Data Communication Fundamentals

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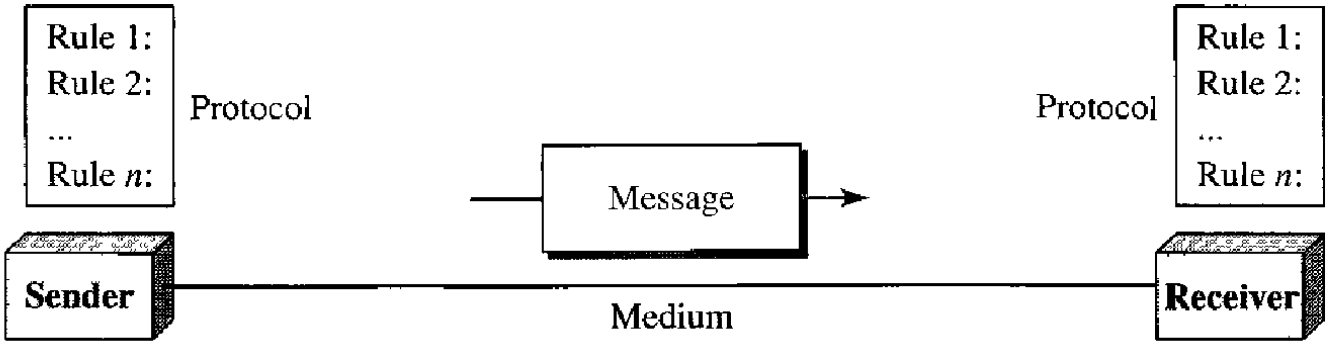
Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable. The effectiveness of a data communications system depends on four fundamental characteristics: delivery, accuracy, timeliness and jitter.

Delivery: The system must deliver data to the correct destination. Data must be received by the intended device or user.
Accuracy: The system must deliver data accurately. Data that have been altered in transmission and left uncorrected are unusable.
Timeliness: The system must deliver data in a timely manner. Data delivered late are useless. This characteristic is responsible for real-time transmission.

Jitter: Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets.

Components:

A data communications system has five components.



Message: The message is the information (data) to be communicated. Popular forms of information include text, number, pictures, audio and video.

Sender: The sender device that sends the data message. It can be a computer, workstation, and so on.

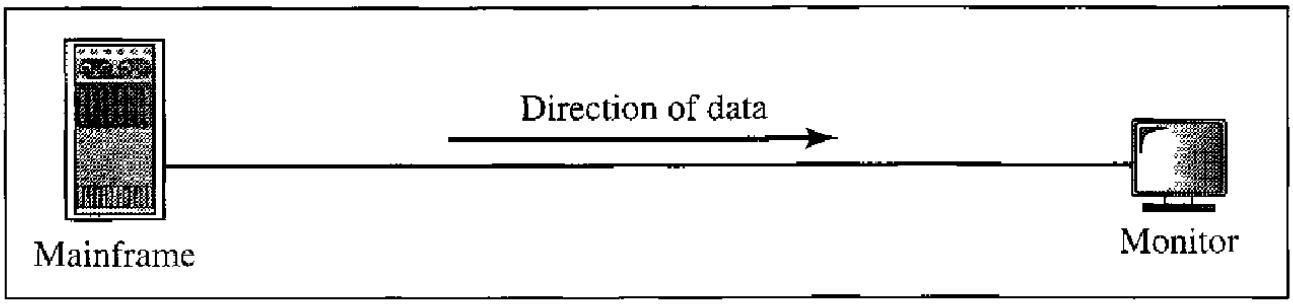
Receiver: The receiver is the device that receives the message. It can be a computer, workstation, and so on.

Transmission medium: The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission medium are twisted-pair wire, coaxial cable, fiber-optic cable and radio waves.

