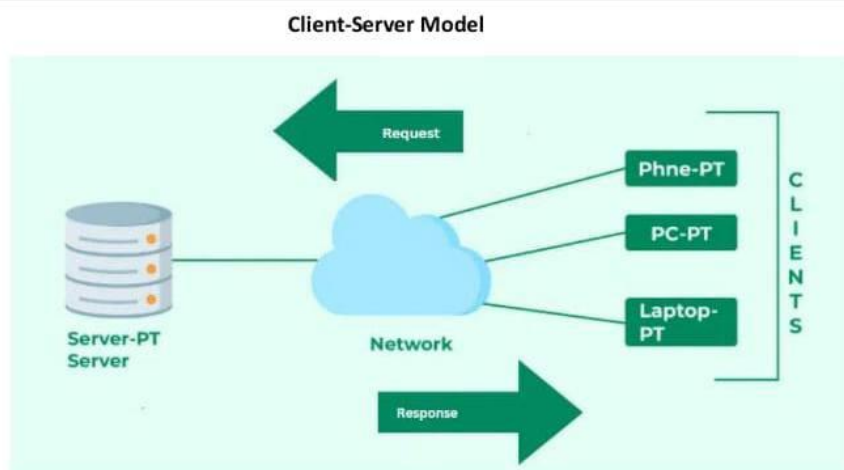


Chapter 1: Basic Network Concepts

1. Explain client-server model & peer-to-peer model with a suitable diagram. Write advantages & disadvantages.

Client-Server Model:

- A centralized network where a server provides resources/services to multiple clients.
- Advantages: Centralized control, better security, efficient data management.
- Disadvantages: High cost, requires maintenance, server failure affects all clients.

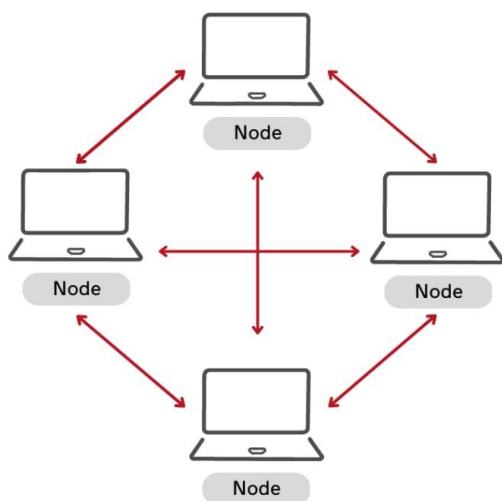


Peer-to-Peer (P2P) Model:

- A decentralized network where each device acts as both client and server.
- Advantages: Cost-effective, easy setup, no need for a dedicated server.
- Disadvantages: Less secure, difficult to manage, slower performance for large networks.

CFTE

P2P Networks



2. Compare OSI & TCP/IP model, stating advantages & disadvantages.

OSI Model

7 Layers

Developed by ISO

Used in Theoretical model for networking

Clear distinction of functions ,highly modular

Complex, rarely used in practice

TCP/IP Model

4 Layers

Developed by DARPA

Used in Practical model used in real-world communication

Not as modular as OSI

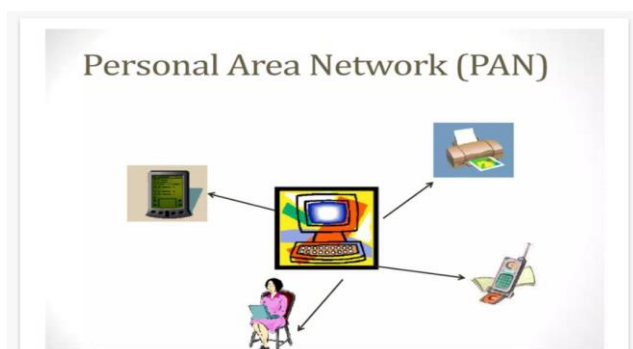
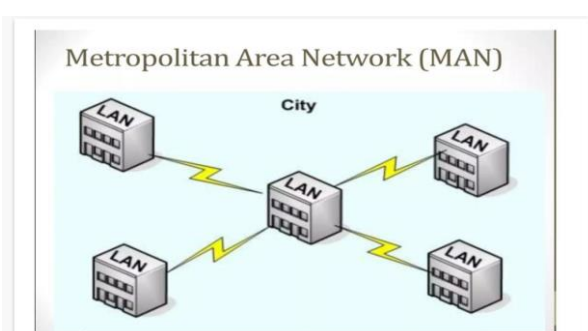
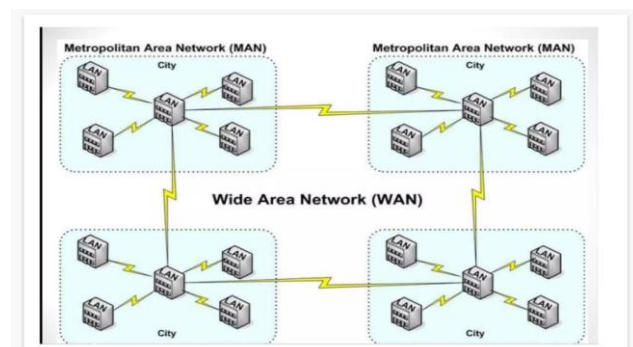
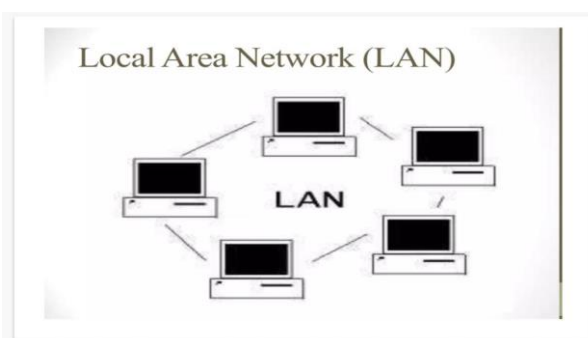
Simpler, widely implemented

