

*Network

The collection of interconnected computers is called a computer network. Two computers are said to be interconnected if they are capable of sharing and exchanging information.

*Transmission Media

It is the transmission media in which signals are confined to a specific path using wire or cable. The types of Bounded/ Guided are discussed below.

•data is transmitted over copper wires, fiber optic cable, radio and microwaves. the term 'media' is used to generically refer to the physical connectors, wires or devices used to plug things together.

* Characteristics of transmission media-:

1. Cost of media-: while designing the network, the cost of media must be considered.

The cost property is decided by user as per application & standard of resources

2. Bandwidth. It refers to the data carrying capacity of a channel or medium. Higher bandwidth communication channels support higher data rates.

2. Radiation. It refers to the leakage of signal from the medium due to undesirable electrical characteristics of the medium.

3. Immunity from electromagnetic Interference (EMI)-: i) It refers to the susceptibility of the media to external electrical noise that can cause distortion of data signal.

ii)EMI is interfering the signals & makes difficult for computers to decode the signal.

4. Attenuation. It refers to loss of energy as signal propagates outwards. The amount of energy lost depends on frequency. Radiations and physical characteristics of media contribute to attenuation.

5. Band usage-: i)In baseband transmission mode base band devotes the entire capacity of the medium to one communication channel.

ii)In broadband transmission mode, broadband enables two or more communication channels to share the bandwidth of communication medium.