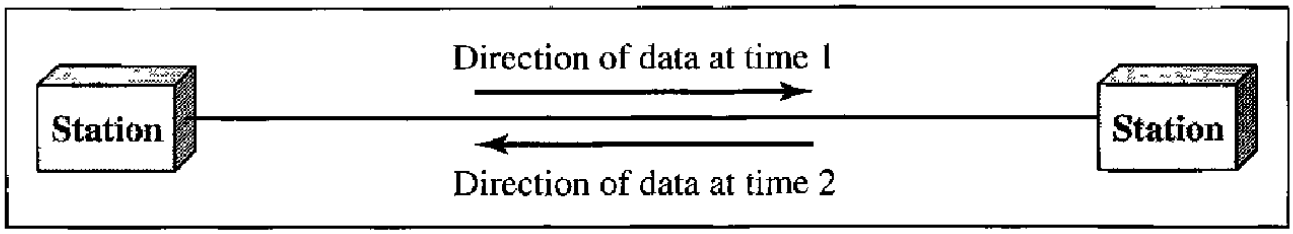
Protocol: A protocol is a set of rules that govern data communication. It represents an agreement between the communicating devices.

Data Flow:

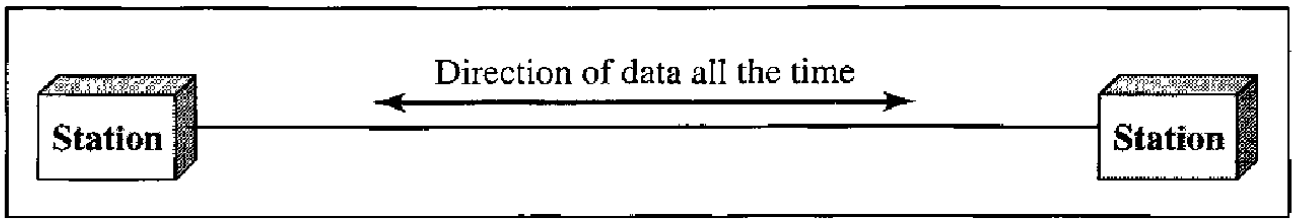
Communication between two devices can be simplex, half-duplex, or full-duplex as shown in below.



a. Simplex



b. Half-duplex



c. Full-duplex

Simplex: In simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit; the other can only receive. Keyboard and monitor are examples of simplex devices.

Half-Duplex: In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive and vice versa. Walkie-talkies and CB radios are both half-duplex systems.

Full-Duplex: In full-duplex mode (also called duplex) both stations can transmit and receive simultaneously. One common example of full-duplex communication is the telephone network.

NETWORK: A network is a set of devices (often referred to as nodes) connected by communication links. A node can be a computer, printer, or any other device capable of sending and/or receiving data generated by other nodes on the network. A link can be a cable, air, optical fiber, or any medium which can transport signal carrying information.

Network Criteria: A network must be able to meet a certain number of criteria. The most important of these are Performance, Reliability and Security.

Performance

Depends on Network Elements

Measured in terms of Delay and Throughput

Reliability

Failure rate of network components

Measured in terms of availability/robustness

Security

Data protection against corruption/loss of data due to:

Errors

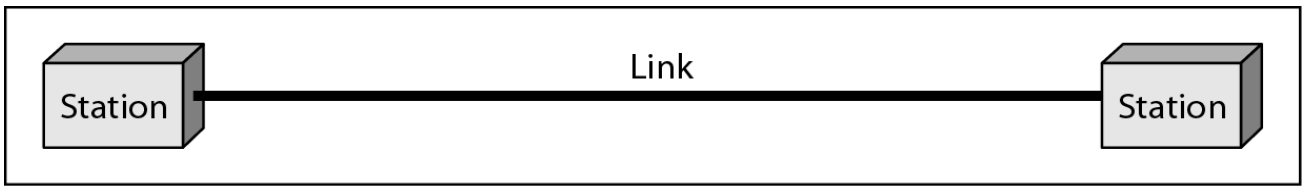
Malicious users

Physical Structures: A network must be able to meet a certain number of attributes. The most important of these are Type of Connection and Physical Topology.