3. Explain physical, logical, port, and socket address.

- Physical Address: Also called MAC address, uniquely identifies a device in a network.
- Logical Address: An IP address assigned to devices for communication over a network.
- Port Address: A unique number assigned to a process for communication (e.g., port 80 for HTTP).
- Socket Address: Combination of IP address and port number, used to establish a connection.

4. Explain various types of networks with suitable diagrams.

- LAN (Local Area Network): Small network within a single location (e.g., office, home).
- MAN (Metropolitan Area Network): Covers a city or large campus (e.g., cable TV network).
- WAN (Wide Area Network): Covers large distances (e.g., the internet).
- PAN (Personal Area Network): Small network for personal devices (e.g., Bluetooth).



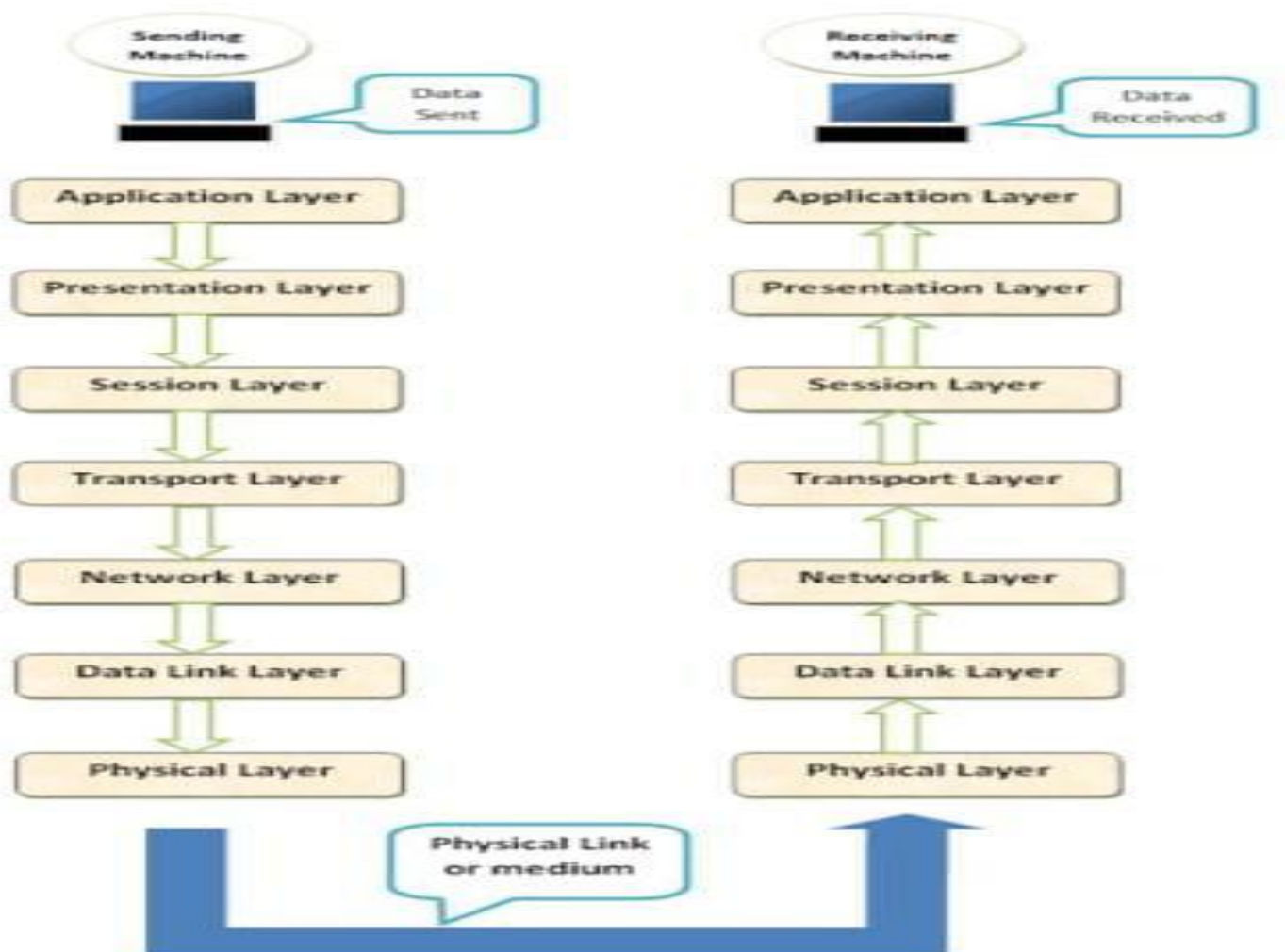
5. List any 4 applications of computer networks.