*Advantages of Computer Networking

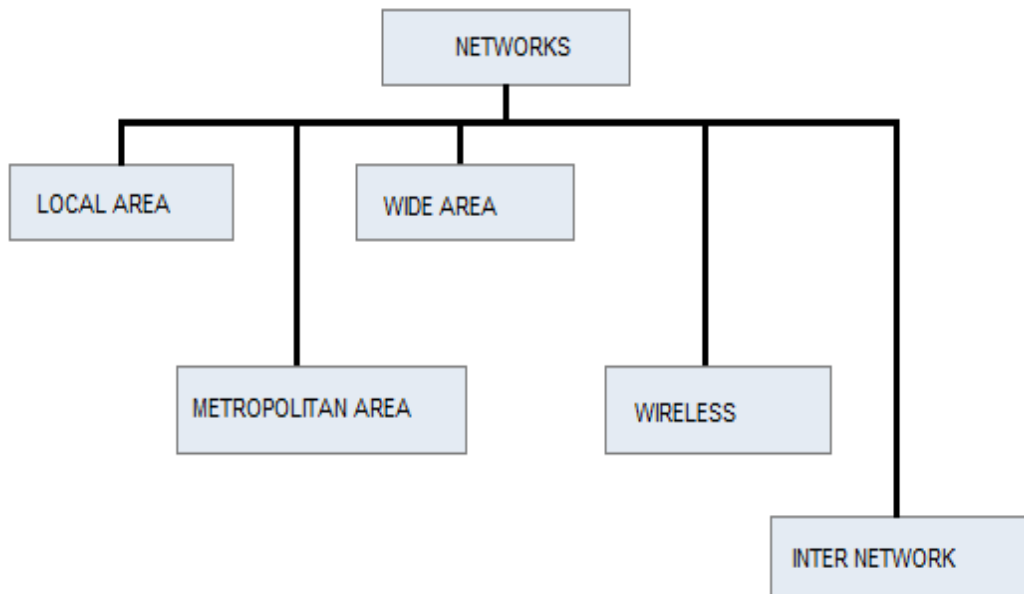
.Allows File Sharing

.Inexpensive

.SystemFlexible to be Used

.Increase in Storage Capacity of the Software

*Types of Communication Networks

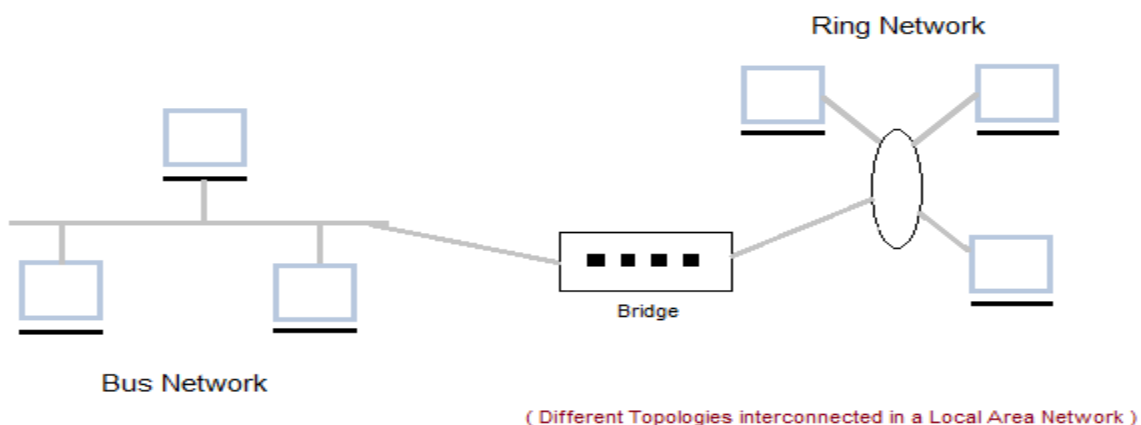


1. Local Area Network (LAN)

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.

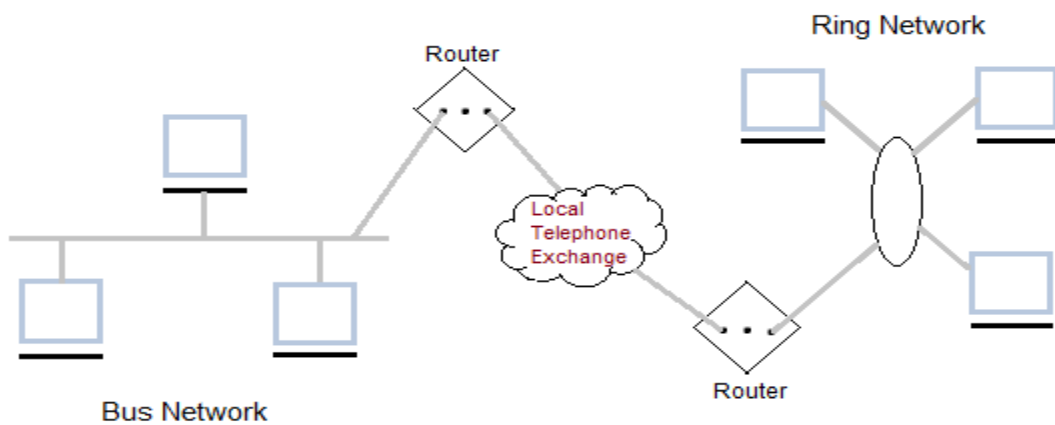


Applications of LAN

- 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.

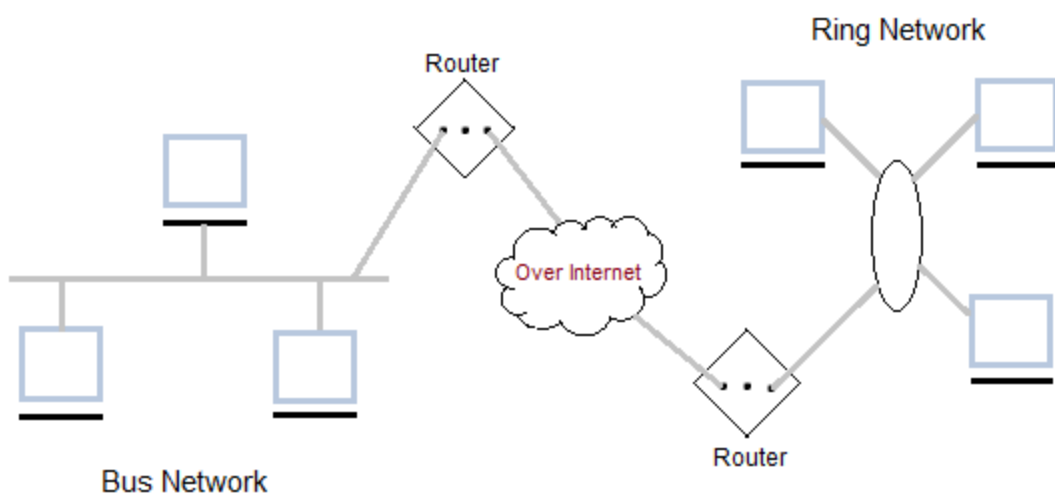
2. Metropolitan Area Network (MAN)

