Computer Systems and Applications Paper - I

Third Year Bachelor of Commerce

Semester V

Data Communication & Networking

- Data Communication
    1. It is also called as Data Transmission.
    2. They are the exchange of data between two devices via some form of transmission medium cable or wire or even wireless.
    3. For data communications, the communicating devices must be part of communication system consists of hardware and software.

Data Communication & Networking

- Data Communications(Continue.)

    4. The success of data communications systems depends on four fundamental characteristics:

        A. Delivery:

        B. Accuracy:

        C. Timeliness:

        D. Jitter:

Data Communication & Networking

- Data Communications(Continue.)
4. A. **<u>Delivery</u>**: The system must deliver data to the correct destination.

    B. **<u>Accuracy:</u>** The system must deliver data accurately.

    C. **<u>Timeliness:</u>** The system must deliver data in a timely manner. Data delivered late are useless

    D. **<u>Jitter:</u>** Jitter refers to the variation in the arrival time. There should not be variation in arrival time.

Data Communication Components

- A data communications system has five components: (MSRTP)

  1. Message
  2. Sender
  3. Receiver
  4. Transmission medium
  5. Protocol

1. Message

- The message is the data to be communicated. It can be text, numbers, pictures, audio and video.

2. Sender

- The sender is the device that sends the data message. It can be a Computer, telephone handset, video camera and so on.

3. Receiver

- The receiver is the device that receives the message. It can be a Computer, telephone handset, video camera and so on.

4. Transmission medium

- It is physical path by which a message travels from send to receiver.

  e.g.

  1. Twisted pair cable

  2. Coaxial Cable

  3.Fiber Optic Cable

  4. Radio waves

  and so on.

5. Protocol

- It is set of rules for two devices to communicate.

- Communication is not possible without a protocol.

Data Transmission Mode (Data Flow)

1. Simplex Mode:

- Simplex mode permits data to flow in only one direction.

- A terminal connected to such a line is either to send only or receive device.

- This mode is generally not used.

- e.g. TV, Radio, Mouse, Printer etc.

Data Transmission Mode (Data Flow)

2. <u>Half Duplex Mode:</u>

- In this mode data can be transmitted back and forth between 2 stations, but data can only go in one of the two directions at any given point of time i.e. Two ways but on way at a time

- e.g. Walkie-talkie etc.

Data Transmission Mode
(Data Flow)

3. **Full Duplex Mode:**

- In this mode data can be simultaneously send & receive between 2 stations.

- It is commonly used method.

- e.g. Computer to Computer etc.

Network

- It is a group **of computer and other devices, such as printers and scanners**, connected by a communications link, enabling all the devices to interact with each other and share applications, data and hardware components.

- It can be small or large, permanently connected through wires or cables, or temporarily connected through phone lines or wireless transmissions.

- The largest network is the Internet, which is a worldwide group of networks.

Types of Network

- LAN (Local Area Network)
- MAN (Metropolitan Area Network)
- WAN (Wide Area Network)

LAN (Local Area Network)

- It is a small network of connected computers, where in computers are connected to each other physically with the help of wire or cable.
- Each computer may work with peripheral devices such as printer, data storage devices.
- Connected computers must be within certain radius limit; generally, one kilometer.
- In other words LAN is confined to a small area.
- In LAN at least one computer is designed as file server.
- In some LAN files server is referred to as network drivers.
- The Microcomputers managed by the file server are called workstations or nodes.
- In LAN resources such as printers, data storage devices, software etc can be shared.

LAN (Local Area Network) (continue)

- The file server manages the communication and sharing of peripherals devices.
- If required, LAN can contain more than one file server.
- Data transfer speed is measured in mega bits per second (MBPS) i.e. (10 MBPS or So).
- Two or more LANs can be connected to each other with the help of Bridges or Gateways.
- LAN is generally owned by an organisation. (Privately Owned).

LAN (Local Area Network) (continue)

- 0, 1 bit
- 1000 bit = 1 Kilobit (Kbps\ Kilo bit per second)
- 1000 Kb = 1 Mega bit
- 1000 Mb = 1 Giga bit
- 1000 Gb = Tera bit

MAN (Metropolitan Area Network)

- It is a bigger network of connected computers, where in computers are connected to each other physically with the help of fiber optic cable

- Each computer may work with peripheral devices such as printer, data storages devices.

- Connected computers must be within certain radius limit; generally 40 to 60 kilo meters.

- In other words, MAN is confined to a bigger area than LAN.

- Generally, MAN contains more than one file server.

- The microcomputers managed by the file server are called as workstations or nodes.

MAN (Metropolitan Area Network) (Continue)

- In MAN resources such as printers, data storage devices, software etc. can be shared.

- The file server manages the communication and sharing of peripheral devices.

- Data transfer speed is measured in megabits per second (MBPS) (20 MBPS or So).

- Two or more MANs can be connected to each other with the help of bridges or Gateways.

- LAN can connected to MAN.

- MAN is generally not owned by a single organisation.

WAN (Wide Area Network)

- It is a bigger network of connected computers, where in computers are connected to each other physically with the help of various communication facilities such as long-distance telephone services, satellite transmission, under sea-cables etc.

- Each computer may work with peripheral devices such as printer, data storages devices.

- WAN covers wide geographical area.

- Generally, MAN contains more than one file server.

- The microcomputers managed by the file server are called as workstations or nodes.

WAN (Wide Area Network)

- In WAN resources such as data storage devices, software etc can be shared.

- The file server manages the communication and sharing of peripheral devices.

- Data transfer speed is slow; it is measured in kilo bits per second(kbps).

- Less freedom compared to LAN, because public telecommunication is involved.

- MAN can be connected to WAN.