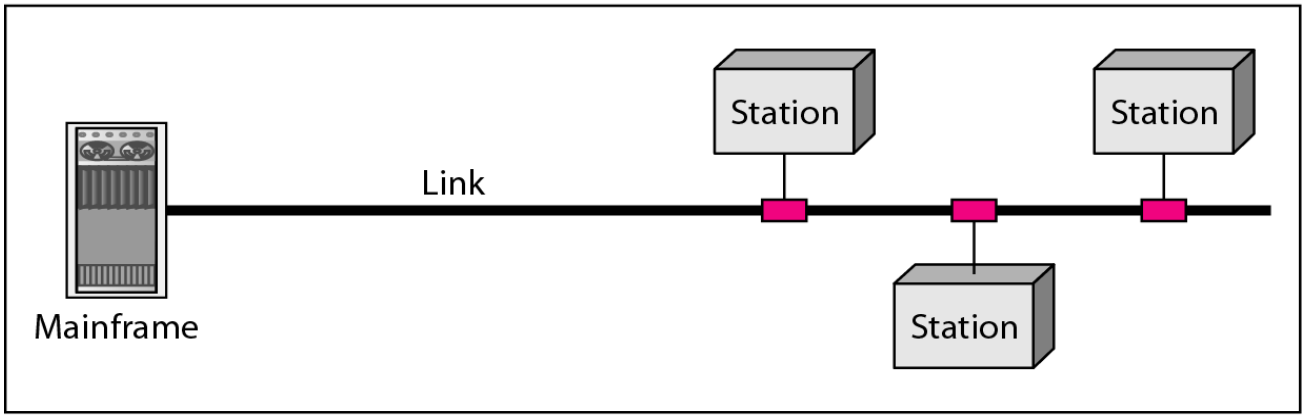
Type of Connection: A network is two or more devices connected through links. A link is a communications pathway that transfers data from one device to another. There are two possible types of connections: Point to Point and Multipoint.

Point to Point – A point to point connection provides a dedicated link between two devices in which one device acts as transmitter and other one acts as receiver.

Multipoint –A multipoint connection is one in which more than two specific devices share a single link. Its orientation is multiple recipients of single transmission.



