

Chapter 2 (Information Network)

Short + Long Questions

Short Questions

Information networks,

also known as computer networks, merge computing and telecommunications technologies. These networks encompass various types, including local area networks (LANs), metropolitan networks (MANs), wide-area networks (WANs), and the Internet.

Workgroup computing

is crucial in today's business, academic, technological, and research environments. Enables individuals and teams to use computer networks for cooperation, consultation, and information sharing.

Groupware

short for "group software," is a term used to describe software applications and tools designed to support and enhance collaboration within groups or teams. It enables multiple users to work together on a shared project or activity.

Global Village

The term "global village" is used to describe how the internet and other electronic communication technologies have made the world feel like a small, closely connected community. It's as if the entire world is now just a click or a message away, allowing people from different corners of the globe to interact and collaborate seamlessly, transcending geographical distances.

Benefits of E-mail Communication:

E-mail communication offers rapid, cost-effective, and versatile messaging (we can send letter, files notes etc). And its non-anonymous (it shows who sent it). We can receive E-mail without interruptions.

ARPANET

ARPANET (Advanced Research Project Agency Network), created in the late 1960s by the US Department of Defense's DARPA, started as a research network connecting scientists worldwide. It later expanded into various military networks over the decades.

Define E-mail and write its benefits.

E-mail

E-mail (Electronic mail) is the process of sending message directly from one computer to another linked through wired or wireless connection. This facility is provided by some specialized website called E-mail server like yahoo, Hotmail and Gmail.

Benefits of E-mail Communication:

- 1. Instantaneous Communication:** E-mail allows for rapid communication with anyone on the internet, regardless of their physical location. Messages are typically delivered within minutes or seconds.
- 2. Cost-Effective:** E-mail is a cost-effective means of communicating with friends, colleagues, or business associates. It eliminates the need for physical postage or long-distance phone calls.
- 3. Versatile Communication:** E-mail facilitates the sending of various types of content, including letters, notes, files, data, and reports. It offers a consistent method for sending different forms of information.
- 4. Uninterrupted Work:** Recipients can receive e-mails without interrupting their current tasks. E-mails are delivered to a mailbox on the server, allowing users to access and respond to them at their convenience.
- 5. Flexible Timing:** E-mails can be received and read at any time, even if the recipient's computer is powered off when the messages arrive. This flexibility enables convenient access to information.
- 6. Non-Anonymity:** E-mails are not anonymous and always include the originator's address. This transparency ensures the source and destination of the communication are known and verifiable.

Birth of Internet

- In the late 1960s, the Internet had its origins as ARPANET (Advanced Research Project Agency Network), initiated by the US Department of Defense's DARPA, in conjunction with universities and research organizations.
- Initially, ARPANET was primarily for research in communication technology, enabling scientists at different locations to share information.
- Over the following decades, ARPANET evolved into multiple networks, mostly used for military purposes.
- In 1989, these military networks were replaced by the National Science Foundation's NSFNET, marking a turning point where the Internet began serving both civilian and military communities.
- The Internet, despite commercialization, still receives support from organizations like NSF.
- Since 1990, the Internet has experienced rapid growth, with over two million computer networks and more than one hundred million connected computers worldwide.

Define Internet and write its Uses/ Benefits.**Internet**

The Internet is a global network of billions of computers and other electronic devices. With the Internet, it's possible to access almost any information, communicate with anyone else in the world, and do much more.

How the Internet is Useful?

Internet has many more components of immense utilization. Few of them are as given below

1. World Wide Web (www): The World Wide Web is a vast collection of web pages and websites.

It organizes Internet resources for easy access to information.

2. Electronic Mail (E-mail): E-mail is the process of sending and receiving messages and files among Internet users.

3. Telnet: Telnet is a software tool that allows one computer to connect to another and utilize its information.

4. File Transfer Protocol (FTP): FTP is a tool for transferring files between computers.

Downloading refers to getting files from a remote computer to our local computer, while **uploading** means sending files from our local computer to a remote computer.

5. Gopher: Gopher is an information access and retrieval system that covers a wide range of resources, including reference materials, magazine articles, government documents, and speeches

6. Chat Groups: Internet users with common interests form online forums for real-time discussions.

7. Intranet: An intranet is a private and secure business network based on Internet technology, but not necessarily connected to the public Internet. It allows companies to make internal information accessible to employees regardless of location or hardware, ensuring security.