NETWORK TOPOLOGY (STRUCTURE)

- The geometrical arrangement of computer resources, remote devices and communication facilities is known as network topology or network structure. The network topology determines which element in a computer network can communicate with each other.
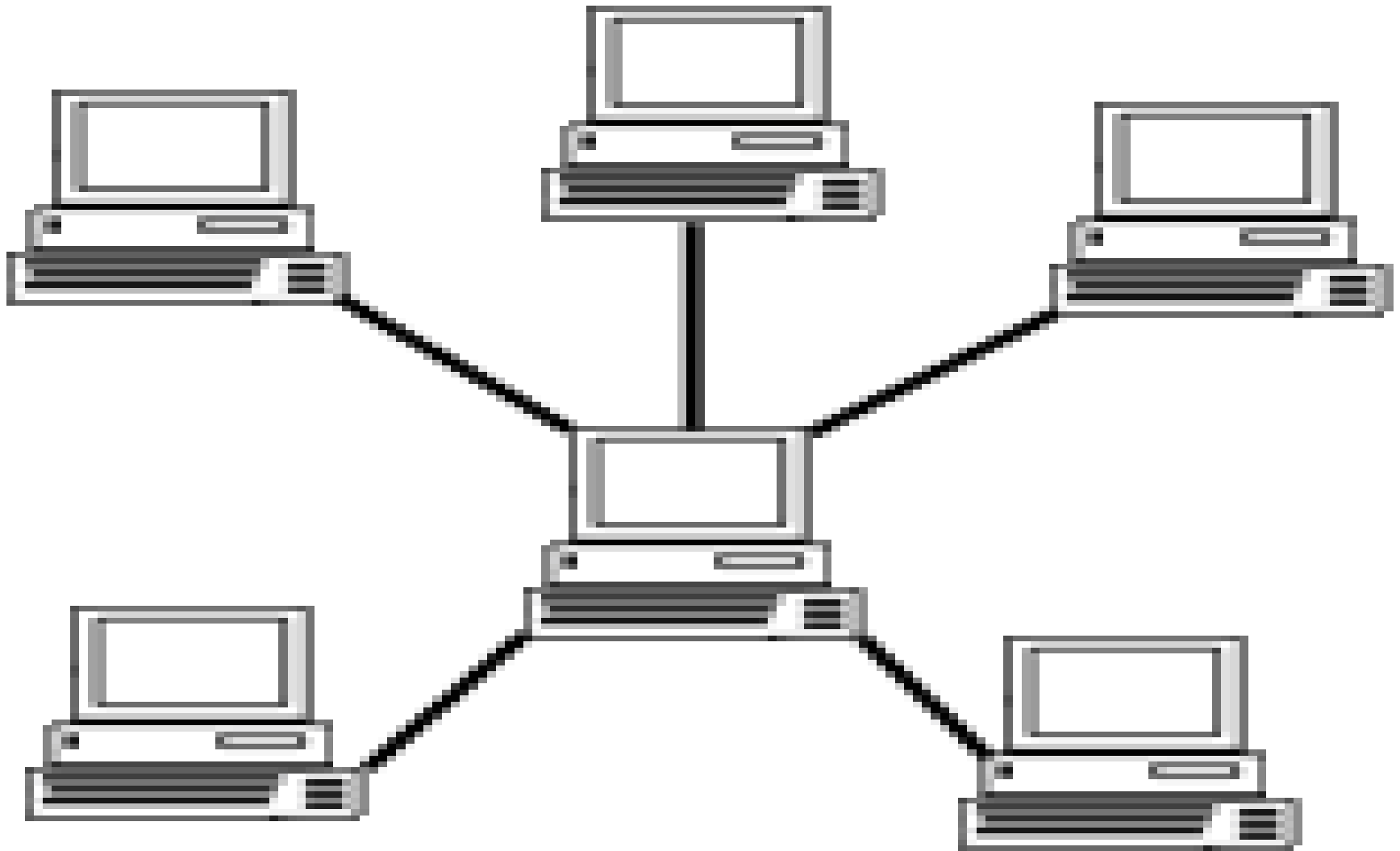
Star Network (Topology)

- This structure / topology is commonly used.
- It consists of a centralized computer system from which the various communication channel originate.
- Each Terminal / Computer can communicate only with the central computer system.
- If the terminals want to transfer data among themselves, it can be done only by sending the data to the central system which in turn sends them to the destination.
- This structure is appropriate for organization that requires a centralized data base on centralized data processing facility.

Star Network (Topology)

- Advantages:-
  - Easy to add / remove nodes.
  - A node failure does not bring down entire network.
  - It is easier to diagnose network problems through a central computer.
- Disadvantage:-
  - Failure of central computer (server) will bring down entire network.
  - As every node requires new cable, the cable cost is more.

Star Topology

Bus Network / Topology

- This structure is very popular for LAN.

- In this structure a single network cable runs in the building / campus & all nodes are linked with this communication line with two end points called as bus or backbone.

- The two ends of the cable are terminated with terminators.

Bus Network / Topology

- Advantages:-
  - Cable cost is reduced.
  - Reliability in very small network and easy to understand and use.
  - Easy to extend . Two cables can be easily joined with connector, making a longer cable for more computers to join.
  - Repeater can also be used to extend a bus configuration.
  - Failure of any node does not affect the whole network.

- Disadvantages:-
  - Heavy network traffic can slow a bus network.
  - Each connection between two cables weakens the electrical signal.
  - If main cable fails, the whole network is damaged.
  - Failure of main computer (server) will bring down entire network.