a. Point-to-point

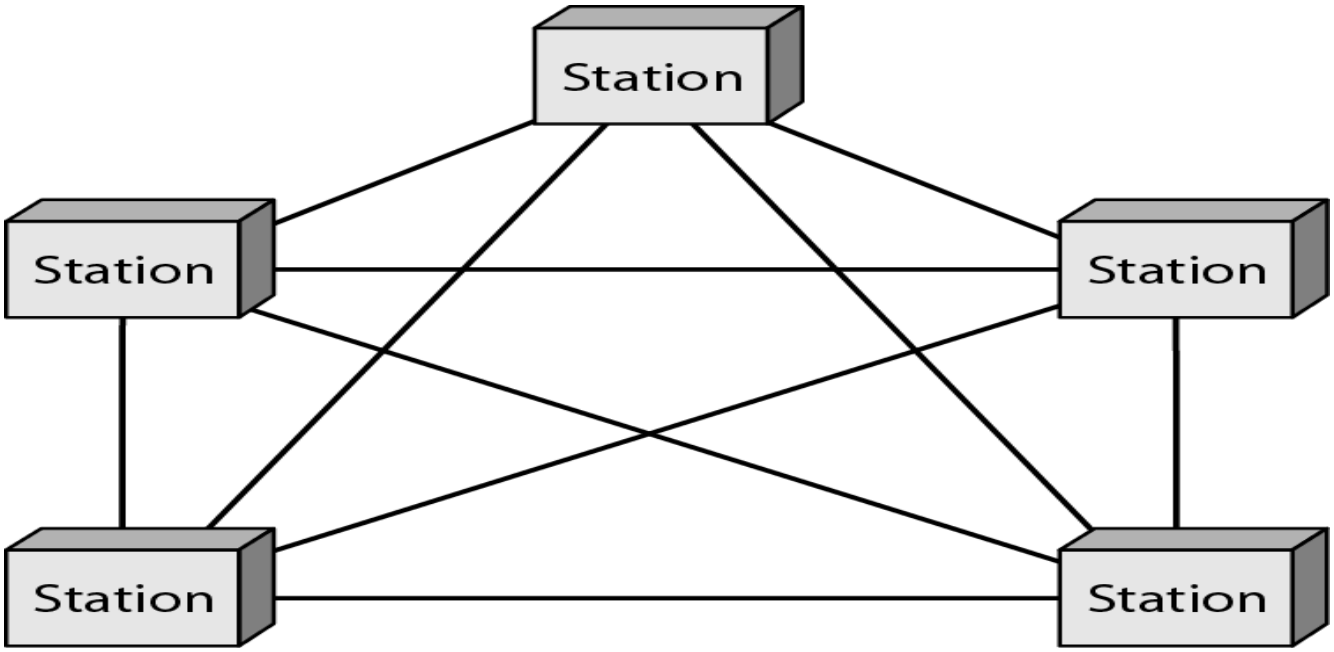


b. Multipoint

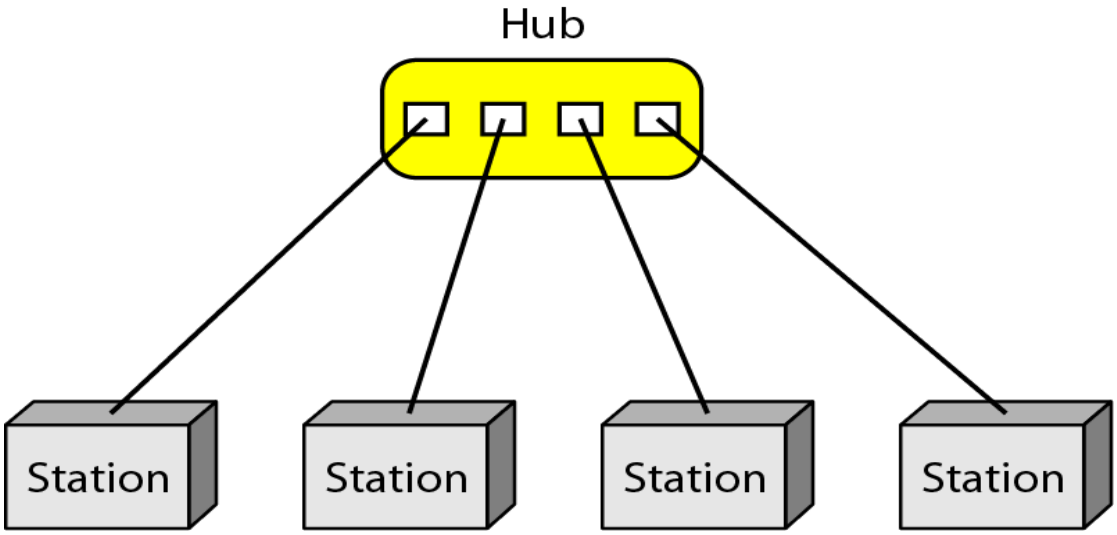
Physical Topology:

The term physical topology refers to the way in which a network is laid out physically. Two or more devices connect to a link; two or more links form a topology. The topology of a network is the geometric representation of the relationship of all the links and linking devices to one another. There are four basic topologies possible: mesh, star, bus and ring.

