NETWORK CLASSIFICATIONS

Networks can be defined by:

1. Geography
2. Topology
3. Resource location

Networks Defined by Geography

We can classify networks according to how geographically dispersed network components are.

(A) Local Area Network (LAN)

Interconnects components within a local region (for example a building) Examples of Common LAN Technologies you are likely to encounter include Ethernet (IEEE 802.3) and wireless networks (IEEE 802.11).

(B) Wide Area Network (WAN)

Interconnects network components that are Geographically separated. For example, a Corporate Headquarters might have multiple WAN connections to remote office sites.

It covers a wide geographical area comprising a region, a country, a continent, or even the whole world. WAN includes the technologies to transmit multi-media information over long distance and among different LANs and MANs.

The Distinguishing features of WAN are;

- 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.

- They generally have a higher bit error rate.

Examples

- The internet

(C) Campus Area Network (CAN)

It is a group of interconnected LANs within a limited geographical area like school campus, university campus, military bases, or organizational campuses and corporate buildings etc. A Campus Area Network is larger than Local Area Network but smaller than Metropolitan Area Network (MAN) and Wide Area Network (WAN).

Sometimes this network is also referred as Residential Network or ResNet as it is only used by residents of specific campus only. Campus Area Network is network of interconnected Local Area Networks where these LANs are connected via Switches and routers and create a single network like CAN. Campus Area Network covers areas of around 1 to 5 km range and it can be both wired or wireless connectivity.
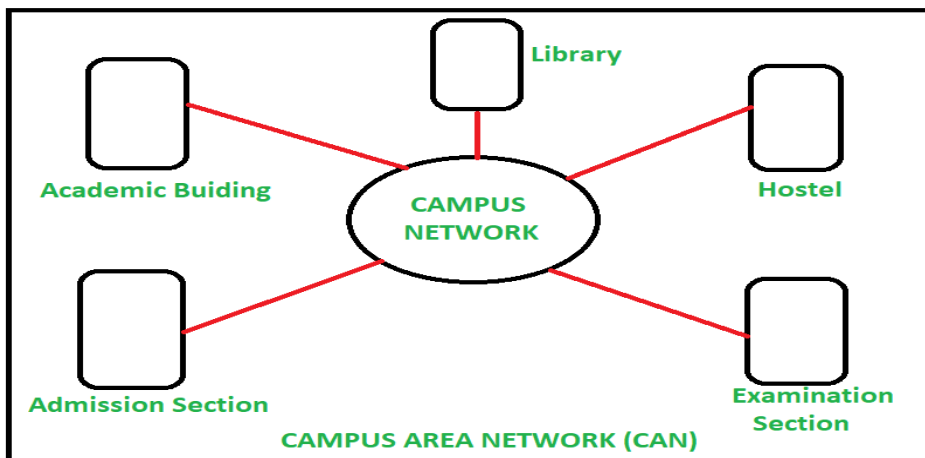
(D) Metropolitan Area Network (MAN)

A metropolitan area network (MAN) is a large computer network that usually spans a city or a large campus. A MAN Network is optimized for a larger geographical area than a LAN, ranging from several blocks of buildings to entire cities.

MAN, Networks are formed by connecting multiple LANs. Thus, MAN Networks are larger than LANs but smaller than wide-area networks (WAN).

The purpose of MAN (Metropolitan Area Network) is to provide the link to the internet in the long run. MAN Network provides Internet connectivity for LANs in a metropolitan region, and connect them to wider area networks like the Internet. " **It can also be used in cable television.**

Characteristics of MAN

1. Network size generally ranges from 5 to 50 km. It may be as large as covering the whole city.

2. In general, a MAN is either owned by a user group or by a network provider who sells service to users, rather than a single organization as in LAN.

