Unit 1 Computer Networking

Computer Networks

1. Definition: - "A computer network is a group of computer systems and other computing hardware devices that are linked together through communication channels to facilitate communication and resource-sharing among a wide range of users."
2. A computer network is defined as two computers that are linked together through either a physical cable, or a wireless device. This link then allows the computers on the network to share resources such as an Internet connection, printers, files and programs.
3. A popular example of a computer network is the Internet, which allows millions of users to share information.

Every Network Includes:

1. At least two computers that have something to share.
2. A cable or wireless pathway, called **Transmission Media**, for computers to signal each other.
3. Rules, called **Protocols**, so that computers can use the unified principle of data communication.
4. Networking Interface Cards (NIC)

Question: ****List various Goals and Applications of Networking

Goal of computer Network:-

1. **Resource Sharing:-**The main goal of networking is "Resource sharing", and it is to make all programs, data and equipment available to anyone on the network without the regard to the physical location of the resource and the user. So we don't need separate resource for each computer.
2. **High Reliability:**- A second goal is to provide high reliability by having alternative sources of supply. For example, all files could be replicated on two or three machines, so if one of them is unavailable, the other copies could be available.
3. **Saving Money:**- Another goal is saving money. Small computers have a much better price/performance ratio than larger ones. Mainframes are roughly a factor of ten times faster than the fastest single chip microprocessors, but they cost thousand times more. This imbalance has caused many system designers to build systems consisting of powerful personal computers, one per user, with data kept on one or more shared file server machines. This goal leads to networks with many computers located in the same building. Such a network is called a LAN (local area network).
4. **Work Load Distribution:**- Another closely related goal is to increase the systems performance as the work load increases by just adding more processors. With central mainframes, when the system is full, it must be replaced by a larger one, usually at great expense and with even greater disruption to the users.
5. **Powerful Communication Media:**- Computer networks provide a powerful communication medium. A file that was updated/modified on a network can be seen by the other users on the network immediately.
6. **Expandability:-** If the current networking system having only fewer machines we can expand the number of machines in any quantity and in any time.
7. **Security Mechanism:-** Each person belongs to the network has got different user account. Such user account has different user name and password facility by which every user secures the data created by his own. There are certain levels maintaining for access the data.
8. **Preserving information:-** Information can be backed up to a central location. It is difficult to maintain regular backup standalone computer.
9. **Backup:-** Similarly, in computer network taking an backup is very easy. Because data is stored on server. By using a single floppy or CD writer we can take an backup.

Applications of Computer Network:-

1.Access to remote programs from other computers:-

Access the remote programs involves interaction between a person and a remote database. Access to remote information comes in many forms of like:-

a) Home shopping, paying telephone, electronic bills, e-banking, online share markets etc.
b) Newspaper is on-line and is personalized digital library consisting of books magazines, scientific journals etc.
c) Electronic business: The business can be done electronically with the help of network. Many companies is doing business electronically with other companies. The manufacturers can place order electronically as needed by the company.
d) E-commerce: The electronic commerce is doing business with consumers over the Internet. Many companies provide catalogs of their goods and services on-line and take orders on-line. Examples: Airlines, bookstores, etc.

2. Person to Person Communication:-

a) Electronic –mail
b) Word wide new groups in which one person posts a message and all other subscribers to the newsgroup can read it or give their feedback.
c) Videoconferencing: The people at distant locations can hold a meeting, conference, and writing on a shared virtual black board. This application saves lot of cost and time which is devoted to travel.

3. **Interactive entertainment :-**

a) Multiperson real time simulation games.
b) Video on demand
c) Participation in live TV Programmes like quiz, contest, discussions etc.

4. Access to remote databases from servers or other computers.

Components of Network: (How does the Computer Network Works?)

A Computer network is exchange of the data between two or more computer machine. A data communication system is made up the five components are:-

1) Sender 2) Receiver 3) Message 4) Medium 5) Protocol

As shown in fig 1.1

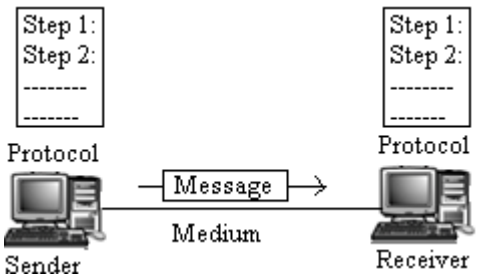


Fig 1.1 Component of Network.

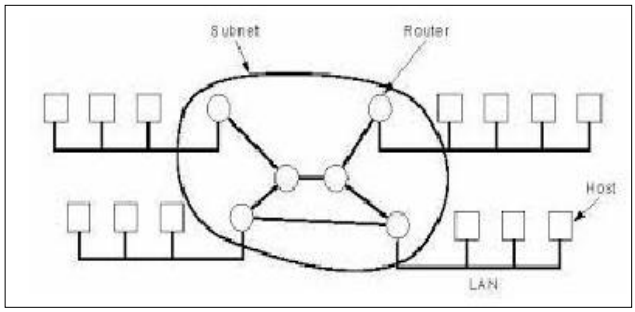
1. Sender
   i. Sender is the source from where actual message is generated, and sends to the other devices.
   ii. For example:- Computers, Workstation, Telephones , Mobiles, Pagers may be a sender
2. Receiver:-
   i. This is the destination node of the data communication system. At this side one device which accepts or receives all the information which is sent by the sender.
   ii. For example:- Computers, Workstation, Telephones , Mobiles, Pagers may be a receiver.

3. Medium:-
    i. Medium established the path between sender and the receiver which is physical form.
    ii. Message will be start traveling through these medium from sender to receiver.
    iii. Medium may be the wired(Coaxial cable, twisted cable, fiber optical cable) or Wireless (radio waves, terrestrial or satellite communication)
4. Message:-
    i. Message is nothing but the information/ data which is used for the communication purpose.
    ii. It may be in multimedia forms, text, graphics, numerical information, pictures, audio, video etc.
5. Protocol:-
    i. It is a set of rules required for the data communication.
    ii. It represented the agreement between the two communication devices.
    iii. The job of protocol is similar to the translator.

