# Data Communication and Networks

Unit=1

Data communications are the exchange of data between two devices via some form of transmission medium such as a wire cable. For data communications to occur, the communicating devices must be part of a communication system made up of a combination of hardware (physical equipment) and software (programs). The effectiveness of a data communications system depends on four fundamental characteristics: delivery, accuracy, timeliness, and jitter.

1. **Delivery.** The system must deliver data to the correct destination. Data must be received by the intended device or user and only by that device or user.
2. **Accuracy**. The system must deliver the data accurately. Data that have been altered in transmission and left uncorrected are unusable.
3. **Timeliness.** The system must deliver data in a timely manner. Data delivered late are useless. In the case of video and audio, timely delivery means delivering data as they are produced, in the same order that they are produced, and without significant delay. This kind of delivery is called *real-time* transmission.
4. **Jitter**. Jitter refers to the variation in the packet arrival time. It is the uneven delay in the delivery of audio or video packets.

Components:
A data communications system has five components.
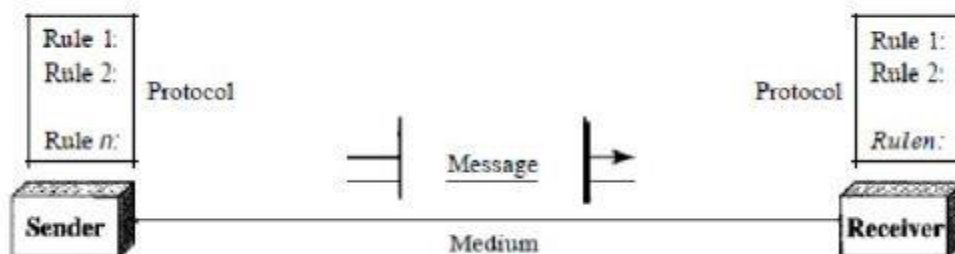
1. **Message**. The message is the information (data) to be communicated. Popular forms of information include text, numbers, pictures, audio, and video.
2. **Sender**. The sender is the device that sends the data message. It can be a computer, workstation, telephone handset, video camera, and so on.
3. **Receiver**. The receiver is the device that receives the message. It can be a computer, workstation, telephone handset, television, and so on.
4. **Transmission medium**. The transmission medium is the physical path by which a message travels from sender to receiver. Some examples of transmission media include twisted-pair wire, coaxial cable, fiber-optic cable, and radio waves
5. **Protocol**. A protocol is a set of rules that govern data communications. It represents an agreement between the communicating devices.

Evolution Of Computer Networks

The term *computer* networks resulted from the 'combination of two major areas, namely *computers* and *communications.*

It was during the 1950's, that computers were treated as large complex machines and were operated by specially trained people. Jobs were given to computers in the form of batches. Punched cards, paper tapes, or magnetic tapes were used as input devices. There was no direct communication or interaction between the user and the computer. Users suffered with extremely long delays between the submission of jobs and the receipt of output results

In the 1960's, interactive terminals were developed. Remote users can be connected to a large mainframe computer via a low speed data line. The network resembles the one shown in Figure.

When more devices are' connected to a computer, it is not so economical to have a separate communication line from each device to the computer. To solve this problem, multiplexers and concentrators were developed. These devices collect the output from a set of peripheral devices and send it over a common communication link. Special communication processors called *front-ends* were developed to relieve the mainframe computers from performing all the communication functions.

Time-sharing systems were developed and that led to the development of many applications centered on a single computer. The concept of a large-scale, general-purpose network was developed. Such a network consists of a set of nodes called *network switches* or *interface message processors* (IMP) connected by means of interconnecting transmission links. Interconnecting links can be a wire, microwave radio, optical fiber, or satellite communication links. Nodes are located at geographically separated locations. Each node forwards the message passing through it to the next node in the concerned path.

As technology advanced, inexpensive personal computers started replacing medium and large systems in many commercial and educational institutions. Local Area Networks (LAN) were developed. A LAN is capable of sharing expensive resources like laser printers, enterprise software, etc., and provides access to a large database. LANs were initially used for the purpose of connecting people. It supports high speed switching. Special software known as *Network* OS was developed to manage and control the access of these Local Area Networks. The users demanded access to resources outside the LAN. The most common resources were printers and large databases. These resources may be components of other LAN. Remote file transfer and remote login were then developed. The concept of Wide Area Networking (WAN) evolved by interconnecting hundreds of thousands of Local Area Networks.

Batch Processing Systems

The computers of the 1950s — large, bulky, and expensive — were intended for a small n umber of privileged users. Quite often, these monstrous constructions occupied entire buildings. Such computers were not able to serve users interactively. Instead, they batched jobs and delivered results later.

Batch-processing systems were usually based on mainframes and were powerful and reliable universal computers. Users would prepare punched cards containing data and pro- gram code and then would transfer these cards to the computing center. Operators would enter these cards into the computer, and users would receive the results a day later in the form of a printout (Figure 1.2). Thus, a single punch card containing an error would mean a delay of at least 24 hours.
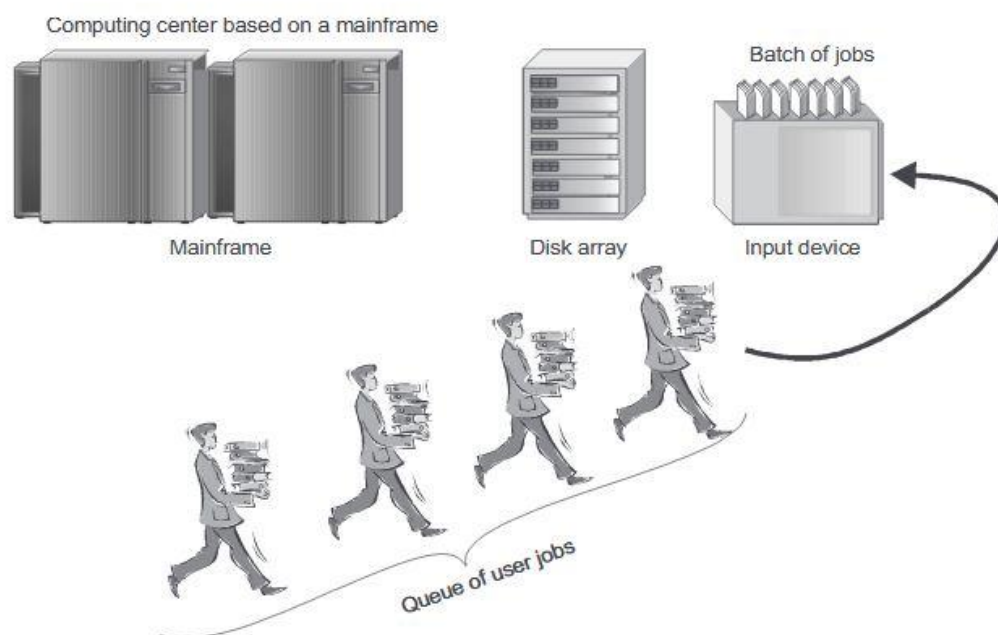

Multiterminal Systems: Prototype of the Computer Network

As processors became cheaper in the early 1960s, new methods of organizing computer processing appeared. These methods provided the possibility of taking end-user conve- nience into account. Thus, multiterminal systems evolved (Figure 1.3). In such time-sharing systems, the computer was at the disposal of several users. Users had their own termi- nals from which they could communicate with the computer. The response time of the computing system was short enough to mask that the computer served multiple users in parallel.

Terminals moved out of computing centers and onto desktops over entire organiza- tions. Although processing power remained fully centralized, some functions, such as data input and output, became distributed. Such centralized, multiterminal systems looked similar to Local Area Networks (LANs). End users perceived working at the terminal prac- tically the same way that most people now view working at a PC