Server   Workstation   Workstation   Laptop

Printer   Laptop   Workstation
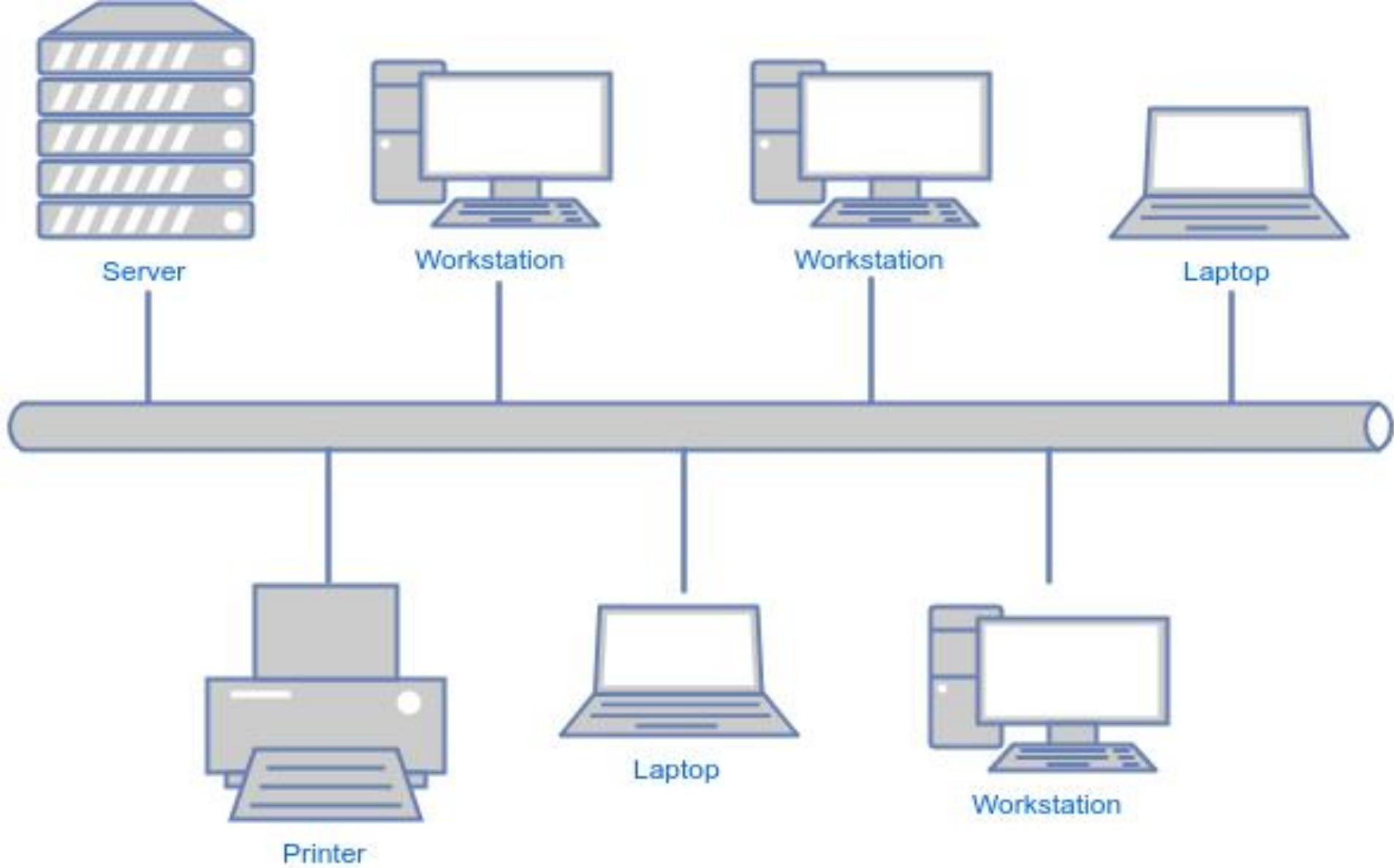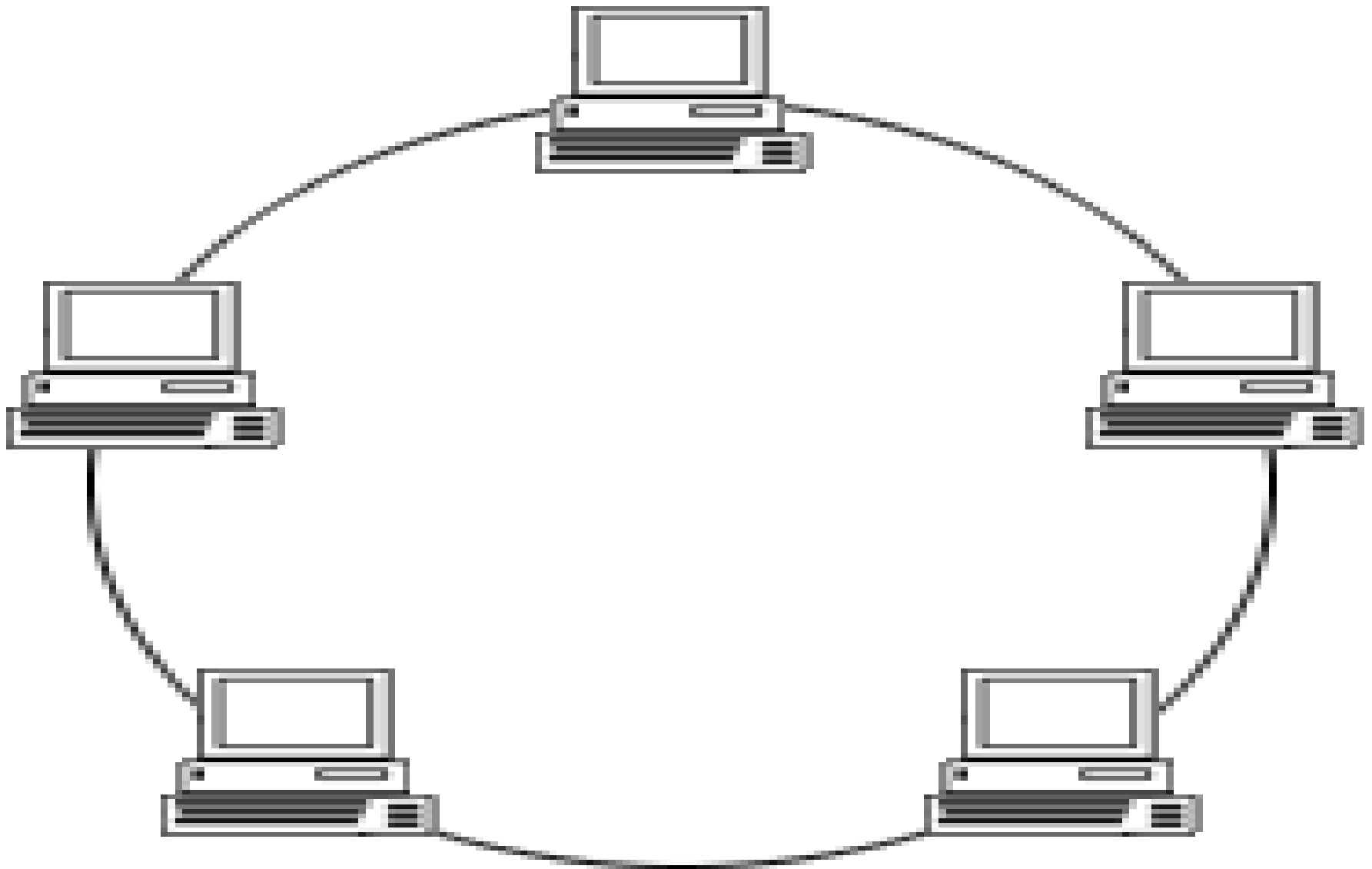
Bus Topology Network
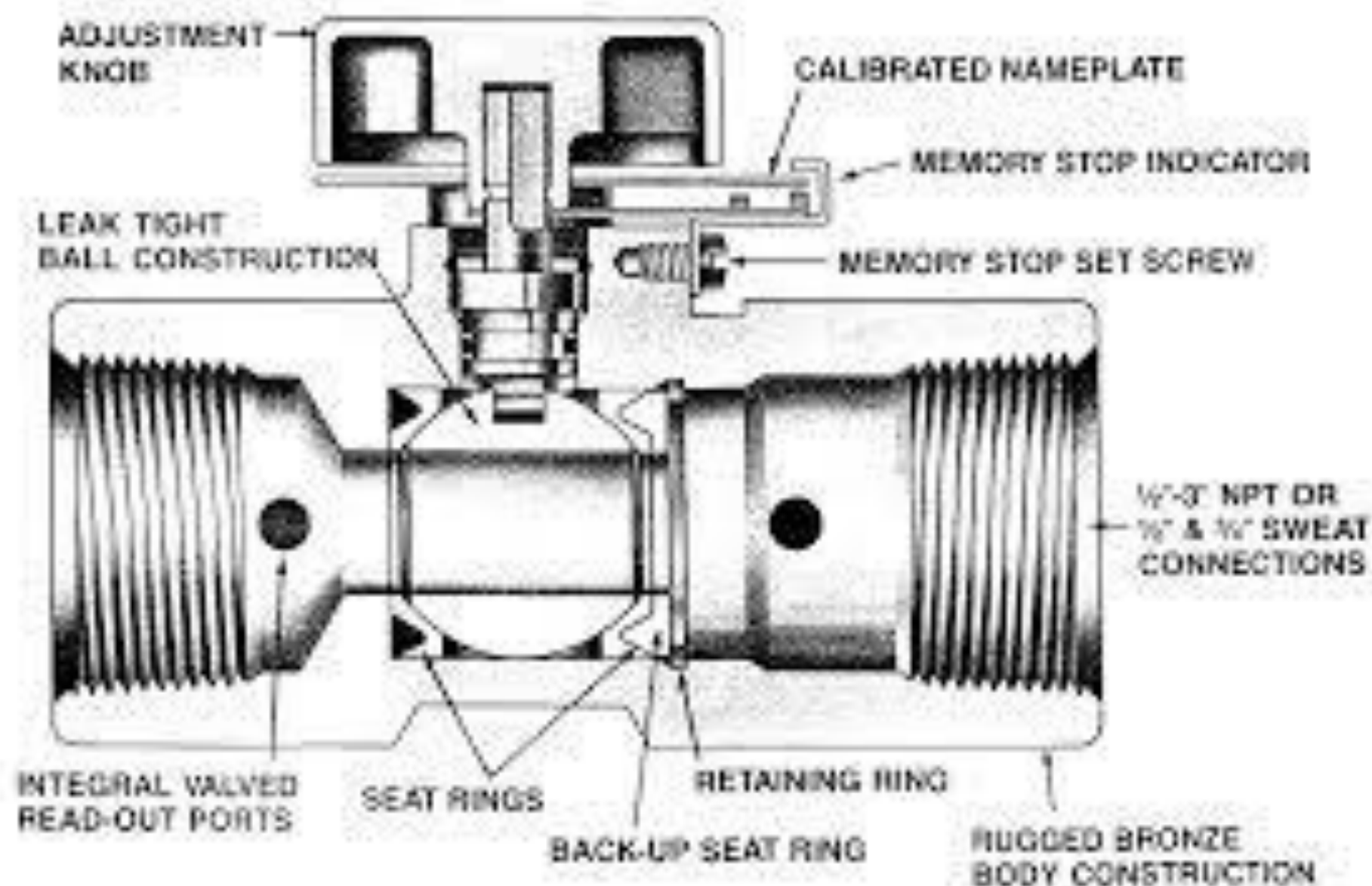
Ring / Loop Network / Topology