Network Structure:-

In any network there are collections of machines intended for application user programs. Any network should have following elements:

1. Hosts: - Hosts are the machines intended for running user application. They are also called end systems because they are the end users.
2. Communication subnet:- Hosts are connected with each other by communication subnet.



The job of the subnet is to carry messages from host to host. The subnet plays an important role in network addressing which is needed in inter networking.

Depending upon the boundary of the communication subnet, network is classified as:

- LAN(Local area network)
- WAN Wide area network)
- MAN(Metropolitan area network)

3. Transmission lines: - These are also referred as circuits, channels or trunks. These move bits between machines. For communication these lines are very important.
4. Switching element: - These is also called as IMP i.e. Interface Message Processors. IMPs are specialized computers used them packet switched node, Intermediate system and data switching exchange, routers.

   Fig. Shows the relation between host and the subnets.

Question: - Define Topology. Explain its various types

Topology:-

Definition:-

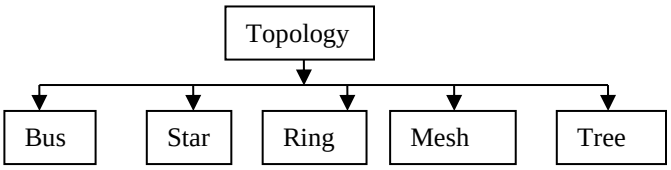
The way in which network is physically connected is called as physical topology.

A topology define the arrangement of nodes, cables and connectivity devices that make up the network,

A topology is a map of computers which allow how to connect the computers with each other.

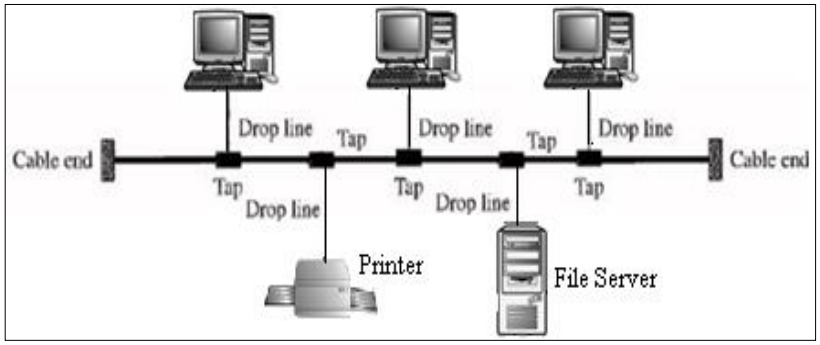
Types of topology:-

Following fig shows the different types of the topology:-



1) **Bus Topology:-**

- Bus topology uses the single communication line called backbone which is shared by all the nodes or computers to communicate.



- Drop lines and taps are used to connect node to this backbone. A drop line is a connection between the node and the Backbone. A tap is the Connector.
- It is used for smaller networks mainly and is one of the most simplest and reliable ways to communicate.
- Each node or workstation is connected along the single communication line cable (usually co-axial cable), data to be transmitted is sent along the communication line or bus. Data packet contains the information like source and the destination address which determine the node that receives the data.
- When the one computer send the signals up the cable, all the computer on the network receives the information but the one will the address that matches the one encoded information while all others rejected the message.
- Bus topology is passive in a sense that nodes only lookout for a signal and does not in any way facilitate signal transmission.

Advantages of Bus Topology:

1. Quite easy to implement and can be extended by adding other peripherals.
2. Cost efficient as less cable length is required.
3. Suitable for smaller networks.
4. Even if one node breaks down network doesn't get hampered.
5. Nodes or workstation can be easily taken out at will from the network.

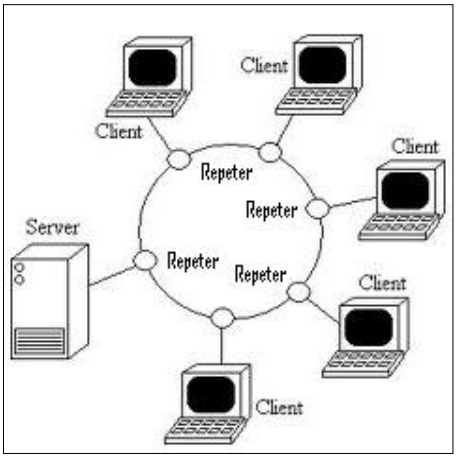
Disadvantages of Bus Topology

1. Within a given cable length limited number of nodes can be added.
2. If there is a problem with a network then the entire network breaks down.
3. Data transfer rate slows down if more nodes are added.
4. Only one data packet can be transferred at a particular moment, when two signals are added on communication bus then the collision occurs between both of them.

2) **Ring Topology:-**

- Ring topology is a network topology in which the nodes or the computers are connected in a closed loop. Each node is connected to two other nodes.

- In the ring topology, the network consists of a set of *repeaters* joined by point-to-point links in a closed loop. The repeater is a comparatively simple device, capable of receiving data on one link and transmitting them, bit by bit, on the other link as fast as they are received, with no buffering at the repeater.



- The links are unidirectional; that is, data are transmitted in one direction only and all are oriented in the same way. Thus, data circulate around the ring in one direction (clockwise or counterclockwise).
- Each station attaches to the network at a repeater and can transmit data onto the network through that repeater.
- Ring networks do token passing. A short message called a token is passed around the ring until the computer wishes to send information to another computer.
- The computer modifies the token, add an electronic address and data and send it around the ring.
- Each computer receives the token and information and passes then to the next computer until the electronic address matches the address of computer or the token return back to its origin.
- The receiving computer returns a message to the originator indicating that the message has been received.