1. File sharing
2. Remote access
3. Internet services (email, web browsing)
4. Online communication (VoIP, video conferencing)

6. Explain the working of OSI model with a suitable diagram. Describe roles and responsibilities of each layer.

The OSI model consists of 7 layers:

1. Physical Layer: Transmits raw data bits over physical medium.
2. Data Link Layer: Ensures error-free data transfer between nodes.
3. Network Layer: Handles IP addressing and routing.
4. Transport Layer: Ensures reliable data delivery (TCP, UDP).
5. Session Layer: Manages and maintains connections.
6. Presentation Layer: Translates data formats, encryption, compression.
7. Application Layer: Interfaces with user applications (HTTP, FTP, SMTP).



Chapter 2: Network Topologies and Networking Devices

1. Calculate the number of cables required for different topologies.

- Bus Topology: Requires $(n-1)$ cables for 'n' devices.
- Star Topology: Requires 'n' cables (each device connects to a central hub/switch).
- Ring Topology: Requires 'n' cables (each device connects to two neighbors).
- Mesh Topology: Requires $(n(n-1))/2$ cables for full connectivity.

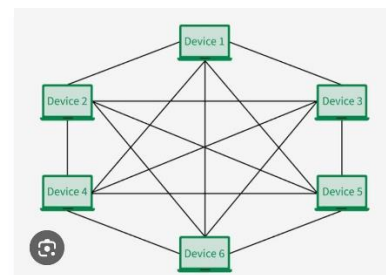
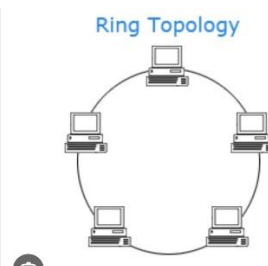
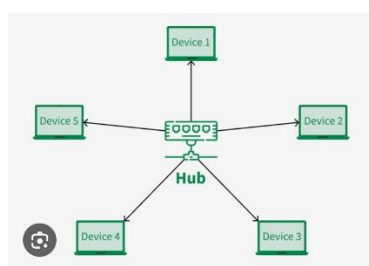
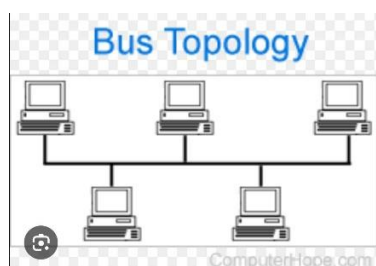
2. Differentiate between Hub & Switch.

Hub | Switch

- | Function | Broadcasts data to all devices | Sends data only to the intended device |
- | Speed | Slower due to network congestion | Faster due to efficient switching |
- | Security | Less secure (anyone can access data) | More secure (data is directed) |
- | Efficiency | Inefficient in large networks | Highly efficient |

3. List and explain network topologies with suitable diagrams, characteristics, advantages & disadvantages.

- Bus Topology: Single backbone cable, easy to implement, but failure disrupts the network.
- Star Topology: Central hub connects all devices, reliable, but hub failure affects all.
- Ring Topology: Data moves in a circular path, efficient but one failure affects all.
- Mesh Topology: Every device connects to every other, very reliable but expensive.



1. Types of Network Topologies:

- Star Topology: All devices are connected to a central hub or switch. If the hub fails, the entire network is affected.
- Bus Topology: A single central cable (bus) connects all computers. If the main cable fails, the network stops working.
- Ring Topology: Devices are connected in a circular manner. Data travels in one or both directions.
- Mesh Topology: Every device is connected to every other device, providing redundancy and reliability.
- Tree Topology: A hierarchical structure with multiple levels of branches.
- Hybrid Topology: A combination of two or more different topologies.