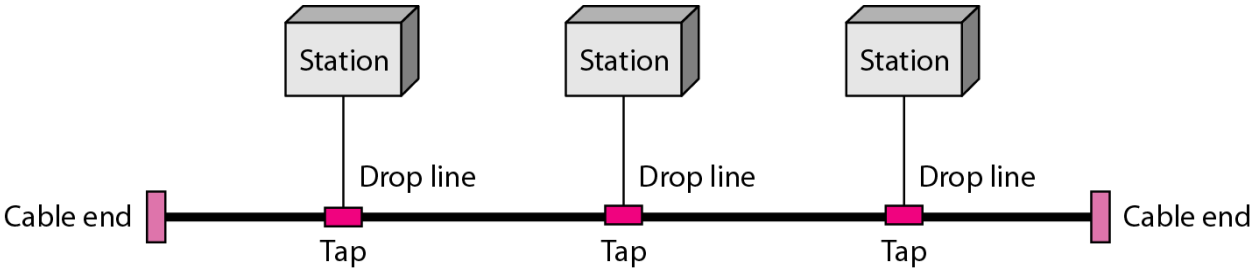
Mesh: In a mesh topology, every device has a dedicated point to point link to every other device. The term dedicated means that the link carries traffic only between the two devices it connects.



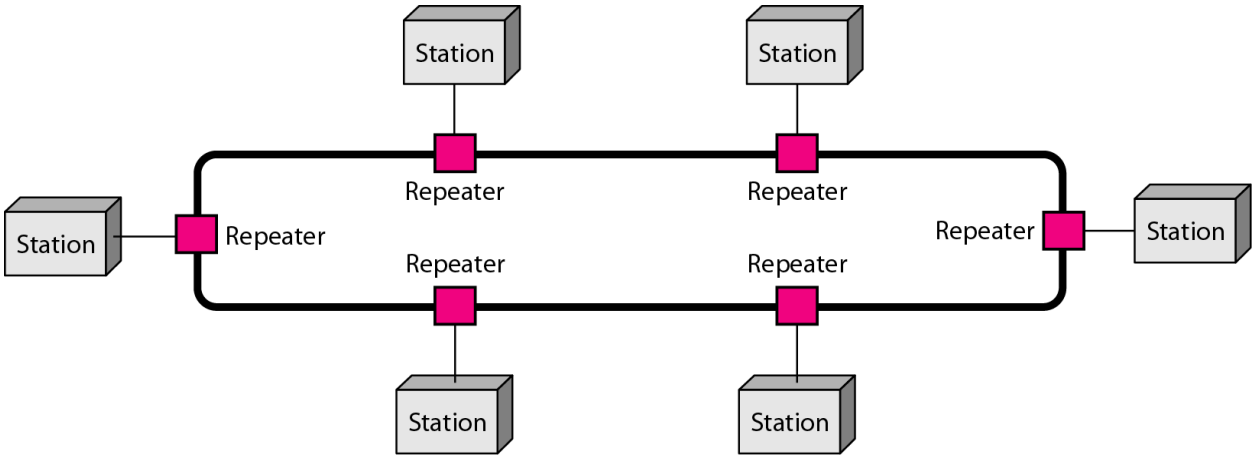
Star: In a star topology, each device has a dedicated point-to-point link only to a central controller, usually called a hub. The devices are not directly linked to one another.



Bus: A bus topology is multipoint. One long cable acts as a backbone to link all the devices in a network. Nodes are connected to the bus cable by drop lines and taps.



Ring: In a ring topology, each device has a dedicated point to point connection with only the two devices on either side of it. A signal is passed along the ring in one direction, from device to device, until it reaches its destination. Each device in the ring incorporates a repeater.



<u>Categories of Networks</u>

Local Area Networks (LANs): A Local area network (LAN) is usually privately owned and links the devices in a single office, building, or campus. Depending on the needs of an organization and the type of technology used, a LAN can be as simple as two PCs and printer in someone's home office.

Wide Area Networks (WANs): A wide area network (WAN) provides long distance transmission of data, image, audio, and video information over large geographic areas that may comprise a country, a continent, or even the whole world.

Metropolitan Area Networks (MANs): A metropolitan area network (MAN) is a network with a size between a LAN and a WAN. It normally covers the area inside a town or a city. It is designed for customers who need a high speed connectivity, normally internet, and have endpoints spread over a city or part of city.