A computer network is a group of computers that has the potential to transmit, receive and exchange voice, data, and video traffic. A network connection can be set up with the help of either cable or wireless media. In 1957, when SPUTNIK Satellite was launched by Russia. An agency named ADVANCED RESEARCH PROJECT AGENCY (ARPA) was started by American, and its first satellite was launched within 18 months after establishment. Then they used ARPANET to share the information on another computer.

What is a Computer Network?

- **Computer Network** is a group of computers connected with each other through wires, optical fibres or optical links so that various devices can interact with each other through a network.
- The aim of the computer network is the sharing of resources among various devices.
- In the case of computer network technology, there are several types of networks that vary from simple to complex level.

How Does a Computer Network Work?

Computer Networks simply work using nodes and links. Data Communication Equipment is simply termed as Nodes. For example, Modems, Hubs, Switches, etc. whereas links in Computer networks can be referred to as a connection between two nodes. We have several types of links like cable wires, optical fibers, etc.

What Do Computer Networks Do?

Computer Networks are one of the important aspects of Computer Science. In the early days, it is used for data transmission on telephone lines and had a very limited use, but nowadays, it is used in a variety of places.

Computer Networks help in providing better connectivity that helps nowadays.

Criteria of a Good Network

Performance: It can be measured in many ways, including transmit time and response time. Transit time is the amount of time required for a message to travel from one device to another. Response time is the elapsed time between an inquiry and a response. The performance of the network depends on a number of factors, including the number of users, the type of medium & Hardware

Reliability: In addition to accuracy is measured by frequency of failure, the time it takes a link to recover from failure, and the network's robustness in catastrophe.

Security: Network security issues include protecting data from unauthorized access, protecting data from damage and development, and implementing policies and procedures for recovery from breaches and data loss.

Goals of Computer Networking

- Programs do not have to execute on a single system because of resource and load sharing.
- Reduced costs – Multiple machines can share printers, tape drives, and other peripherals.
- Reliability – If one machine fails, another can take its place.
- Scalability (it's simple to add more processors or computers)
- Communication and mail (people living apart can work together)
- Information Access (remote information access, access to the internet, e-mail, video conferencing, and online shopping)
- Entertainment that is interactive (online games, videos, etc.)
- Social Networking

Types of Computer Networks

Division Based on the Communication Medium

Wired Network: As we all know, "wired" refers to any physical medium made up of cables. Copper wire, twisted pair, or fiber optic cables are all options. A wired network employs wires to link devices to the Internet or another network, such as laptops or desktop PCs.

Wireless Network: "Wireless" means without wire, media that is made up of electromagnetic waves (EM Waves) or infrared waves. Antennas or sensors will be present on all wireless devices. Cellular phones, wireless sensors, TV remotes, satellite dish receivers, and laptops with WLAN cards are all examples of wireless devices. For data or voice communication, a wireless network uses radio frequency waves rather than wires.

Division Based on Area Covered

Local Area Network (LAN): A LAN is a network that covers an area of around 10 kilometers. For example, a college network or an office network. Depending upon the needs of the organization, a LAN can be a single office, building, or Campus.

Metropolitan Area Network (MAN): MAN refers to a network that covers an entire city. For example: consider the cable television network.

Wide Area Network (WAN): WAN refers to a network that connects countries or continents. For example, the Internet allows users to access a distributed system called www from anywhere around the globe.WAN interconnects connecting devices such as switches, routers, or modems. A LAN is normally privately owned by an organization that uses it.

Based on Types of Communication

Point To Point networks: Point-to-Point networking is a type of data networking that establishes a direct link between two networking nodes.

A direct link between two devices, such as a computer and a printer, is known as a point-to-point connection.

Multipoint: is the one in which more than two specific devices share links. In the multipoint environment, the capacity of the channel is shared, either spatially or temporally. If several devices can use the link simultaneously, it is a spatially shared connection.