- It was commonly used network structure for LAN.
- It is an extension of bus network where last computer is connected with the first.
- In this topology the network cable passes from one node to another until all nodes are connected in a form of a ring.
- There is direct point to point link between two neighboring nodes.
- The links are unidirectional which ensures that transmission by node, which made request for the transmission.
- Data is transmitted using Token Ring.

Ring / Loop Network / Topology

- Advantages:-
  - Less cable cost.
  - Ring network are easily extendable.
- Disadvantages:-
  - Failure of any node / server / cable will damage whole network.
  - Data has to travel through every computer through transmission line.
  - Relatively expensive and difficult to install.

Ring Topology

ADJUSTMENT KNOB

CALIBRATED NAMEPLATE

MEMORY STOP INDICATOR

LEAK TIGHT BALL CONSTRUCTION

MEMORY STOP SET SCREW

½"-3" NPT OR ⅝" & ⅞" SWEAT CONNECTIONS

INTEGRAL VALVED READ-OUT PORTS

SEAT RINGS

RETAINING RING

BACK-UP SEAT RING

RUGGED BRONZE BODY CONSTRUCTION

Mesh Topology / Network

- It refers to random arrangements of computer using telecommunication link.

- In this arrangement each computer & terminal in connected to each other by a dedicated point to point link & thus eliminates routing function.

- This network provides high reliability as there are alternate paths available if the direct link between two nodes down or dysfunctional.

Mesh Network / Topology

- Advantages:-
  - Direct connection is available between any two computers.
- Disadvantages:-
  - Cable cost is more.
  - Difficult to install.