Advantages of Ring Topology

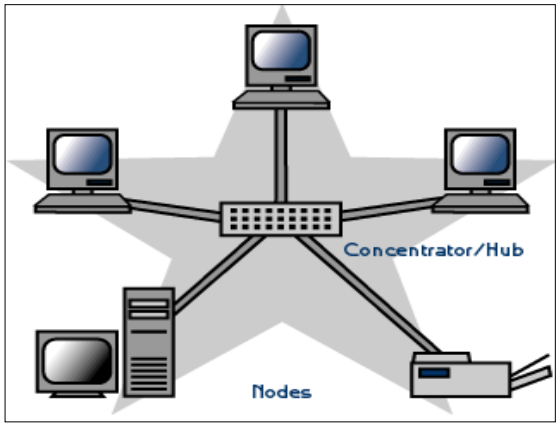
1. High performance delivered
2. Token ring technology reduces the need of server or central hub to manage the workstations
3. All nodes have equal opportunity to transmit the data

Disadvantages of Ring Topology

1. If one node is disrupted then the whole network goes down
2. It becomes difficult to add/remove nodes
3. If more than one token is generated then it may cause ambiguity in the sending of both kinds.

3) Star Topology:-

A star topology is designed with each node (workstations, file server and peripherals) connected directly to a central network concentrator (switch or hub).



- The hub is a specially designated device which allows the transmission of the data through itself.
- Data on a star network passes through the hub or concentrator before continuing to its destination. The concentrator manages and controls all functions of the network.
- Mostly Star topology uses twisted pair cable; however it can also be used without twisted pair cable.

- Each station attaches to a central node, referred to as the star coupler, via two point-to-point links, one for transmission and one for reception. In general, there are two alternatives for the operation of the central node. One approach is for the central node to operate in a broadcast fashion.
- A transmission of a frame from one station to the node is retransmitted on all of the outgoing links.
- In this case, although the arrangement is physically a star, it is logically a bus; a transmission from any station is received by all other stations, and only one station at a time may successfully transmit. Another approach is for the central node to act as a frame switching device. An incoming frame is buffered in the node and then retransmitted on an outgoing link to the destination station.

Advantages of Star Topology

1. Easy to install and implement
2. Give better performance as messages doesn't pass through various nodes unlike Bus topology
3. Faulty nodes can be easily removed without affecting the other nodes in the loop

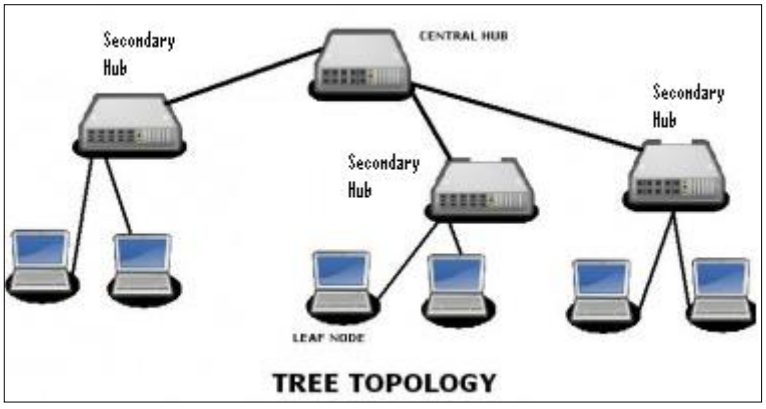
Disadvantages of Star Topology

1. If the central hub fails then the whole network is disrupted
2. If more nodes are to be added then more cable would be required and this would increase the cost
3. Data transfer and capability depends on capacity of the central hub

4) Tree Topology:-

A tree topology combines the characteristics of bus and star topologies.

- It consists of groups of star-configured workstations connected to a linear bus backbone cable.
- Tree topologies allow for the expansion of an existing network and enable colleges to configure a network to meet their needs.



- In the star topology various nodes are connected to the hub, but in the Tree topology secondary hubs are connected to the central hub.
- A central hub in the tree topology is the active hub which contains repeater. The repeater amplifies the signal and increase the distance a signal can travel.
- The secondary hubs can be active or passive. A passive hub provides a simple physical connection between the attached devices.

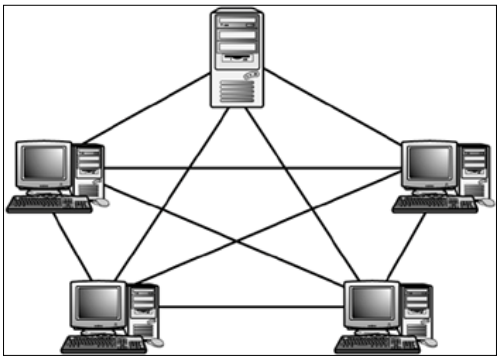
Advantages of Tree Topology

1. It is most suitable for large networks where ring and star topologies are not efficient.
2. Since it divides the network in sub-parts, so it becomes more manageable
3. There is no hassle in either expanding or removing the nodes.
4. For individual segments there is dedicated line wiring to the local hub.

Disadvantages of Tree Topology

1. The network is vulnerable as it is wholly dependent on the central hub.
2. If the network becomes extremely large it becomes difficult to manage.
3. The cabling cost is more.

5) Mesh Topology:-



- In a mesh topology, every device has a dedicated point-to-point link to every other device. The term dedicated means that the link carries traffic only between the two devices it connects.
- To find the number of physical links in a fully connected mesh networks with n nodes, we first consider that each node must be connected to every other node.
- Node 1 must be connected to n-1 nodes, node 2 must be connected to n-1 nodes, and finally node n must be connected to n-1 nodes.

In others words, we can say that in a mesh topology, we need duplex-mode link.

$$n(n-1)/2$$

Advantages of Mesh Topology

1. It is efficient in a sense when one node fails, others continue to work without disruption
2. Network can be easily expanded
3. In one particular instance you can send the data from one node to many nodes
4. Since the message travels along dedicated link, mesh topology is more secure

Disadvantages of Mesh Topology

1. It is quite expensive since a higher length of cable is required
2. Implementation can be a very arduous task.

6) Hybrid Topology

1. A combination of any two or more network topologies.
2. A hybrid topology always accrues when two different basic network topologies are connected.
3. It is a mixture of above mentioned topologies. Usually, a central computer is attached with sub-controllers which in turn participate in a variety of topologies

Advantages of a Hybrid Topology

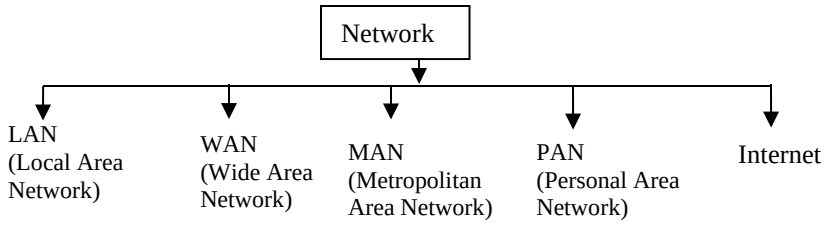
1. It is extremely flexible.
2. It is very reliable.