connected to a network. The user could access shared files and peripheral devices and maintain the illusion of using the computer in an exclusive mode, since the user could start any required program at any moment and receive the results almost immediately. (Some users were even con- vinced that all calculations were made somewhere inside the computer display.
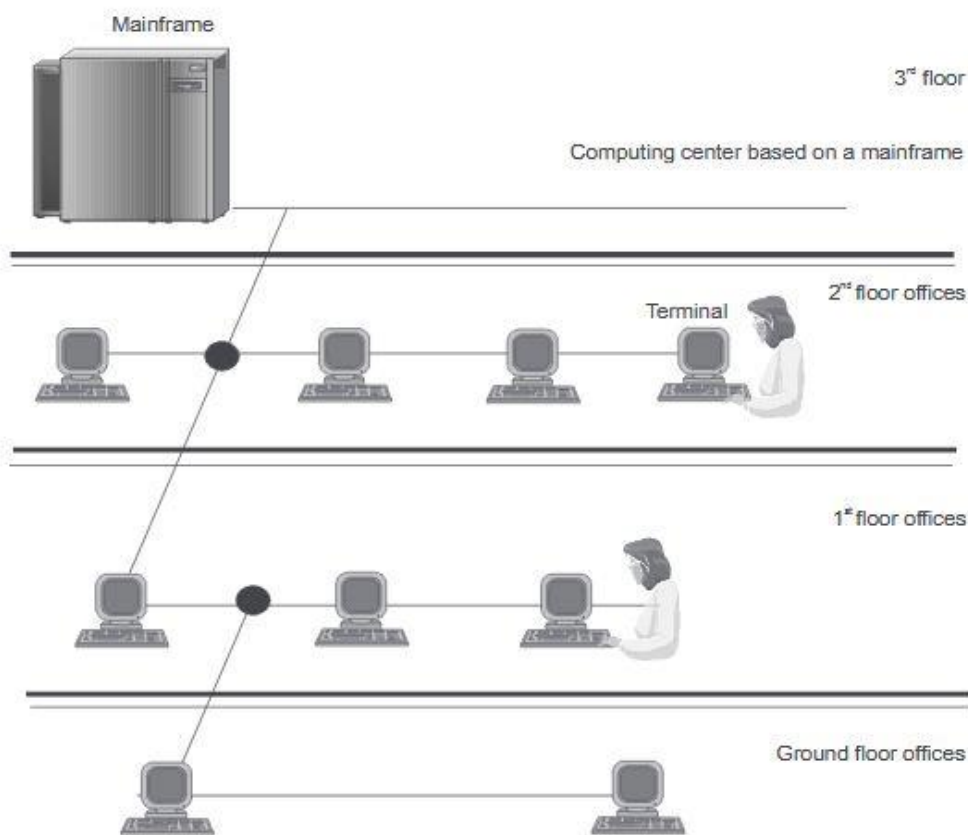
Network Architecture

Network Architecture is the complete framework of an organization's computer network. The diagram of the network architecture provides a full picture of the established network with detailed view of all the resources accessible. It includes hardware components used for communication, cabling and device types, network layout and topologies, physical and wireless connections, implemented areas and future plans. In addition, the software rules and protocols also constitute to the network architecture. This architecture is always designed by a network manager/administrator with coordination of network engineers and other design engineers.

In **client/server network architecture** (one of the most common architectures), one or more of the computers acts as servers that provide services to the rest of the network (the clients).
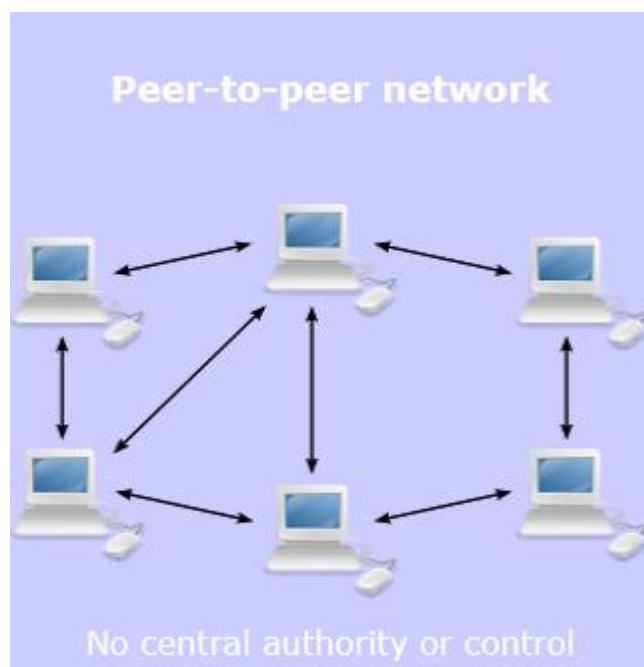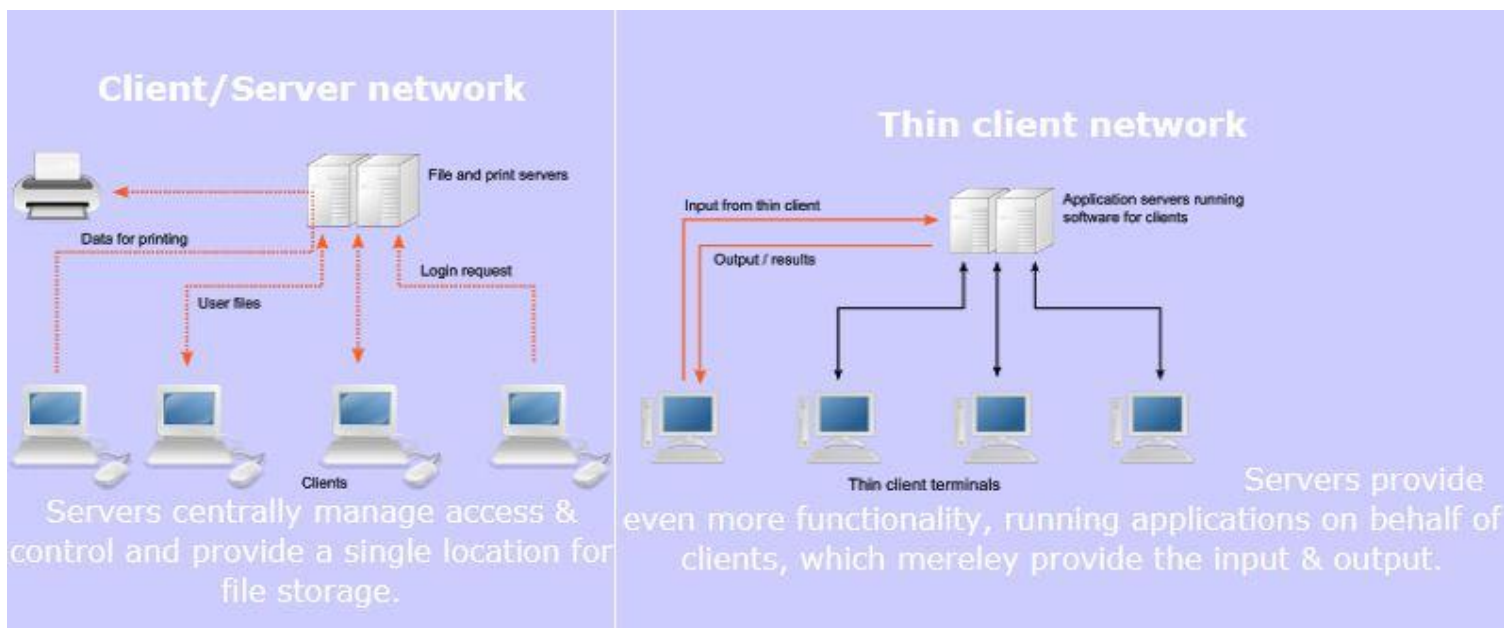
Client-server architecture (client/server) is a network architecture in which each computer or process on the network is either a *client* or a *server*.

<u>Servers</u> are powerful computers or processes dedicated to managing disk drives (*file servers*), printers (*print servers*), or network traffic (*network servers*). Clients are <u>PCs</u> or <u>workstations</u> on which users run <u>applications</u>. Clients rely on servers for <u>resources</u>, such as <u>files</u>, <u>devices</u>, and even processing power.

In thin-client network architecture the client computers rely heavily on a server not only to store files and applications, but to run the software on the clients behalf. The thin client merely acts as a terminal for accepting input and display.

In peer-to-peer network architecture every client (peer) has equal status and there is no central authority or server. Peer-to-peer networks are common in homes and small businesses.
Often referred to simply as *peer-to-peer*, or abbreviated *P2P*, a type of <u>network</u> in which each <u>workstation</u> has equivalent capabilities and responsibilities. This differs from <u>client/server architectures</u>, in which some computers are <u>dedicated</u> to serving the others. Peer-to-peer networks are generally simpler, but they usually do not offer the same performance under heavy <u>loads</u>.

Clint/Server Architecture

With a client server network the files will not be stored on the hard drive of each workstation. Instead they will be stored on a specialised computer called a server. A server is designed to efficiently provide data to a remote client.

If you are using a client server network then you will have a user account and you will have to log on with a user name and password.

There are a number of reasons why you do this.

The first is to identify you to the server so that it knows which files belong to you and so it can make them available them for you.

The second is so that the security systems can check that you are actually who you say you are and that the account belongs to you.

On a large network there may be more than just the file server. There might also be an email server which deals with the internal email system. There may be a web server that controls access to the internet and blocks access to any unsuitable sites and a print server which deals with all of the printing requests.

So that is the 'server' part of the client server network. - file, email and web servers

The 'client' part is the workstation that is connected to the network.

The 'clients' rely on servers to do their job and fetch the files that the users require and manage the tasks and peripherals that the user wants to access.

| Advantages	Disadvantages
All files are stored in a central location	A specialist network operating system is needed
Network peripherals are controlled centrally	The server is expensive to purchase
Backups and network security is controlled centrally	Specialist staff such as a network manager is needed
Users can access shared data which is centrally controlled	If any part of the network fails a lot of disruption can occur

Peer-To-Peer Network

This type of network is where two or more computers are connected together without needing a file server to be part of the network.

