Data Communications

When we communicate, we are sharing information. This sharing can be local or remote. Between individuals, local communication usually occurs face to face, while remote communication takes place over distance. The term telecommunication, which includes telephony, telegraphy and television, means communication at a distance (tele is Greek for "far")

The word data refers to information presented in whatever form is agreed upon by the parties creating and using the data.

The effectiveness of a data communications system depends on four fundamental characteristics:

1. Delivery: The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.

2. Accuracy Timeliness: The system must deliver data in a timely manner. In the case of video and audio timely delivery means delivering data as they are produced, in the same order that they are produced and without significant delay. This kind of delivery is called real-time transmission.

3. Timeliness Accuracy: The system must deliver the accurately. Data that have been altered in transmission and left uncorrected are unusable.

4. Jitter: Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets. If some of the packets arrive with 30ms delay and

and others with 40ms delay, an uneven quality in the video is the result.

Components

A data communications system has five components

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

2. **Sender:** The sender is the device that sends the data message.

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

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

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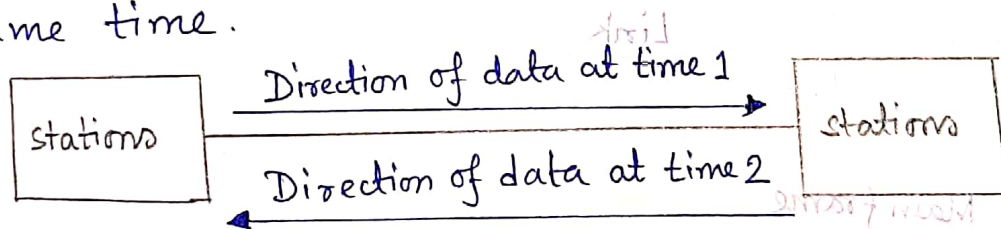
Modes of data communication

Communication between two devices can be simplex, half-duplex, or full-duplex

Simplex: In simplex mode, the communication is unidirectional, only one of the two devices on a link can transmit; the other can only receive.

Keyboards and traditional monitors are examples of simplex devices. The simplex mode can use the entire capacity of the channel to send data in one direction.

Mainframe ———— Direction of data ————→ Monitor
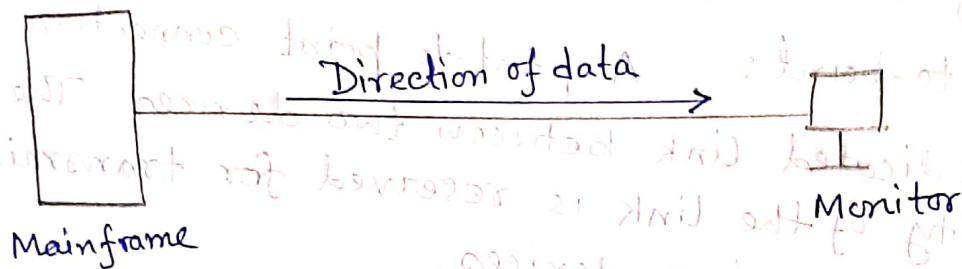
Half-duplex: In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa. Walkie-talkies and CB (citizens band) radios are both half-duplex systems. The half-duplex mode is used in cases where there is no need for communication in both directions at the same time.

stations ——— Direction of data at time 1 ———→ stations
stations ←——— Direction of data at time 2 ——— stations

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. When two people are communicating by a telephone line, both can talk and listen at the same time.

Station ← Direction of data all the time → Station
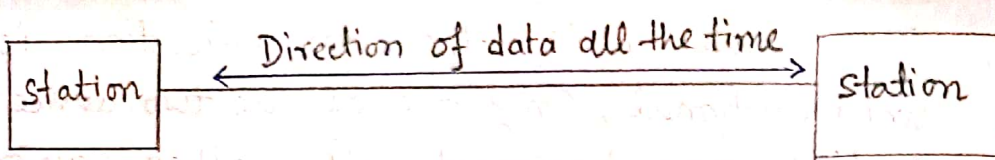
Type of Connection

A network is two or more devices connected through links. A link is a communications pathway that transfers data from one device to another.

Point-to-point: A point-to-point connection provides a dedicated link between two devices. The entire capacity of the link is reserved for transmission between those two devices.

