Operating System

An operating system (OS) is a program that acts as an interface between the system hardware and the user. Moreover, it handles all the interactions between the software and the hardware. All the working of a computer system depends on the OS at the base level. Further, it performs all the functions like handling memory, processes, the interaction between hardware and software, etc. Now, let us look at the functions of operating system.
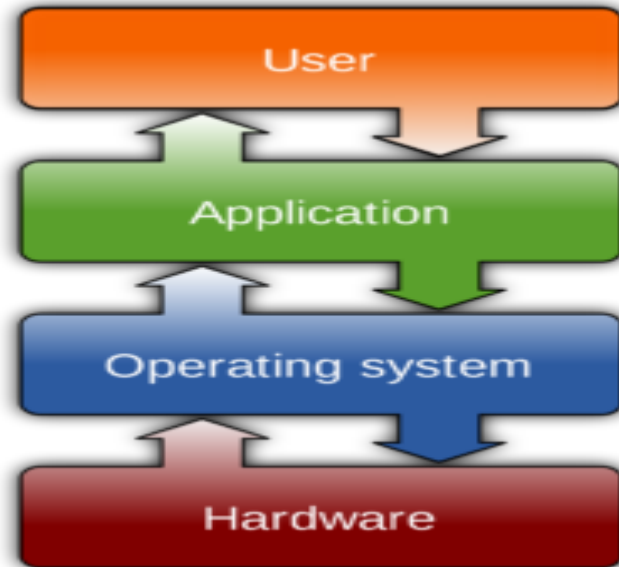
Objectives of OS

The primary goals of an operating system are as follows:

- **Convenience** – An operating system improves the use of a machine. Operating systems enable users to get started on the things they wish to complete quickly without having to cope with the stress of first configuring the system.

- **Efficiency** – An operating system enables the efficient use of resources. This is due to less time spent configuring the system.

- **Ability to evolve** – An operating system should be designed in such a way that it allows for the effective development, testing, and introduction of new features without interfering with service.

- **Management of system resources** – It guarantees that resources are shared fairly among various processes and users.

Functions of Operating System

1. Memory Management

It is the management of the main or primary memory. Whatever program is executed, it has to be present in the main memory. Main memory is a quick storage area that may be accessed directly by the CPU. When the program is completed, the memory region is released and can be used by other programs. Therefore, there can be more than one program present at a time. Hence, it is required to manage the memory.

The operating system:

- Allocates and deallocates the memory.

- Keeps a record of which part of primary memory is used by whom and how much.

- Distributes the memory while multiprocessing.

- In multiprogramming, the operating system selects which processes acquire memory when and how much memory they get.

2. Processor Management/Scheduling

Every software that runs on a computer, whether in the background or in the frontend, is a process. Processor management is an execution unit in which a program operates. The operating system determines the status of the processor and processes, selects a job and its processor, allocates the processor to the process, and de-allocates the processor after the process is completed.

When more than one process runs on the system the OS decides how and when a process will use the CPU. Hence, the name is also **CPU Scheduling**. The OS:

- Allocates and deallocates processor to the processes.

- Keeps record of CPU status.

Certain algorithms used for CPU scheduling are as follows:

- First Come First Serve (FCFS)

- Shortest Job First (SJF)

- Round-Robin Scheduling

- Priority-based scheduling etc.

Purpose of CPU scheduling

The purpose of CPU scheduling is as follows:

- Proper utilization of CPU. Since the proper utilization of the CPU is necessary. Therefore, the OS makes sure that the CPU should be as busy as possible.

- Since every device should get a chance to use the processor. Hence, the OS makes sure that the devices get fair processor time.

- Increasing the efficiency of the system.

3. Device Management

An operating system regulates device connection using drivers. The processes may require devices for their use. This management is done by the OS. The OS:

- Allocates and deallocates devices to different processes.

- Keeps records of the devices.

- Decides which process can use which device for how much time.

4. File Management

The operating system manages resource allocation and de-allocation. It specifies which process receives the file and for how long. It also keeps track of information, location, uses, status, and so on. These groupings of resources are referred to as file systems. The files on a system are stored in different directories. The OS:

- Keeps records of the status and locations of files.

- Allocates and deallocates resources.

- Decides who gets the resources.

5. Storage Management

Storage management is a procedure that allows users to maximize the utilization of storage devices while also protecting data integrity on whatever media on which it lives. Network virtualization, replication, mirroring, security, compression, deduplication, traffic analysis, process automation, storage provisioning, and memory management are some of the features that may be included. The operating system is in charge of storing and accessing files. The creation of files, the creation of directories, the reading and writing of data from files and directories, as well as the copying of the contents of files and directories from one location to another are all included in storage management.

The OS uses storage management for:

- Improving the performance of the data storage resources.

- It optimizes the use of various storage devices.

- Assists businesses in storing more data on existing hardware, speeding up the data retrieval process, preventing data loss, meeting data retention regulations, and lowering IT costs

What are the functions of Operating System

- **Security** – For security, modern operating systems employ a firewall. A firewall is a type of security system that monitors all computer activity and blocks it if it detects a threat.

- **Job Accounting** – As the operating system keeps track of all the functions of a computer system. Hence, it makes a record of all the activities taking place on the system. It has an account of all the information about the memory, resources, errors, etc. Therefore, this information can be used as and when required.

- **Control over system performance** – The operating system will collect consumption statistics for various resources and monitor performance indicators such as reaction time, which is the time between requesting a service and receiving a response from the system.

- **Error detecting aids** – While a computer system is running, a variety of errors might occur. Error detection guarantees that data is delivered reliably across susceptible networks. The operating system continuously monitors the system to locate or recognize problems and protects the system from them.

- **Coordination between other software and users** – The operating system (OS) allows hardware components to be coordinated and directs and allocates assemblers, interpreters, compilers, and other software to different users of the computer system.

- **Booting process** – The process of starting or restarting a computer is referred to as Booting. Cold booting occurs when a computer is totally turned off and then turned back on. Warm booting occurs when the computer is restarted. The operating system (OS) is in charge of booting the computer.

Browse more Topics under Operating System

- Need for Operating System

- Types of Operating System-Interactive (GUI Based)

- Time Sharing

- Real Time Operating System (RTOS)

- Distributed Operating System

- Commonly Used Operating System

- Mobile OS

Types of Operating System

The operating system can be of different types. They are as follows:

1. Batch OS

In this system, the OS does not forward the jobs/tasks directly to the CPU. It works by grouping together similar types of jobs under one category. Further, we name this group as a 'batch'. Hence, the name batch OS.