Broadcast networks: In broadcast networks, a signal method in which numerous parties can hear a single sender. Radio stations are an excellent illustration of the "Broadcast Network" in everyday life.

Based on the Type of Architecture

P2P Networks: Computers with similar capabilities and configurations are referred to as peers.

"Peer to Peer" is the abbreviation for "peer to peer." The "peers" in a peer-to-peer network are computer systems that are connected to each other over the Internet. Without the use of a central server, files can be shared directly between systems on the network.

Client-Server Networks: Each computer or process on the network is either a client or a server in a client-server architecture (client/server). The client asks for services from the server, which the server provides. Servers are high-performance computers or processes that manage disc drives (file servers), printers (print servers), or network traffic (network servers)

Hybrid Networks: The hybrid model refers to a network that uses a combination of client-server and peer-to-peer architecture. Eg: Torrent.

Types of Computer Network Architecture

Computer Network Architecture is of two types. These types are mentioned below.

1. Client-Server Architecture: Client-Server Architecture is basically the architecture where the clients and the server are connected as two clients can communicate with each other and the devices present work as servers in the network.

2. Peer-to-Peer Architecture: Peer-to-Peer Architecture, computers are connected to each other and each computer is equally capable of working as there is no central server here. Each device present here can be used as a client or server.

Types of Enterprise Computer Networks

There are three main types of Enterprise Computer Networks which are mentioned below.

1. Local Area Network (LAN): Local Area Networks are small-scale networks used in small companies or as test networks. It has a limited size.

2. Wide Area Networks (WAN): Wide Area Networks are networks that are used for a larger area than local area networks and are used for long-distance communication.

3. Service Provider Networks: Service Provider Networks are the networks that help in wireless communication, high-speed internet access, etc.

Network Topology

A network topology is the physical and logical arrangement of nodes and connections in a network.
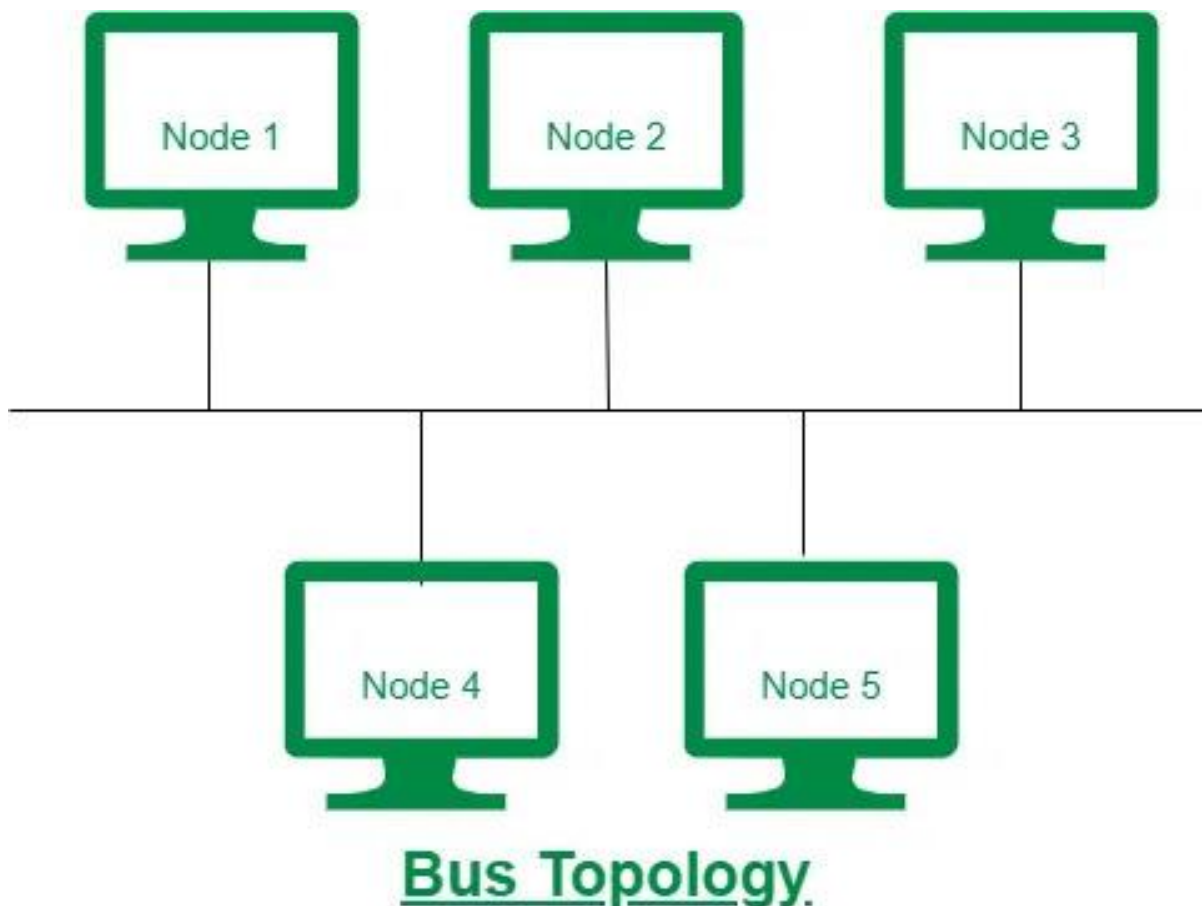
Bus Topology