A peer to peer network can be as simple as two people in the same room temporarily connecting their computers via a Universal Serial Bus to enable them to transfer or share files directly with one another.

It can also include a more permanent network where say half-a-dozen computers in a small office are connected together with copper cables.

For example in the 'Windows Explorer' view opposite you see two networked computers - Cigs_5thPC and Debbie-4thPC. These share a network and have set up folders that are visible to each machine. So no expensive server is required to be able to work together.
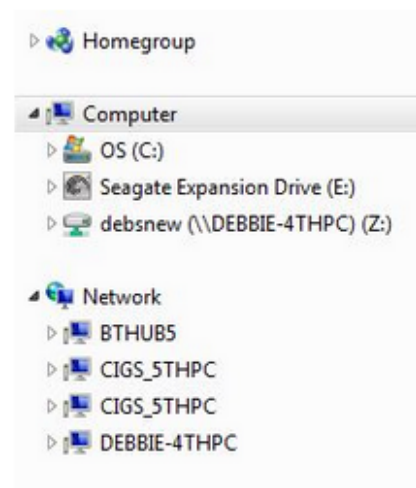
This type of network means that every PC, once connected to the network is acting both as a server and a client. There is no need for a special network operating system.

Access rights to files, folders and data is controlled by setting the sharing permissions on individual machines.

So for example, if Debbie wants access to some files from the Cigs computer, Cigs must set their permissions to allow this. Otherwise, Debbie won't be able to see or access any of Cig's work.

Permissions can be set to allow complete access to every file, folder and document stored on your system or just for particular things.

| Advantages	Disadvantages
No need for a network operating system	Because each computer might be being accessed by others it can slow down the performance for the user
Does not need an expensive server because individual workstations are used to access the files	Files and folders cannot be centrally backed up
No need for specialist staff such as network technicians because each user sets their own permissions as to which files they are willing to share.	Files and resources are not centrally organised into a specific 'shared area'. They are stored on individual computers and might be difficult to locate if the computer's owner doesn't have a logical filing system.
Much easier to set up than a client-server network - does not need specialist knowledge	Ensuring that viruses are not introduced to the network is the responsibility of each individual user
If one computer fails it will not disrupt any other part of the network. It just means that those files aren't available to other users at that time.	There is little or no security besides the permissions. Users often don't need to log onto their workstations.

Network Types
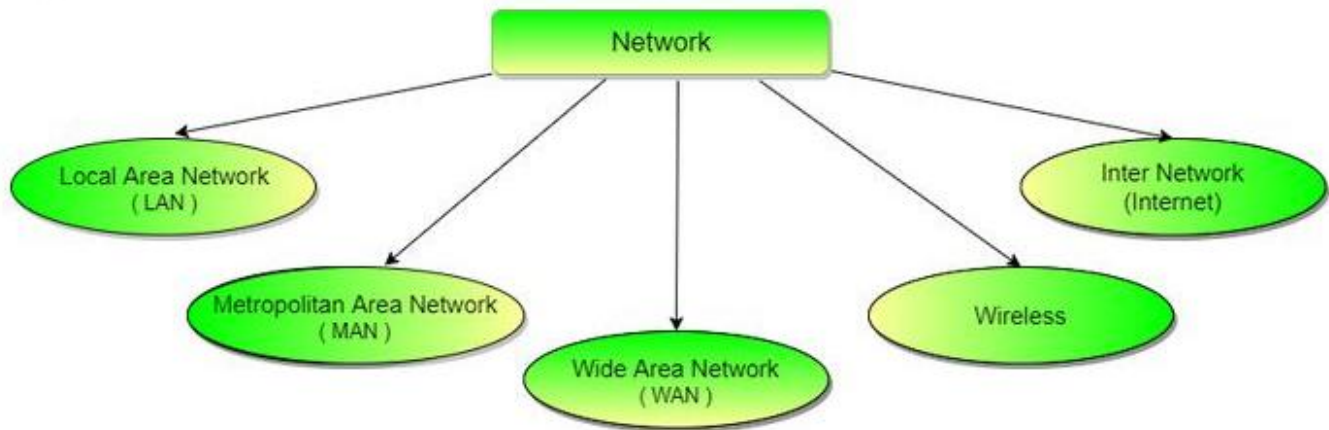
Local Area Network (LAN)

It is also called LAN and designed for small physical areas such as an office, group of buildings or a factory. LANs are used widely as it is easy to design and to troubleshoot. Personal computers and workstations are connected to each other through LANs. We can use different types of topologies through LAN, these are Star, Ring, Bus, Tree etc.

LAN can be a simple network like connecting two computers, to share files and network among each other while it can also be as complex as interconnecting an entire building.

LAN networks are also widely used to share resources like printers, shared hard-drive etc.
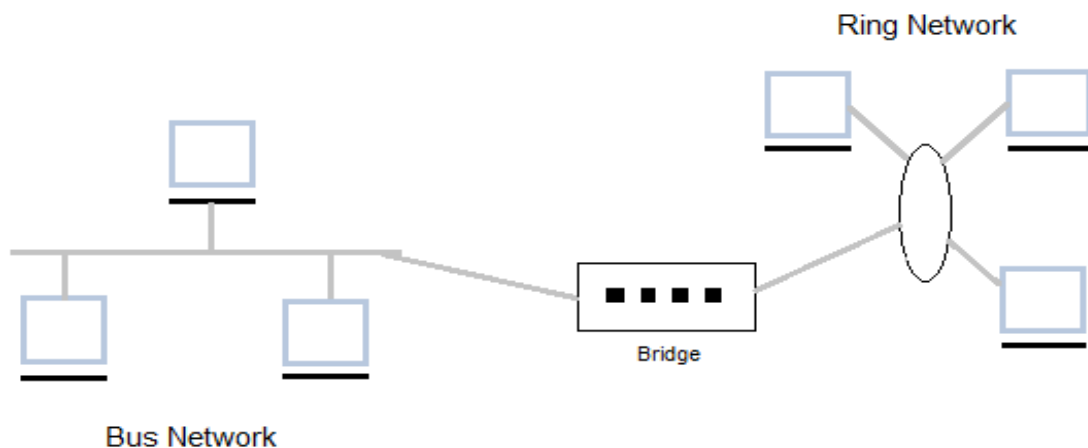
(Different Topologies interconnected in a Local Area Network)

Characteristics of LAN

- LAN's are private networks, not subject to tariffs or other regulatory controls.
- LAN's operate at relatively high speed when compared to the typical WAN.
- There are different types of Media Access Control methods in a LAN, the prominent ones are Ethernet, Token ring.
- It connects computers in a single building, block or campus, i.e. they work in a restricted geographical area.

Applications of LAN

- One of the computer in a network can become a server serving all the remaining computers called clients. Software can be stored on the server and it can be used by the remaining clients.
- Connecting Locally all the workstations in a building to let them communicate with each other locally without any internet access.
- Sharing common resources like printers etc are some common applications of LAN.
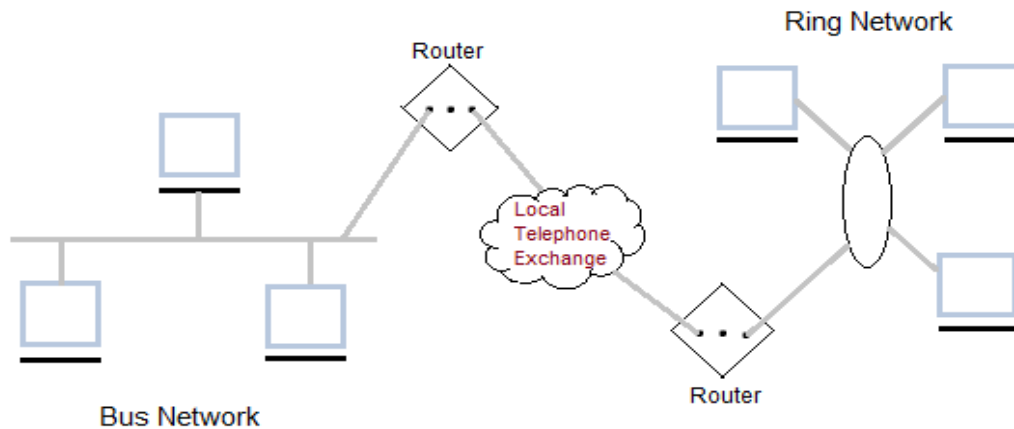
Advantages of LAN

- **Resource Sharing:** Computer resources like printers, modems, DVD-ROM drives and hard disks can be shared with the help of local area networks. This reduces cost and hardware purchases.
- **Software Applications Sharing:** It is cheaper to use same software over network instead of purchasing separate licensed software for each client a network.
- **Easy and Cheap Communication:** Data and messages can easily be transferred over networked computers.
- **Centralized Data:** The data of all network users can be saved on hard disk of the server computer. This will help users to use any workstation in a network to access their data. Because data is not stored on workstations locally.
- **Data Security:** Since, data is stored on server computer centrally, it will be easy to manage data at only one place and the data will be more secure too.
- **Internet Sharing:** Local Area Network provides the facility to share a single internet connection among all the LAN users. In Net Cafes, single internet connection sharing system keeps the internet expenses cheaper.