Examples are the payroll system, bank statement, etc.

2. Time-Shared OS

When more than one task takes place on the system it is called time-shared OS. As multiple tasks can run at the system at a time as per requirement. Hence, they all share the CPU time one by one. Therefore, we also name it **multitasking**. The time that each task gets is called **quantum**.

A fixed interval of time is decided for each task. When the first task executes for that period of time, the second task executes, and so on.

Examples are UNIX etc.

3. Distributed OS

In this system, there is more than one CPU present. The OS distributes the tasks among all the processors. The processors do not share any memory or clock time. OS handles all communication between them through various communication lines.

Examples are LOCUS etc.

4. Network OS

In these OS various systems are connected to a server. It allows the system to share resources such as files, printers, applications, etc. Moreover, it gives the capability to serve to manage these resources.

Examples are UNIX, LINUX, Microsoft Windows Server 2008, etc.

5. Real-Time OS (RTOS)

In these systems, the time interval for processing and responding to inputs is very small. Therefore, due to this quality, these are used in real-time situations. For example in missile systems, robots, etc.

They have two categories as follows:

a) Hard Real-Time Systems

In this, the time constraint is very short and strict. Even seconds of delay is not acceptable.

b) Soft Real-Time Systems

In this, the time constraint is not so short and strict.

Difference between CLI and GUI

| Features	CLI	GUI
Definition	A CLI is an interface that allows the user to perform tasks by issuing commands in successive lines of text or command lines.	A graphical user interface enables users to interact with the operating system or application.
Memory Requirement	It needs less memory than the GUI.	It needs more memory because it has various graphics components.
Ease of use	It is not easy to use.	It is easy to use.
Speed	It is faster than the GUI.	It is slower than the CLI.
Flexibility	It is less flexible than GUI.	It is more flexible than CLI.
Device Used	It needs the only keyboard.	It needs both a keyboard and a mouse.
Appearance	Its appearance may not be modified or changed.	Its appearance may be modified or changed.
Precision	Its precision is high as compared to GUI.	Its precision is low as compared to CLI.
Data Presentation	The information can be viewed to the user in plain text and files in the CLI.	In a GUI, information can be viewed or presented to the user in several ways, including simple text, videos, graphics, etc.
Errors	Spelling mistakes and typing errors are not avoided.	Spelling mistakes and typing errors are avoided.
Graphics	No graphics are used in the CLI.	Graphics are used in the GUI.
Menus	No menus are provided in the CLI.	Menus are provided in the GUI.

What is a Computer Network?

A **Computer Network** is a group of two or more interconnected computer systems that use common connection protocols for sharing various resources and files. You can establish a computer network connection using either cable or wireless media. Every network involves hardware and software that connects computers and tools.

Different Types of Computer Networks

There are various types of Computer Networking options available. The classification of network in computers can be done according to their size as well as their purpose.

The size of a network should be expressed by the geographic area and number of computers, which are a part of their networks. It includes devices housed in a single room to millions of devices spread across the world. Following are the popular types of Computer Network:
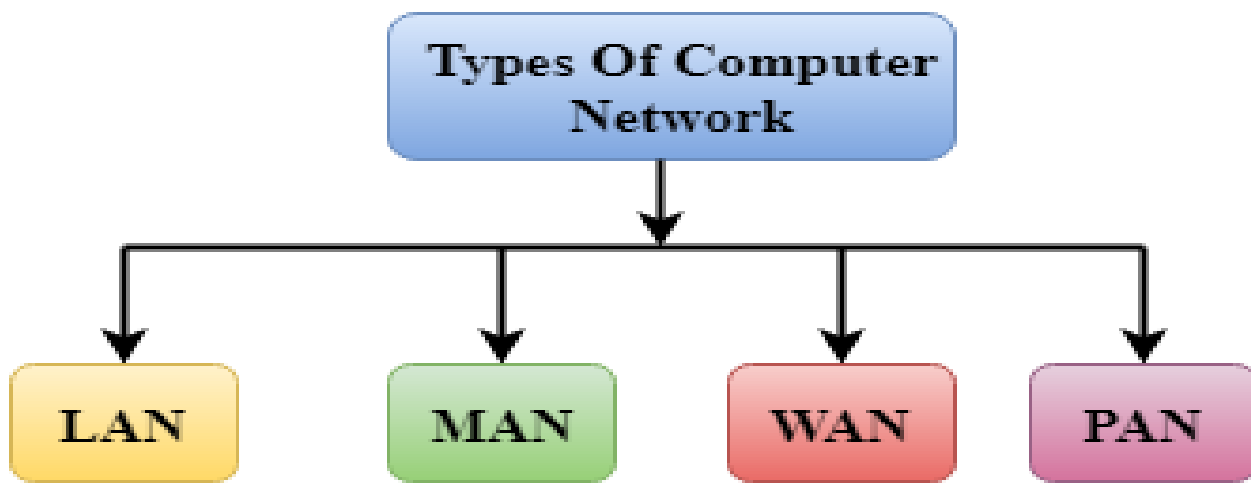
Some of the most popular computer network types are:

- PAN (Personal Area Network)
- LAN (Local Area Network)
- MAN (Metropolitan Area Network)
- WAN (Wide Area Network)

Let's study all of these types of networking in detail.

What is PAN (Personal Area Network)?

PAN (Personal Area Network) is a computer network formed around a person. It generally consists of a computer, mobile, or personal digital assistant. PAN can be used for establishing communication among these personal devices for connecting to a digital network and the internet.

Characteristics of PAN

Below are the main characteristics of PAN:

- It is mostly personal devices network equipped within a limited area.
- Allows you to handle the interconnection of IT devices at the surrounding of a single user.
- PAN includes mobile devices, tablet, and laptop.
- It can be wirelessly connected to the internet called WPAN.
- Appliances use for PAN: cordless mice, keyboards, and Bluetooth systems.

Advantages of PAN

Here are the important pros/benefits of PAN network:

- PAN networks are relatively secure and safe
- It offers only short-range solution up to ten meters
- Strictly restricted to a small area

Disadvantages of PAN

Here are the cons/drawbacks of using PAN network:

- It may establish a bad connection to other networks at the same radio bands.
- Distance limits.

What is a LAN (Local Area Network)?