Station —— Link —— Station
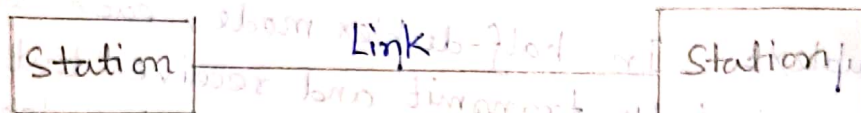
Multipoint:

A multipoint connection is one in which more than two specific devices share a single link.

Main frame —— Link —— Station / Station / Station
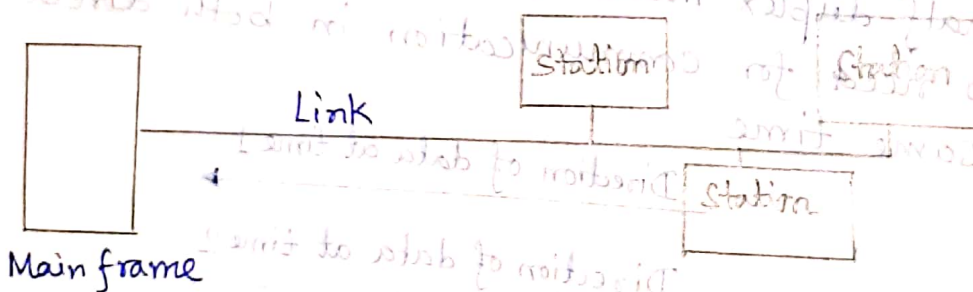
Physical Topology

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, store, 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.

advantages: i) The use of dedicated links guarantees that each connection can carry its own data load, thus eliminating the traffic problems that can occur when links must be shared by multiple devices.

ii) A mesh topology is robust. If one link becomes unusable, it does not incapacitate the entire system.

iii) There is the advantage of privacy or security. When every message travels along a dedicated line, only the intended recipient sees it.

disadvantages: i) Huge amount of cabling and the number of I/o ports required.

ii) Every device must be connected to every other device, installation and reconnection are difficult.

Station

Station   Station

Station   Station

Store Topology
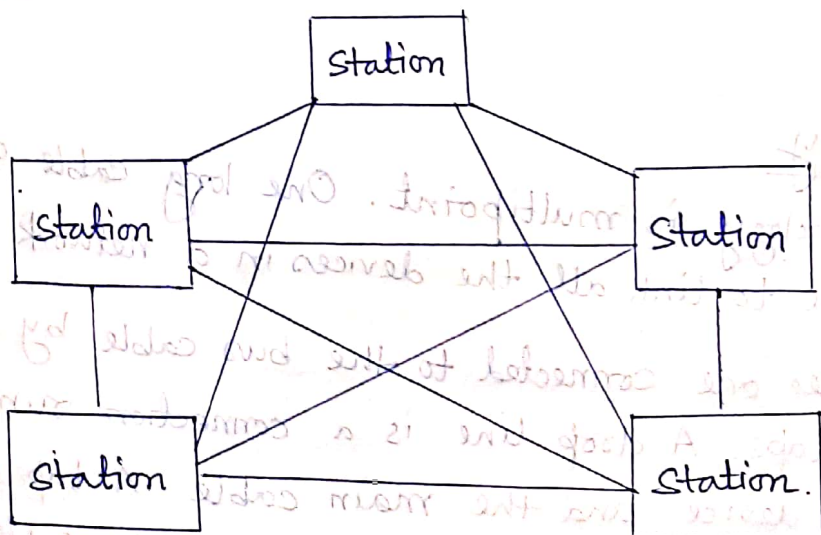
In a store topology, each device has a dedicated point-to-point link only a central controller, usually called a hub.

A store topology is less expensive than a mesh topology. In a star, each device needs only one link and one I/o port to connect it to any number of others.

advantages: i) robustness. If one link fails, only that link is affected. All other links remain active. This factor also lends itself to easy fault identification and fault isolation.

disadvantages: Big disadvantages of star topology is the dependency of the whole topology on one single point, the hub. If the hub goes down, the whole system is dead.

The star topology is used in local-area networks (LANs).