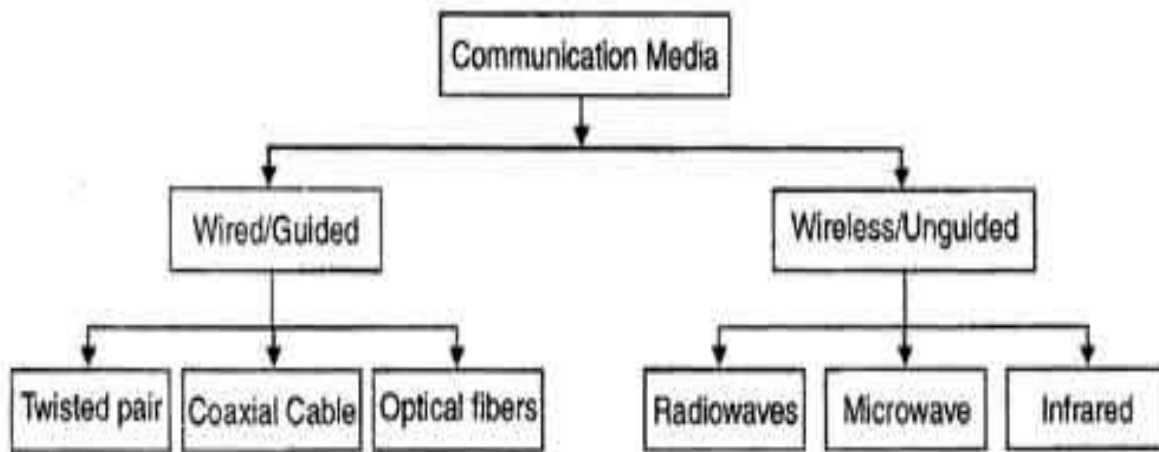
It is basically a bigger version of LAN. It is also called MAN and uses the similar technology as LAN. It is designed to extend over the entire city. It can be means to connecting a number of LANs into a larger network or it can be a single cable. It is mainly hold and operated by single private company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



3. 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.