A **Local Area Network** (LAN) is a group of computer and peripheral devices which are connected in a limited area such as school, laboratory, home, and office building. It is a widely useful network for sharing resources like files, printers, games, and other application. The simplest type of LAN network is to connect computers

and a printer in someone's home or office. In general, LAN will be used as one type of transmission medium. It is a network which consists of less than 5000 interconnected devices across several buildings.
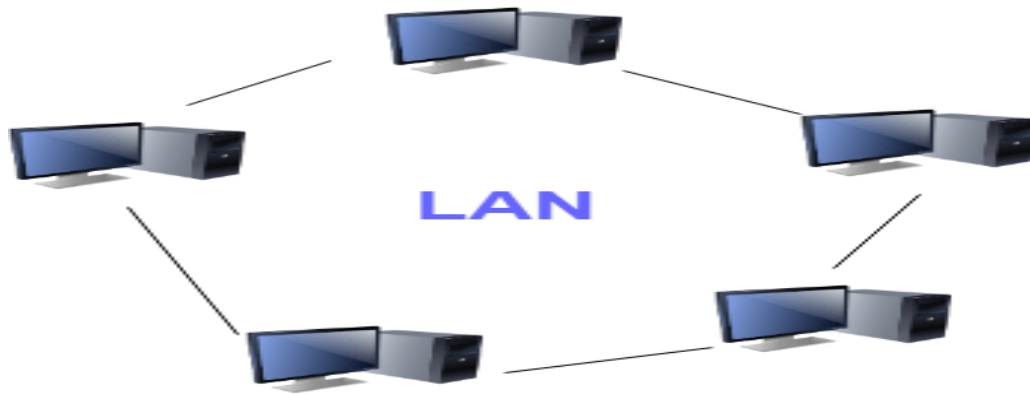
Characteristics of LAN

Here are the important characteristics of a LAN network:

- It is a private network, so an outside regulatory body never controls it.
- LAN operates at a relatively higher speed compared to other WAN systems.
- There are various kinds of media access control methods like token ring and ethernet.

Advantages of LAN

Here are the pros/benefits of LAN:

- Computer resources like hard-disks, DVD-ROM, and printers can share local area networks. This significantly reduces the cost of hardware purchases.
- You can use the same software over the network instead of purchasing the licensed software for each client in the network.
- Data of all network users can be stored on a single hard disk of the server computer.
- You can easily transfer data and messages over networked computers.
- It will be easy to manage data at only one place, which makes data more secure.
- Local Area Network offers the facility to share a single internet connection among all the LAN users.
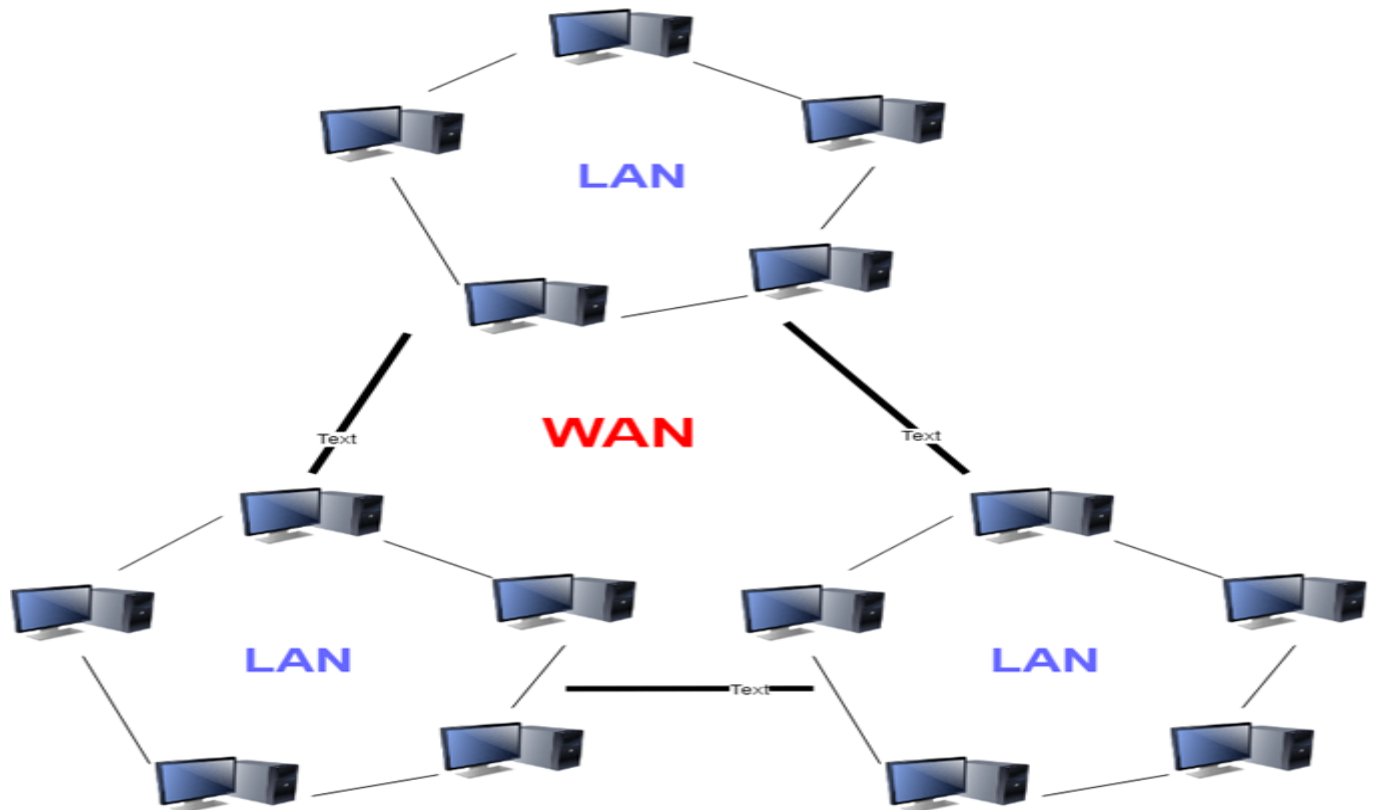
Disadvantages of LAN

Here are the cons/drawbacks of LAN:

- LAN will indeed save cost because of shared computer resources, but the initial cost of installing Local Area Networks is quite high.
- The LAN admin can check personal data files of every LAN user, so it does not offer good privacy.
- Unauthorized users can access critical data of an organization in case LAN admin is not able to secure centralized data repository.
- Local Area Network requires a constant LAN administration as there are issues related to software setup and hardware failures

What is WAN (Wide Area Network)?

