

## Unit-2

### Network structure

A network structure is the logical arrangement of nodes and links in a computer network, defining how devices communicate and interact with each other. It establishes the topology, protocols, and rules for data transmission within the network.

A network structure typically consists of the following elements:

- **Nodes:** Devices that connect to the network and communicate with each other. These can include computers, servers, routers, switches, and other [Networking equipment](#).
- **Links:** Physical or wireless connections that establish communication pathways between nodes. These can include cables, fiber optics, Wi-Fi, and cellular networks.
- **Topology:** The geometric arrangement of nodes and links that defines the overall shape of the network. Common topologies include bus, star, ring, and mesh.
- **Protocols:** Rules and standards that govern how data is transmitted, formatted, and processed within the network. These protocols ensure compatibility and interoperability between different devices and applications.

The network structure determines the performance, reliability, and scalability of the network. It influences factors such as data throughput, latency, fault tolerance, and network security

### History

The concept of network structure has evolved over time with the development of networking technologies. In the early days of computing, networks were limited to simple connections between a few devices. As the number of devices and the volume of data grew, the need for structured and scalable networks became apparent.

The first significant advancements in network structure came with the development of the Ethernet protocol in the 1970s. Ethernet introduced the use of star topology, where devices connect to a central switch or hub. This structure simplified network management and allowed for easier expansion.

In the 1980s and 1990s, the development of routing protocols and the creation of the Internet led to the emergence of larger and [More](#) complex networks. Network structures became more hierarchical and interconnected, with core networks connecting multiple subnetworks.

The advent of wireless networking technologies in the 2000s further expanded the possibilities of network structures. Wi-Fi, Bluetooth, and cellular networks enabled the creation of highly mobile and flexible networks for a wide range of applications.

## What is Topology?

Topology is derived from two Greek words topo and logy, where topo means 'place' and logy means 'study'. In computer networks, a topology is used to explain how a network is physically connected and the logical flow of information in the network. A topology mainly describes how devices are connected and interact with each other using communication links.

“Topology defines the structure of the network of how all the components are interconnected to each other”.

**There are two types of topology: physical and logical topology.**

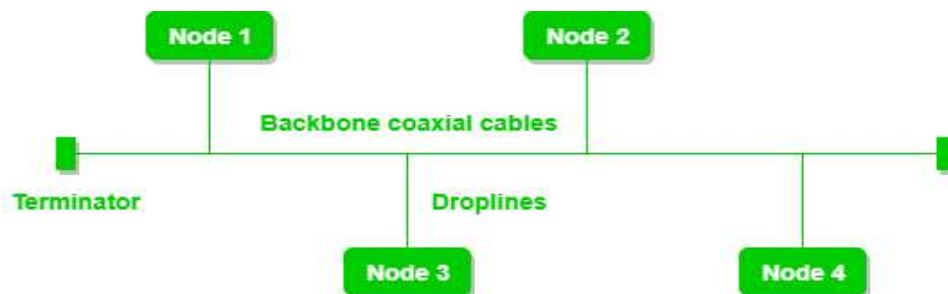
**Physical topology** is the geometric representation of all the nodes in a network.

**logical topology** defines how data is moved throughout the network and which path it takes. In other words, it is the way in which the devices communicate internally.

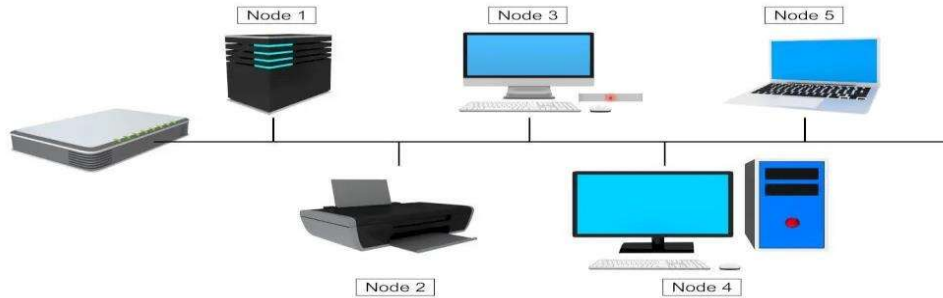
## Types of Topology-

### 1. Bus Topology

- The bus topology is designed in such a way that all the stations are connected through a single cable known as a backbone cable.
- Each node is either connected to the backbone cable by drop cable or directly connected to the backbone cable.
- When a node wants to send a message over the network, it puts a message over the network. All the stations available in the network will receive the message whether it has been addressed or not.
- The bus topology is mainly used in 802.3 (ethernet) and 802.4 standard networks.
- The configuration of a bus topology is quite simpler as compared to other topologies.
- The backbone cable is considered as a "**single lane**" through which the message is broadcast to all the stations.