Mesh Topology
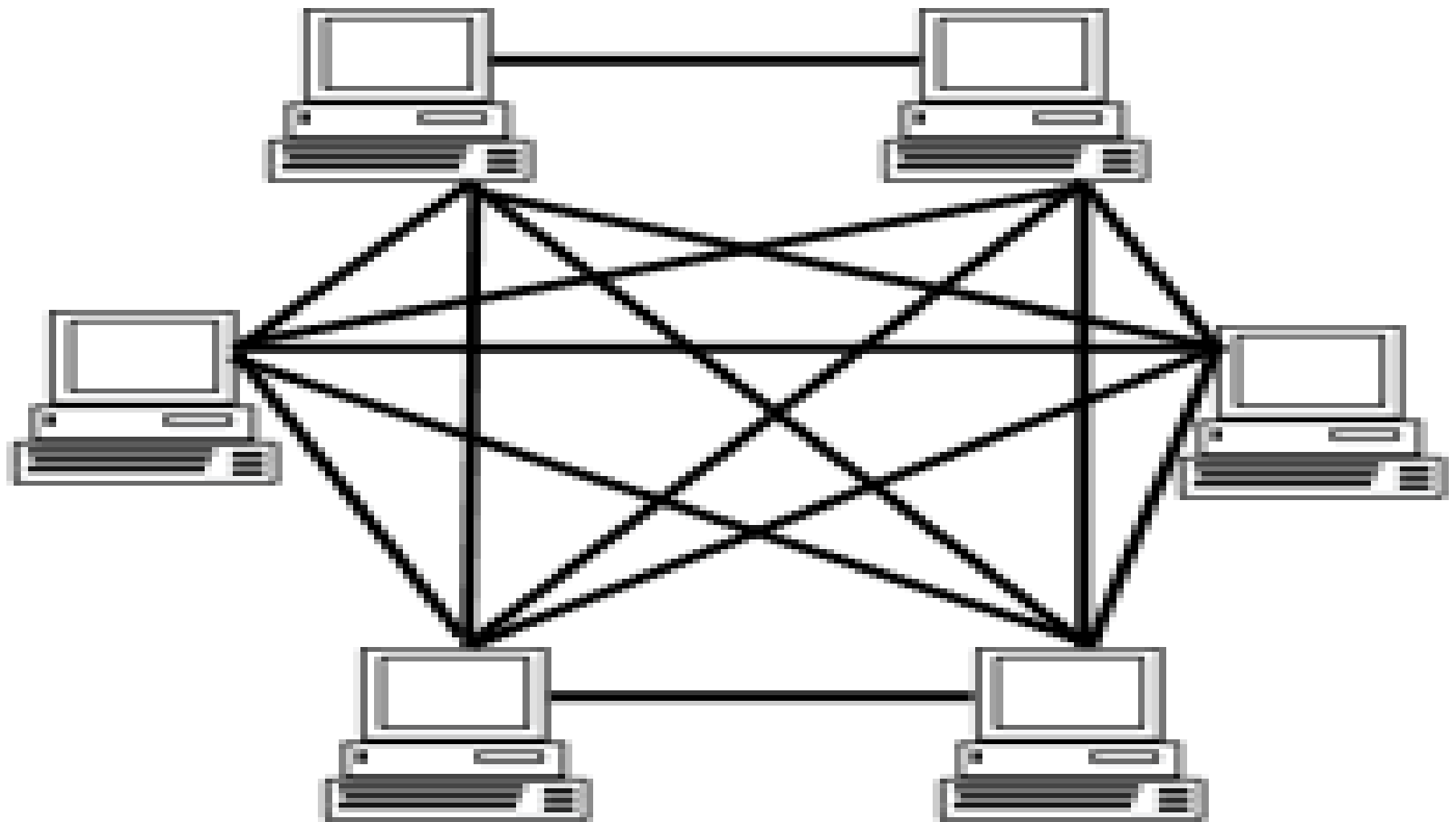
Network Media

1. WIRED OR GUIDED OR BOUNDED MEDIA

2. WIRELESS OR UNGUIDED OR UNBOUNDED MEDIA

WIRED OR GUIDED OR BOUNDED MEDIA

1. TWISTED PAIR CABLE

2. COAXIAL CABLE

3. FIBER OPTIC CABLE

WIRELESS OR UNGUIDED OR UNBOUNDED MEDIA

1. RAIDO WAVES

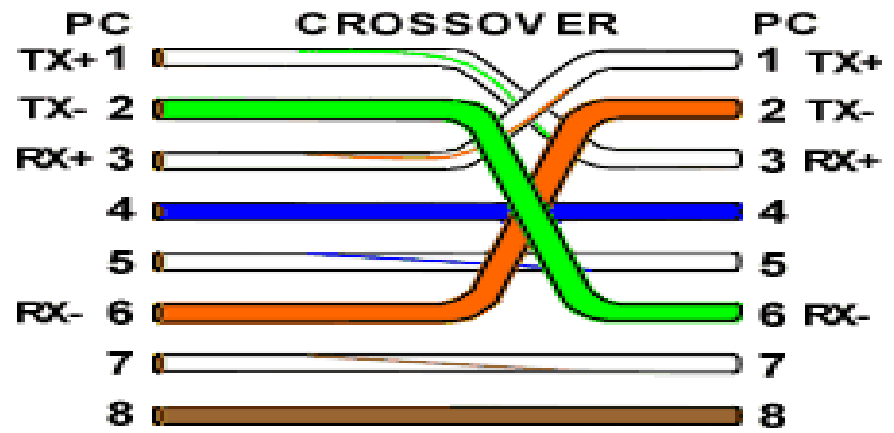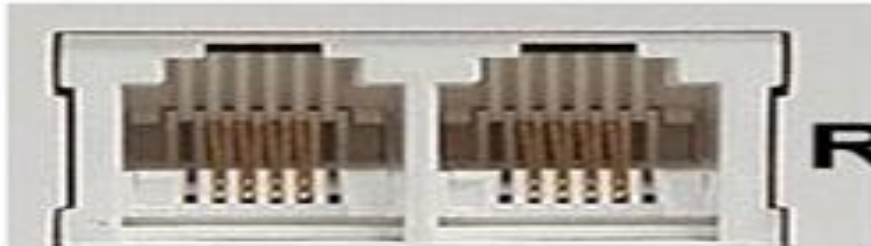2. MICROWAVES

   I. TERRESTRIAL MICROWAVES

   II. SATELLITE MICROWAVES

3. INFRARED

TWISTED PAIR CABLE

- Normally consists of four pairs of wires.
- Individual pairs have two wires that are separately insulated in plastic, then twisted around each other and bound together in a layer of plastic.
- Except for plastic coating, nothing shields this type of wire from outside interference, so it is also called as unshielded twisted pair (UTP) wire.
- Some twisted-pair wire is enclosed in a metal case and therefore called as shielded twisted-pair (STP) wire.
- Twisted-pair cable is not immune to the electromagnetic interference.
- Data is transferred using electrical current.
- Now-a-days Twisted-pair wires can support speed up to 100 Mbps.
- Twisted-pair cables are normally used for LAN.
- 2 pair cable uses RJ-11 connector.
- 4 pair cable uses RJ-45 connector.
- [RJ = Registered Jack].
- Signals must be "refreshed" every one to two miles through the use of repeaters, which is expensive.