2. Characteristics of Data Rate for Noiseless Channel (Shannon's Capacity Formula):

Shannon's theorem states that the maximum data rate for a noiseless channel is given by:

$$C = B [\log_2 (1 + S/N)]$$

Where:

- C is the channel capacity (bits per second)
- B is the bandwidth of the channel (Hz)
- S/N is the signal-to-noise ratio

3. Factors Affecting Network Performance:

- Bandwidth: Higher bandwidth means better performance.
- Latency: The delay in data transmission affects performance.
- Packet Loss: Lost data packets can slow down communication.
- Network Congestion: Too much traffic can slow down the network.
- Hardware Limitations: Poor-quality routers and switches can affect performance.

4. Design a Network for an Application (Example):

- Example: College network with servers, routers, access points, and connected computers in different departments.

5. Data Transmission Impairments:

- Attenuation: Signal strength decreases over distance.
- Noise: External interference distorts signals.
- Latency: Delay in data transmission.
- Jitter: Variation in packet arrival times.

6. Network Devices and Their Functions:

- Hub: Connects multiple devices in a network. Can be active (powered) or passive (unpowered).
- Switch: A smarter hub that forwards data to specific devices.
- Bridge: Connects two networks and filters traffic.
- Router: Directs data between different networks.
- Gateway: Acts as a bridge between different network protocols.
- Repeater: Amplifies weak signals to extend the network range.

Chapter 3

1. What is Switching?

Switching is how data moves from one place to another in a network. There are three types:

Circuit Switching: A direct path is created before communication starts (like phone calls).

Packet Switching: Data is broken into small parts (packets) and sent separately (like emails and web browsing).

Message Switching: Entire messages are sent from one node to another until they reach the destination (like postal mail).

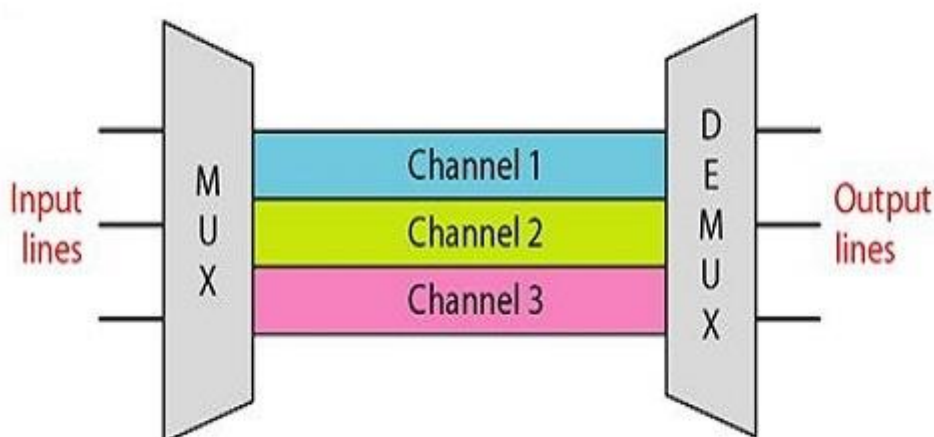
2. What is Multiplexing?

Multiplexing means combining multiple signals to send them over a single communication channel.

Types:

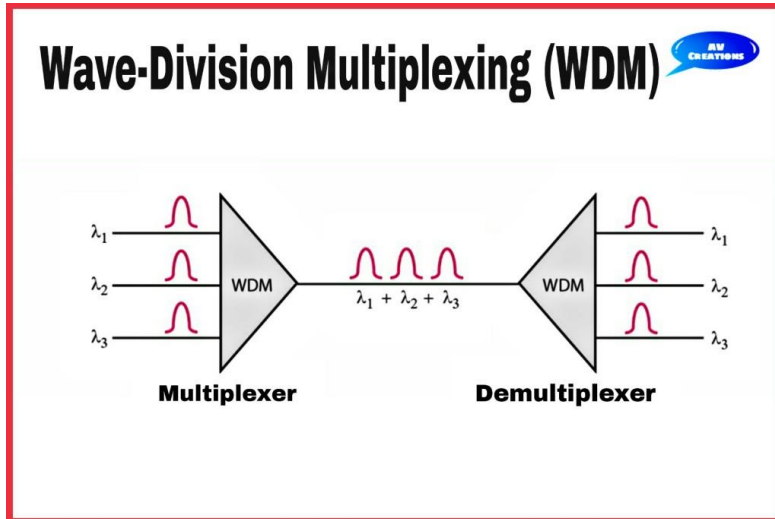
FDM (Frequency Division Multiplexing):

FDM is a technique where the total bandwidth available in a communication medium is divided into a series of non-overlapping frequency bands, each carrying a separate signal simultaneously.