8. Extranet: An extranet connects two or more intranets, enabling collaboration among companies. Each company can make specific parts of its intranet accessible to employees of other companies for shared data, training, project management, and more. Security from individual intranets is maintained to restrict unauthorized access

Discus Five network components in detail.

1. Interconnection System:

- LANs use various methods for interconnecting devices. Options include shared network cables, twisted wire pairs, coaxial cables, fiber optic cables, and wireless connections. Each has its advantages and limitations.

2. Network Interface Card (NIC):

- A NIC, or network interface card, connects each computer to the network wiring. It is often a circuit board that fits into a computer's internal expansion slot. Some computers come with built-in NICs.

3. Bridges:

- Bridges are devices that connect similar networks. They recognize messages on one network and pass on those addressed to nodes on other networks.

4. Gateways:

- A gateway is a collection of hardware and software resources that enable a node to communicate with computers on different networks. For instance, it can connect a local area network (LAN) to a wide-area network (WAN).

5. Routers:

- Routers connect two or more networks and consist of a combination of hardware and software. They include physical interfaces for various networks and use routing protocols and operating systems.

Explain LAN's protocol in detail.

1. Ethernet:

- Ethernet is a commonly used protocol known for its high-speed network cable and bus topology. It ensures data transmission reliability. Computers on the network follow rules to avoid data collisions.

Ethernet Protocol (CSMA/CD)

- Common LAN protocol.
- Uses high-speed network cable and bus topology.
- Nodes share the same cable for data exchange.
- CSMA/CD ensures no simultaneous data transmission.
- Nodes listen before data transmission.
- Node wait if the cable is busy.

- If cable is free, node transmits immediately.
- Before sending data, nodes listen for network activity.
- If a collision occurs, a collision signal is sent.
- Nodes halt data transmission, wait for random intervals.
- Random waits reduce chances of simultaneous retries.
- Enhances efficient data transmission in Ethernet networks.

2. Token Ring:

- Token Ring, associated with IBM, operates using ring network topology and a token passing method (controlling access to the shared network). Only one token circulates on the network, and only one device can access the network at a time.

3. ARCnet (Attached Resource Computer Network):

- ARCnet has its topology and networking technology. It uses twisted-pair wire or coaxial cable, often in a star topology with hubs. It was popular due to its low cost, reliability, and ease of setup. Fast ARCnet increased the transmission rate.

4. TCP/IP (Transmission Control Protocol / Internet Protocol):

- TCP/IP is the universal protocol used by computers on the Internet. It ensures reliable connections and unique identification for every device on the Internet. All computers on the Internet must have TCP/IP configured.

5. ISDN (Integrated Services Digital Network):

- ISDN is a set of international communication standards for transmitting voice, video, and data as digital signals over telephone lines. Basic rate ISDN offers higher quality and reliability compared to analog connections.

6. DSL (Digital Subscriber Line):

- DSL provides high-speed digital data transmission over existing telephone lines. It offers faster digital connections and doesn't require modems. DSL is a popular alternative to ISDN.

Discuss different types of networks. / Discuss LAN, MAN and WAN in detail.