‘OR’



### Advantages of Bus topology:

1. Simple to use and install.
2. **Limited failure:** A failure in one node will not have any effect on other nodes.
3. **Low-cost cable:** In bus topology, nodes are directly connected to the cable without passing through a hub. Therefore, the initial cost of installation is low.

### Disadvantages of Bus topology:

1. Efficiency is less when nodes are more (strength of signal decreases).
2. If the bus fails, the network will fail.
3. Whenever network traffic is heavy, or nodes are too many, the performance time of the network significantly decreases.
4. Security issues and risks are more as messages are broadcasted to all nodes.

## 2. Ring Topology

- Ring topology is a topology in which each computer is connected to exactly two other computers to form the ring.
- The node that receives the message from the previous computer will retransmit to the next node.
- The data flows in one direction, i.e., it is unidirectional.
- The data in a ring topology flow in a clockwise direction.
- The most common access method of the ring topology is **token passing**.
  - **Token passing:** It is a network access method in which token is passed from one node to another node.
  - **Token:** It is a frame that circulates around the network.



### Advantages:

- **Network Management:** Faulty devices can be removed from the network without bringing the network down.
- **Reliable:** It is a more reliable network because the communication system is not dependent on the single host computer.

### Disadvantages:

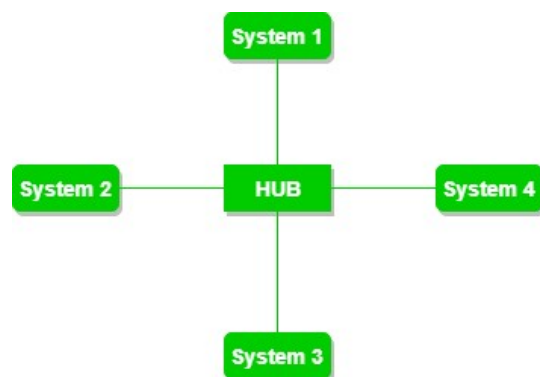
- **Reconfiguration difficult:** Adding new devices to the network would slow down the network.
- **Delay:** Communication delay is directly proportional to the number of nodes. Adding new devices increases the communication delay.

## 3. Star Topology

**“Star topology is a computer network topology in which all the nodes are connected to a centralized hub.”**

The hub or switch acts as a middleware between the nodes. Any node requesting for service or providing service, first contact the hub for communication. The central device (hub or switch) has point to point communication link (the dedicated link between the devices which cannot be accessed by some other computer) with the devices.

In a star topology, hub and switch act as a server, and the other connected devices act as clients. Only one input-output port and one cable are required to connect a node to the central device. This topology is better in terms of security because the data does not pass through every node.



### Advantages

1. Centralized control.
2. Less Expensive.
3. Easy to scale(nodes can be added or removed to the network easily).

### Disadvantages

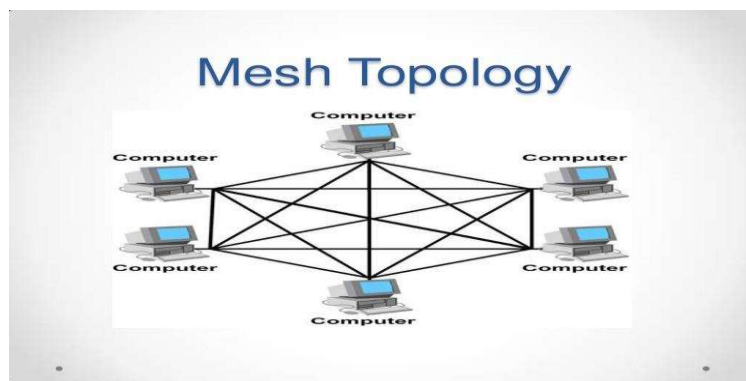
**1.A Central point of failure:** If the central hub or switch goes down, then all the connected nodes will not be able to communicate with each other.