3. Data rates are moderate to high.

4. It facilitates the sharing of regional resources.

5. They provide uplinks for connecting LANs to WANs and the Internet.

Examples of areas where MAN is used

- Digital cable television

- Used in government agencies

- University campuses

- Used to connect several branches of the local school

- In hospital (for communication between doctors, research offices, labs)

- A network of fire stations

- In airports

- Networking between community colleges within the country

- Used in public libraries

(E) Personal Area Network:

A personal area network (PAN) is a computer network organized around an individual for personal use only. They are typically used for connecting different devices like smartphones, tablets, printers, computers, and other digital devices within the environment of an individual user (typically within 10 meters or 33 feet).

Personal Area Network is used for a personal purpose like for data sharing among devices within the personal area network range of 10 meters or 33 feet. For Example, if a computer is connected with the printer, scanner, and digital camera within the range of 33 feet then it is known as *Personal Area Network.*

Characteristics of a Personal Area Network

- It is mostly a personal device's network equipped within a small area.

- It allows you to deal with information devices interconnected with a single user environment.

- PAN includes mobile phones, tablets, and laptops.

- It is possible to connect wirelessly to the Internet called WPAN.

- Devices used for PAN: wireless mice, keyboards, and Bluetooth systems

- Short-range communication

- It requires very low power

- Low cost

Networks Defined by Topology

Network topology can either be physical or logical topology. Physical topology refers to how the network devices are physically organized in the network while logical topology refers to how data actually flows in the network.

For example

Just because a network appears to be a star topology (that is, where the network components all connect back to a centralized device, such as a switch), the traffic might be flowing in a circular pattern through all the network components attached to the centralized device.

Physical Topologies

Star Topology

In star topology, all the devices are connected to a single hub/switch through a cable. This switch is the central node and all other nodes are connected to the central node. The hub is passive? in nature i.e. not intelligent hub such as broadcasting devices, on the other hand a switch is intelligent.
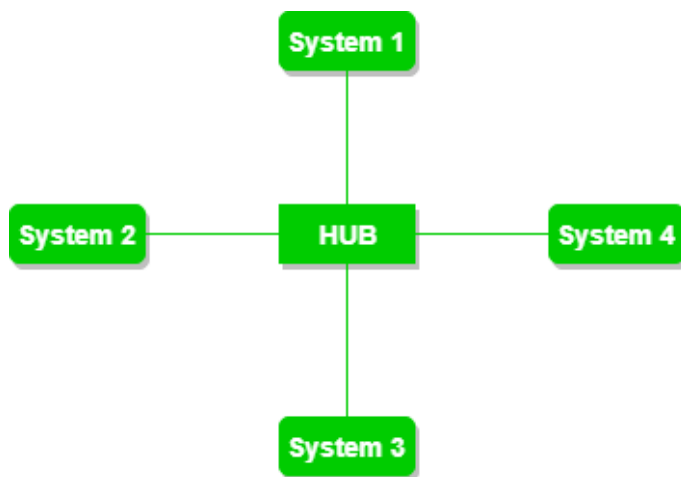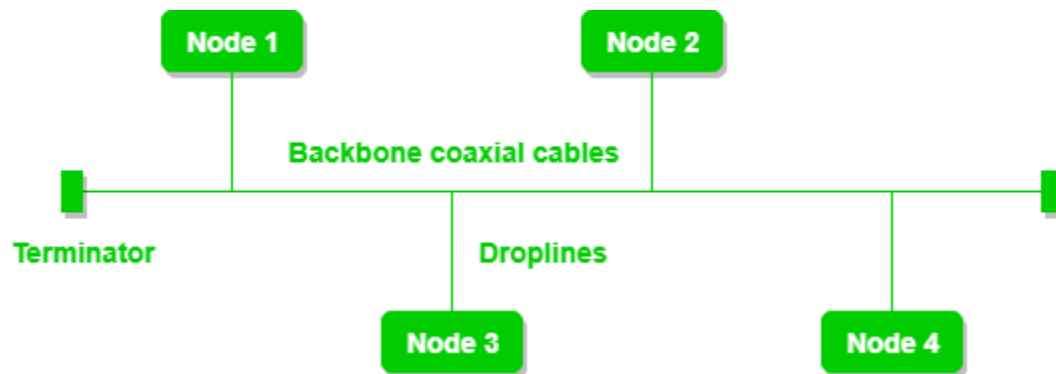