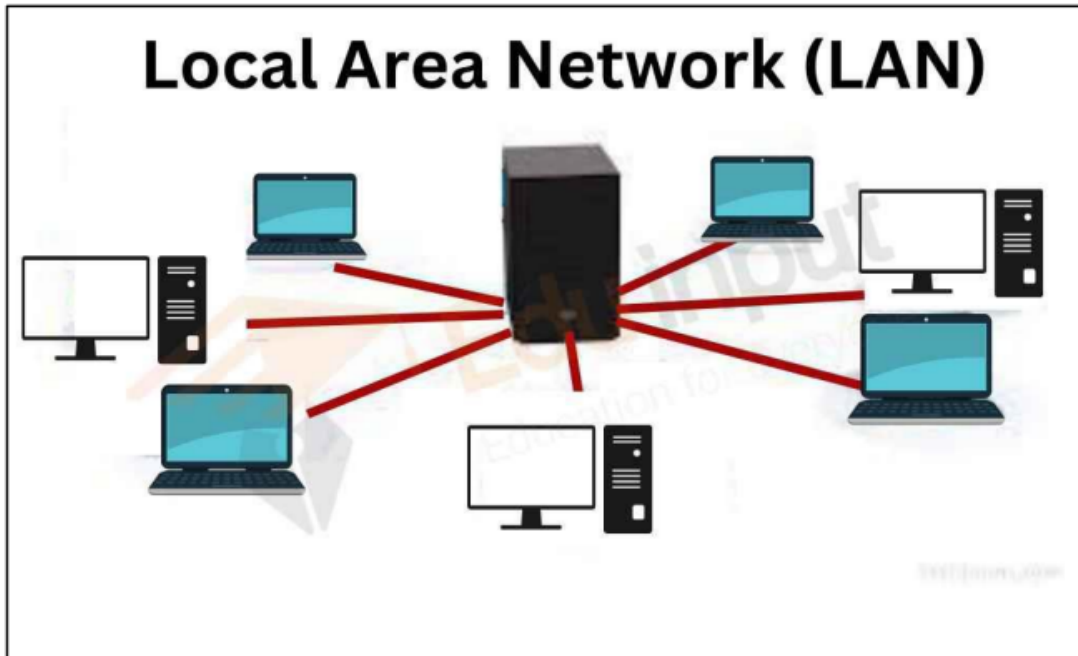
Types of Network

Local Area Network (LAN):

- A LAN is a network of computers, typically microcomputers, that share hardware, software, and data resources.
- LANs connect personal computers, enabling resource sharing.
- LANs cover short distances, usually within a single office, building, or a close group of nearby buildings.

Example 1: A company's office network, where all the computers and devices within the office building are connected to share resources like printers and files.

Example 2: Home Wi-Fi networks that connect all the devices in a household, such as laptops, smartphones, tablets, and smart home devices.



Advantages of LAN:

1. Efficient resource sharing among connected computers.
2. High data transfer speeds within the local area.

Disadvantages of LAN:

1. Limited coverage area, suitable for small-scale networks.
2. Initial setup and maintenance costs can be relatively high.

Wide Area Network (WAN):

- A WAN comprises geographically distant computers and terminals.
- Personal computers may connect to mainframes or minicomputers in remote locations.

- PCs can imitate terminals by using terminal emulation software, allowing them to act as terminals.
- Larger computers treat PCs as input/output devices (terminals).
- The host computer is the larger one to which terminals or PCs are attached.
- File transfer software facilitates downloading and uploading of data files between PCs and host computers.
- WAN communication occurs over telephone lines, microwave, or satellite links.
- WANs connect two or more LANs across a wide geographical area.
- The Internet is a global WAN connecting thousands of computers and LANs, forming the World Wide Web (WWW).

Example 1: The internet itself is a global WAN that connects computers and networks worldwide.

Terminal Emulation Software:

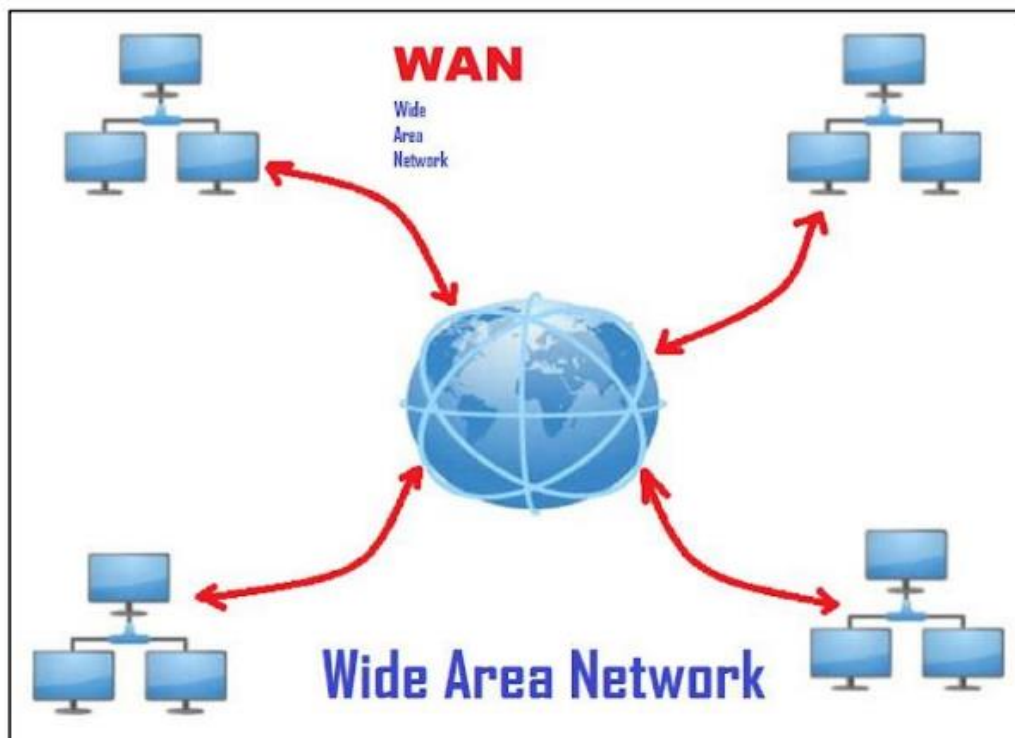
Terminal emulation software enables personal computers to mimic terminals, allowing them to communicate with larger computers as if they were terminals.

Advantages of WAN:

1. Enables communication and data exchange between geographically distant locations.
2. Access to larger mainframe or minicomputer resources for remote users.

Disadvantages of WAN:

1. Slower data transfer speeds compared to LANs.
2. Costly setup and maintenance, especially for long-distance communication.



Metropolitan Area Network (MAN):

- A MAN is a communication network that covers the geographical area of a city.
- MANs are often used to bypass local telephone companies for long-distance services.

Example: Cellular mobile phone systems are examples of MANs.

Advantages of MAN:

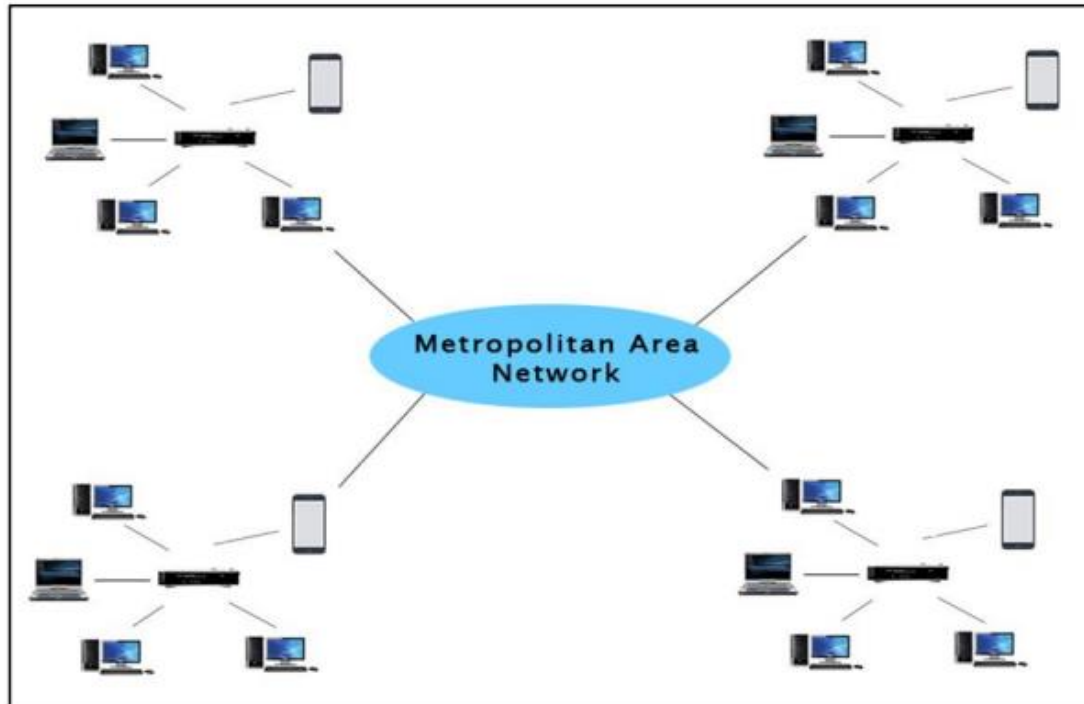
Provides high-speed communication within a city or metropolitan area.