Disadvantages of a Hybrid Topology

1. Expensive

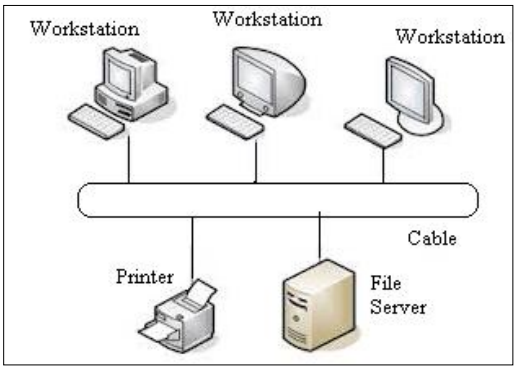
Different Types of Networks (Categories of Network):-

• Depending upon the geographical area covered by a network, it is classified as:



A) LAN:-

1. A LAN is a network that is used for communicating among computer devices, usually within an office building or home.
2. LAN's enable the sharing of resources such as files or hardware devices that may be needed by multiple users
3. Is limited in size, typically spanning a few hundred meters, and no more than a mile
4. Is fast, with speeds from 10 Mbps to 10 Gbps.
5. Requires little wiring, typically a single cable connecting to each device
6. Has lower cost compared to MAN's or WAN's LAN's can be either wired or wireless.



Twisted pair coaxes or fiber optic cable can be used in wired LAN's.

7. Every LAN uses a protocol – a set of rules that governs how packets are configured and transmitted.
8. Nodes in a LAN are linked together with a certain topology. These topologies include:
   A) Bus
   B) Ring
   C) Star
9. LANs are capable of very high transmission rates (100s Mb/s to G b/s).

Advantages of LAN

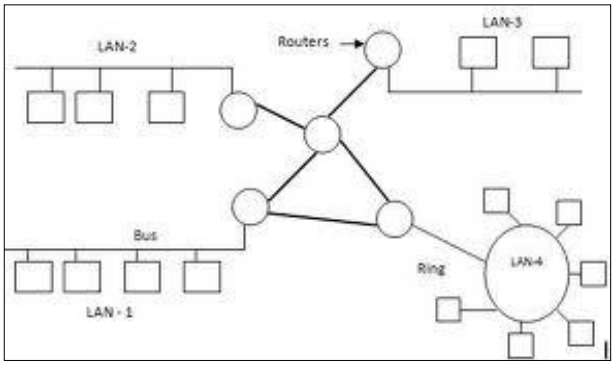
1. Speed is high
2. Cost is low
3. Security is high
4. Use for E-mail
5. Use in Resource Sharing

Disadvantages of LAN

1. Expensive To Install
2. Requires Administrative Time
3. File Server May Fail
4. Cables May Break

B) Metropolitan Area Network (MAN)

1. A **metropolitan area network** (**MAN**) is a large computer network that usually spans a city or a large campus.

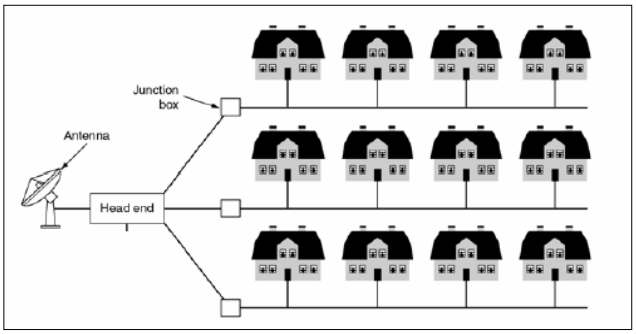


2. A MAN is optimized for a larger geographical area than a LAN, ranging from several blocks of buildings to entire cities.
3. A MAN might be owned and operated by a single organization, but it usually will be used by many individuals and organizations. A MAN often acts as a high speed network to allow sharing of regional resources
4. In the figure, each host (computer) has connected to its LAN on which router is present. The collection of transmission lines and routers (excluding host) from a subnet where Subnet is responsible for moving packets from one end of host to destination host.
5. A MAN typically covers an area of between 5 and 50 km diameter.

6. Examples of MAN: Telephone company network that provides a high speed DSL to customers and cable TV network.

C) Wide Area Network (WAN)

1. WAN covers a large geographic area such as country, continent or even whole of the world.
2. A WAN is two or more LANs connected together. The LANs can be many miles apart.
3. To cover great distances, WANs may transmit data over leased high-speed phone lines or wireless links such as satellites. Multiple LANs can be connected together using devices such as bridges, routers, or gateways, which enable them to share data.