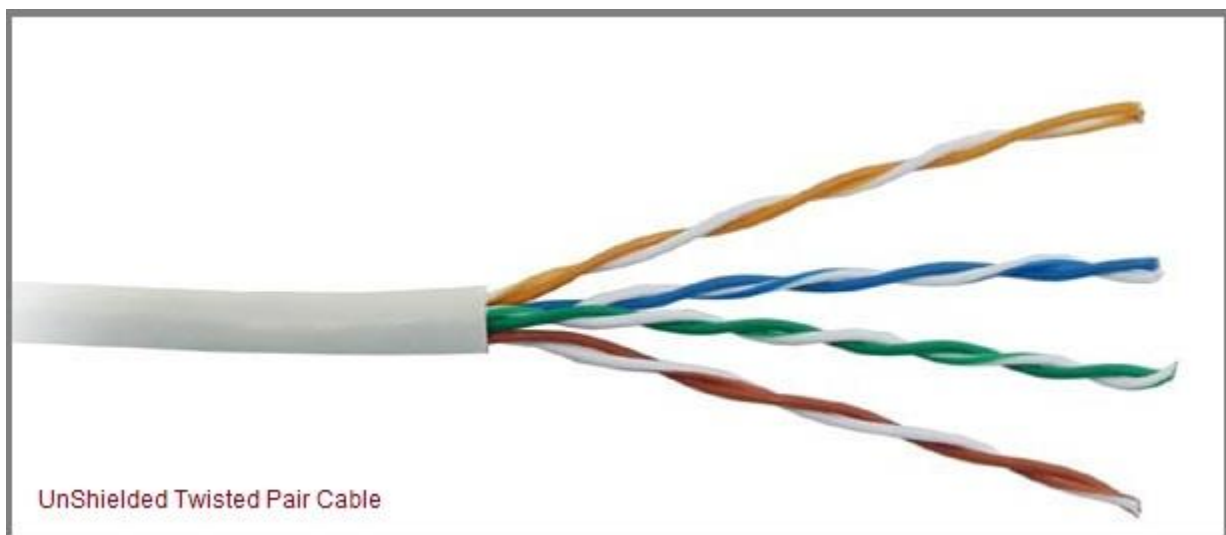




1.Unshielded Twisted Pair Cable

It is the most common type of telecommunication when compared with Shielded Twisted Pair Cable which consists of two conductors usually copper, each with its own colour plastic insulator. Identification is the reason behind coloured plastic insulation.

UTP cables consist of 2 or 4 pairs of twisted cable. Cable with 2 pair use **RJ-11** connector and 4 pair cable use **RJ-45** connector.



Advantages :

- Installation is easy
- Flexible
- Cheap
- It has high speed capacity,
- 100 meter limit
- Higher grades of UTP are used in LAN technologies like Ethernet.

It consists of two insulating copper wires (1mm thick). The wires are twisted together in a helical form to reduce electrical interference from similar pair.

Disadvantages :

- Bandwidth is low when compared with Coaxial Cable

- Provides less protection from interference.
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2. Shielded Twisted Pair Cable

This cable has a metal foil or braided-mesh covering which encases each pair of insulated conductors. Electromagnetic noise penetration is prevented by metal casing. Shielding also eliminates crosstalk (explained in KEY TERMS Chapter).

It has same attenuation as unshielded twisted pair. It is faster than the unshielded and coaxial cable. It is more expensive than coaxial and unshielded twisted pair.



Advantages :

- Easy to install
- Performance is adequate
- Can be used for Analog or Digital transmission
- Increases the signaling rate
- Higher capacity than unshielded twisted pair
- Eliminates crosstalk

Disadvantages :

- Difficult to manufacture
 - Heavy
-

3. Coaxial Cable

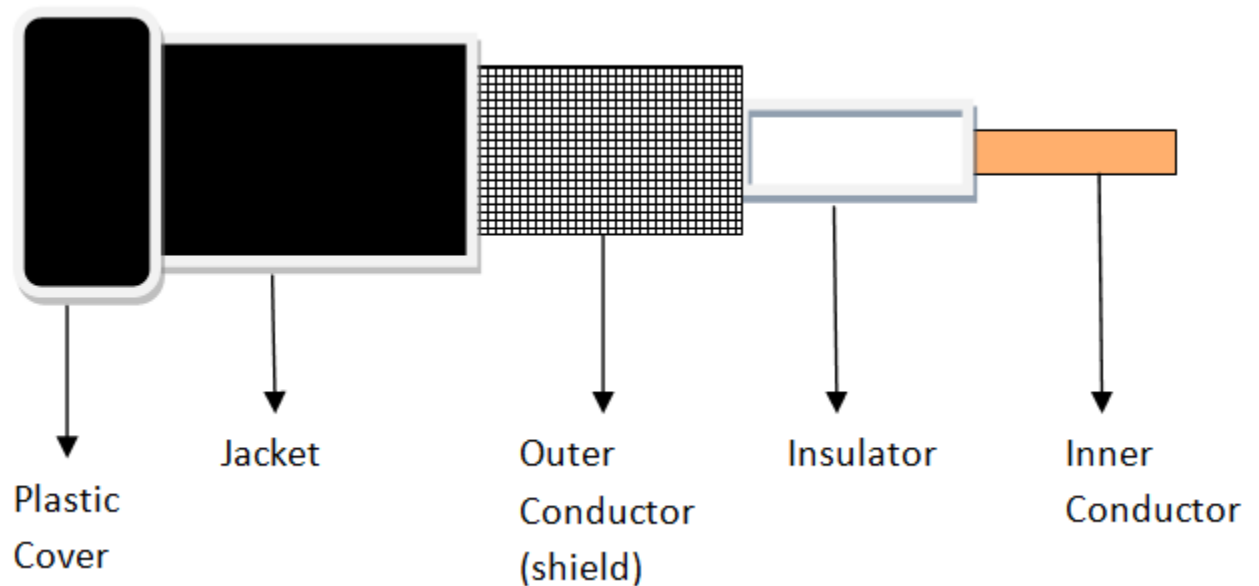
Coaxial is called by this name because it contains two conductors that are parallel to each other. Copper is used in this as centre conductor which can be a solid wire or a standard one. It is surrounded by PVC insulation, a sheath which is encased in an outer conductor of metal foil, braid or both.