Disadvantages of LAN

- **High Setup Cost:** Although the LAN will save cost over time due to shared computer resources, but the initial setup costs of installing Local Area Networks is high.
- **Privacy Violations:** The LAN administrator has the rights to check personal data files of each and every LAN user. Moreover he can check the internet history and computer use history of the LAN user.
- **Data Security Threat:** Unauthorised users can access important data of an organization if centralized data repository is not secured properly by the LAN administrator.
- **LAN Maintenance Job:** Local Area Network requires a LAN Administrator because, there are problems of software installations or hardware failures or cable disturbances in Local Area Network. A LAN Administrator is needed at this full time job.
- **Covers Limited Area:** Local Area Network covers a small area like one office, one building or a group of nearby buildings.

Metropolitan Area Network (MAN)

It was developed in 1980s.It is basically a bigger version of LAN. It is also called MAN and uses the similar technology as LAN. It is designed to extend over the entire city. It can be means to connecting a number of LANs into a larger network or it can be a single cable. It is mainly hold and operated by single private company or a public company.

Characteristics of MAN

- It generally covers towns and cities (50 km)
- Communication medium used for MAN are optical fibers, cables etc.
- Data rates adequate for distributed computing applications.

Advantages of MAN

- Extremely efficient and provide fast communication via high-speed carriers, such as fibre optic cables.
- It provides a good back bone for large network and provides greater access to WANs.
- The dual bus used in MAN helps the transmission of data in both directions simultaneously.
- A MAN usually encompasses several blocks of a city or an entire city.

Disadvantages of MAN

- More cable required for a MAN connection from one place to another.
- It is difficult to make the system secure from hackers and industrial espionage(spying) graphical regions.

Wide Area Network (WAN)

It is also called WAN. WAN can be private or it can be public leased network. It is used for the network that covers large distance such as cover states of a country. It is not easy to design and maintain. Communication medium used by WAN are PSTN or Satellite links. WAN operates on low data rates.
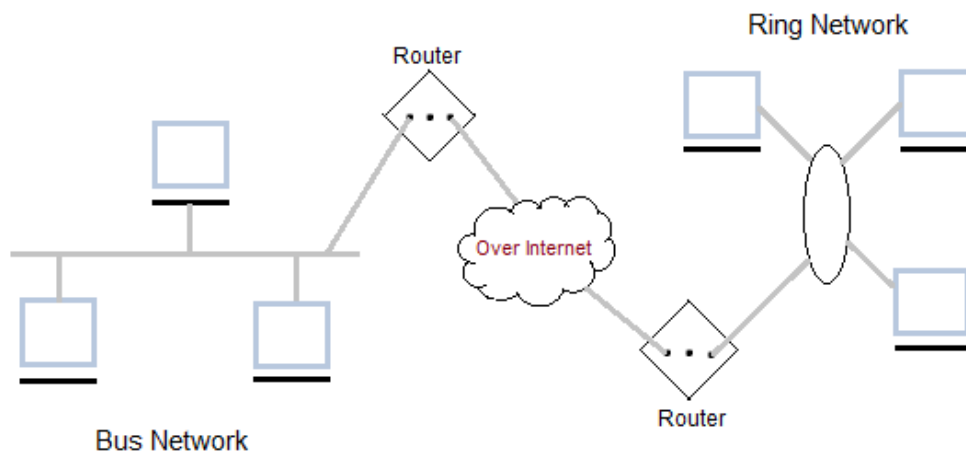
Characteristics of WAN

- It generally covers large distances(states, countries, continents).
- Communication medium used are satellite, public telephone networks which are connected by routers.

Advantages of WAN

- Covers a large geographical area so long distance business can connect on the one network.
- Shares software and resources with connecting workstations.
- Messages can be sent very quickly to anyone else on the network. These messages can have picture, sounds or data included with them(called attachments).
- Expensive things(such as printers or phone lines to the internet) can be shared by all the computers on the network without having to buy a different peripheral for each computer.
- Everyone on the network can use the same data. This avoids problems where some users may have older information than others.

Disadvantages of WAN

- Need a good firewall to restrict outsiders from entering and disrupting the network.
- Setting up a network can be an expensive, slow and complicated. The bigger the network the more expensive it is.
- Once set up, maintaining a network is a full-time job which requires network supervisors and technicians to be employed.
- Security is a real issue when many different people have the ability to use information from other computers. Protection against hackers and viruses adds more complexity and expense.

Wireless Network

Digital wireless communication is not a new idea. Earlier, **Morse code** was used to implement wireless networks. Modern digital wireless systems have better performance, but the basic idea is the same.

Wireless Networks can be divided into three main categories:

1. **System interconnection**
2. **Wireless LANs**
3. **Wireless WANs**

System Interconnection

System interconnection is all about interconnecting the components of a computer using **short-range radio**. Some companies got together to design a short-range wireless network called **Bluetooth** to connect various components such as monitor, keyboard, mouse and printer, to the main unit, without wires. Bluetooth also allows digital cameras, headsets, scanners and other devices to connect to a computer by merely being brought within range.

In simplest form, system interconnection networks use the master-slave concept. The system unit is normally the **master**, talking to the mouse, keyboard, etc. as **slaves**.
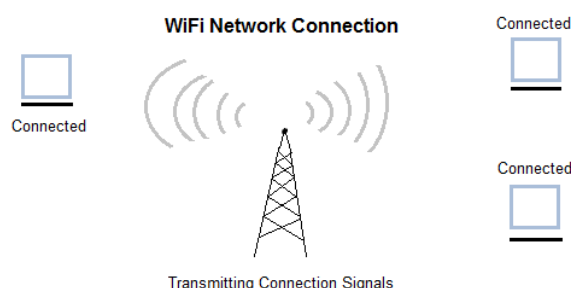
Wireless LANs

These are the systems in which every computer has a **radio modem** and **antenna** with which it can communicate with other systems. Wireless LANs are becoming increasingly common in small offices and homes, where installing **Ethernet** is considered too much trouble. There is a standard for wireless LANs called **IEEE 802.11**, which most systems implement and which is becoming very widespread.

Wireless WANs

The radio network used for cellular telephones is an example of a low-bandwidth wireless WAN. This system has already gone through three generations.

- The first generation was analog and for voice only.
- The second generation was digital and for voice only.
- The third generation is digital and is for both voice and data.

WiFi Network Connection

Connected

Connected

Connected

Connected

Transmitting Connection Signals

Inter Network

Inter Network or Internet is a combination of two or more networks. Inter network can be formed by joining two or more individual networks by means of various devices such as routers, gateways and bridges.
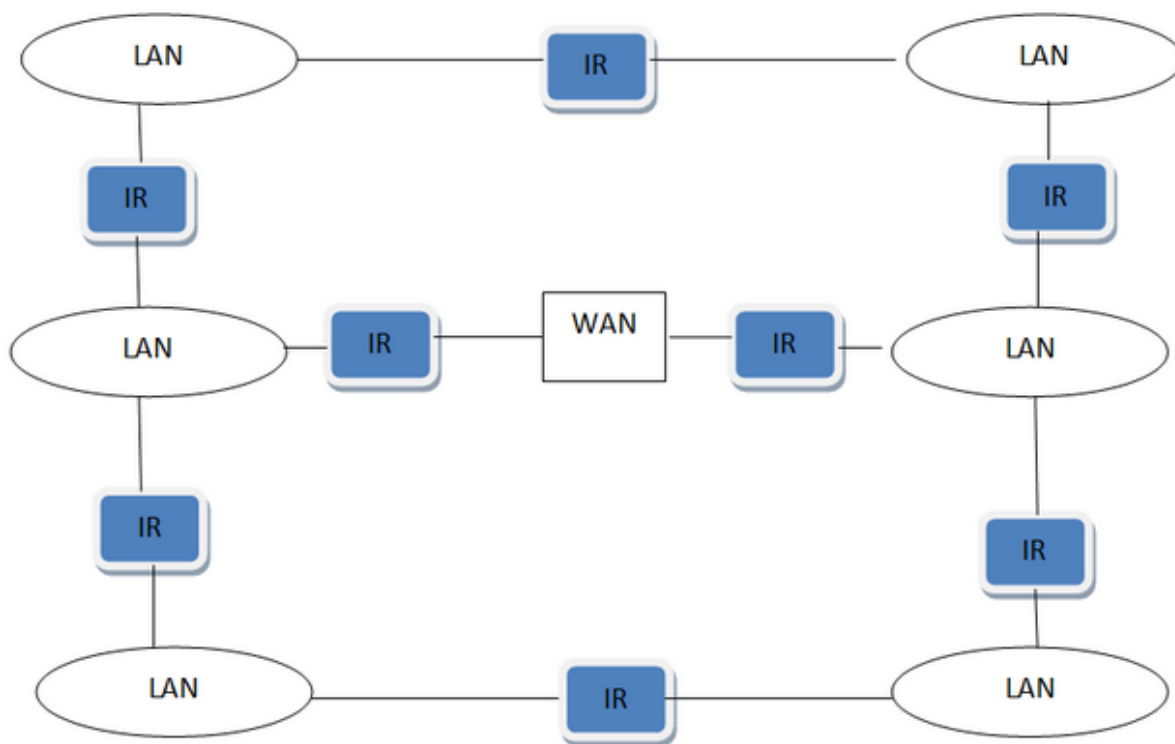
Line Configuration

Line configuration refers to the way two or more communication devices attached to a link. Line configuration is also referred to as connection. A Link is the physical communication pathway that transfers data from one device to another. For communication to occur, two devices must be connected in same way to the same link at the same time.
There are two possible line configurations.
 1. Point-to-Point.
  2. Multipoint.