4. The world's most popular WAN is the Internet.

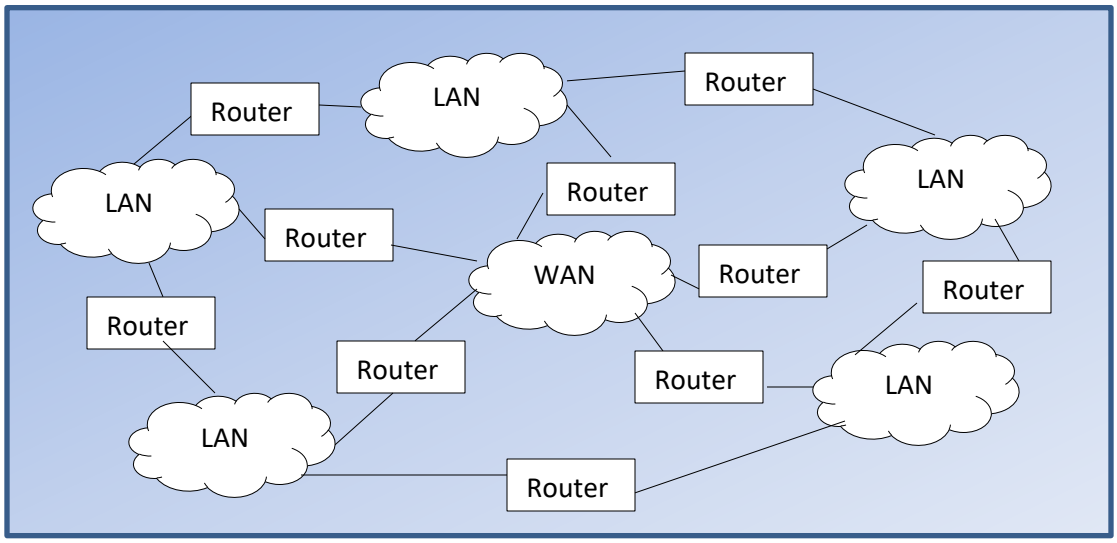
D) Personal Area Network (PAN)



1. A PAN is a network that is used for communicating among computers and computer devices (including telephones) in close proximity of around a few meters within a room
2. It can be used for communicating between the devices themselves, or for connecting to a larger network such as the internet.
3. PAN's can be wired or wireless
4. A **personal area network** (**PAN**) is a computer network used for communication among computer devices, including telephones and personal digital assistants, in proximity to an individual's body.
5. The devices may or may not belong to the person in question. The reach of a PAN is typically a few meters.

F) Internet:-

1. Definition: When two or more networks are connected, they becomes an Internetwork or Internet.
2. The Internet is come since the 1960
3. Today is huge hierarchical structure.
4. A common form of Internet is a collection of LANs connected by a WAN.
5. The common representation of the Internet is not shown by any way. Because it is wider representation. There are various routers, switches, gateways or bridges are used in the different manner. Fig. gives the small ideas about the structure of internet.
6. Now a day various users uses the Internet Service Providers (ISPs) for Internet connection. According to there limitation for providing these services there are various service providers are available today like international service providers, national services providers, regional services providers and local service providers.
7. Note that Internet service is provided by the private companies only and not by the government.



Comparison chart

Points	LAN	WAN
Definition:	LAN (Local Area Network) is a computer network covering a small geographic area, like a home, office, schools, or group of buildings.	WAN (Wide Area Network) is a computer network that covers a broad area (e.g., any network whose communications links cross metropolitan, regional, or national boundaries over a long distance
Speed:	high speed(1000mbps)	less speed(150mbps)
Data transfer rates:	LANs have a high data transfer rate	WANs have a lower data transfer rate as compared to LANs
Example:	Network in an organization can be a LAN	Internet is a good example of a WAN
Technology:	Tend to use certain connectivity technologies, primarily Ethernet and Token Ring	WANs tend to use technology like MPLS, ATM, Frame Relay and X.25 for connectivity over the longer distances
Connection:	one LAN can be connected to other LANs over any distance via telephone lines and radio waves	Computers connected to a wide-area network are often connected through public networks, such as the telephone system. They can also be connected through leased lines or satellites
Components:	Layer 2 devices like switches, bridges. layer1 devices like hubs , repeaters	Layers 3 devices Routers, Multi-layer Switches and Technology specific devices like ATM or Frame-relay Switches etc.
Fault Tolerance:	LANs tend to have fewer problems associated with them, as there are a smaller amount of systems to deal with.	WANs tend to be fewer faults tolerant. As it consists of a large amount of systems there is a lower amount of fault tolerance.
Data Transmission Error:	Experiences fewer data transmission errors	Experiences more data transmission errors as compared to LAN

Points	LAN	WAN
Ownership:	Typically owned, controlled, and managed by a single person or organization	WANs (like the Internet) are not owned by any one organization but rather exist under collective or distributed ownership and management over long distances
Set-up costs:	If there is a need to set-up a couple of extra devices on the network, it is not very expensive to do that	In this case since networks in remote areas have to be connected hence the set-up costs are higher. However WANs using public networks can be setup very cheaply, just software (VPN etc)
Maintenance costs:	Because it covers a relatively small geographical area, LAN is easier to maintain at relatively low costs.	Maintaining WAN is difficult because of its wider geographical coverage and higher maintenance costs.
Geographical Spread:	Have a small geographical range and do not need any leased telecommunication lines	Have a large geographical range generally spreading across boundaries and need leased telecommunication lines

Broadcast and Point-To-Point Networks:

In general terms, computer networks can be classified in two different ways: Broadcast and point to point.

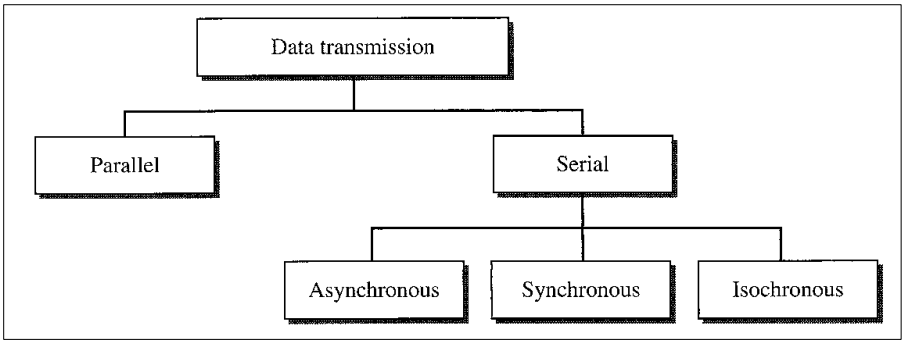
A) Broadcast Networks:
   1. A computer network which has a single communication channel. A packet sent by one computer is received by all the others computers on the network.
   2. In telecommunication and information theory, broadcasting refers to a method of transferring a message to all recipients simultaneously.
   3. Broadcasting can be performed as a high level operation in a program, for example broadcasting Message Passing Interface, or it may be a low level networking operation, for example broadcasting on Ethernet.