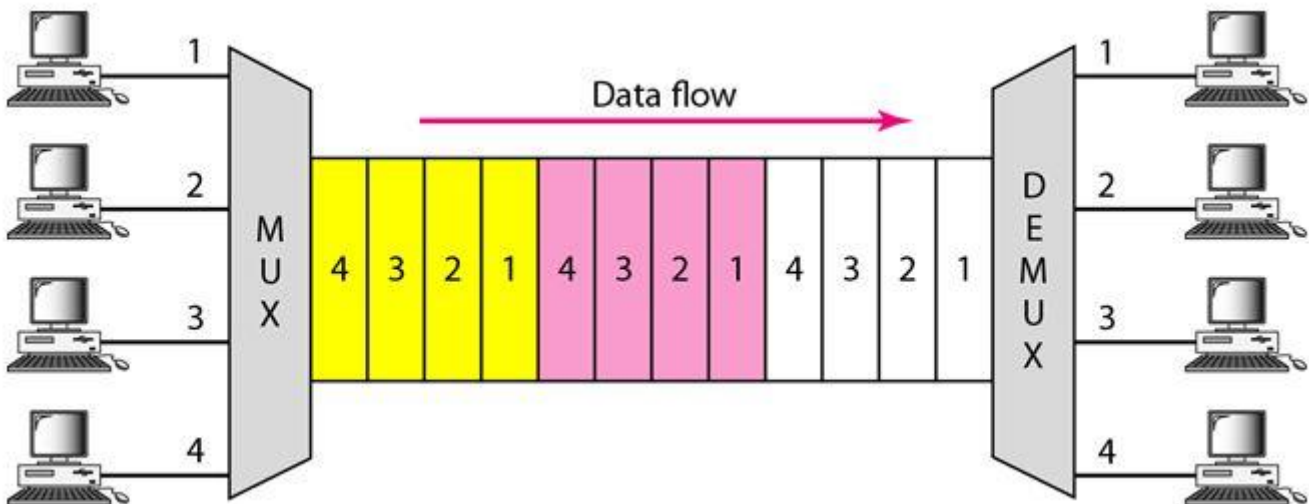
WDM (Wavelength Division Multiplexing):

WDM is a special type of FDM used in **optical fiber communication**, where multiple light signals of different wavelengths (colors) are combined and transmitted over a single fiber.



TDM (Time Division Multiplexing):

TDM divides the available time on a communication channel into time slots. Each user gets the full channel bandwidth but only during their assigned time slot.



3. Bluetooth Technology

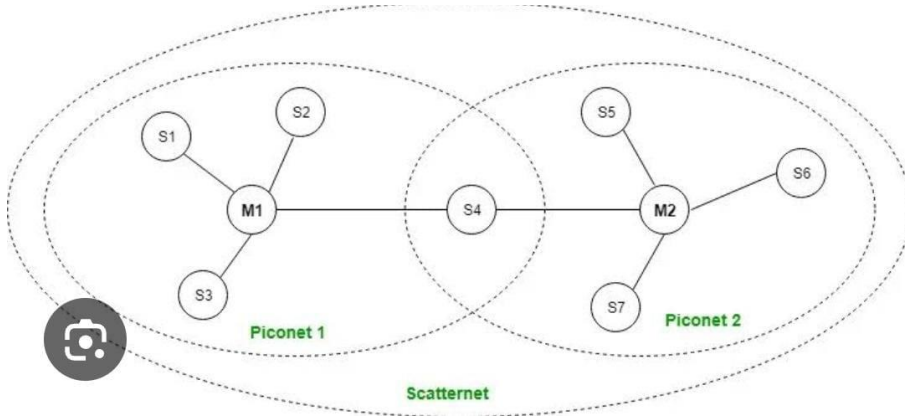
Bluetooth allows wireless communication between devices like phones, headphones, and smartwatches.

How It Works:

A piconet is formed, where one device (master) connects with others (slaves).

Multiple piconets together create a scatternet.

Uses short-range radio waves for communication.



4. What is Wi-Fi?

Wi-Fi allows devices to connect to the internet without wires.

Uses radio waves to send and receive data.

Works on 2.4 GHz and 5 GHz frequencies.

Common in homes, offices, and public places.

5. What is Guided Media?

Guided media means using physical cables to send data.

Types:

1. Twisted Pair Cable – Two copper wires twisted together (used in LAN networks).
2. Coaxial Cable – A single copper wire with insulation (used for cable TV).
3. Fiber Optic Cable – Uses light signals (used for fast internet).

6. Why Do We Need Transmission Media?

Transmission media is important because:

It carries data from one place to another.

It connects computers, phones, and other devices.

It affects speed, security, and quality of communication.