Every computer and network device is connected to a single cable in a bus topology network. Linear Bus topology is defined as having exactly two terminals.

Advantages

- Installation is simple.
- Compared to mesh, star, and tree topologies, the bus utilizes less cabling.

Disadvantages

- Difficulty in reconfiguring and isolating faults.
- A bus cable malfunction or break interrupts all communication.
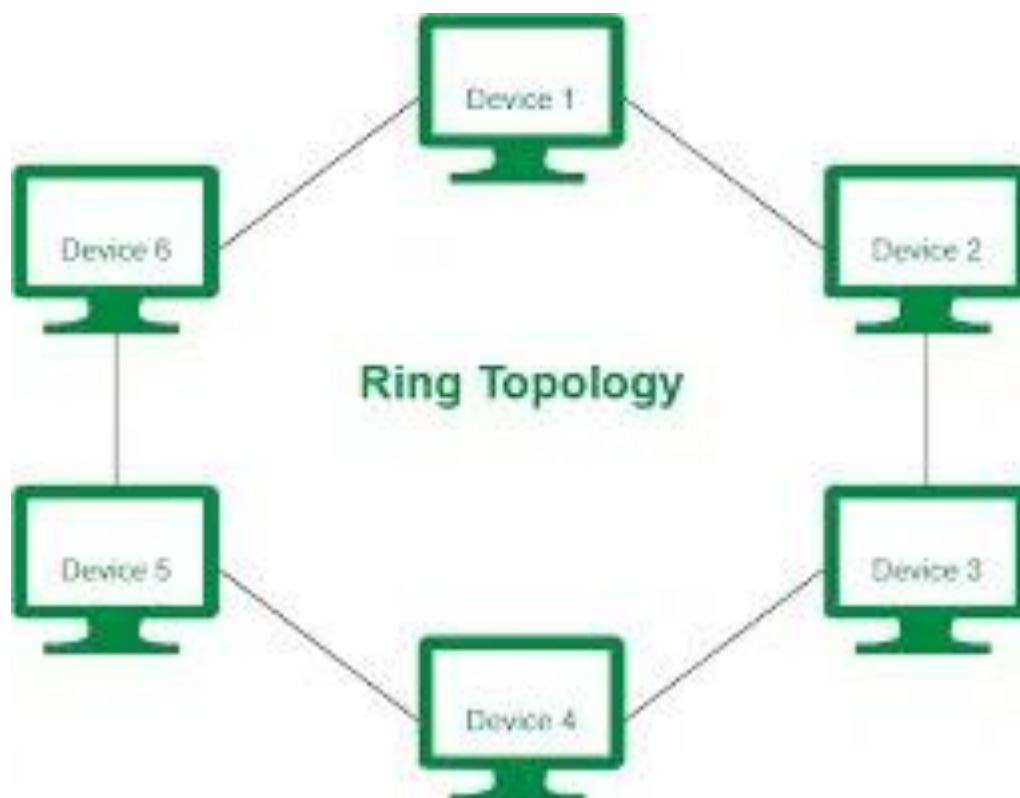