Outer metallic wrapping is used as a shield against noise and as the second conductor which completes the circuit. The outer conductor is also encased in

an insulating sheath. The outermost part is the plastic cover which protects the whole cable.

Here the most common coaxial standards.

- 50-Ohm RG-7 or RG-11 : used with thick Ethernet.
- 50-Ohm RG-58 : used with thin Ethernet
- 75-Ohm RG-59 : used with cable television
- 93-Ohm RG-62 : used with ARCNET.



There are two types of Coaxial cables :

BaseBand

This is a 50 ohm (Ω) coaxial cable which is used for digital transmission. It is mostly used for LAN's. Baseband transmits a single signal at a time with very high speed. The major drawback is that it needs amplification after every 1000 feet.

BroadBand

This uses analog transmission on standard cable television cabling. It transmits several simultaneous signal using different frequencies. It covers large area when compared with Baseband Coaxial Cable.

Advantages :

- Bandwidth is high
- Used in long distance telephone lines.
- Transmits digital signals at a very high rate of 10Mbps.
- Much higher noise immunity
- Data transmission without distortion.
- The can span to longer distance at higher speeds as they have better shielding when compared to twisted pair cable

Disadvantages :

- Single cable failure can fail the entire network.
 - Difficult to install and expensive when compared with twisted pair.
 - If the shield is imperfect, it can lead to grounded loop.
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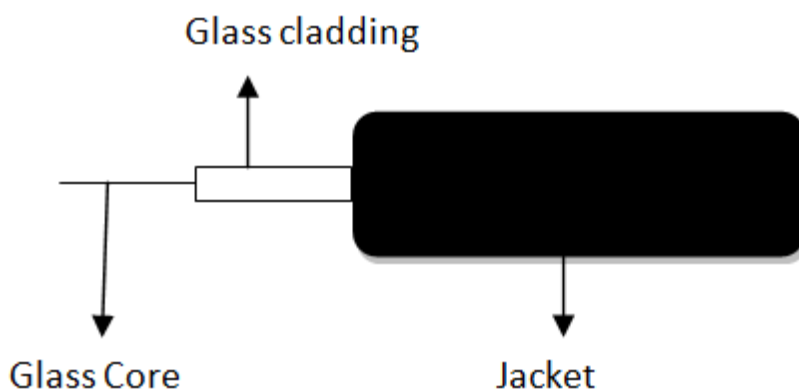
4.Fiber Optic Cable

These are similar to coaxial cable. It uses electric signals to transmit data. At the center is the glass core through which light propagates.

In multimode fibres, the core is 50microns, and In single mode fibres, the thickness is 8 to 10 microns.

The core in fiber optic cable is surrounded by glass cladding with lower index of refraction as compared to core to keep all the light in core. This is covered with a thin plastic jacket to protect the cladding. The fibers are grouped together in bundles protected by an outer shield.