Advantages of Star Topology

1. Easy to manage and maintain the network because each node requires separate cable.

2. Easy to locate problems because cable failure only affects a single user.

3. Easy to extend the network without disturbing the entire network

4. Due to switch device network control and management is much easier.

5. Fault identification and removing nodes in a network is easy.

6. It provides very high speed of data transfer.

Disadvantages of Star Topology:

1. Entire performance of the network depends on the single device switch.

2. If the switch device goes down, the entire network will be dead.

3. Star topology requires more wires compared to the ring and bus topology.

Bus Topology

Bus topology is a network type in which every computer and network device is connected to single cable. It transmits the data from one end to another in single direction. No bi-directional feature is in bus topology.

Advantages of Bus Topology:

1. Easy to connect or remove devices in a network without affecting any other device.

2. In case of any computer or device failure, there will be no effect on other devices or network.

3. Cable cost is less as compared to other network topology i.e. mesh and star.

4. It is easy to understand topology.

5. Easy to expand by joining two cables together

Disadvantages of Bus Topology:

1. In the case of any device failure, it is difficult to find faults in a network.

2. If the backbone cable damages the entire system/network will fail.

3. If network traffic increases or devices increase, the performance of the network decreases.

4. Proper termination is required to prevent bouncing of signals. The use of terminators is a must.

5. It is slower because one computer transmits at a time.

6. It provides very low security because all the computers receive the sent signal from the source.

7. The length of cable is limited

Ring Topology

In this topology, it forms a ring connecting devices with its exactly two neighboring devices.

A number of repeaters are used for Ring topology with a large number of nodes, because if someone wants to send some data to the last node in the ring topology with 100 nodes, then the data will have to pass through 99 nodes to reach the 100th node. Hence to prevent data loss repeaters are used in the network.

The transmission is unidirectional, but it can be made bidirectional by having 2 connections between each Network Node, it is called Dual Ring Topology.
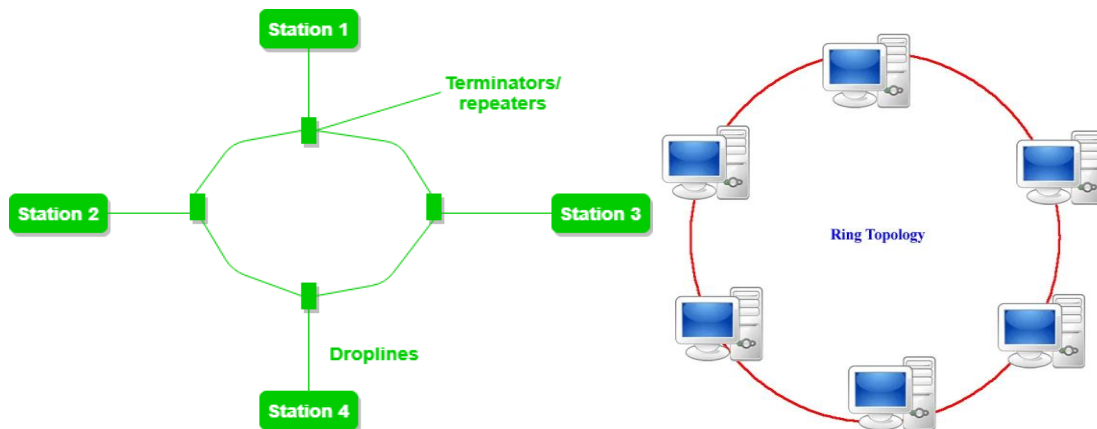
Advantages of Ring Topology:

1. Flow of data is in circular direction which minimizes the chance of packet collision.

2. The uni-directional ring topology provides very high speed.

3. It has better performance than bus topology, even when the nodes are increased.

4. Ring network can handle high volume of nodes in a network (Robust).

5. It can handle heavy traffic as compared to bus topology due to Token passing principal.

6. The maintenance of ring network is much easier compared to the bus network.

7. There is no need of network server to control the flow of data.

8. Troubleshooting in ring network is much easier because cable faults can be easily located.

9. Ring network is less costly compared to the other topologies I.e. (mesh, hybrid, and tree topology).

Disadvantage of Ring Topology:

1. A single break in the cable can cause disturbance in the entire network

2. In Uni-directional Ring, a data packet (token) must pass through all the nodes.

3. Addition and removal of any node in a network is difficult and can cause issue in network activity.

4. Ring network is much slower than Ethernet network under normal load conditions.

Mesh Topology

In Mesh Topology, all the computers are inter-connected to each other in a network. Each computer not only sends its own signals but also relays data from other computers. This type of topology is very expensive as Its very difficult to establish the connections of the mesh topology.

In a Mesh topology every node has a [point-to-point connection](#) to the other node. The connections in the mesh topology can be wired or [wireless](#).

Mesh Topology can be divided into two types:

1. Fully connected mesh topology

2. Partially connected mesh topology

1) Fully Connected Mesh Topology:

A fully connected mesh topology has all the computers connected to every other computer. Full Mesh is a network in which devices are organized in a mesh topology. A full mesh topology provides a great deal of redundancy, but because it can be prohibitively expensive to implement, it is usually reserved for network backbones. Even after considering the cost and the redundancy factor of this network, its main advantage is that the network traffic can be redirected to other nodes if one of the nodes goes down. Full mesh network is used only for backbone networks.

2) Partial Connected Mesh Topology:

Partial Mesh topology is more practical as compared to full mesh topology. In partially connected mesh topology, all the nodes are not necessary to be connected with each other in a network. This partial mesh topology is less costly compared to full mesh topology and also it reduces the redundancy.

Advantages of Mesh Topology:

1. there is no traffic problem as there are dedicated point to point links for each computer.

2. It has multiple links, so if one route is blocked then other can be accessed for data communication.

3. It provides high privacy and security.

4. Fault identification is easy because of point-to-point connection.

Disadvantages of Mesh Topology:

1. Mesh topology requires high NO: of cables and I/o ports for the communication.

2. Installation is very difficult in mesh topology, as each node is connected to every node.

3. Mesh topology is costly compared to the other network topologies i.e. star, bus, point to point topology.

Hybrid Topology

Hybrid topology is an 'integration of two or more different topologies to form a resultant topology which has many advantages (as well as disadvantages) of all the constituent basic topologies rather than having characteristics of one specific topology.