WAN (Wide Area Network) is another important computer network that which is spread across a large geographical area. WAN network system could be a connection of a LAN which connects with other LAN's using telephone lines and radio waves. It is mostly limited to an enterprise or an organization.

Characteristics of WAN

Below are the characteristics of WAN:

- The software files will be shared among all the users; therefore, all can access to the latest files.
- Any organization can form its global integrated network using WAN.

Advantages of WAN

Here are the benefits/pros of WAN:

- WAN helps you to cover a larger geographical area. Therefore business offices situated at longer distances can easily communicate.
- Contains devices like mobile phones, laptop, tablet, computers, gaming consoles, etc.
- WLAN connections work using radio transmitters and receivers built into client devices.

Disadvantages of WAN

Here are the drawbacks/cons of WAN network:

- The initial setup cost of investment is very high.
- It is difficult to maintain the WAN network. You need skilled technicians and network administrators.
- There are more errors and issues because of the wide coverage and the use of different technologies.
- It requires more time to resolve issues because of the involvement of multiple wired and wireless technologies.
- Offers lower security compared to other types of networks in computer.

What is MAN (Metropolitan Area Network)?

A **Metropolitan Area Network** or MAN is consisting of a computer network across an entire city, college campus, or a small region. This type of network is large than a LAN, which is mostly limited to a single building or site. Depending upon the type of configuration, this type of network allows you to cover an area from several miles to tens of miles.
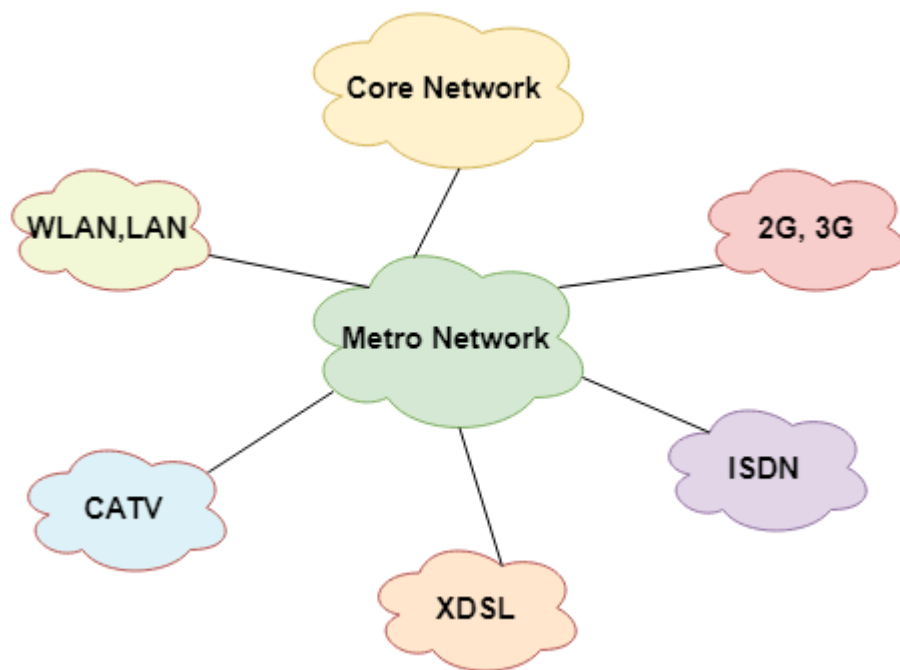
Characteristics of MAN

Here are important characteristics of the MAN network:

- It mostly covers towns and cities in a maximum 50 km range
- Mostly used medium is optical Fibers, cables.
- Data rates adequate for distributed computing applications.

Advantages of MAN

Here are the pros/benefits of MAN network:

- It offers fast communication using high-speed carriers, like fiber optic cables.
- It provides excellent support for an extensive size network and greater access to WANs.
- The dual bus in MAN network provides support to transmit data in both directions concurrently.
- A MAN network mostly includes some areas of a city or an entire city.

Disadvantages of MAN

Here are drawbacks/cons of using the MAN network:

- You need more cable to establish MAN connection from one place to another.
- In MAN network it is tough to make the system secure from hackers.

Other Types of Computer Networks

Apart from above mentioned computer networks, here are some other important types of networks:

- WLAN (Wireless Local Area Network)
- Storage Area Network
- System Area Network
- Home Area Network
- POLAN- Passive Optical LAN
- Enterprise private network
- Campus Area Network
- Virtual Area Network

Let's see all these different types of networks in detail:

1) WLAN

WLAN (Wireless Local Area Network) helps you to link single or multiple devices using wireless communication within a limited area like home, school, or office building. It gives users an ability to move around within a local coverage area which may be connected to the network. Today most modern day's WLAN systems are based on IEEE 802.11 standards.

2) Storage-Area Network (SAN)

A Storage Area Network is a type of network which allows consolidated, block-level data storage. It is mainly used to make storage devices, like disk arrays, optical jukeboxes, and tape libraries.

3) System-Area Network

System Area Network is used for a local network. It offers high-speed connection in server-to-server and processor-to-processor applications. The computers connected on a SAN network operate as a single system at quite high speed.

4) Passive Optical Local Area Network

POLAN is a networking technology which helps you to integrate into structured cabling. It allows you to resolve the issues of supporting Ethernet protocols and network apps.

POLAN allows you to use optical splitter which helps you to separate an optical signal from a single-mode optical fiber. It converts this single signal into multiple signals.

5) Home Area Network (HAN):

A Home Area Network is always built using two or more interconnected computers to form a local area network (LAN) within the home. For example, in the United States, about 15 million homes have more than one computer.

These types of network connections help computer owners to interconnect with multiple computers. This network allows sharing files, programs, printers, and other peripherals.

6) Enterprise Private Network:

Enterprise private network (EPN) networks are built and owned by businesses that want to securely connect numerous locations in order to share various computer resources.

7) Campus Area Network (CAN):

A Campus Area Network is made up of an interconnection of LANs within a specific geographical area. For example, a university campus can be linked with a variety of campus buildings to connect all the academic departments.

8) Virtual Private Network:

A VPN is a private network which uses a public network to connect remote sites or users together. The VPN network uses "virtual" connections routed through the internet from the enterprise's private network or a third-party VPN service to the remote site.