Bypasses local telephone companies, potentially reducing communication costs.

Disadvantages of MAN:

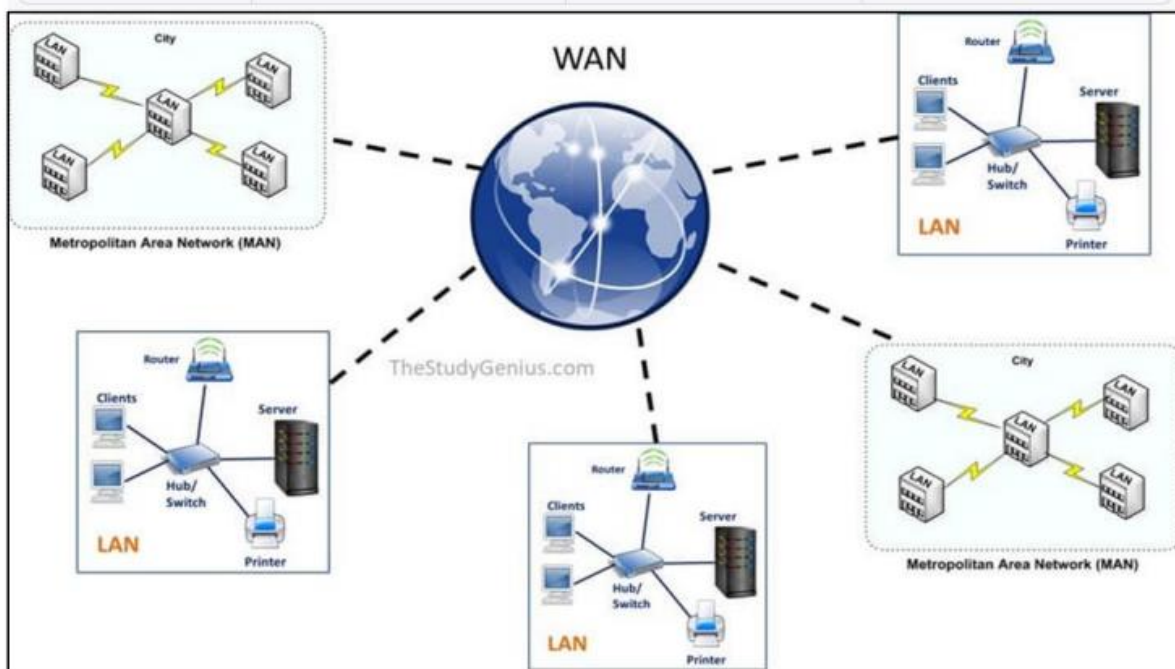
Limited geographical coverage compared to WANs.

Requires significant infrastructure and investment to establish and maintain.



Differentiate between LAN, MAN and WAN.

Aspect	Local Area Network (LAN)	Metropolitan Area Network (MAN)	Wide Area Network (WAN)
Geographical Coverage	Small, typically within a building or a campus.	Larger, covers a city or metropolitan area.	Very large, spans countries or even the entire globe.
Transmission Speed	High-speed communication within the network.	High-speed within the city but slower over long distances.	Variable, can be fast but often slower over long distances.
Ownership and Control	Privately owned and controlled by the organization or entity.	Often a mix of private and public ownership, with regulatory authorities.	Diverse ownership, often involving multiple service providers.
Infrastructure	Uses Ethernet, Wi-Fi, or other local area network technologies.	Utilizes a mix of technologies, including fiber optics and wireless.	Utilizes a range of technologies, including leased lines and satellite.
Typical Usage	Commonly found in homes, offices, and campuses for internal communication.	Used by organizations within a city, universities, and government agencies.	Employed by large organizations and telecom companies for global connectivity.



Uses of Networks

- Networks allow users simultaneous access to shared programs and data.
 - Networks also allow users to share peripheral devices, such as printers and hard disks.
 - Networks usually include the capability to send e-mail along with big attachments (files etc.)
 - Some networks also aid communication by providing tools for teleconferencing and videoconferencing
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Explain different network models in detail.