 This combination of topologies is done according to the requirements of the organization. For example, if there is a ring topology in one office department while a bus topology in another department connecting these two will result in Hybrid topology. Star Ring and Star Bus networks are most common examples of' hybrid network.
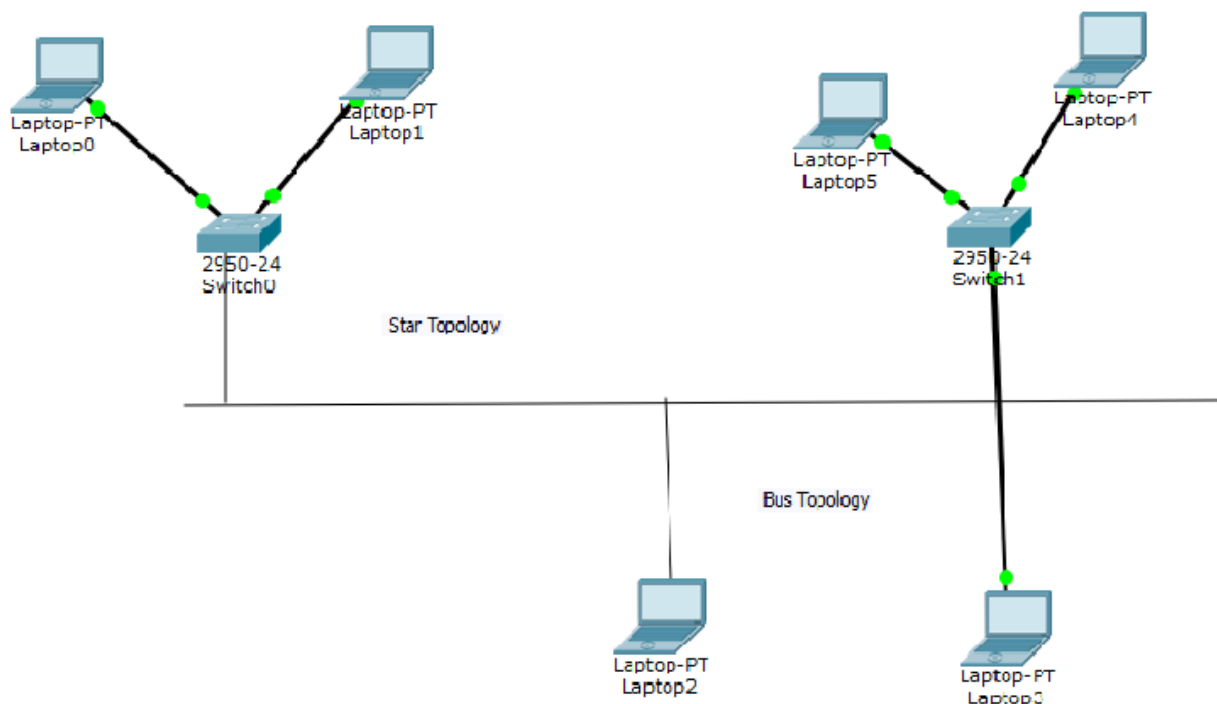
Point-to-point Topology

Point to Point topology is the simplest topology that connects two nodes directly together with a common link. The entire bandwidth of the common link is reserved for transmission between those two nodes. The point-to-point connections use an actual length of wire or cable to connect the two ends, but other options, such as satellite links, or microwaves are also possible.

When you change TV channels by remote, you are establishing a *point-to-point* connection between the remote control and the TV's control system.

The transfer of data in a **point-to-point topology** can be in multiple ways across the network: in a simplex, in full duplex, or half duplex.

- In Simplex mode of communication, signal flows in ONE direction and only one node transmit and the other receives.

- In Half duplex mode of communication, each node can transmit and receive but NOT at the same time.

- In Full-duplex mode of communication, both stations transmit and receive simultaneously.

Hub and Spoke

When interconnecting multiple sites (for example, multiple corporate locations) via WAN links, a hub-and-spoke topology has a WAN link from each remote site (that is, a spoke site) to the main site (that is, the hub site).

• With WAN links, a service provider is paid a recurring fee for each link

• Therefore, a hub-and-spoke topology helps minimize WAN expenses by not directly connecting any two spoke locations.
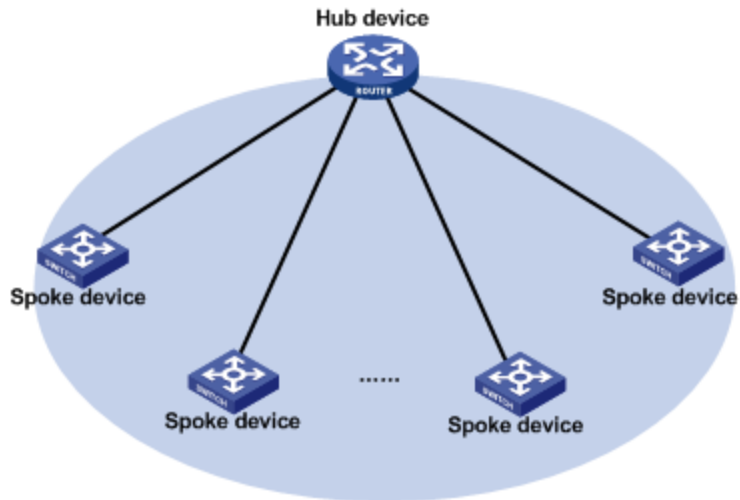
Network Defined by Resource Location

Client-server Networks

A dedicated file server provides shared resources e.g files, a networked printer.