7. Factors Affecting Transmission Media

1. Speed – Faster cables mean better performance.
2. Interference – Wireless signals can be disturbed by other devices.
3. Cost – Fiber optic cables are expensive but fast.
4. Security – Wired networks are safer than wireless.
5. Distance – Longer cables may weaken the signal.
6. Maintenance – Some cables need more care.

8. ISO Seven-Layer Model (OSI Model)

This model helps understand how networks work in 7 layers:

1. Physical – Wires, cables, and signals.
2. Data Link – Ensures data is sent correctly.
3. Network – Finds the best path for data.
4. Transport – Ensures complete and error-free data.
5. Session – Keeps communication active.
6. Presentation – Converts data into a readable format.
7. Application – What users see (like websites, emails).

9. Twisted Pair Cable

Twisted pair cable has two copper wires twisted together to reduce interference and crosstalk.

UTP (Unshielded Twisted Pair):

Used in homes and offices for internet connections.

Cheaper and easier to install.

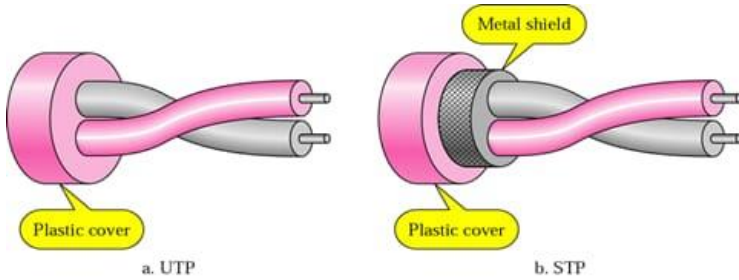
Offers less protection from electrical noise.

STP (Shielded Twisted Pair):

Used in industries and noisy environments.

Has extra shielding to block interference.

More expensive and slightly harder to install.

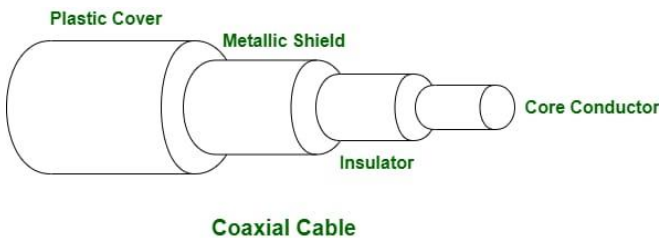


10. Coaxial Cable

Coaxial cable has one central copper wire, covered by insulation and shielding.

It protects signals from outside interference and supports high-frequency transmission.

Commonly used for TV connections, internet services, and CCTV camera setups.



11. Fiber Optic Cable

Fiber optic cables use light signals to transmit data, offering very high speed and long-distance communication.

Single-Mode Fiber (SMF):

Used for long-distance communication like telephone and internet lines.

Has a very thin core allowing only one light signal to pass through.

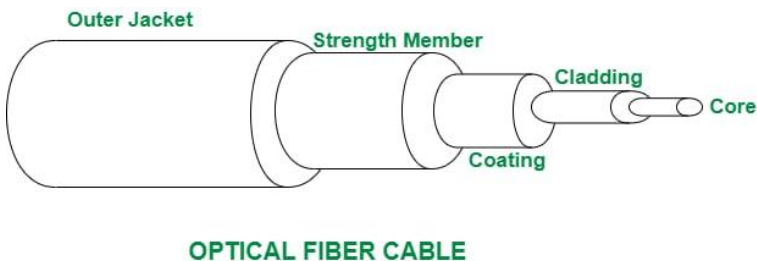
Gives higher speed and less signal loss over long distances.

Multi-Mode Fiber (MMF):

Used for short distances like inside buildings and LAN networks.

Has a thicker core allowing multiple light signals at once.

Cheaper than SMF but suffers more signal loss over distance.



Extra imp questions

1) Computer Network – Definition, Applications, Advantages

Definition of Computer Network:

A **computer network** is a system of interconnected computers and other devices that communicate with each other to share resources, data, and applications. The connections may be through cables (wired) or wireless media.

Applications of Computer Networks:

1. **Resource Sharing:** Allows sharing of hardware like printers, scanners, and storage devices.
 2. **Data Sharing:** Enables easy and fast sharing of files and data between systems.
 3. **Internet Access:** Provides access to web services like email, websites, and cloud platforms.
 4. **Communication:** Supports tools like email, instant messaging, video conferencing, etc.
 5. **E-Commerce and Online Banking:** Facilitates online business transactions and banking services.
 6. **Remote Access:** Users can access data and systems from remote locations.
 7. **Multiplayer Gaming and Media Streaming:** Supports online gaming and streaming services.
-

Advantages of Computer Networks:

1. **Cost Efficiency:** Reduces the need for duplicate hardware by enabling resource sharing.
 2. **Improved Communication:** Enhances communication speed and convenience.
 3. **Data Security and Backup:** Centralized data storage allows better control and backup.
 4. **Scalability:** Networks can grow easily as more devices are added.
 5. **Increased Productivity:** Fast access to information improves work efficiency.
 6. **Remote Access:** Users can work from anywhere, increasing flexibility.
-

2) Types of Signals – Analog vs Digital, Advantages, Applications, Comparison

Types of Signals in Computer Networks:

Signals are used to transmit data over communication channels. The two main types are:

1. Analog Signals:

- Analog signals are **continuous** in time and amplitude.
- They represent data using **varying voltage or current** over time.