Point-to-Point

A **Point to Point Line Configuration** Provide dedicated link between two devices use actual length of wire or cable to connect the two end including microwave & satellite link. Infrared remote control & tvs remote control.
The entire capacity of the channel is reserved for transmission between those two devices. Most point-to-point line configurations use an actual length of wire or cable to connect the two ends, but other options, such as microwave or satellite links, are also possible.
Point to point network topology is considered to be one of the easiest and most conventional network topologies. It is also the simplest to establish and understand.

To visualize, one can consider point to point network topology as two phones connected end to end for a two way communication.
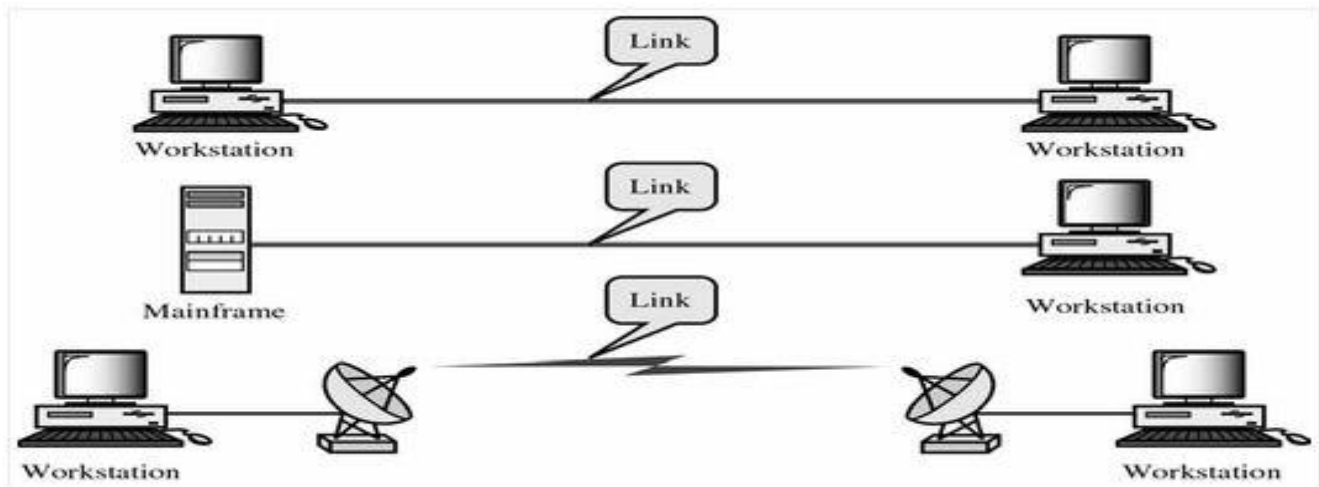

Multipoint Configuration

Multipoint Configuration also known as **Multidrop line configuration** one or more than two specific devices share a single link capacity of the channel is shared.

More than two devices share the Link that is the capacity of the channel is shared now. With shared capacity, there can be two possibilities in a Multipoint Line Config:

- **Spatial Sharing**: If several devices can share the link simultaneously, its called Spatially shared line configuration

- **Temporal (Time) Sharing**: If users must take turns using the link , then its called Temporally shared or Time Shared Line Configuration
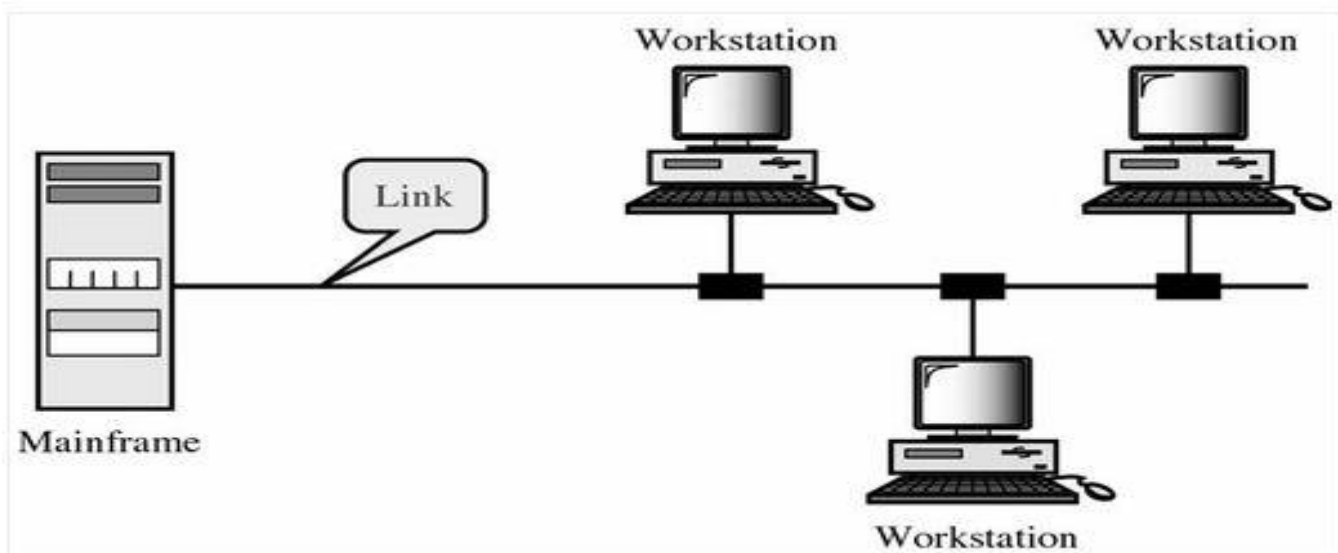
Network Topology

A Network Topology is the arrangement with which computer systems or network devices are connected to each other. Topologies may define both physical and logical aspect of the network. Both logical and physical topologies could be same or different in a same network.