1. Client/Server (Dedicated Server Network)

In a client/server network, there is a central server that controls the network. The server typically holds shared files/databases on its hard disks and offers shared resources, like a quality printer. The server handles most of the network processing, allowing clients (other computers on the network) to use its resources.

Example:

A large office network where all files are stored on a server, and computers (clients) access these files and shared printers.

Advantages:

1. Reduces data traffic, allowing faster response times.
2. Allows less expensive computers to be used as clients since the server does most of the processing.

Disadvantages:

1. If the server fails, the whole network is affected.
2. Requires expensive server hardware and maintenance.

2. Peer-to-Peer

In a peer-to-peer network, all computers have equal status, and no one computer controls the others. Files and devices are distributed across several computers, and users can share data and devices as needed.

Example:

A small home network where all computers can access shared files and printers directly.

Advantages:

1. Simple and inexpensive to set up.
2. All users can easily share resources.

Disadvantages:

1. Slows down under heavy use.
2. Lacks security, making sensitive data vulnerable.

3. Hybrid Network

A hybrid network is a combination of both client/server and peer-to-peer networks. It takes the benefits of both, using a server for important tasks while also allowing peer-to-peer sharing among some nodes.

Example:

A medium-sized company where a central server manages critical resources, but users can still share files directly between their computers.

Advantages:

1. Combines the strengths of both models.
2. Offers flexibility in resource sharing.

Disadvantages:

1. More complex to manage.
 2. Can be expensive to set up.
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Network Standards

The standards are the precise documents containing technical and physical specifications about the network being designed. Normally those standards are taken into considerations, which are worldwide, acceptable.

De Facto standard

De facto means "by tradition" or "by facts". These standards are most commonly used by the organizations worldwide.

De jure standard

De jure means "according to law or regulation". The networks governing body have properly approved these standards.

Few of networks governing body

- American National Standard Institute (ANSI)
- The Institute of Electrical and Electronics Engineers (IEEE)
- The International Standard Organization (ISO)
- The Electronic Industries Association (EIA)
- Telcordia

Define Network topology. Explain Bus or star or mesh or tree topology.

Network Topologies

- Network topologies describe the arrangement of connected devices on a network, defining its structure.
- Various basic topologies include Bus, Ring, Star, Tree, and Mesh, and more complex networks can be combinations of these.

Bus Topology:

- Bus networks use a shared backbone cable to connect all devices.
- Devices tap into this common communication medium with interface connectors.
- When a device wants to communicate, it broadcasts a message on the cable; only the intended recipient processes it.
- Commonly used for Ethernet networks like 10Base-2 ("ThinNet") and 10Base-5 ("ThickNet").

Access methods for devices in Bus Topology

CSMA/CD (Carrier Sense Multiple Access/Collision Detection):

- Local area network access method resolving contention between stations through collision detection.
- When two stations transmit simultaneously, they stop and signal a collision.
- They wait for a predetermined time before retransmitting, choosing random intervals to avoid another collision.
- In Ethernet, a station must keep transmitting until a 50-microsecond period ends and may need to pad data with zeros for short frames.

CSMA/CS (Carrier Sense Multiple Access/Carrier Sense):

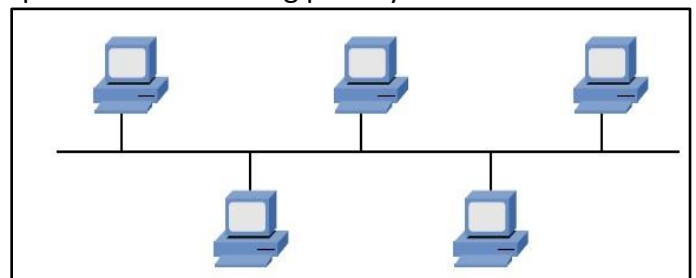
- A node listens to the bus before transmitting and waits for the current transmission to finish.

CSMA/CR (Carrier Sense Multiple Access/Collision Resolution):

- Allows multiple devices to talk simultaneously, with a protocol determining priority.

Advantages:

- Easy to install with minimal cabling requirements.
- Suitable for small to medium-sized networks.