RJ11 vs RJ45

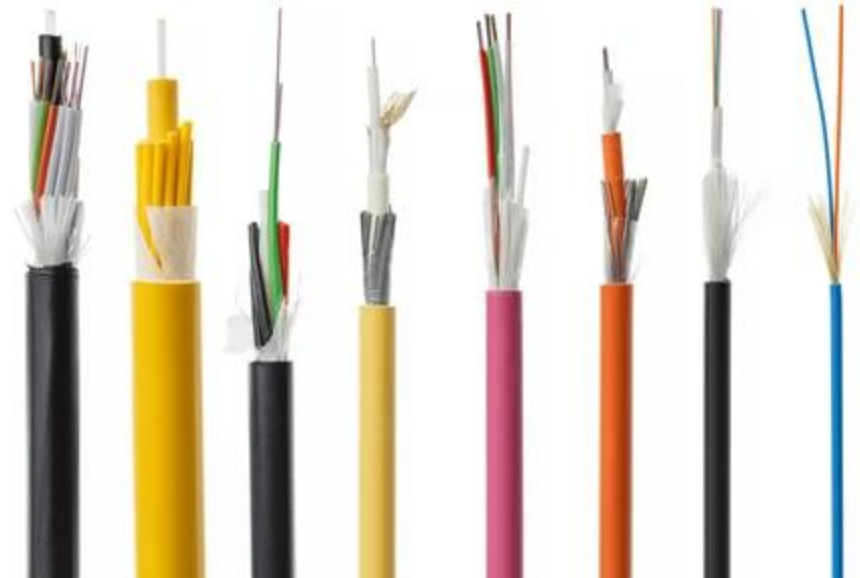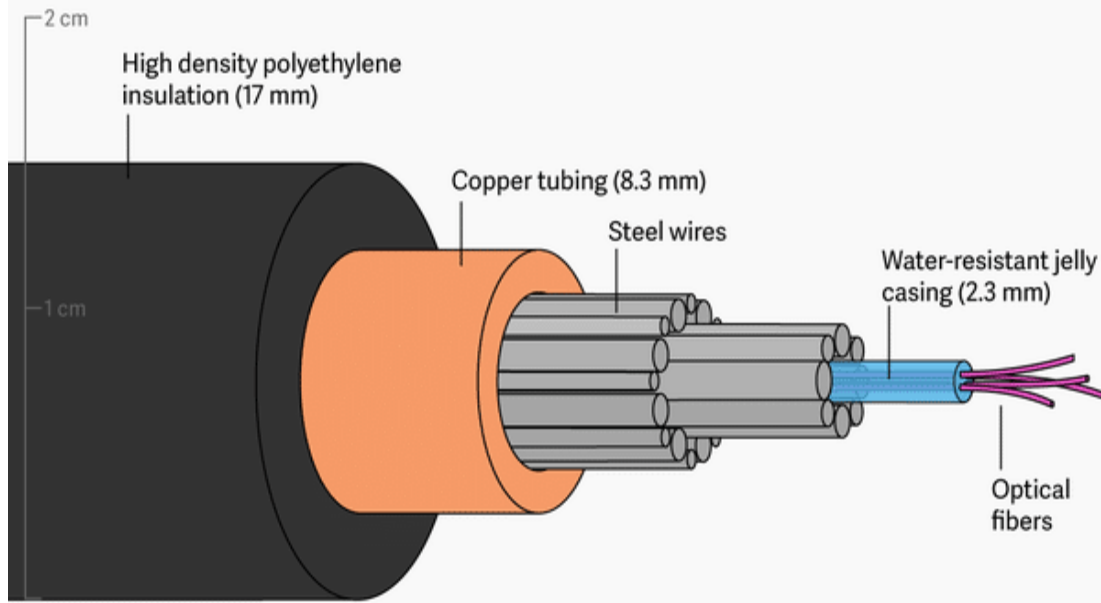| PC	STRAIGHT-THRU	HUB		PC	CROSSOVER	PC
TX+ 1		1 RX+		TX+ 1		1 TX+
TX- 2		2 RX-		TX- 2		2 TX-
RX+ 3		3 TX+		RX+ 3		3 RX+
4		4		4		4
5		5		5		5
RX- 6		6 TX-		RX- 6		6 RX-
7		7		7		7
8		8		8		8

COAXIAL CABLE

- This cable has two conductors.
- One is a single wire in the centre of the cable, and the other is a wire mesh shield that surrounds the first wire, with an insulator between.
- Coaxial cable is not immune to the electromagnetic interference.
- Data is transferred using electrical current.
- It can support speed up to 10 Mbps.
- Coaxial cables were used for LAN in the earlier days. It is easy to install and less expensive.
- Base-band co-axial cables are used for digital transmission whereas Broadband co-axial cables are used for analog transmission.