Fiber optic cable has bandwidth more than **2 gbps (Gigabytes per Second)**



Advantages :

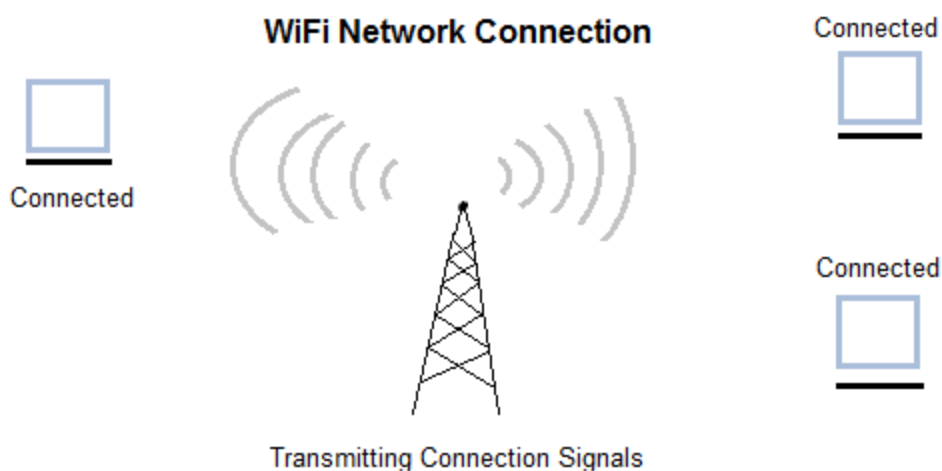
- Provides high quality transmission of signals at very high speed.
- These are not affected by electromagnetic interference, so noise and distortion is very less.
- Used for both analog and digital signals.

Disadvantages :

- It is expensive
- Difficult to install.
- Maintenance is expensive and difficult.
- Do not allow complete routing of light signals.

***Wireless Network**

It is the fastest growing segment of computer. They are becoming very important in our daily life because wireless connections are not possible in cars or aeroplane. We can access Internet at any place avoiding wire related troubles.. These can be used also when the telephone systems gets destroyed due to some calamity/disaster. WANs are really important now-a-days.



*UnBounded/UnGuided Transmission Media

Unguided or wireless media sends the data through air (or water), which is available to anyone who has a device capable of receiving them. Types of unguided/ unbounded media are discussed below :

- Radio Transmission
- MicroWave Transmission

1.Radio Transmission

Its frequency is between 10 kHz to 1GHz. It is simple to install and has high attenuation. These waves are used for multicast communications.

Types of Propagation

Radio Transmission utilizes different types of propagation :

- **Troposphere** : The lowest portion of earth's atmosphere extending outward approximately 30 miles from the earth's surface. Clouds, jet planes, wind is found here.
- **Ionosphere** : The layer of the atmosphere above troposphere, but below space. Contains electrically charged particles.

2.Microwave Transmission

It travels at high frequency than the radio waves. It requires the sender to be inside of the receiver. It operates in a system with a low gigahertz range. It is mostly used for unicast communication.

There are 2 types of Microwave Transmission :

1. Terrestrial Microwave
2. Satellite Microwave

Advantages of Microwave Transmission

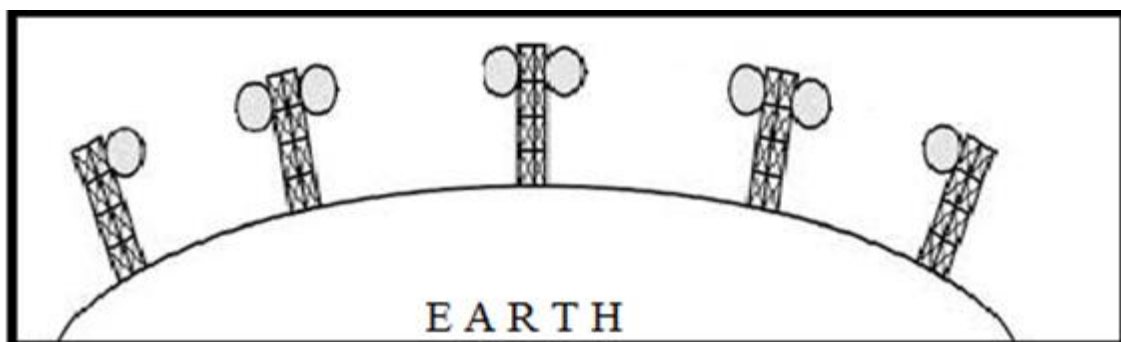
- Used for long distance telephone communication
- Carries 1000's of voice channels at the same time