Hub

| | Station | Station | Station | Station |
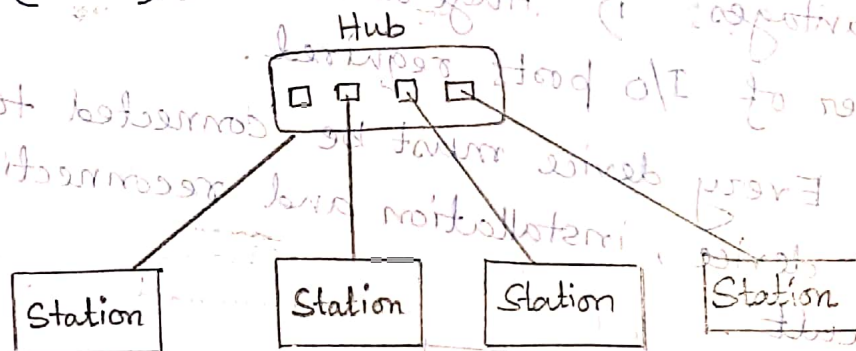
Bus Topology

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. A drop line is a connection running between the device and the main cable. A tap is a connector that either splices into the main cable or punctures the sheathing of a cable to create a contac

with the metallic core.

Advantages; ease of installation, uses less cabling than mesh or star topologies.

Disadvantages: difficult reconnection and fault isolation.
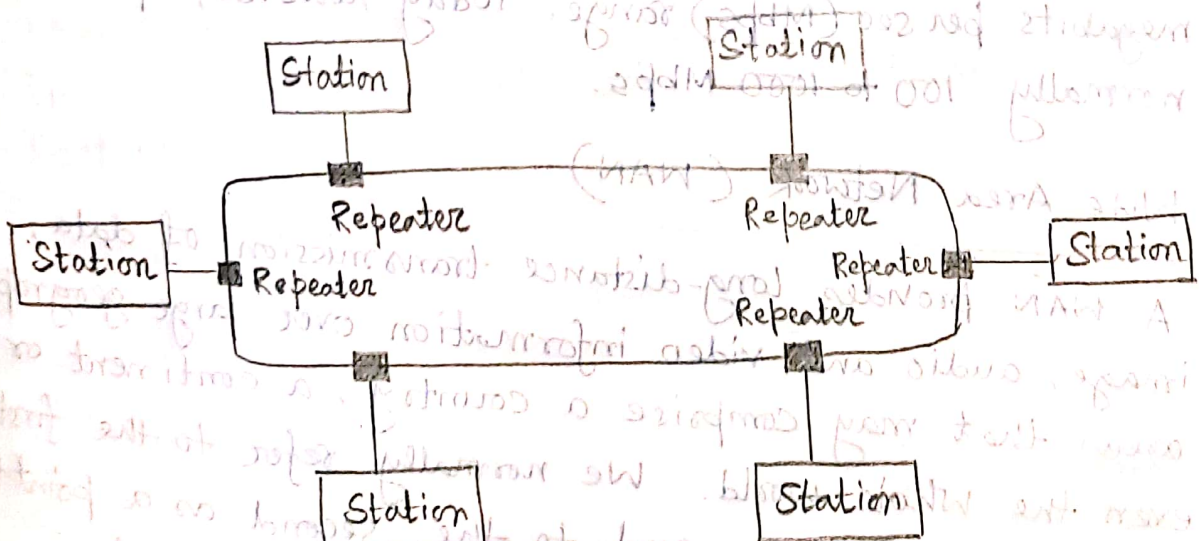
Ring Topology:

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; when a device receives a signal intended for another device, its repeater regenerates the bits and passes them along.
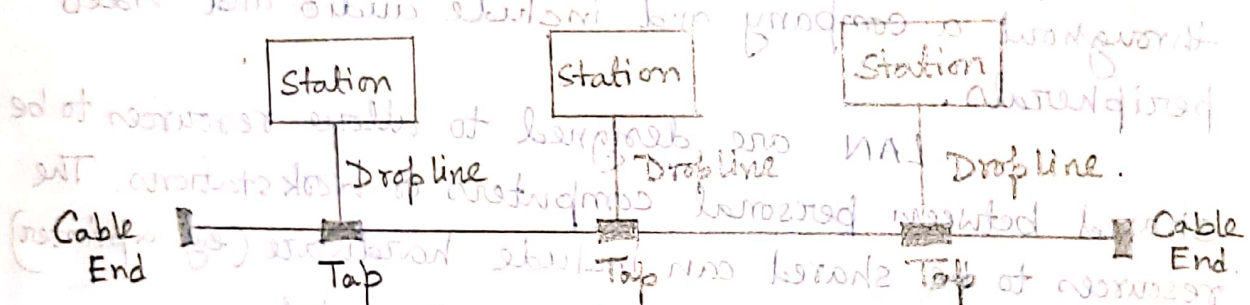
bus topology.