B) Point to Point Network :
   1. A simple Point to Point Network is a permanent link between two endpoints.
   2. A point-to-point connection provides a dedicated link between two devices.
   3. The entire capacity of the link is reserved for transmission between those two devices.
   4. Most point-to-point connections 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.
   5. When you change television channels by infrared remote control, you are establishing a point-to-point connection between the remote control and the television's control system. A Point to Point Network can be: Permanent (dedicated) or Switched.

C) Multipoint Network:
   1. A multipoint (also called multidrop) connection is one in which more than two specific devices share a single link. In a multipoint environment, the capacity of the channel is shared, either spatially or temporally.
   2. If several devices can use the link simultaneously, it is a spatially shared connection. If users must take turns, it is a timeshared connection.

Data Transmission: (Communication Type)

1. Data transmission refers to the movement of data in the form of bits between two or more digital devices. This transfer of data takes place via some form of transmission media (for example, coaxial cable, fiber optics, etc.).
2. Data transmission is of two types:
3. The transmission of binary data across a link can be accomplished in either parallel or serial mode. In parallel mode, multiple bits are sent with each clock tick.



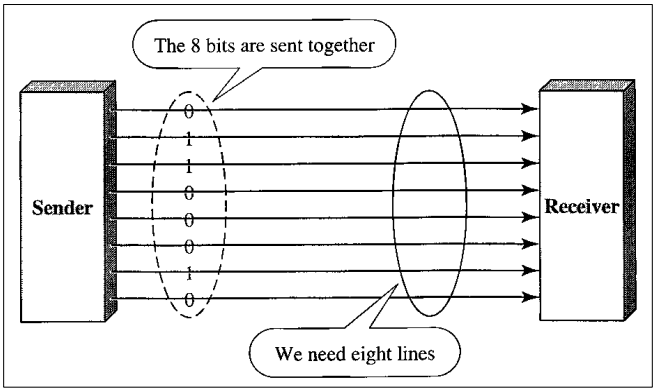
4. In serial mode, 1 bit is sent with each clock tick. While there is only one way to send parallel data, there are three subclasses of serial transmission: asynchronous, synchronous, and isochronous.

A. Parallel Transmission

i. Binary data, consisting of l's and O's, may be organized into groups of n bits each. Computers produce and consume data in groups of bits.

ii. By grouping, we can send data n bits at a time instead of 1. This is called **parallel transmission**.

iii. The mechanism for parallel transmission is a conceptually simple one: Use n wires to send n bits at one time.



iv. That way each bit has its own wire, and all n bits of one group can be transmitted with each clock tick from one device to another.

v. The following figure shows how parallel transmission works for n = 8. Typically, the eight wires are bundled in a cable with a connector at each end.

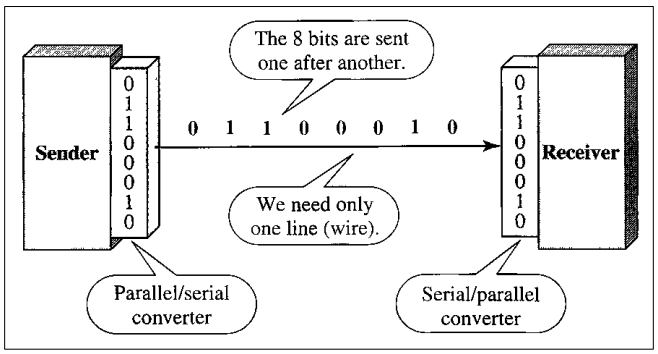
vi. The advantage of parallel transmission is speed. All else being equal, parallel transmission can increase the transfer speed by a factor of n over serial transmission.

vii. But there is a significant disadvantage: cost. Parallel transmission requires n communication lines just to transmit the data stream. Because this is expensive, parallel transmission is usually limited to short distances.

B. Serial Transmission

i. In **serial transmission** one bit follows another, so we need only one communication channel rather than n to transmit data between two communicating devices.

ii. The advantage of serial over parallel transmission is that with only one communication channel,



serial transmission reduces the cost of transmission over parallel by roughly a factor of n.

iii. Since communication within devices is parallel, conversion devices are required at the interface between the sender and the line (parallel-to-serial) and between the line and the receiver (serial-to-parallel).

iv. Serial transmission occurs in one of three ways: asynchronous, synchronous, and isochronous.

- ***Asynchronous Transmission***

i. Asynchronous transmission is so named because the timing of a signal is unimportant. Instead, information is received and translated by agreed upon patterns.

ii. As long as those patterns are followed, the receiving device can retrieve the information without regard to the rhythm in which it is sent.

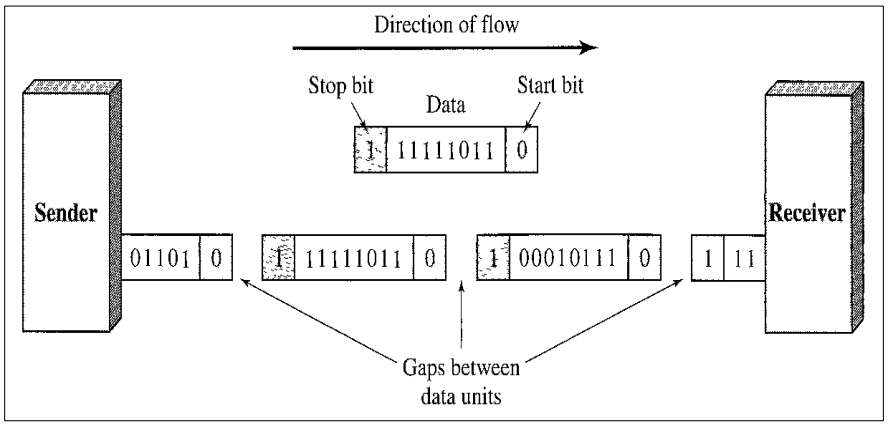
iii. Patterns are based on grouping the bit stream into bytes. Each group, usually 8 bits, is sent along the link as a unit. The sending system handles each group independently, relaying it to the link whenever ready, without regard to a timer.