Bus Topology

In case of Bus topology, all devices share single communication line or cable.Bus topology may have problem while multiple hosts sending data at the same time. Therefore, Bus topology either uses CSMA/CD technology or recognizes one host as Bus Master to solve the issue. It is one of the simple forms of networking where a failure of a device does not affect the other devices. But failure of the shared communication line can make all other devices stop functioning.
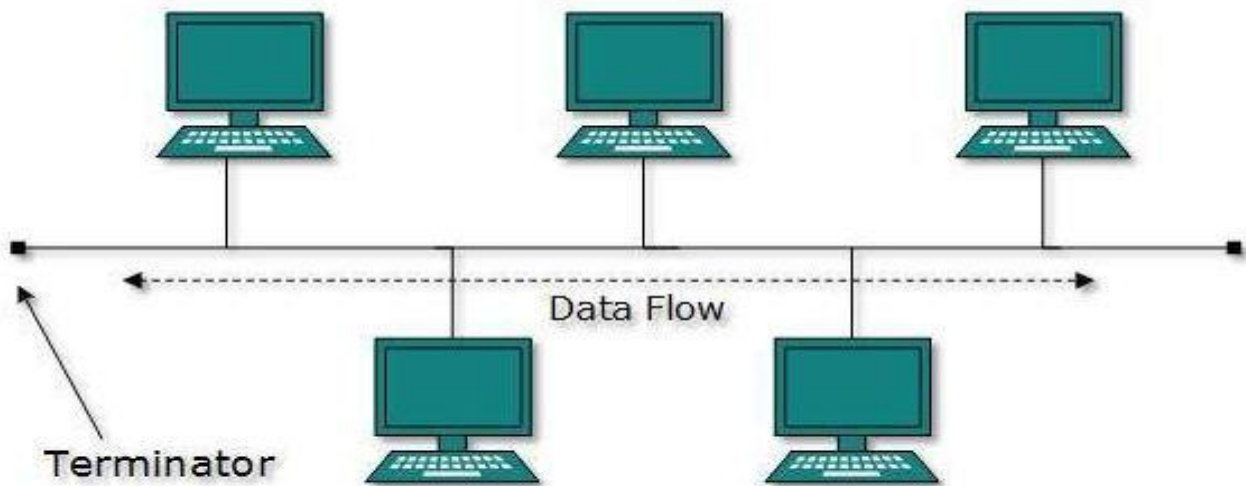
Both ends of the shared channel have line terminator. The data is sent in only one direction and as soon as it reaches the extreme end, the terminator removes the data from the line.
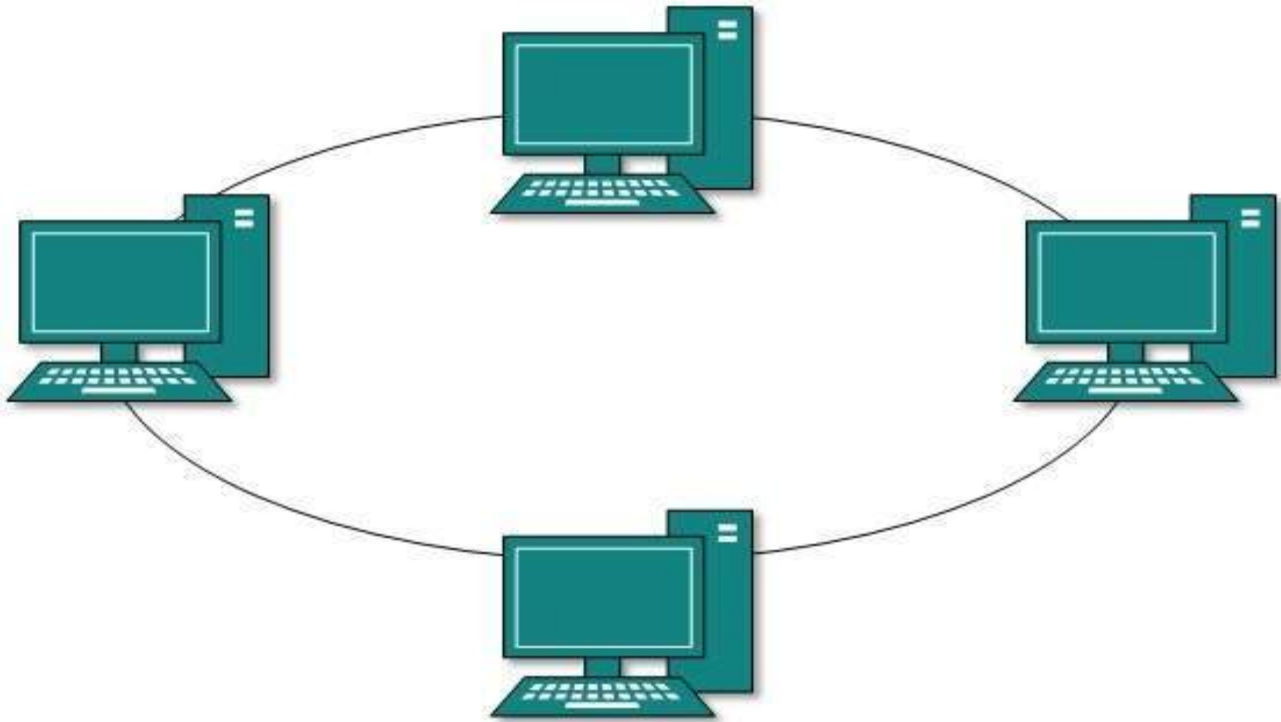
Advantages of Bus Topology

1. It is cost effective.
2. Cable required is least compared to other network topology.
3. Used in small networks.
4. It is easy to understand.
5. Easy to expand joining two cables together.

Disadvantages of Bus Topology

1. Cables fails then whole network fails.
2. If network traffic is heavy or nodes are more the performance of the network decreases.
3. Cable has a limited length.
4. It is slower than the ring topology.

Ring Topology

In ring topology, each host machine connects to exactly two other machines, creating a circular network structure. When one host tries to communicate or send message to a host which is not adjacent to it, the data travels through all intermediate hosts. To connect one more host in the existing structure, the administrator may need only one more extra cable.

Failure of any host results in failure of the whole ring.Thus, every connection in the ring is a point of failure. There are methods which employ one more backup ring.

Advantages of Ring Topology

1. Transmitting network is not affected by high traffic or by adding more nodes, as only the nodes having tokens can transmit data.

2. Cheap to install and expand

Disadvantages of Ring Topology

1. Troubleshooting is difficult in ring topology.

2. Adding or deleting the computers disturbs the network activity.

3. Failure of one computer disturbs the whole network.

Star Topology

All hosts in Star topology are connected to a central device, known as hub device, using a point-to-point connection. That is, there exists a point to point connection between hosts and hub. The hub device can be any of the following:

- Layer-1 device such as hub or repeater
- Layer-2 device such as switch or bridge
- Layer-3 device such as router or gateway
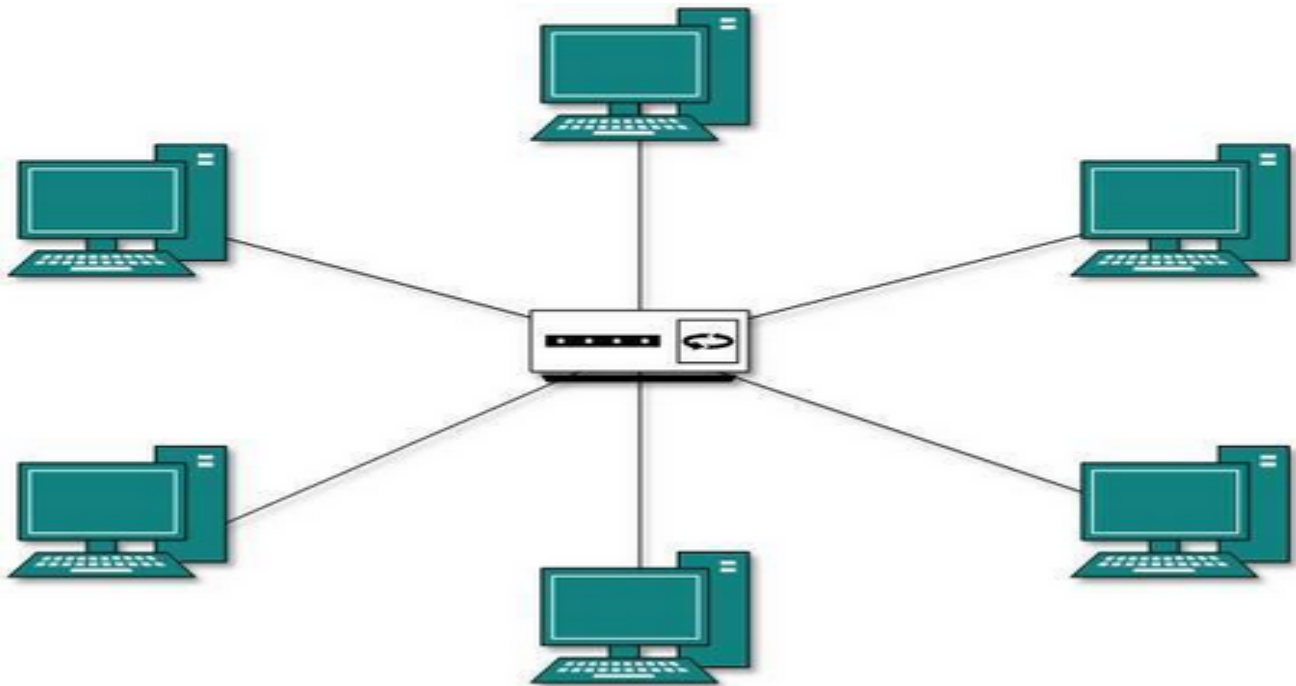
As in Bus topology, hub acts as single point of failure. If hub fails, connectivity of all hosts to all other hosts fails. Every communication between hosts, takes place through only the hub. Star topology is not expensive as to connect one more host, only one cable is required and configuration is simple.