Ring topology

Categories of Networks

We are generally referring to two primary categories: local-area networks and wide-area networks. A LAN normally covers an areas less than 2 mi; a WAN can be worldwide. Networks of a size in between are normally referred to as metropolitan area networks and span ten of miles.

Local Area Network (LAN)

It 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 a printer in someone's home office; or it can exter throughout a company and include audio and video peripherals.

      LAN are designed to allow resources to be shared between personal computers or work stations. The resources to be shared can include hardware (e.g. a printer) software (e.g. an application program) or data.

      Early LANs had data rates in the 4 to 16 megabits per sec (Mbps) range. Today however, speeds are normally 100 to 1000 Mbps.

Wide Area Network (WAN)

A WAN provides long-distance transmission of data, image, audio and video information over large geograph areas that may comprise a country, a continent or even the whole world. We normally refer to the first as a switched WAN and to the second as a point to point WAN. The switched WAN connects the end systems, which usually comprise a router that connects to another LAN or WAN.

The point-to-point WAN is normally a line leased, from a telephone or cable TV provider that connects a home computer or a small LAN to an Internet service provider (ISP). This type of WAN is often used to provide Internet access.

Switched WAN

point to-point WAN
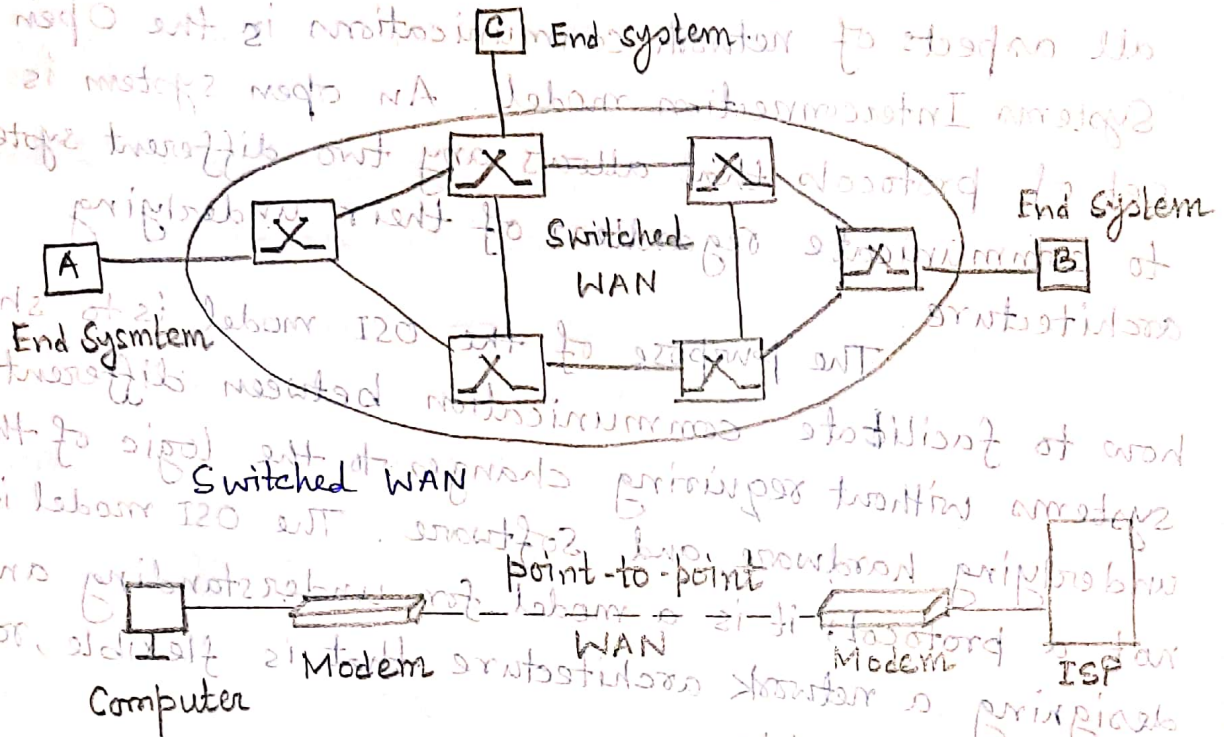
Metropolitan Area Networks. (MAN)

It 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 to the Internet, and have endpoints spread over a city or part of city.