Data communication

Human beings are the only creatures on the earth who are able to communicate with each other through the medium of language. But humans take this gift to another extent. Distance, time, and physical existence of the person don't matter in communication these days because they build a communication system through which they can communicate or share data like images, videos, text, files, etc with their loved ones anytime anywhere. Communication is defined as a process in which more than one computer transfers information, instructions to each other and for sharing resources. Or in other words, communication is a process or act in which we can send or receive data. A network of computers is defined as an interconnected collection of autonomous computers. Autonomous means no computer can start, stop or control another computer.

Components of Data Communication

A communication system is made up of the following components:

1. **Message:** A message is a piece of information that is to be transmitted from one person to another. It could be a text file, an audio file, a video file, etc.
2. **Sender:** It is simply a device that sends data messages. It can be a computer, mobile, telephone, laptop, video camera, or workstation, etc.
3. **Receiver:** It is a device that receives messages. It can be a computer, telephone mobile, workstation, etc.
4. **Transmission Medium / Communication Channels:** Communication channels are the medium that connect two or more workstations. Workstations can be connected by either wired media or wireless media.
5. **Set of rules (Protocol):** When someone sends the data (The sender), it should be understandable to the receiver also otherwise it is meaningless. For example, Sonali sends a message to Chetan. If Sonali writes in Hindi and Chetan cannot understand Hindi, it is a meaningless conversation.
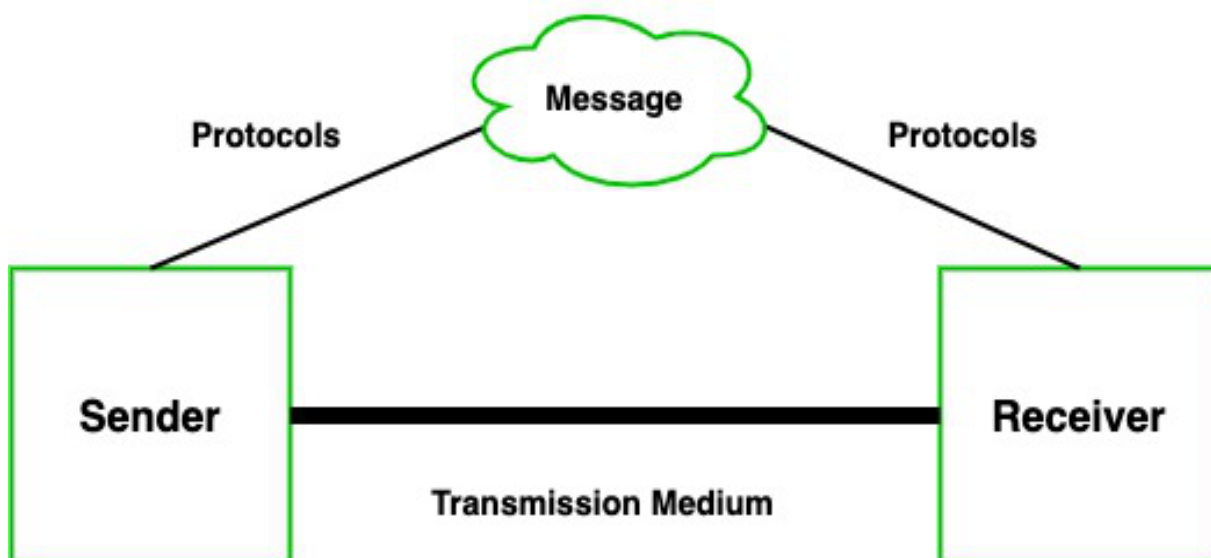
Therefore, there are some set of rules (protocols) that is followed by every computer connected to the internet and they are:

- **TCP (Transmission Control Protocol)**: It is responsible for dividing messages into packets on the source computer and reassembling the received packet at the destination or recipient computer. It also makes sure that the packets have the information about the source of the message data, the destination of the message data, the sequence in which the message data should be re-assembled, and checks if the message has been sent correctly to the specific destination.

- **IP (Internet Protocol)**: Do You ever wonder how does computer determine which packet belongs to which device. What happens if the message you sent to your friend is received by your father? Scary Right. Well! IP is responsible for handling the address of the destination computer so that each packet is sent to its proper destination.

Type of data communication

As we know that data communication is communication in which we can send or receive data from one device to another. The data communication is divided into three types:

1. **Simplex Communication:** It is one-way communication or we can say that unidirectional communication in which one device only receives and another device only sends data and devices uses their entire capacity in transmission. For example, IoT, entering data using a keyboard, listing music using a speaker, etc.
2. **Half Duplex communication:** It is a two-way communication or we can say that it is a bidirectional communication in which both the devices can send and receive data but not at the same time. When one device is sending data then another device is only receiving and vice-versa. For example, walkie-talkie.
3. **Full-duplex communication:** It is a two-way communication or we can say that it is a bidirectional communication in which both the devices can send and receive data at the same time. For example, mobile phones, landlines, etc.

Communication Channels

Communication channels are the medium that connects two or more workstations. Workstations can be connected by either wired media or wireless media. It is also known as a transmission medium. The transmission medium or channel is a link that carries messages between two or more devices. We can group the communication media into two categories:

- **Guided media transmission**
- **Unguided media transmission**

1. Guided Media: In this transmission medium, the physical link is created using wires or cables between two or more computers or devices, and then the data is transmitted using these cables in terms of signals. Guided media transmission of the following types:

1. Twisted pair cable: It is the most common form of wire used in communication. In a twisted-pair cable, two identical wires are wrapped together in a double helix. The twisting of the wire reduces the crosstalk. It is known as the leaking of a signal from one wire to another due to which signal can corrupt and can cause network errors. The twisting protects the wire from internal crosstalk as well as external forms of signal interference. Types of Twisted Pair Cable :

- **Unshielded Twisted Pair (UTP):** It is used in computers and telephones widely. As the name suggests, there is no external shielding so it does not protects from external interference. It is cheaper than STP.
- **Shielded Twisted Pair (STP):** It offers greater protection from crosstalk due to shield. Due to shielding, it protects from external interference. It is heavier and costlier as compare to UTP.

2. Coaxial Cable: It consists of a solid wire core that is surrounded by one or more foil or wire shields. The inner core of the coaxial cable carries the signal and the outer shield provides the ground. It is widely used for television signals and also used by large corporations in building security systems. Data transmission of this cable is better but expensive as compared to twisted pair.