Advantages of Star Topology

1. Fast performance with few nodes and low network traffic.

2. Hub can be upgraded easily.

3. Easy to troubleshoot.

4. Easy to setup and modify.

5. Only that node is affected which has failed, rest of the nodes can work smoothly.

Disadvantages of Star Topology

1. Cost of installation is high.

2. Expensive to use.

3. If the hub fails then the whole network is stopped because all the nodes depend on the hub.

4. Performance is based on the hub that is it depends on its capacity

Mesh Topology

In this type of topology, a host is connected to one or multiple hosts.This topology has hosts in point-to-point connection with every other host or may also have hosts which are in point-to-point connection to few hosts only.
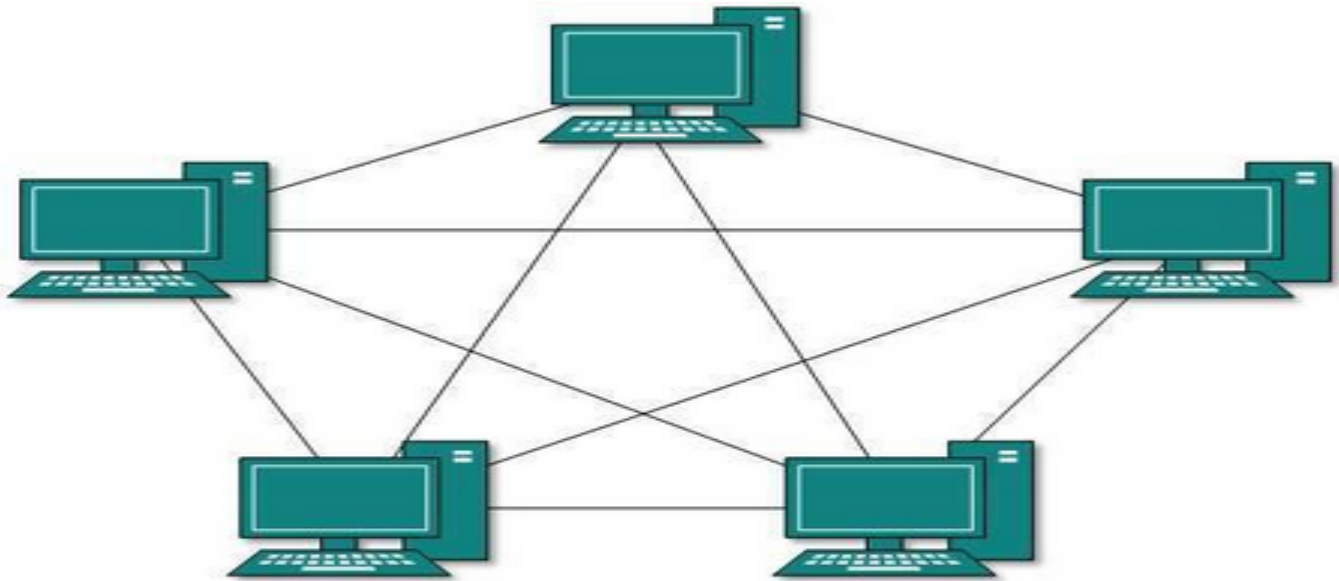
Hosts in Mesh topology also work as relay for other hosts which do not have direct point-to-point links. Mesh technology comes into two types:

- **Full Mesh**: All hosts have a point-to-point connection to every other host in the network. Thus for every new host n(n-1)/2 connections are required. It provides the most reliable network structure among all network topologies.
- **Partially Mesh**: Not all hosts have point-to-point connection to every other host. Hosts connect to each other in some arbitrarily fashion. This topology exists where we need to provide reliability to some hosts out of all.

Advantages of Mesh Topology

1. Each connection can carry its own data load.
2. It is robust.
3. Fault is diagnosed easily.
4. Provides security and privacy.

Disadvantages of Mesh Topology

1. Installation and configuration is difficult.
2. Cabling cost is more.
3. Bulk wiring is required.

Tree Topology

Also known as Hierarchical Topology, this is the most common form of network topology in use presently.This topology imitates as extended Star topology and inherits properties of bus topology.

This topology divides the network in to multiple levels/layers of network. Mainly in LANs, a network is bifurcated into three types of network devices. The lowermost is access-layer where computers are attached. The middle layer is known as distribution layer, which works as mediator between upper layer and lower layer. The highest layer is known as core layer, and is central point of the network, i.e. root of the tree from which all nodes fork.
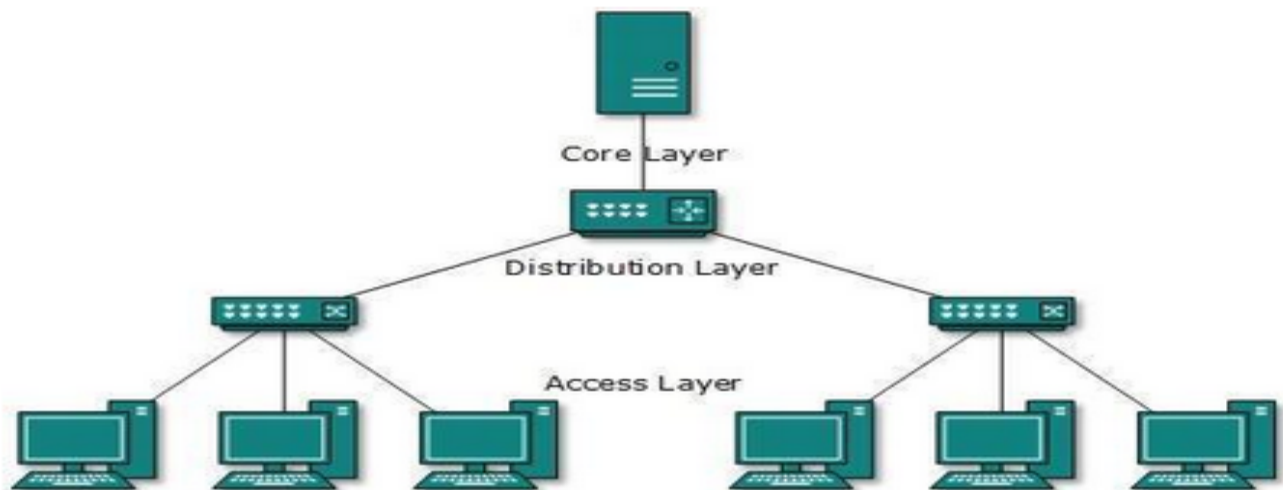
All neighboring hosts have point-to-point connection between them.Similar to the Bus topology, if the root goes down, then the entire network suffers even.though it is not the single point of failure. Every connection serves as point of failure, failing of which divides the network into unreachable segment.

Advantages of Tree Topology

1. Extension of bus and star topologies.

2. Expansion of nodes is possible and easy.

3. Easily managed and maintained.

4. Error detection is easily done.

Disadvantages of Tree Topology

1. Heavily cabled.

2. Costly.

3. If more nodes are added maintenance is difficult.

4. Central hub fails, network fails.

Hybrid Topology

A network structure whose design contains more than one topology is said to be hybrid topology. Hybrid topology inherits merits and demerits of all the incorporating topologies.
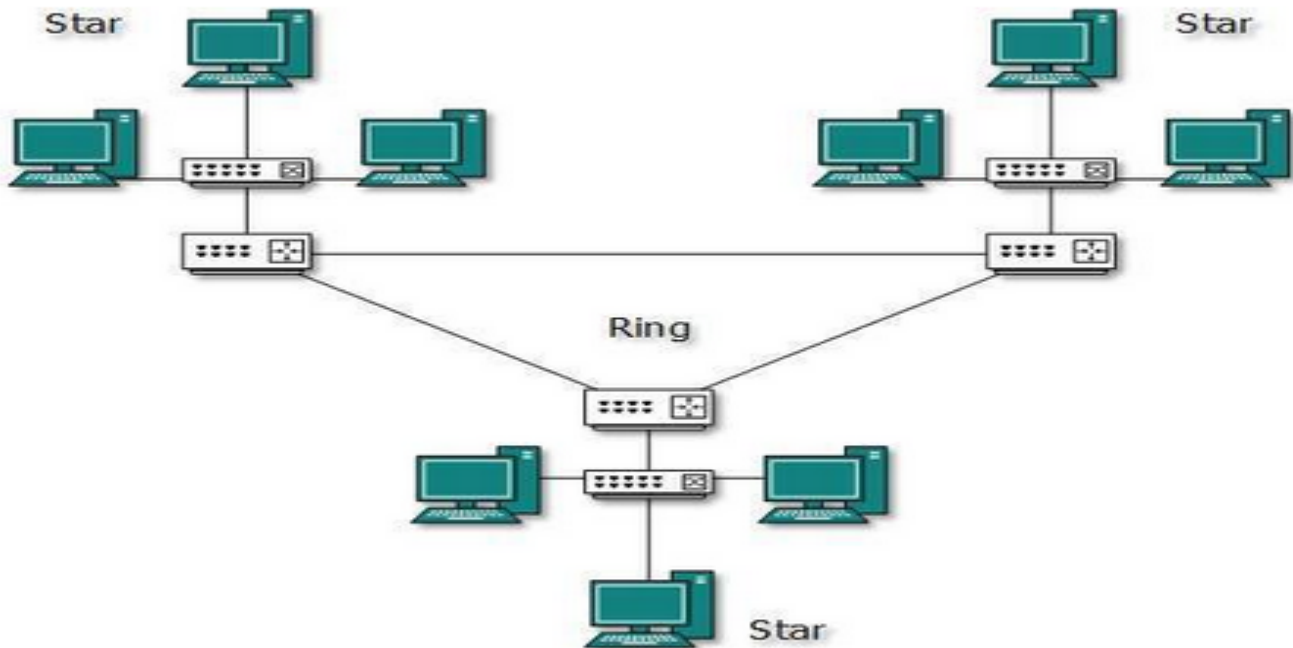
The above picture represents an arbitrarily hybrid topology. The combining topologies may contain attributes of Star, Ring, Bus, and Daisy-chain topologies. Most WANs are connected by means of Dual-Ring topology and networks connected to them are mostly Star topology networks. Internet is the best example of largest Hybrid topology

Advantages of Hybrid Topology

1. Reliable as Error detecting and trouble shooting is easy.

2. Effective.

3. Scalable as size can be increased easily.

4. Flexible.

Disadvantages of Hybrid Topology

1. Complex in design.

2. Costly.

Transmission Modes

Transmission mode means transferring of data between two devices. It is also called communication mode. These modes direct the direction of flow of information. There are three types of transmission mode. They are :
- Simplex Mode
- Half duplex Mode
- Full duplex Mode

Simplex Mode

In Simplex mode, the communication is unidirectional, as on a one-way street. Only one of the two devices on a link can transmit, the other can only receive. The simplex mode can use the entire capacity of the channel to send data in one direction.

