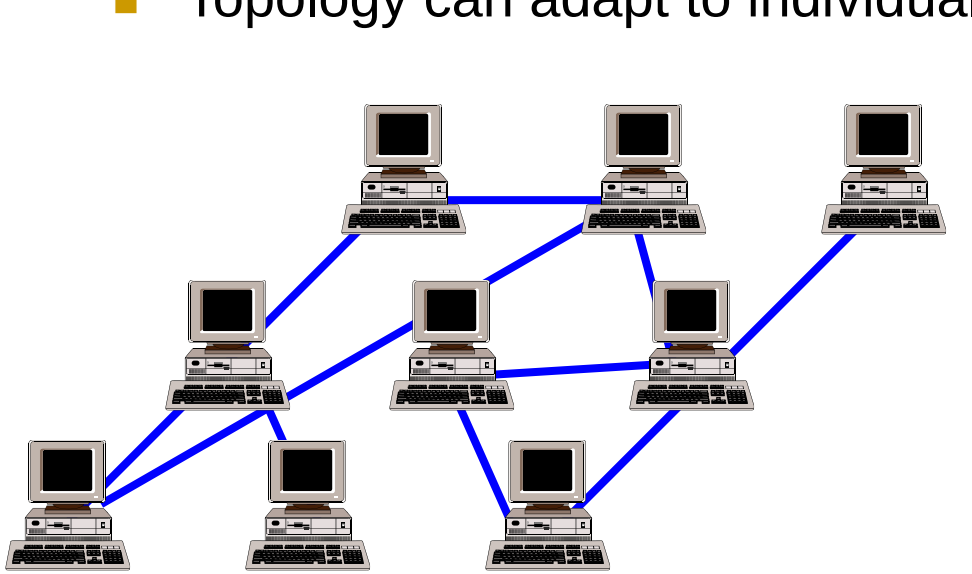
Mesh Network Topology

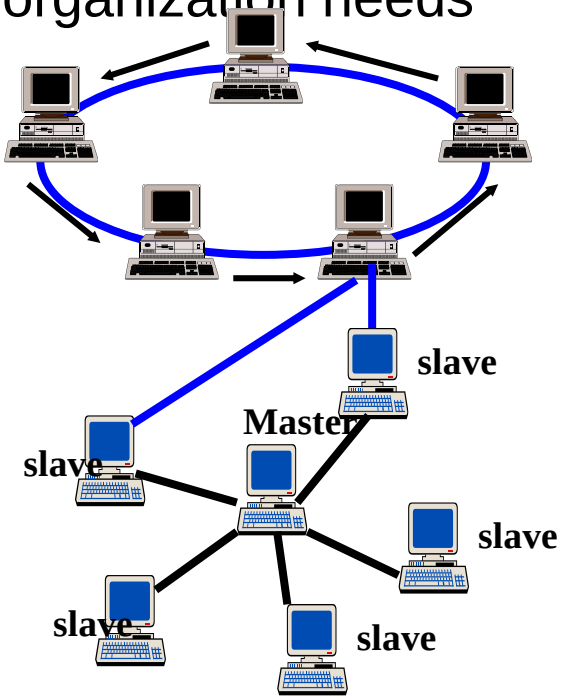
- Nodes are arranged in grids
  - each node can talk to its neighbors directly
  - non-neighbor nodes needs store-and-forward for communication



Hyper Network Topology

- No restrictions on how to link the nodes
- Topology can adapt to individual organization needs





Considerations When Choosing a Topology:

Money. A linear bus network may be the least expensive way to install a network; you do not have to purchase concentrators.

Length of cable needed. The linear bus network uses shorter lengths of cable.

Future growth. With a star topology, expanding a network is easily done by adding another concentrator.

Cable type. The most common cable in schools is unshielded twisted pair, which is most often used with star topologies.

Protocols

A Protocol is a convention or standard that controls or enables the connection, communication, and data transfer between two computing endpoints. Protocols may be implemented by hardware, software, or a combination of the two.

Most protocols specify one or more of the following:

- Detection of the underlying physical connection (wired or wireless)
- How to start and end a message
- How to format a message
- What to do with corrupted or improperly formatted messages (error correction)
- How to detect unexpected loss of the connection , and what to do next
- Termination of the session or connection

Common protocols

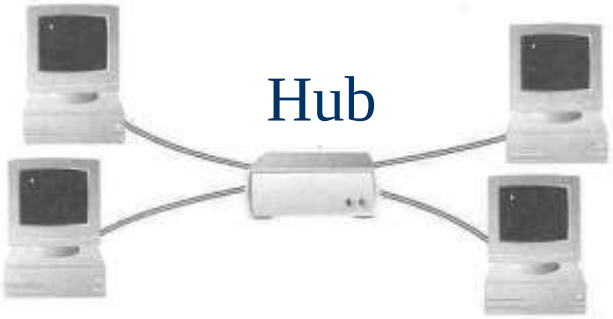
- IP (Internet Protocol)
- UDP (User Datagram Protocol)
- TCP (Transmission Control Protocol)
- DHCP (Dynamic Host Configuration Protocol)
- HTTP (Hypertext Transfer Protocol)
- FTP (File Transfer Protocol)
- Telnet (Telnet Remote Protocol)
- SSH (Secure Shell Remote Protocol)
- POP3 (Post Office Protocol 3)
- SMTP (Simple Mail Transfer Protocol)
- IMAP (Internet Message Access Protocol)
- SOAP (Simple Object Access Protocol)
- PPP (Point-to-Point Protocol)

HUBS

→A device connected to several other devices

or

→A common connection point for computers and devices in a network that takes an incoming signal and repeats it on all other ports



Different Types of Hub

Passive hub serves simply as a conduit for the data, enabling it to go from one device (or segment) to another.

Intelligent hub include additional features that enables an administrator to monitor the traffic passing through the hub and to configure each port in the hub. Intelligent hubs are also called manageable hubs.

Switching hub actually reads the destination address of each packet and then forwards the packet to the correct port.

NODES

- The computers used in the network are referred to nodes