Client-server networks are commonly used by businesses.

Since resources are located on one or more servers, administration is simpler than trying to administer network resources on multiple peer devices.

Clients request resources from the server and the server provides the clients with the resources that they need.
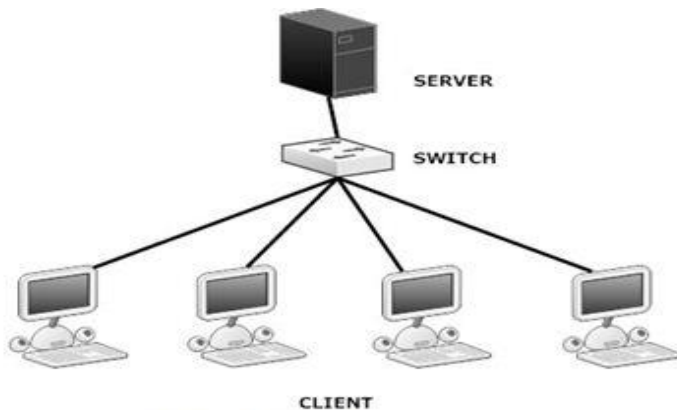

Fig-1.1 Client/Server network.

Advantages of Client Server Computing

The different advantages of client server computing are −

- All the required data is concentrated in a single place i.e. the server. So it is easy to protect the data and provide authorisation and authentication.

- The server need not be located physically close to the clients. Yet the data can be accessed efficiently.

- It is easy to replace, upgrade or relocate the nodes in the client server model because all the nodes are independent and request data only from the server.

- All the nodes i.e clients and server may not be build on similar platforms yet they can easily facilitate the transfer of data.

Disadvantages of Client Server Computing

The different disadvantages of client server computing are −

- If all the clients simultaneously request data from the server, it may get overloaded. This may lead to congestion in the network.

- If the server fails for any reason, then none of the requests of the clients can be fulfilled. This leads of failure of the client server network.

- The cost of setting and maintaining a client server model are quite high.

Peer-To-Peer

In peer-to-peer network two or more computers connected with each other to share the resources and files directly without any server. A peer-to-peer network contains different nodes that equally performed in a network. All the work is divided between all nodes. Here the term node is used for the computer. These all nodes interact with each other to share resources like hard disk and printer etc.

Peer-to-Peer application allows users to manage many operations. Like how many user connections allow at one time. How many resources will be shared among users?

Characteristics of the Peer-to-Peer network

The different characteristics of peer to peer networks are as follows:

- In a peer-to-peer network, fewer nodes is connected. All computers store their own data using individual security and also data is shared among all computers.\

- The entire computer shares resources like drive and printer etc. When a number of computers are increased the resources sharing capacity of the peer-to-peer network also increases.

- The main problem in a peer-to-peer network is security because nodes act as a server and as well as a server.

- Much modern operating systems like Windows and Mac OS used a peer-to-peer network.

Advantages of a peer-to-peer network

There are many advantages of the peer-to-peer network

1. There is no need for a server because sever are more expensive.

2. It is very easy to install or set user needs no technical knowledge.

3. It is less expensive.

4. Each user has to manage its own PC so there is no need for a network manager.

5. Peer-to-peer networks mostly used at home and in small offices.

6. There is less traffic than another network.

Disadvantages of the peer-to-peer network

1. Every computer has access to share the data from every computer it slows down overall performance.

2. There is a security issue because each computer in the network shares resources and data.

3. There is no centrally backup for files and folders.

4. Each user is responsible for ensuring viruses that are not properly introduced in the network.

5. All files and folders are nor logically organized, did they all store I-on individual computers.

Peer to Peer Relationship