Disadvantages of Microwave Transmission

- It is Very costly

i) Terrestrial Microwave

For increasing the distance served by terrestrial microwave, repeaters can be installed with each antenna .The signal received by an antenna can be converted into transmittable form and relayed to next antenna as shown in below figure. It is an example of telephone systems all over the world



ii) Satellite Microwave

This is a microwave relay station which is placed in outer space. The satellites are launched either by rockets or space shuttles carry them.

These are positioned 3600KM above the equator with an orbit speed that exactly matches the rotation speed of the earth. As the satellite is positioned in a geo-synchronous orbit, it is stationery relative to earth and always stays over the same point on the ground. This is usually done to allow ground stations to aim antenna at a fixed point in the sky.



Features of Satellite Microwave :

- Bandwidth capacity depends on the frequency used.
- Satellite microwave deployment for orbiting satellite is difficult.

Advantages of Satellite Microwave :

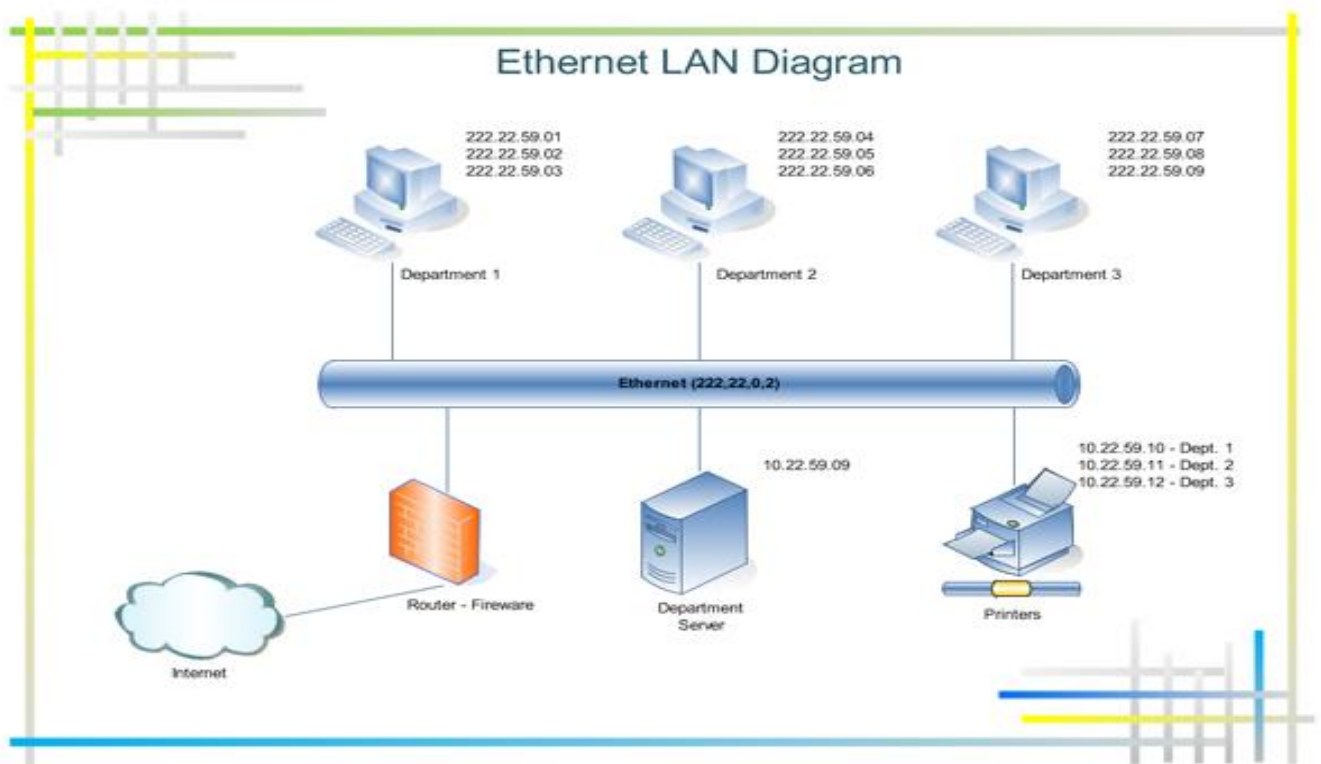
- Transmitting station can receive back its own transmission and check whether the satellite has transmitted information correctly.
- A single microwave relay station which is visible from any point.