Coaxial cable

Outside insulation

Insulation

Copper mesh

Copper wire
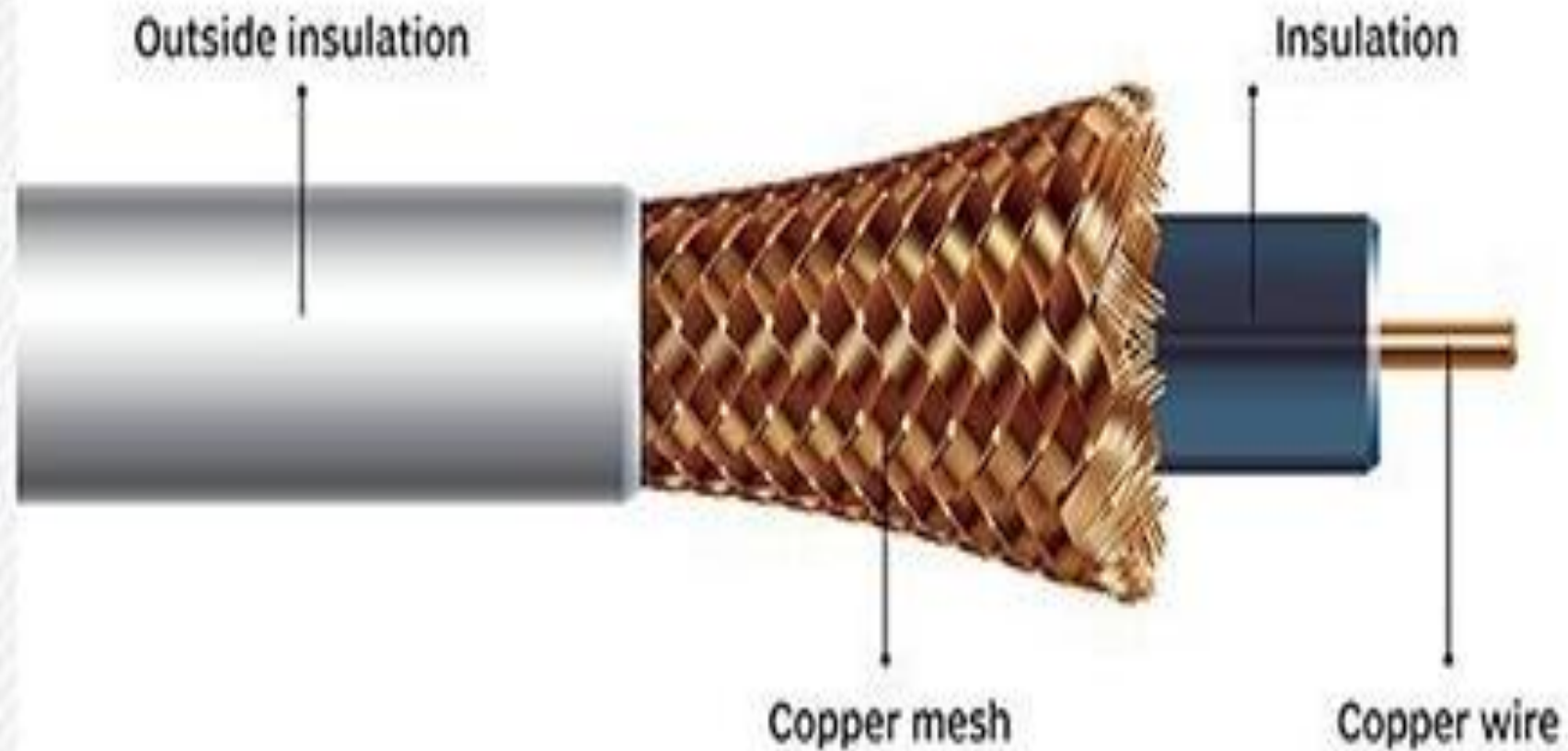
FIBER OPTIC CABLE

- It is a thin thread of glass that transmits lively beams of light rather than electric current.
- Fiber-optic cable can carry data at a higher speed.
- Fiber-optic cable is immune to the electromagnetic interference.
- Normally in fiber optic cable light moves only in one direction (single mode).
- For two-way communication (Multi-mode) to take place a second connection must be made.
- Now-a-days it can support speed of more than 2 Gbps.
- Fiber-optic cables are used for MAN.
- It is difficult to install and very expensive.

High density polyethylene insulation (17 mm)

Copper tubing (8.3 mm)

Steel wires

Water-resistant jelly casing (2.3 mm)

Optical fibers

RAIDO WAVES

1. Radio waves are easy to generate and they can travel longer distance.

2. It has frequency between 10 KHz to 1 GHz.

3. They can travel in all directions and hence they can also penetrate through obstacles.

4. Different types of radio waves are:

I. Short waves

II. VHF (Very High Frequency)

III. UHF (Ultra High Frequency)

MICROWAVES

1. Microwaves travels at high frequency than radio waves.

2. Microwaves are of two types

I. Terrestrial Microwaves

II. Satellite Microwaves

Terrestrial Microwaves

1. Terrestrial (Ground Based) Microwaves are used to transmit wireless signals across a few miles i.e. 1.6KM

2. These systems operate in a low GHz.

3. It has a capacity 1 Mbps to 10 Mbps.

4. Terrestrial Microwaves requires antennas pointed to each other.

5. Due to the curvature of earth, mountains and other structures often block the line of sight; because of this reason many repeaters are required for long distance which increases cost.

Terrestrial Microwaves
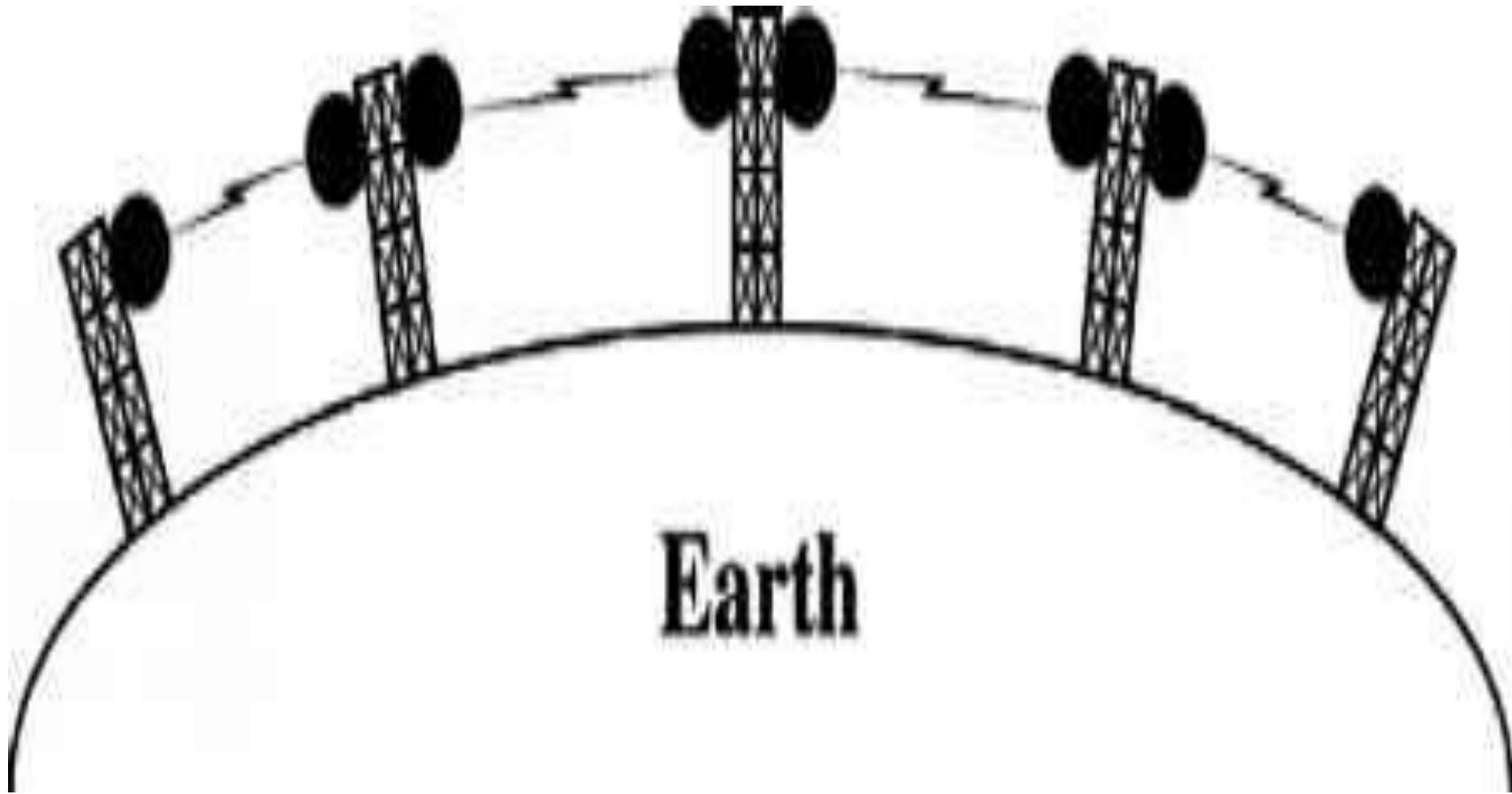
Satellite Microwaves

1. Satellite Microwaves transmission is used to transmit signals throughout the world.

2. This system uses satellites in orbit.

3. Satellite dishes (earth station) are used to send the signals to the satellite, which will in-turn send them to the receiver dish.