Cost-effective and straightforward for connecting devices.

Disadvantages:

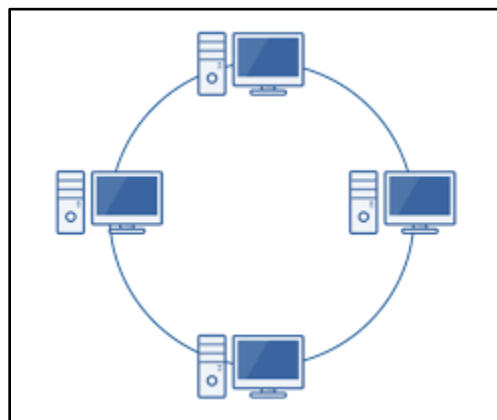
Limited scalability; performance issues arise with many devices.

A failure in the backbone cable disrupts the entire network.

Broadcast messages can lead to network congestion.

Ring Topology:

In a ring network, each device connects to exactly two neighbors for communication. Data messages circulate through the ring in a unidirectional manner (either clockwise or counterclockwise). Token passing is used for managing access to the network. Ring topologies offer uniform access to all devices on the network.



Advantages:

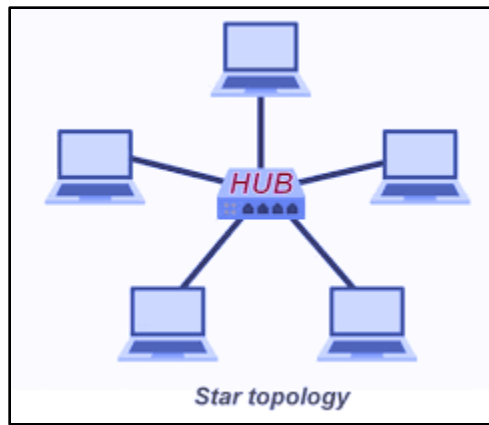
- Predictable data transmission due to unidirectional flow.
- Fair access for all devices on the network.
- Token passing prevents data collisions.

Disadvantages:

- A single cable or device failure can disrupt the entire network.
- Limited scalability.
- Adding or removing devices is complicated.

Star Topology:

Star networks are commonly used in home networks. They feature a central connection point, which can be a hub or a switch. Devices connect to the central hub using Unshielded Twisted Pair (UTP) Ethernet cables. Cable failures in a star network affect only the connected device, not the entire network. However, if the central hub fails, the entire network becomes inoperative.



Advantages:

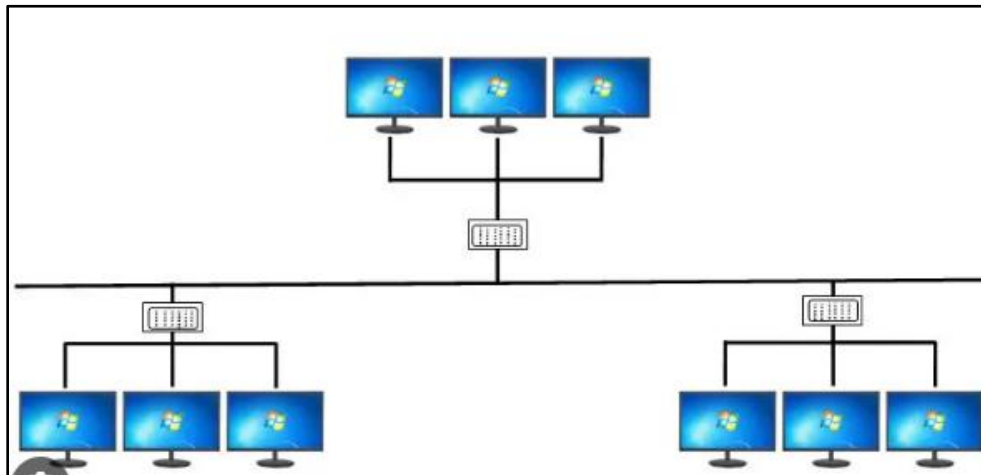
- Easy to install and configure.
- Cable failures affect only the connected device.
- Centralized management at the hub.