3. Optical fibers: Optical fiber is an important technology. It transmits large amounts of data at very high speeds due to which it is widely used in internet cables. It carries data as a light that travels inside a thin glass fiber. The fiber optic cable is made up of three pieces:

1. **Core:** Core is the piece through which light travels. It is generally created using glass or plastic.
2. **Cladding:** It is the covering of the core and reflects the light back to the core.
3. **Sheath:** It is the protective covering that protects fiber cable from the environment.

2. Unguided Media: The unguided transmission media is a transmission mode in which the signals are propagated from one device to another device wirelessly. Signals can wave through the air, water, or vacuum. It is generally used to transmit signals in all directions. Unguided Media is further divided into various parts:

1. Microwave: Microwave offers communication without the use of cables. Microwave signals are just like radio and television signals. It is used in long-distance communication. Microwave transmission consists of a

transmitter, receiver, and atmosphere. In microwave communication, there are parabolic antennas that are mounted on the towers to send a beam to another antenna. The higher the tower, the greater the range.

2. Radio wave: When communication is carried out by radio frequencies, then it is termed radio waves transmission. It offers mobility. It is consisting of the transmitter and the receiver. Both use antennas to radiate and capture the radio signal.

3. Infrared: It is short-distance communication and can pass through any object. It is generally used in TV remotes, wireless mouse, etc.

What is Network Topology?

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

Types of Network Topology

Physical topology is the geometric representation of all the nodes in a network. There are six types of network topology which are Bus Topology, Ring Topology, Tree Topology, Star Topology, Mesh Topology, and Hybrid Topology.
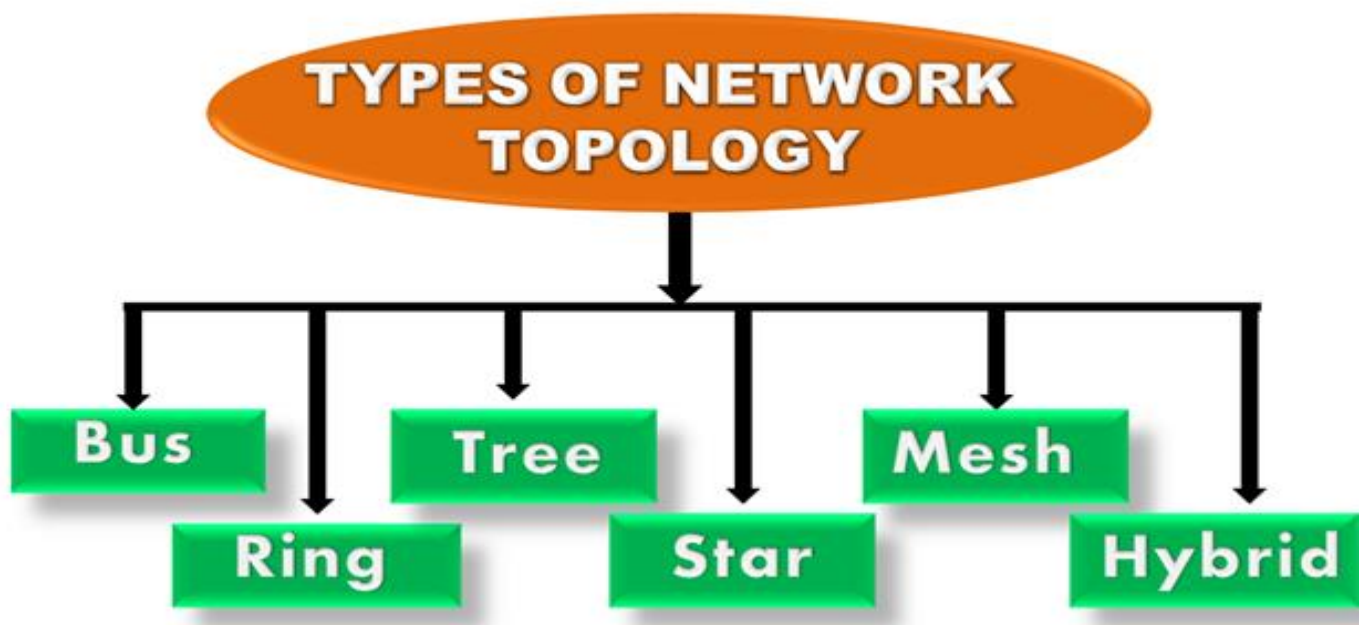
1) Bus Topology

- o The bus topology is designed in such a way that all the stations are connected through a single cable known as a backbone cable.
- o Each node is either connected to the backbone cable by drop cable or directly connected to the backbone cable.
- o 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.
- o The bus topology is mainly used in 802.3 (ethernet) and 802.4 standard networks.
- o The configuration of a bus topology is quite simpler as compared to other topologies.
- o The backbone cable is considered as a **"single lane"** through which the message is broadcast to all the stations.
- o The most common access method of the bus topologies is **CSMA** (Carrier Sense Multiple Access).

CSMA: It is a media access control used to control the data flow so that data integrity is maintained, i.e., the packets do not get lost. There are two alternative ways of handling the problems that occur when two nodes send the messages simultaneously.

- o **CSMA CD:** CSMA CD (**Collision detection**) is an access method used to detect the collision. Once the collision is detected, the sender will stop transmitting the data. Therefore, it works on "**recovery after the collision**".
- o **CSMA CA: CSMA CA (Collision Avoidance)** is an access method used to avoid the collision by checking whether the transmission media is busy or not. If busy, then the sender waits until the media becomes idle. This technique effectively reduces the possibility of the collision. It does not work on "recovery after the collision".

Advantages of Bus topology:

- o **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.
- o **Moderate data speeds:** Coaxial or twisted pair cables are mainly used in bus-based networks that support upto 10 Mbps.
- o **Familiar technology:** Bus topology is a familiar technology as the installation and troubleshooting techniques are well known, and hardware components are easily available.
- o **Limited failure:** A failure in one node will not have any effect on other nodes.

Disadvantages of Bus topology:

- o **Extensive cabling:** A bus topology is quite simpler, but still it requires a lot of cabling.
- o **Difficult troubleshooting:** It requires specialized test equipment to determine the cable faults. If any fault occurs in the cable, then it would disrupt the communication for all the nodes.
- o **Signal interference:** If two nodes send the messages simultaneously, then the signals of both the nodes collide with each other.

- o **Reconfiguration difficult:** Adding new devices to the network would slow down the network.
- o **Attenuation:** Attenuation is a loss of signal leads to communication issues. Repeaters are used to regenerate the signal.