Advantages:

- Simple to generate and process.
- Better suited for **audio and video transmissions**.
- Consumes less bandwidth in some cases.

Applications:

- Telephony (traditional landlines)
 - Radio broadcasting
 - Analog TV signals
 - Audio transmission in speakers
-

2. Digital Signals:

- Digital signals are **discrete** in nature (binary values: 0 and 1).
- Represent data as a sequence of **pulses (high and low voltages)**.

Advantages:

- Less affected by noise and distortion.
- Easier to store, process, and encrypt.
- Enables error detection and correction.
- Suitable for **computer and data communication**.

Applications:

- Computers and digital devices
 - Internet and LAN communications
 - Digital telephony (VoIP)
 - CD/DVD media and digital broadcasting
-

Comparison: Analog vs Digital Signals

Feature	Analog Signal	Digital Signal
Nature	Continuous	Discrete (binary: 0 & 1)
Noise Resistance	Low (easily affected by noise)	High (less affected by noise)
Transmission Quality	Degrades over distance	Maintains quality over long distances
Storage & Processing	Difficult	Easy
Cost	Generally cheaper	May be expensive initially
Bandwidth	Low to moderate	Can require high bandwidth
Examples	Radio, TV, Analog phone	Computers, Internet, Digital phones

3) "Modes of Communication with Diagram"

Modes of Communication:

Communication modes refer to the direction in which data flows between two devices. There are **three main modes** of data communication:

1. Simplex Mode:

- Data flows in **one direction only**.
- The sender can only send; the receiver can only receive.
- No reverse communication is possible.

Example: Keyboard to CPU, Monitor display

2. Half-Duplex Mode:

- Data flows in **both directions**, but **only one direction at a time**.
- Devices take turns to send and receive data.