Disadvantages:

- If the central hub fails, the entire network goes down.
- Requires more cabling than bus topologies.
- Limited scalability due to hub port constraints.

Tree Topology:

Tree topologies combine multiple star topologies into a bus arrangement. In its basic form, only hub devices are directly connected to the tree bus. Each hub serves as the "root" of a branch of connected devices. Tree topologies provide scalability, allowing for network expansion beyond the limitations of bus or star topologies. They offer better expandability while avoiding excessive broadcast traffic and port limitations.



Advantages:

- Supports better expandability compared to bus or star topologies.
- Reduces broadcast traffic and network congestion.

Disadvantages:

- If the root hub fails, it impacts the entire branch of devices.
- Cable failures in the tree bus can disrupt multiple devices.
- Complex to install and manage.

Mesh Topology:

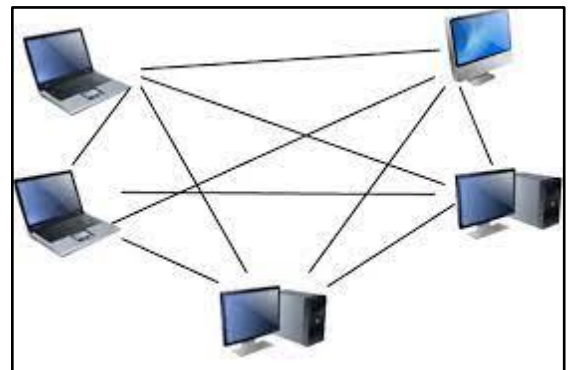
Mesh topologies offer multiple routes for data transmission between devices. Messages in a mesh network can take various paths from the source to the destination. Mesh networks, such as the Internet, provide high fault tolerance due to multiple links. They can handle heavy network loads efficiently. Troubleshooting in mesh networks is relatively straightforward; faults are identified if data isn't transmitted directly between two connected devices. However, installation, reconfiguration, and maintenance of redundant links can be challenging and costly.

Advantages:

- High fault tolerance due to multiple links and paths.
- Efficient performance under heavy loads.
- Ease of troubleshooting: Faults in direct links are readily identifiable.

Disadvantages:

- Complex to install and reconfigure.
- High cost associated with maintaining redundant links.
- Requires a significant amount of cabling.



Define OSI Model. Discuss its layers.

OSI (Open system interconnection) Model:

The OSI model serves as a reference model for data communication processes across networks. Developed by the International Organization for Standardization (ISO) to facilitate interoperability in the computer industry. Consists of seven layers, each responsible for specific aspects of data communication.

Name of OSI Layers:

1. Application Layer
2. Presentation Layer
3. Session Layer
4. Transport Layer
5. Network Layer
6. Data Link Layer
7. Physical Layer

Upper Layer and Lower Layer

The layers of the OSI model are divided into two groups: the upper layer and lower layer. The upper layers focus on user/applications and how files are represented on the computers prior to transport.

For the most part, network engineers are more concerned with the lower layers. It's the lower layers that concentrate on how the communication across a network actually occurs

Upper Layers

1. Application Layer

- Provides network services to user applications.
- Responsible for tasks like email communication and file transfers.
- Focuses on end-user interactions with the network.

2. Presentation Layer

- Manages data formatting, encryption, and translation.
- Ensures data can be properly interpreted by the receiving system.
- Handles data format conversions and encryption/decryption.

3. Session Layer

- Manages communication sessions between devices.
- Establishes, maintains, and terminates connections.
- Synchronizes data between sender and receiver.

4. Transport Layer

- Responsible for end-to-end communication and data segmentation.
- Breaks down data into smaller segments for transmission.
- Handles error checking to ensure reliable and ordered data delivery.

Lower Layers

1. Network Layer

- Focuses on addressing and routing data across networks.
- Determines the best path for data, handles packetization, and manages network congestion.
- Deals with logical addressing and routing.

2. Data Link Layer

- Manages communication between directly connected nodes.
- Handles data frames, hardware-level addressing (MAC addresses), and ensures reliable data transfer.
- Includes error detection and correction.

3. Physical Layer

- Defines the hardware aspects of data transmission.
- Specifies how bits are transmitted over the physical medium.
- Deals with electrical and mechanical characteristics of the transmission medium.