2) Ring Topology

- o Ring topology is like a bus topology, but with connected ends.
- o The node that receives the message from the previous computer will retransmit to the next node.
- o The data flows in one direction, i.e., it is unidirectional.
- o The data flows in a single loop continuously known as an endless loop.
- o It has no terminated ends, i.e., each node is connected to other node and having no termination point.
- o The data in a ring topology flow in a clockwise direction.
- o The most common access method of the ring topology is **token passing**.
    - o **Token passing:** It is a network access method in which token is passed from one node to another node.
    - o **Token:** It is a frame that circulates around the network.

Working of Token passing

- o A token moves around the network, and it is passed from computer to computer until it reaches the destination.
- o The sender modifies the token by putting the address along with the data.
- o The data is passed from one device to another device until the destination address matches. Once the token received by the destination device, then it sends the acknowledgment to the sender.
- o In a ring topology, a token is used as a carrier.

Advantages of Ring topology:

- o **Network Management:** Faulty devices can be removed from the network without bringing the network down.
- o **Product availability:** Many hardware and software tools for network operation and monitoring are available.
- o **Cost:** Twisted pair cabling is inexpensive and easily available. Therefore, the installation cost is very low.

- o **Reliable:** It is a more reliable network because the communication system is not dependent on the single host computer.

Disadvantages of Ring topology:

- o **Difficult troubleshooting:** It requires specialized test equipment to determine the cable faults. If any fault occurs in the cable, then it would disrupt the communication for all the nodes.
- o **Failure:** The breakdown in one station leads to the failure of the overall network.
- o **Reconfiguration difficult:** Adding new devices to the network would slow down the network.
- o **Delay:** Communication delay is directly proportional to the number of nodes. Adding new devices increases the communication delay.

3) Star Topology

- o Star topology is an arrangement of the network in which every node is connected to the central hub, switch or a central computer.
- o The central computer is known as a **server**, and the peripheral devices attached to the server are known as **clients**.
- o Coaxial cable or RJ-45 cables are used to connect the computers.
- o Hubs or Switches are mainly used as connection devices in a **physical star topology**.
- o Star topology is the most popular topology in network implementation.

Advantages of Star topology

- o **Efficient troubleshooting:** Troubleshooting is quite efficient in a star topology as compared to bus topology. In a bus topology, the manager has to inspect the kilometers of cable. In a star topology, all the stations are connected to the centralized network. Therefore, the network administrator has to go to the single station to troubleshoot the problem.
- o **Network control:** Complex network control features can be easily implemented in the star topology. Any changes made in the star topology are automatically accommodated.
- o **Limited failure:** As each station is connected to the central hub with its own cable, therefore failure in one cable will not affect the entire network.

- o **Familiar technology:** Star topology is a familiar technology as its tools are cost-effective.
- o **Easily expandable:** It is easily expandable as new stations can be added to the open ports on the hub.
- o **Cost effective:** Star topology networks are cost-effective as it uses inexpensive coaxial cable.
- o **High data speeds:** It supports a bandwidth of approx 100Mbps. Ethernet 100BaseT is one of the most popular Star topology networks.

Disadvantages of Star topology

- o **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.
- o **Cable:** Sometimes cable routing becomes difficult when a significant amount of routing is required.

4) Tree topology

- o Tree topology combines the characteristics of bus topology and star topology.
- o A tree topology is a type of structure in which all the computers are connected with each other in hierarchical fashion.
- o The top-most node in tree topology is known as a root node, and all other nodes are the descendants of the root node.
- o There is only one path exists between two nodes for the data transmission. Thus, it forms a parent-child hierarchy.

Advantages of Tree topology

- o **Support for broadband transmission:** Tree topology is mainly used to provide broadband transmission, i.e., signals are sent over long distances without being attenuated.
- o **Easily expandable:** We can add the new device to the existing network. Therefore, we can say that tree topology is easily expandable.
- o **Easily manageable:** In tree topology, the whole network is divided into segments known as star networks which can be easily managed and maintained.
- o **Error detection:** Error detection and error correction are very easy in a tree topology.
- o **Limited failure:** The breakdown in one station does not affect the entire network.
- o **Point-to-point wiring:** It has point-to-point wiring for individual segments.