Example: Keyboard and traditional monitors. The keyboard can only introduce input, the monitor can only give the output.

HALF DUPLEX Mode

Half-duplex data transmission means that data can be transmitted in both directions on a signal carrier, but not at the same time. For example, on a local area network using a technology that has half-duplex transmission, one workstation can send data on the line and then immediately receive data on the line from the same direction in which data was just transmitted. Hence half-duplex transmission implies a bidirectional line (one that can carry data in both directions) but data can be sent in only one direction at a time.

Example of half duplex is a walkie- talkie in which message is sent one at a time and messages are sent in both the directions.
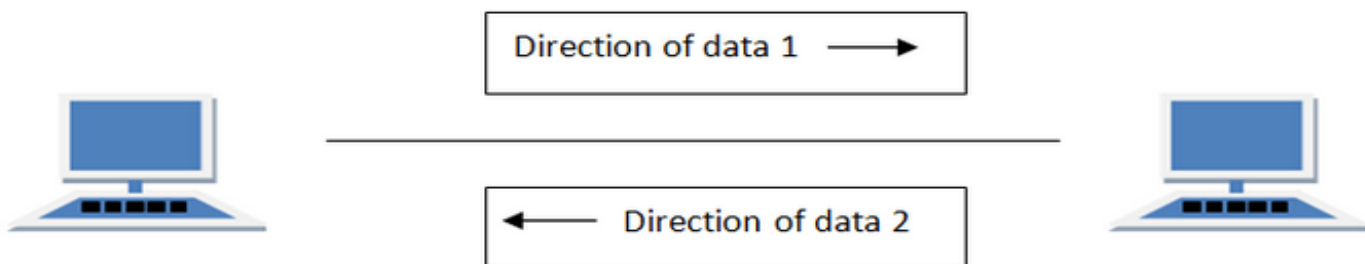

Full-Duplex Mode

In full-duplex mode, both stations can transmit and receive simultaneously. In full_duplex mode, signals going in one direction share the capacity of the link with signals going in other direction, this sharing can occur in two ways:

- Either the link must contain two physically separate transmission paths, one for sending and other for receiving.
- Or the capacity is divided between signals travelling in both directions.

Full-duplex mode is used when communication in both direction is required all the time. The capacity of the channel, however must be divided between the two directions.

Example: Telephone Network in which there is communication between two persons by a telephone line, through which both can talk and listen at the same time.
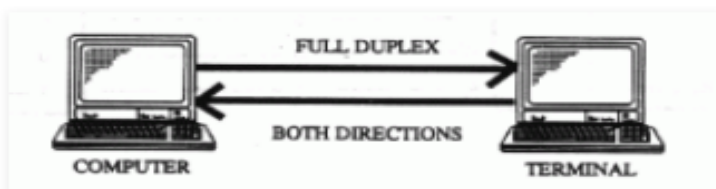
Computer network components

Computer network requires the following devices (some of them are optional):-

• Network Interface Card (NIC)

• Hub

• Switches

• Cables and connectors

• Router

• Modem

1. Network Interface Card

Network adapter is a device that enables a computer to talk with other computer/network. Using unique **hardware addresses (MAC address)** encoded on the card chip, the data-link protocol employs these addresses to discover other systems on the network so that it can transfer data to the right destination.

There are **two types of network cards**: **wired and wireless**. The wired NIC uses cables and connectors as a medium to transfer data, whereas in the wireless card, the connection is made using antenna that employs radio wave technology. All modern laptop computers incorporated wireless NIC in addition to the wired adapter.

Network Card Speed

Network Interface card, one of the main computer network components, comes with different speeds, 10Mbps, 100Mbps, and 1000Mbps, so on. Recent standard **network cards built with Gigabit** (1000Mbps) connection speed. It also supports to connect slower speeds such as 10Mbps and 100Mbps. However, the speed of the card depends on your LAN speed.

For example, if you have a switch that supports up to 100Mbps, your NIC will also transfer a data with this same speed even though your computer NIC has still the capability to transfer data at 1000Mbps (1Gbps). In modern computers, network adapter is integrated with a computer motherboard. However if you want advanced and fast Ethernet card, you may buy and install on your computer using the **PCI slot** found on the motherboard (desktop) and **ExpressCard slots** on laptop .

2. Hub

Hub is a device that splits a network connection into multiple computers. It is like a distribution center. When a computer request information from a network or a specific computer, it sends the request to the hub through a cable. The hub will receive the request and transmit it to the entire network. Each computer in the network should then figure out whether the broadcast data is for them or not.

Currently Hubs are becoming obsolete and replaced by more advanced communication devices such as **Switchs and Routers**.

3. Switch

Switch is a telecommunication device grouped as one of computer network components. Switch is like a Hub but built in with advanced features. It uses **physical device addresses** in each incoming messages so that it can deliver the message to the right destination or port.

Like Hub, switch don't broadcast the received message to entire network, rather before sending it checks to which system or port should the message be sent. In other words switch connects the source and destination directly which increases the speed of the network. Both switch and hub have common features: Multiple RJ-45 ports, power supply and connection lights.

4. Cables and connectors

Cable is one way of transmission media which can transmit communication signals. The wired network typology uses special type of cable to connect computers on a network.

There are a number of solid transmission Media types, which are listed below. - **Twisted pair wire**

It is classified as Category 1, 2, 3, 4, 5, 5E, 6 and 7. Category 5E, 6 and 7 are high-speed cables that can transmit 1Gbps or more. -

Coaxial cable

Coaxial cable more resembles like TV installation cable. It is more expensive than twisted-pair cable but provide high data transmission speed.

Fiber-optic cable

It is a high-speed cable which transmits data using light beams through a glass bound fibers. Fiber-optic cable is high data transmission cable comparing to the other cable types. But the cost of fiber optics is very expensive which can only be purchased and installed on governmental level.

5. Router

When we talk about computer network components, the other device that used to **connect a LAN with an internet connection is called Router**. When you have **two distinct networks** (LANs) or want to share a single internet connection to multiple computers, we use a Router.

In most cases, recent routers also include a switch which in other words can be used as a switch. You don't need to buy both switch and router, particularly if you are installing small business and home networks.

There are two types of Router: **wired and wireless**. The choice depends on your physical office/home setting, **speed** and **cost**.

6. Modems

A modem enables you to connect your computer to the available internet connection over **the existing telephone line**. Like NIC, **Modem is not integrated with a computer motherboard**. It comes as separate part which can be installed on the PCI slots found on motherboard.

A modem is not necessary for LAN, but required for internet connection such as dial-up and DSL.

There are some types of modems, which differs in **speed and transmission rate**. Standard PC modem or Dial-up modems (56Kb data transmission speed), Cellular modem (used in a laptop that enables to connect while on the go), **cable modem (500 times faster than standard modem)** and DSL Modems are the most popular.

Difference between LAN,MAN,WAN and internet

BASIS OF COMPARISON	LAN	MAN	WAN
Expands to	Local Area Network	Metropolitan Area Network	Wide Area Network
Meaning	A network that connects a group of computers in a small geographical area.	It covers relatively large region such as cities, towns.	It spans large locality and connects countries together. Example Internet.
Ownership of Network	Private	Private or Public	Private or Public
Design and maintenance	Easy	Difficult	Difficult
Propagation Delay	Short	Moderate	Long
Speed	High	Moderate	Low
Fault Tolerance	More Tolerant	Less Tolerant	Less Tolerant
Congestion	Less	More	More
Used for	College, School, Hospital.	Small towns, City.	Country/Continent.

Intranet

An intranet is a private computer network that uses Internet protocols, network connectivity, and possibly the public telecommunication system to securely share part of an organization's information or operations with its employees. Sometimes the term refers only to the most visible service, the internal website. The same concepts and technologies of the Internet such as clients and servers running on the Internet protocol suite are used to build an intranet. HTTP and other Internet protocols are commonly used as well, especially FTP and e-mail. There is often an attempt to use Internet technologies to provide new interfaces with corporate 'legacy' data and information systems.

Briefly, an intranet can be understood as "a private version of the Internet," or as a version of the internet confined to an organization.

Internet

The Internet is the worldwide, publicly accessible network of interconnected computer networks that transmit data by packet switching using the standard Internet Protocol (IP). It is a "network of networks" that consists of millions of smaller domestic, academic, business, and government networks, which together carry various information and services, such as electronic mail, online chat, file transfer, and the interlinked Web pages and other documents of the World Wide Web.