iv. Without synchronization, the receiver cannot use timing to predict when the next group will arrive. To alert the receiver to the arrival of a new group, therefore, an extra bit is added to the beginning of each byte.

v. This bit, usually a 0, is called the start bit. To let the receiver know that the byte is finished, 1 or more additional bits are appended to the end of the byte. These bits, usually 1 s, are called stop bits. By this method, each byte is increased in size to at least 10 bits, of which 8 bits is information and 2 bits or more are signals to the receiver.

vi. In addition, the transmission of each byte may then be followed by a gap of varying duration. This gap can be represented either by an idle channel or by a stream of additional stop bits.

vii. The start and stop bits and the gap alert the receiver to the beginning and end of each byte and allow it to synchronize with the data stream. This mechanism is called asynchronous because, at the byte level, the sender and receiver do not have to be synchronized. But within each byte, the receiver must still be synchronized with the incoming bit stream.



viii. That is, some synchronization is required, but only for the duration of a single byte. The receiving device resynchronizes at the onset of each new byte. When the receiver detects a start bit, it sets a timer and begins counting bits as they come in.

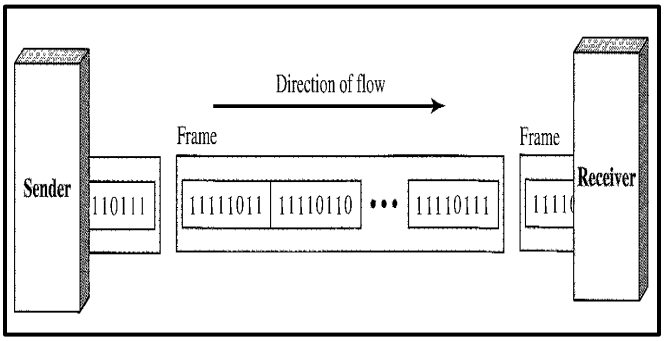
ix. After n bits, the receiver looks for a stop bit. As soon as it detects the stop bit, it waits until it detects the next start bit.

x. The figure is a schematic illustration of asynchronous transmission. In this example, the start bits are 0s, the stop bits are ls, and the gap is represented by an idle line rather than by additional stop bits.

xi. The addition of stop and start bits and the insertion of gaps into the bit stream make asynchronous transmission slower than forms of transmission that can operate without the addition of control information.
xii. But it is cheap and effective, two advantages that make it an attractive choice for situations such as low-speed communication.

- ***Synchronous Transmission***

i. In synchronous transmission, the bit stream is combined into longer "frames," which may contain multiple bytes.
ii. Each byte, however, is introduced onto the transmission link without a gap between it and the next one. It is left to the receiver to separate the bit stream into bytes for decoding purposes.
iii. In other words, data are transmitted as an unbroken string of 1 s and 0s, and the receiver separates that string into the bytes, or characters, it needs to reconstruct the information.



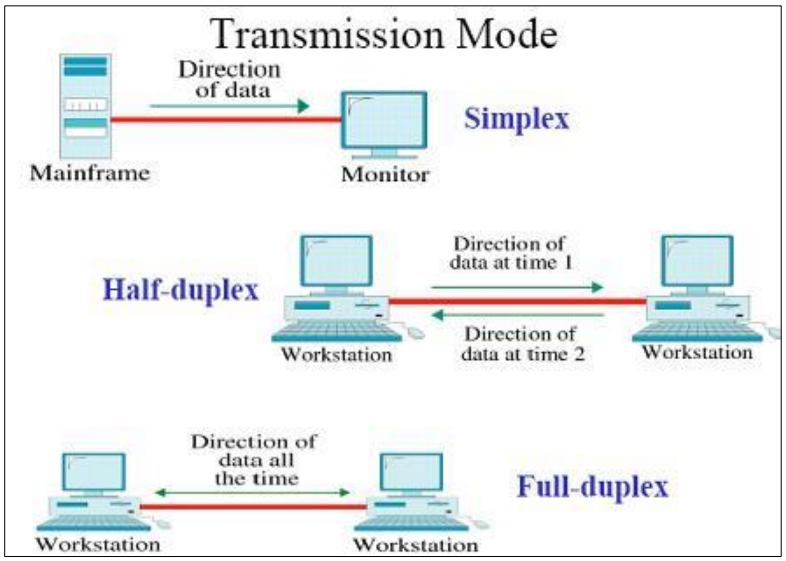
iv. The figure gives a schematic illustration of synchronous transmission. The sender puts its data onto the line as one long string.
v. If the sender wishes to send data in separate bursts, the gaps between bursts must be filled with a special sequence of 0s and ls that means idle. The receiver counts the bits as they arrive and groups them in 8-bit units.
vi. Without gaps and start and stop bits, there is no built-in mechanism to help the receiving device adjust its bit synchronization midstream.
vii. Timing becomes very important, therefore, because the accuracy of the received information is completely dependent on the ability of the receiving device to keep an accurate count of the bits as they come in.
viii. The advantage of synchronous transmission is speed. With no extra bits or gaps to introduce at the sending end and remove at the receiving end, and, by extension, with fewer bits to move across the link, synchronous transmission is faster than asynchronous transmission.
ix. For this reason, it is more useful for high-speed applications such as the transmission of data from one computer to another.

- ***Isochronous***

i. In real-time audio and video, in which uneven delays between frames are not acceptable, synchronous transmission fails.
ii. For example, TV images are broadcast at the rate of 30 images per second; they must be viewed at the same rate. If each image is sent by using one or more flames, there should be no delays between frames. For this type of application, synchronization between characters is not enough; the entire stream of bits must be synchronized.
iii. The isochronous transmission guarantees that the data arrive at a fixed rate.