Disadvantages of Tree topology

- **Difficult troubleshooting:** If any fault occurs in the node, then it becomes difficult to troubleshoot the problem.
- **High cost:** Devices required for broadband transmission are very costly.
- **Failure:** A tree topology mainly relies on main bus cable and failure in main bus cable will damage the overall network.
- **Reconfiguration difficult:** If new devices are added, then it becomes difficult to reconfigure.
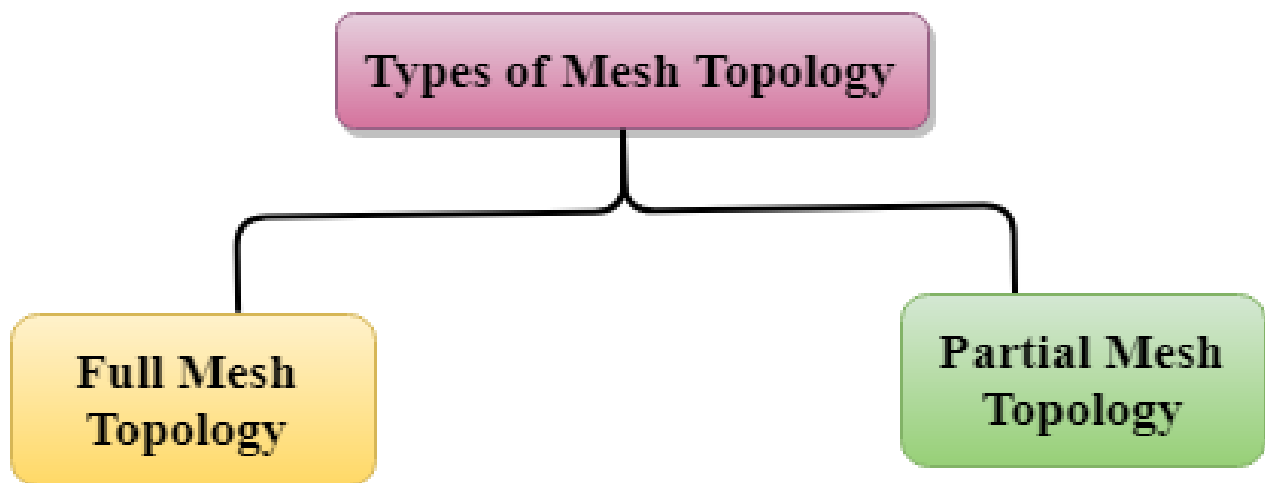
5) Mesh topology
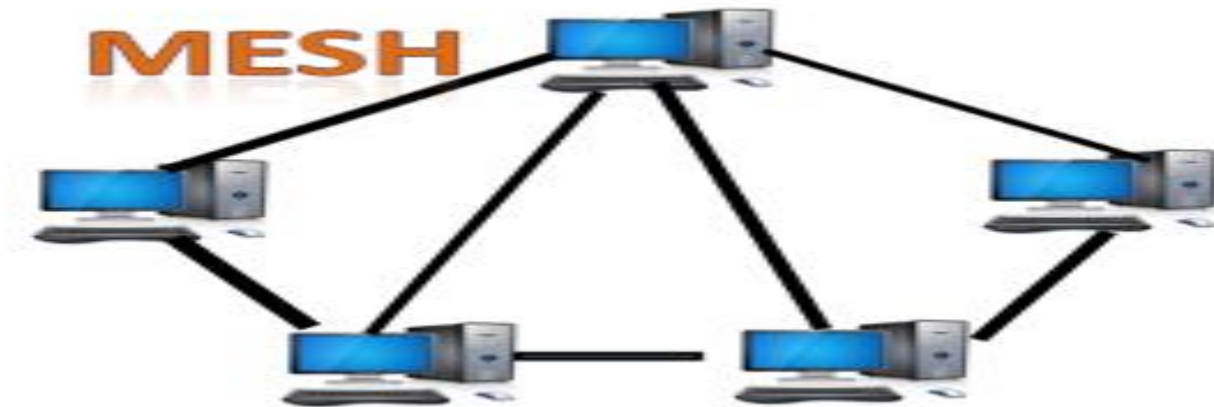
- Mesh technology is an arrangement of the network in which computers are interconnected with each other through various redundant connections.
- There are multiple paths from one computer to another computer.
- It does not contain the switch, hub or any central computer which acts as a central point of communication.
- The Internet is an example of the mesh topology.
- Mesh topology is mainly used for WAN implementations where communication failures are a critical concern.
- Mesh topology is mainly used for wireless networks.
- Mesh topology can be formed by using the formula: **Number of cables = (n*(n-1))/2;**

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

Mesh topology is divided into two categories:

- Fully connected mesh topology
- Partially connected mesh topology

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

Advantages of Mesh topology:

Reliable: The mesh topology networks are very reliable as if any link breakdown will not affect the communication between connected computers.

Fast Communication: Communication is very fast between the nodes.

Easier Reconfiguration: Adding new devices would not disrupt the communication between other devices.

Disadvantages of Mesh topology

- o **Cost:** A mesh topology contains a large number of connected devices such as a router and more transmission media than other topologies.
- o **Management:** Mesh topology networks are very large and very difficult to maintain and manage. If the network is not monitored carefully, then the communication link failure goes undetected.
- o **Efficiency:** In this topology, redundant connections are high that reduces the efficiency of the network.

6) Hybrid Topology
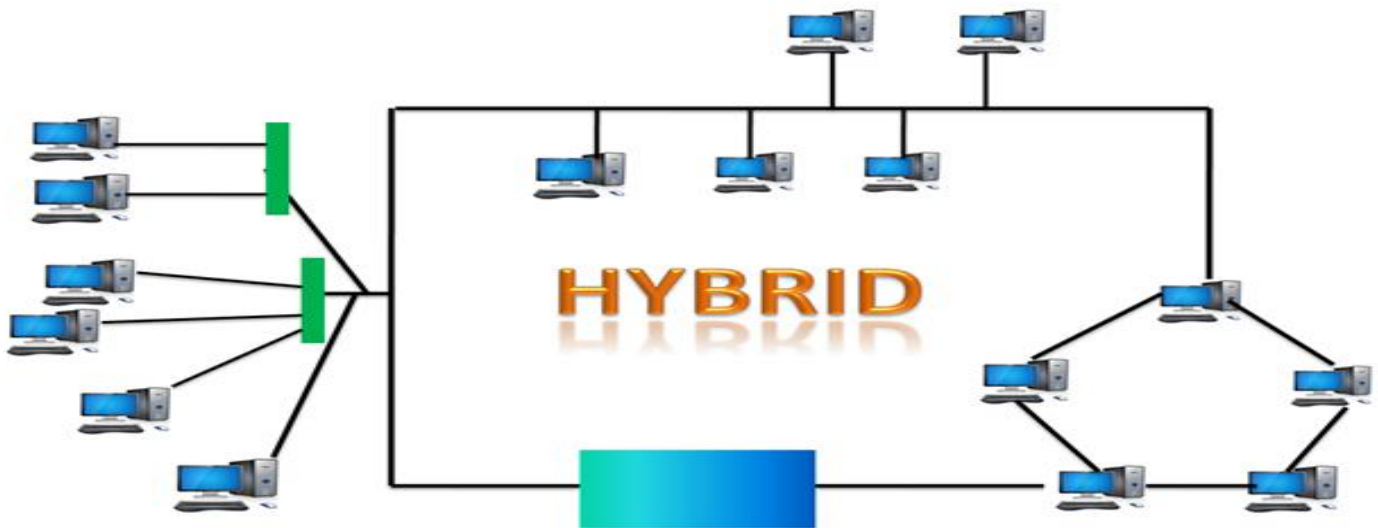
- o The combination of various different topologies is known as **Hybrid topology**.
- o A Hybrid topology is a connection between different links and nodes to transfer the data.
- o When two or more different topologies are combined together is termed as Hybrid topology and if similar topologies are 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 of Hybrid Topology

- o **Reliable:** If a fault occurs in any part of the network will not affect the functioning of the rest of the network.
- o **Scalable:** Size of the network can be easily expanded by adding new devices without affecting the functionality of the existing network.
- o **Flexible:** This topology is very flexible as it can be designed according to the requirements of the organization.
- o **Effective:** Hybrid topology is very effective as it can be designed in such a way that the strength of the network is maximized and weakness of the network is minimized.

Disadvantages of Hybrid topology

- o **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.
- o **Costly Hub:** The Hubs used in the Hybrid topology are very expensive as these hubs are different from usual Hubs used in other topologies.
- o **Costly infrastructure:** The infrastructure cost is very high as a hybrid network requires a lot of cabling, network devices, etc.