Bus Topology

Ring Topology

The topology is named ring topology because one computer is connected to another, with the final one being connected to the first. Exactly two neighbors for each device. A signal is passed along the ring in one direction. Each ring incorporates a repeater.

Advantages

- Data transmission is relatively straightforward because packets only move in one direction.
- There is no requirement for a central controller to manage communication between nodes.
- Easy installation & Reconfiguration
- Simplified Faulty connections

Disadvantages

- In a Unidirectional Ring, a data packet must traverse through all nodes.
- All computers must be turned on in order for them to connect with one another.


Ring Topology

Star Topology

Each device in a star topology has a dedicated point-to-point link to a central controller, which is commonly referred to as the HUB. There is no direct connection between the devices. Traffic between the devices is not allowed in this topology. As an exchange, the controller is used.

Advantages

- When attaching or disconnecting devices, there are no network interruptions.
- It's simple to set up and configure.
- Identifying and isolating faults is simple.
- Less Expensive than mesh
- Easy to install & configure

Disadvantages

- Nodes attached to the hub, switch, or concentrator is failed if they fail.
- Because of the expense of the hubs, it is more expensive than linear bus topologies.
- More cable is required compared to a bus or ring
- Too much dependency on Hub
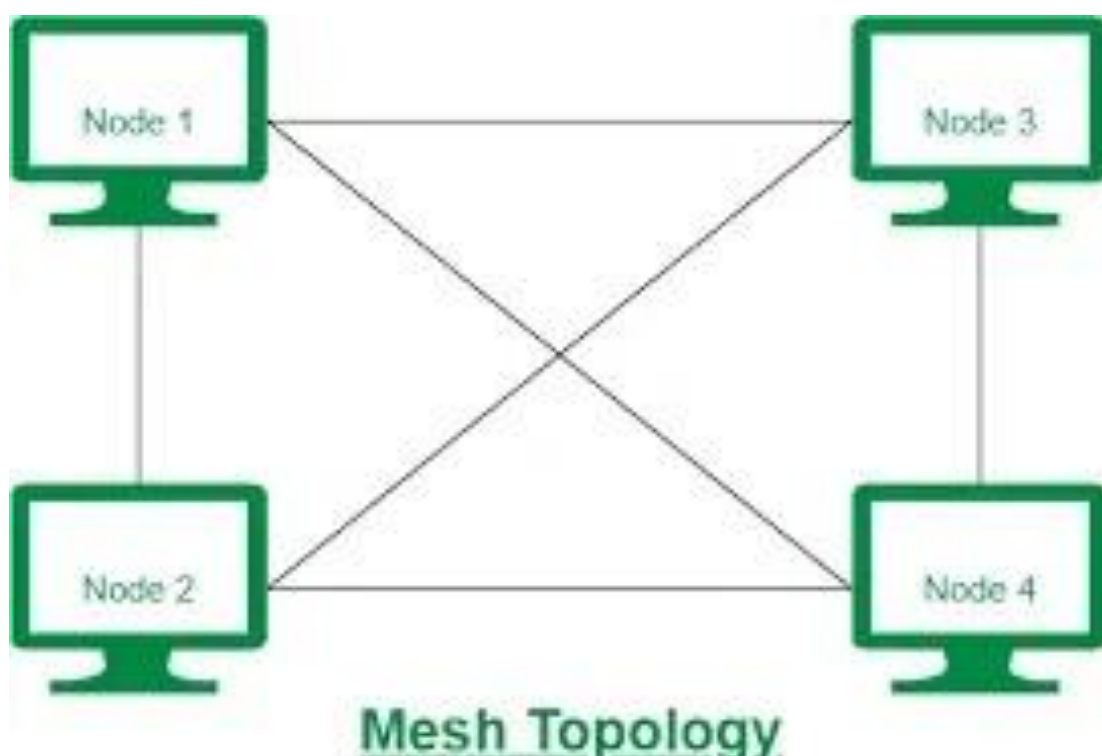