#### 4.Mesh topology

- Mesh topology is an arrangement of the network in which computers are interconnected with each other through various redundant connections.
- It does not contain the switch, hub or any central computer which acts as a central point of communication.
- The Internet is an example of the mesh topology.
- Mesh topology can be formed by using the formula:

$$\text{Number of cables} = (n*(n-1))/2;$$

Where n is the number of nodes that represents the network.



1. **Full Mesh Topology:** In a full mesh topology, each computer is connected to all the computers available in the network.
2. **Partial Mesh Topology:** In a partial mesh topology, not all but certain computers are connected to those computers with which they communicate frequently.

#### Advantages

1. **Reliable:** The mesh topology networks are very reliable as if any link breakdown will not affect the communication between connected computers.
2. Communication is very fast between the nodes.
3. Maintains privacy and security due to a separate channel for communication.

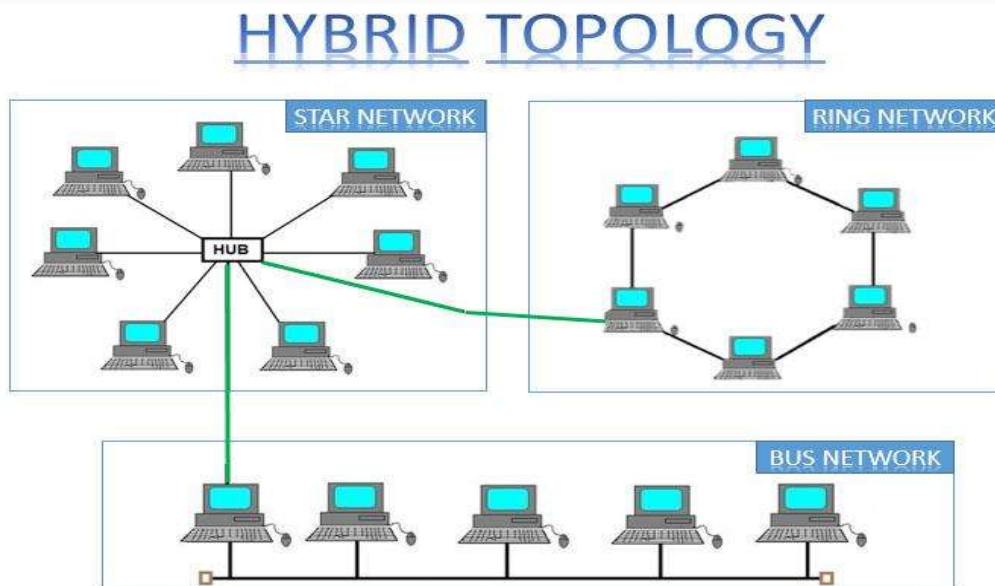
#### Disadvantages

1. **Cost:** A mesh topology contains a large number of connected devices such as a router and more transmission media than other topologies.
2. **Management:** Mesh topology networks are very large and very difficult to maintain and manage.

#### 5. Hybrid topology

- The combination of various different topologies is known as **Hybrid topology**.
- When two or more different topologies are combined together is termed as Hybrid topology and if similar topologies are connected with each other will not result in Hybrid

topology. For example, if there exist a ring topology in one branch of ICICI bank and bus topology in another branch of ICICI bank, connecting these two topologies will result in Hybrid topology.



### **Advantages**

**1.Reliable:** If a fault occurs in any part of the network will not affect the functioning of the rest of the network.

**2.Scalable:** Size of the network can be easily expanded by adding new devices without affecting the functionality of the existing network.

### **Disadvantages**

**1.Complex design:** The major drawback of the Hybrid topology is the design of the Hybrid network. It is very difficult to design the architecture of the Hybrid network.

**2.Costly infrastructure:** The infrastructure cost is very high as a hybrid network requires a lot of cabling, network devices, etc.