Direction Of communication:

1. **Simplex:**
   Simplex transmission allows data to travel only in a single, pre specified direction. An example from everyday life is doorbell the signal can go only from the button to the chime. Two other examples are television and radio broadcasting. The simplex standard is relatively uncommon for most types of computer-based telecommunications applications; even devices that are designed primarily to receive information, such as printers must be able to communicate acknowledgement signals back to the sender devices.
2. **Half-duplex**
   In **half duplex** transmission messages can move in either direction, but only one way at a time. The press to talk radio phones used in police cars employs the half-duplex standard; only one person can talk at a time. Often the line between a desktop workstation and a remote CPU conforms to the half-duplex patterns as well. If another computer is transmitting to a workstation, the operator cannot send new messages until the other computer finishes its message to acknowledge an interruption



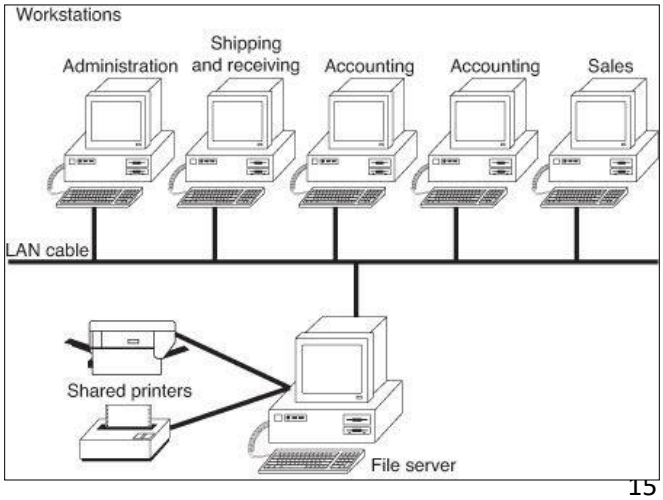
3. **Full-duplex**
   Full duplex transmission works like traffic on a busy two way street the flow moves in two directions at the same time. Full-duplexing is ideal for hardware units that need to pass large amounts of data between each other as in mainframe-to-mainframe communications.

<u>Server Based LANs and Peer to Peer LANs:</u>

There are two major types of LANs: the peer-to-peer LAN and the client/server LAN.

A) <u>Server Based LANs: (Client/Server Networks)</u>

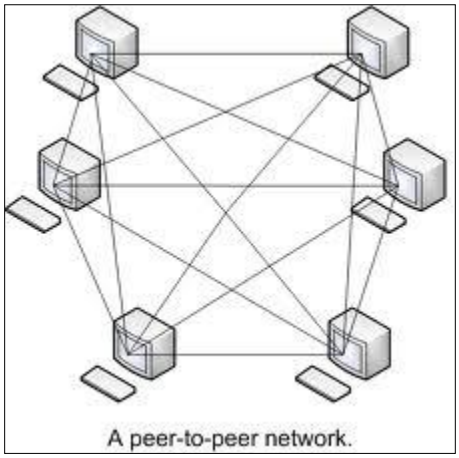
1) On a client/server network, every computer has a distinct role: that of either a client or a server.
2) A server is designed to share its resources among the client computers on the network.
3) Typically, servers are located in secured areas, the rest of the computers on the network function as clients (see image below).



4) The components of a client/server LAN.
   a) Server:
      i. A dedicated server computer often has faster processors, more memory, and more storage space than a client because it might have to service dozens or even hundreds of users at the same time.
      ii. High-performance servers typically use from two to eight processors (and that's not counting multi-core CPUs). Servers
      iii. Facilitate the sharing of its resources. These resources can reside on a single server or on a group of servers.
      iv. When more than one server is used, each server can "specialize" in a particular task (file server, print server, fax server, email server, and so on)
   b) A client
      i. A client computer typically communicates only with servers, not with other clients
      ii. . A client system is a standard PC that is running an OS such as Windows.
5) Advantages of client server
   a. Provide better security.
   b. Arrangements easier for the administration if major network centered on 1 computer.
   c. All data can be backed up at one central location.
6) Disadvantages of client server
   a. NOS software requires an expensive example: NT or Windows 2000 server, XP, Novell, UNIX.
   b. Requires a higher hardware and expensive for the server machine.
   c. Require a professional administrator.
   d. Has a weak point when using a single server, the user data to be nothing if the server dies.

Peer-To Peer networking:-

1) A peer-to-peer network, every computer is equal and can communicate with any other computer on the network to which it has been granted access rights
2) Essentially, every computer on a peer-to-peer network can function as both a server and a client; any computer on a peer-to-peer network is considered a server if it shares a printer, a folder, a drive, or some other resource with the rest of the network.
3) Peer-to-peer networks can be as small as two computers or as large as hundreds of systems and devices. This limit is normally unchangeable and is fixed in the specific version and edition of Windows as follows:
   a. 5 users: Windows XP Home, Vista Starter/Home Basic


A peer-to-peer network.

b. 10 users: Windows NT, 2000, XP Professional, Vista Home Premium/Business/Enterprise/Ultimate
c. 20 users: Windows 7 (all editions)

4) Peer-to-peer networks are more common in small offices or within a single department of a larger organization.
5) For example, a file server to house the hard driver that contains all the files from each user's network and can be accessed from the user's personal computer. After working on the file, the user can save changes and an addition to the files to the network.
6) Advantages peer to peer
   a. The cost of implementation is relatively inexpensive.
   b. Does not require server software NOS (Network Operating System).
   c. Does not require a reliable network administrator.
7) Disadvantages peer to peer
   a. Not suitable for large-scale network, administration becomes uncontrolled.
   b. Each user must be trained to perform administrative tasks.
   c. Less security.

Peer- Peer Networking	**Client Server (Server Based)**
Easy to set up	More difficult to set up
Less expensive to install	Less expensive to install
Can be implemented on a wide range of operating systems	A variety of operating systems can be supported on the client computers, but the server needs to run an operating system that supports networking
More time consuming to maintain the software being used (as computers must be managed individually)	Less time consuming to maintain the software being used (as most of the maintenance is managed from the server)
Very low levels of security Supported or none at all. These can be very cumbersome to set up, depending on the operating system being used	High levels of security are supported, all of which are controlled from the server. Such measures prevent the deletion of essential system files or the changing of settings
Ideal for networks with less than 10 computers	No limit to the number of computers that can be supported by the network
Does not require a server	Requires a server running a server operating system
Demands a moderate level of skill to administer the network	Demands that the network administrator has a high level of IT skills with a good working knowledge of a server operating system