Star Topology
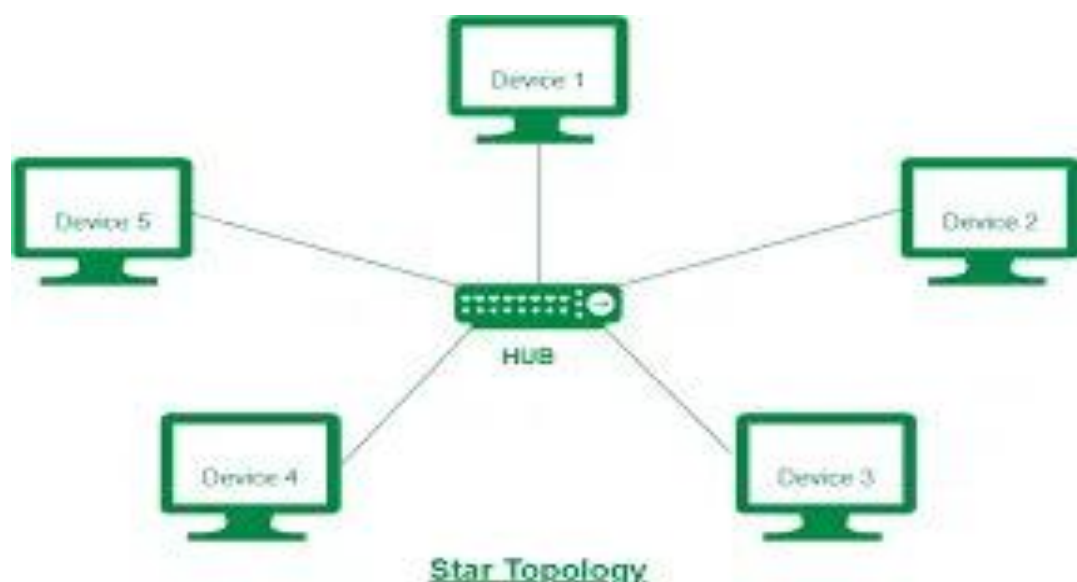
Mesh Topology

Every device in a mesh topology has dedicated point-to-point connectivity to every other device. The term "dedicated" refers to the fact that the link exclusively transports data between the two devices it links.

Advantages

- Data can be sent from multiple devices at the same time. This topology can handle a lot of traffic.
- Even if one of the connections fails, a backup is always available. As a result, data transit is unaffected.
- Physical boundaries prevent other users from gaining access to messages

Disadvantages

- The amount of cabling and the number of I/O ports that are necessary.
- It is difficult to install and reconfigure.

Mesh Topology

Tree Topology

The topology of a tree is similar to that of a star. Nodes in a tree, like those in a star, are connected to a central hub that manages network traffic. It has a root node, which is connected to all other nodes, producing a hierarchy. Hierarchical topology is another name for it. The number of Star networks is connected via Bus in Tree Topology.

Advantages

- Network expansion is both possible and simple.
- We partition the entire network into pieces (star networks) that are easier to manage and maintain.
- Other segments are unaffected if one segment is damaged.

Disadvantages

- Tree topology relies largely on the main bus cable because of its basic structure, and if it fails, the entire network is handicapped.
- Maintenance becomes more challenging when more nodes and segments are added.