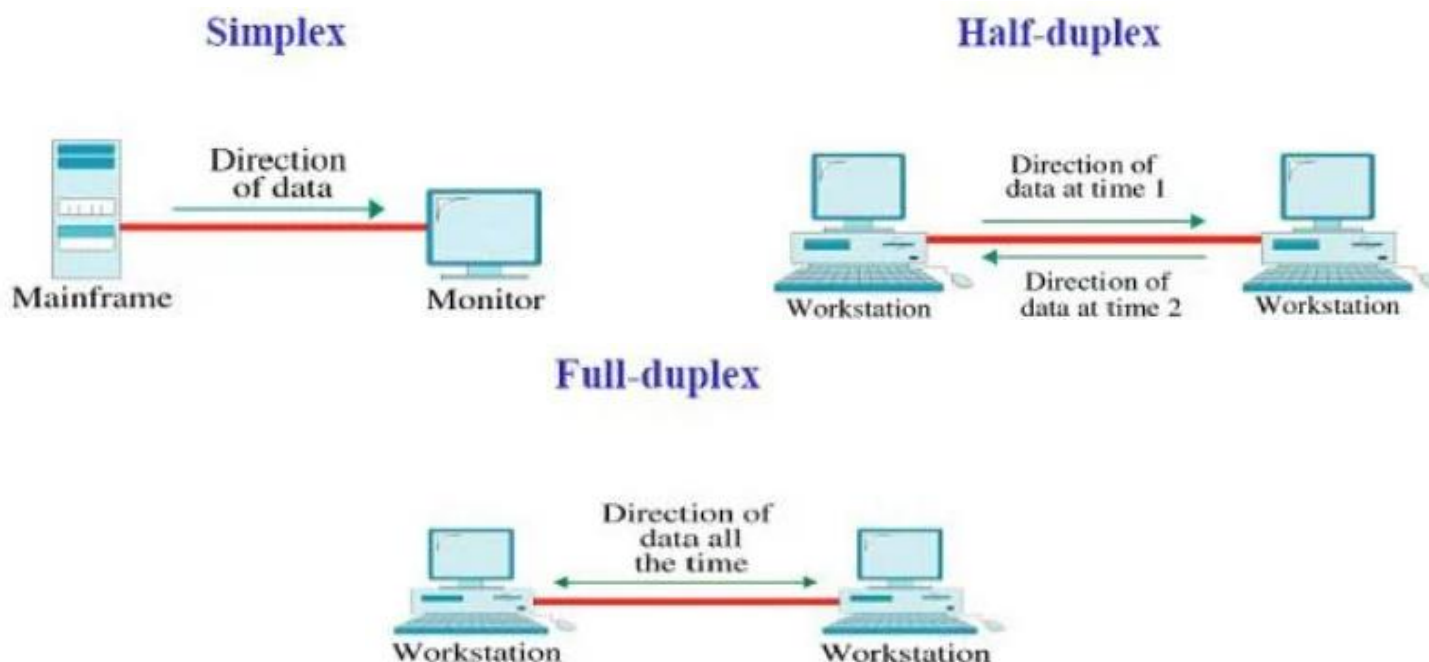
Example: Walkie-Talkie, CB Radio

3. Full-Duplex Mode:

- Data flows in **both directions simultaneously**.
- Both devices can send and receive at the same time.

Example: Telephone, Video calls

Diagrams: Modes of Communication



4) **Client-Server Architecture** and **Peer-to-Peer Architecture**, including working and advantages and disadvantages .

1. Client-Server Architecture

Definition:

Client-Server is a network architecture where multiple clients (users) request and receive services from a centralized server.

Working:

- The **client** sends a request for data or services.
- The **server** processes the request and sends back the required response.
- Clients and servers communicate over a network (like the internet or LAN).

Examples:

- Web browsing (Client: browser, Server: web server)
- Email systems

Advantages:

- Centralized control and security
- Easy to manage large networks

Disadvantages:

- Server is a **single point of failure**
- Can be **costly** to maintain

2. Peer-to-Peer (P2P) Architecture

Definition:

In a P2P network, each device (peer) acts as both a client and a server. There is **no central server**.

Working:

- Each peer can **share and access resources** directly with other peers.
- Peers communicate directly without relying on a central authority.

Examples:

- File-sharing networks (e.g., BitTorrent)
- Local networks between PCs

Advantages:

- Cost-effective, no need for a central server
- Easy to set up for small networks

Disadvantages:

- Less secure and harder to manage
- Not scalable for large networks

5) "Types of Networks – Diagram, Applications, Explanation":

Types of Computer Networks:

Computer networks are classified based on **geographical area** and **purpose**. The main types are:

1. PAN (Personal Area Network):

- Covers a **small area**, typically within a range of **10 meters**.
- Used for **personal devices** like smartphones, laptops, Bluetooth headsets.

Applications:

- Data transfer between mobile and laptop
 - Wireless accessories (e.g., Bluetooth mouse)
-

2. LAN (Local Area Network):

- Covers a **small geographic area**, such as a **home, office, or school**.
- High speed and low latency.

Applications:

- Office networking
 - File and printer sharing in institutions
-

3. MAN (Metropolitan Area Network):

- Covers a **city or town**, larger than LAN but smaller than WAN.
- Often used to connect multiple LANs within a city.

Applications:

- Cable TV networks
 - City-wide Wi-Fi or university campuses
-

4. WAN (Wide Area Network):

- Covers a **large geographic area**, such as countries or continents.
- Uses satellite, fiber optics, or leased telephone lines.

Applications:

- The Internet
- Multinational corporate networks

6) TCP Model – Explanation, Diagram, and Functions of Each Layer

TCP/IP Model:

The **TCP/IP model** (Transmission Control Protocol/Internet Protocol) is a **4-layer** conceptual framework used to describe how data is transmitted over the internet.

It is the foundation of the **Internet** and defines standards for networking and communication.

Layers of TCP/IP Model:

1. **Application Layer**
 2. **Transport Layer**
 3. **Internet Layer**
 4. **Network Access Layer** (also called Link Layer)
-

Functions of Each Layer:

1. Application Layer (Top Layer):

- Provides services and interfaces for user applications.
- Responsible for data formatting, encryption, and user authentication.
- Examples: HTTP, FTP, SMTP, DNS

Function:

- Enables user interaction with the network.
-

2. Transport Layer:

- Ensures reliable or unreliable delivery of data.
- Uses protocols like **TCP** (reliable) and **UDP** (unreliable).
- Handles **segmentation, flow control, and error control**.

Function:

- Manages end-to-end communication between devices.
-

3. Internet Layer:

- Responsible for logical addressing (IP addresses).
- Handles **routing and packet forwarding** using IP.
- Protocols: **IP, ICMP, ARP**

Function:

- Determines the best path for data transmission.

4. Network Access Layer (Link Layer):

- Deals with **physical transmission** of data over network hardware.
- Handles **MAC addressing, framing, and error detection** at the link level.
- Examples: Ethernet, Wi-Fi, DSL

Function:

- Transfers bits over physical medium (cables, wireless).

Diagram: TCP/IP Model