4. Transmitter on the earth sends 6 GHz signals to the satellite.

5. When the signal reaches the satellite, it becomes weak because of distance; the satellite amplifies the weak signal and then transmits it back to the earth at the frequency less than 6 GHz.

6. It is very expensive and difficult to install.

Satellite Microwaves

INFRARED

1. Infrared frequencies are just below visible light.
2. These high frequencies allow high speed data transmission.
3. Remote control of TV uses infrared.
4. Infrared transmission can be affected by obstructing sender or receiver.
5. These transmissions fall into two categories Point to Point and Broadcast.
6. Point to Point transmission requires direct alignment between devices.
7. Broadcast transmission uses spread signal, which goes in all directions instead of direct beam.
8. In broadcast, direct alignment between devices is not required.

Network Hardware

– Modem

– MAC Address

– HUBS

– Switch

– Bridge

– Router

Modem

- The term modem is derived from 2 terms Modulator & Demodulator.
- Modulator means converting digital signals into analog signals & Demodulator means converting Analog signals into digital signals.
- On sending computer Modem works as modulator whereas on the receiving computer Modem works as a demodulator.
- Modem is capable of doing both but it will work as a modulator or demodulator depending on where you are using a Modem.
- Modem is required if data is transferred over a telecommunication line.
- Modem can be either internal / external.
- Diagram for Data communication between Computer1 (C1) and Computer2 (C2) using telecommunication line will be as follows:

C1

Digital Signals

Modem

Analog Signals

Modem

Digital Signals

C2
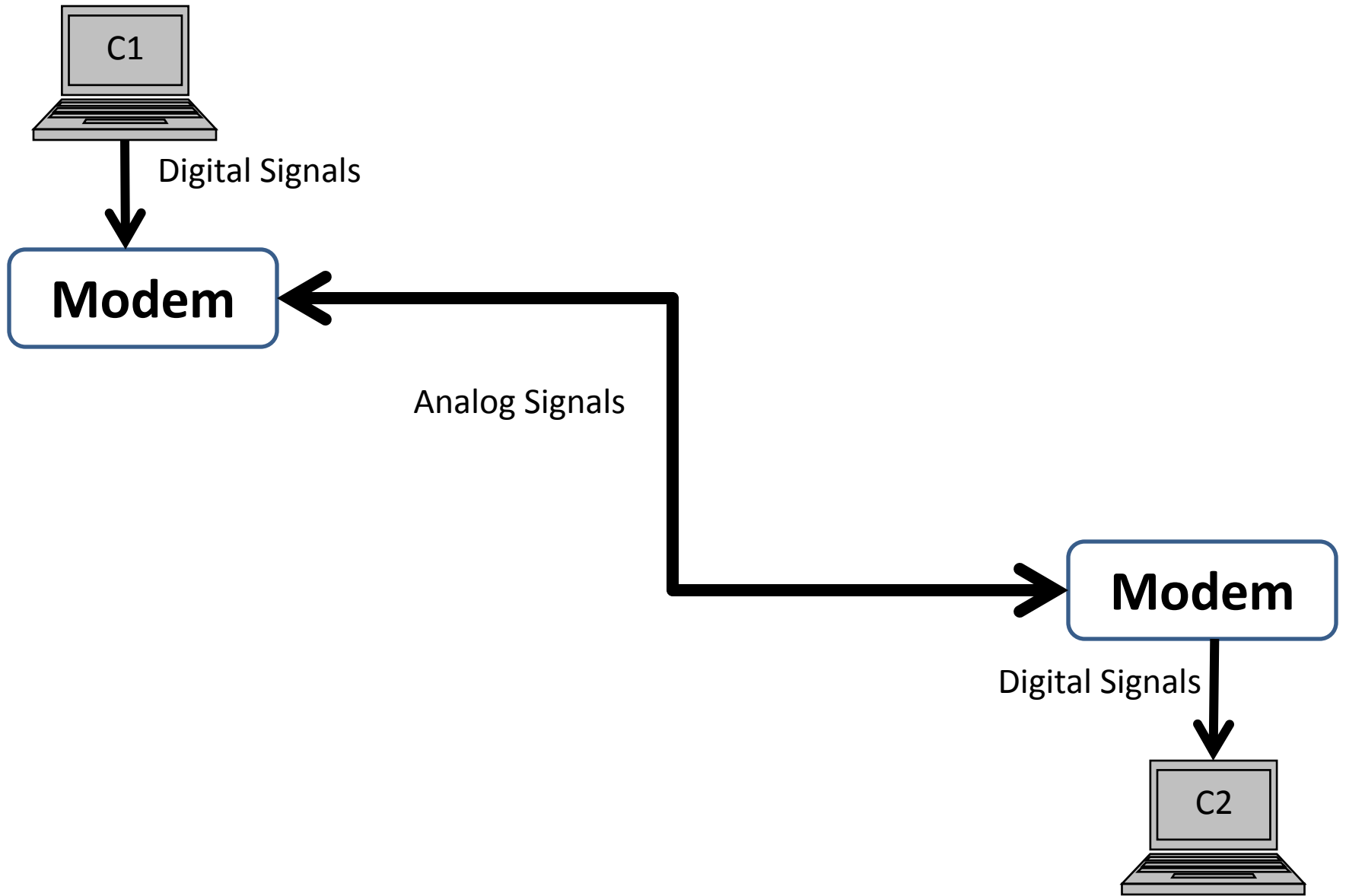
MAC Address

- In computer networking, a Media Access Control address (MAC address) is a unique bit number assigned to Network Interface Card (NIC) to identify it on a LAN.

- Because they are so long, MAC addresses are usually displayed in hexadecimal.

- This address is stored in its hardware, such as the card's read-only memory.