## **Type of Networking**

The size of a computer network defines its classification. A network can be tiny, containing only one system, or as large as needed. The following are the various types of computer networks:

- PAN
- LAN
- MAN
- WAN

## **1. PAN (Personal Area Network)**

- It is the smallest network of computers.
- Bluetooth or other infrared-enabled devices could be used to connect devices.
- It has a 10-metre range of connectivity.
- It can cover up to 30 feet in diameter.
- PAN network enables a single person's personal devices to connect with each other

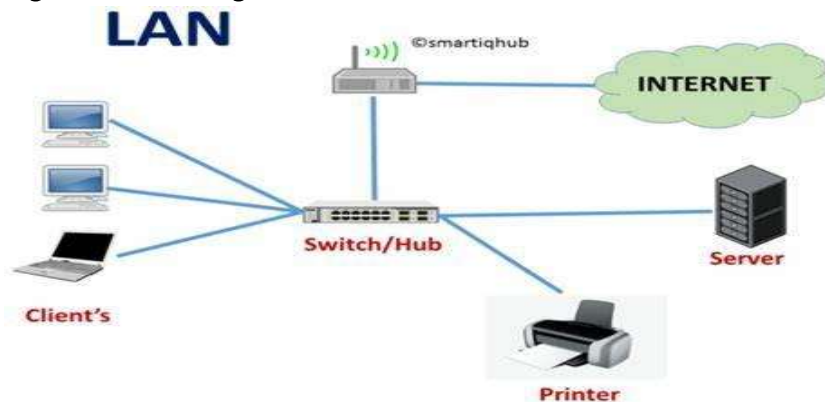


## **2. LAN (Local Area Network)**

A Local Area Network (LAN) is a private network that connects computers and devices within a limited area like a residence, an office, a building or a campus. On a small scale, LANs are used to connect personal computers to printers. However, LANs can also extend to a few kilometers when used by companies.

### **Features of LAN**

- Network size is limited to a small geographical area, presently to a few kilometers.
- Data transfer rate is generally high. They range from 100 Mbps to 1000 Mbps.
- In general, a LAN uses only one type of transmission medium, commonly category 5 coaxial cables.
- A LAN is distinguished from other networks by their topologies. The common topologies are bus, ring, mesh, and star.



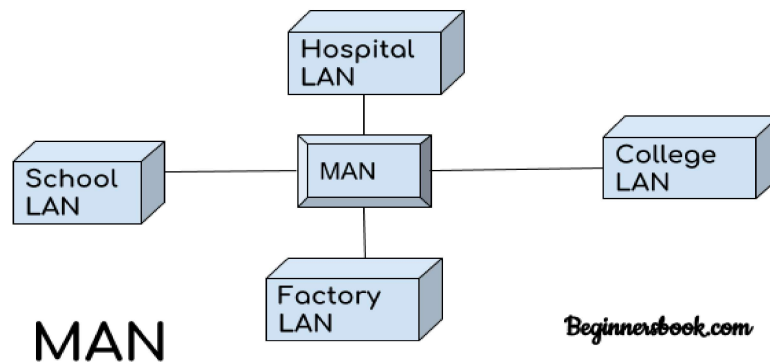


### 3.MAN - Metropolitan Area Network

A metropolitan area network (MAN) is a network with a size greater than LAN but smaller than a WAN. It normally comprises networked interconnections within a city that also offers a connection to the Internet.

#### **Features of MAN**

- Network size generally ranges from 5 to 50 km. It may be as small as a group of buildings in a campus to as large as covering the whole city.
- Data rates are moderate to high.
- It facilitates sharing of regional resources.
- They provide uplinks for connecting LANs to WANs and Internet.
- **Example of MAN**-Cable TV network, Telephone networks



### 4.WAN - Wide Area Network

A wide area network (WAN) is a computer network that covers a large geographical area comprising a region, a country, a continent or even the whole world. WAN includes the technologies to transmit data, image, audio and video information over long distances and among different LANs and MANs.

#### **Features of WAN**

- WANs have a large capacity, connecting a large number of computers over a large area, and are inherently scalable.
- They facilitate the sharing of regional resources.
- They provide uplinks for connecting LANs and MANs to the Internet.
- Communication links are provided by public carriers like telephone networks, network providers, cable systems, satellites etc.
- Typically, they have low data transfer rate and high propagation delay, i.e. they have low communication speed.