Disadvantages of Satellite Microwave :

- Satellite manufacturing cost is very high
- Cost of launching satellite is very expensive
- Transmission highly depends on whether conditions, it can go down in bad weather

***Ethernet definition**

Ethernet is the most widely installed local area network (LAN) technology. Ethernet is a [link layer](#) protocol in the [TCP/IP stack](#), describing how networked devices can format data for transmission to other network devices on the same network segment, and how to put that data out on the network connection. It touches both Layer 1 (the physical layer) and [Layer 2](#) (the data link layer) on the OSI network protocol model. Ethernet defines two units of transmission, packet and frame. The frame includes not just the "payload" of data being transmitted but also addressing information identifying the physical "Media Access Control" (MAC) addresses of both sender and receiver, VLAN tagging and [quality of service](#) information, and error-correction information to detect problems in transmission. Each frame is wrapped in a packet, which affixes several bytes of information used in establishing the connection and marking where the frame starts. Ethernet network is as shown following figure-:



*Access methods of networking:-

1. **contention** is a media access method that is used to share a broadcast medium. In contention, any computer in the network can transmit data at any time (first come-first served).

This system breaks down when two computers attempt to transmit at the same time. This is a case of collision. To avoid collision, carrier sensing mechanism is used. Here each computer listens to the network before attempting to transmit. If the network is busy, it waits until network quiets down. In carrier detection, computers continue to listen to the network as they transmit. If computer detects another signal that interferes with the signal it is sending, it stops transmitting. Both computers then wait for random amount of time and attempt to transmit. Contention methods are most popular media access control method on LANs.

2. Token passing:- In telecommunication, **token passing** is a channel access method where a signal called a token is passed between nodes that authorizes the node to communicate. The most well-known examples are token ring and ARCNET.

Token passing schemes provide round-robin scheduling, and if the packets are equally sized, the scheduling is max-min fair. The advantage over contention based channel access is that collisions are eliminated, and that the channel [bandwidth](#) can be fully utilized without idle time when demand is heavy. The disadvantage is that even when demand is light, a station wishing to transmit must wait for the token, increasing [latency](#).

Some types of token passing schemes do not need to explicitly send a token between systems because the process of "passing the token" is implicit.

Network Topology:-

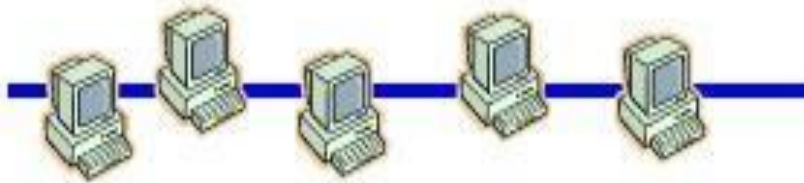
- Network topologies describe the ways in which the elements of a network are mapped. They describe the physical and logical arrangement of the network nodes.

- The physical topology of a network refers to the configuration of cables, computers, and other peripherals.

- **Different Types of Topologies**

- • Bus Topology
- • Star Topology
- • Ring Topology
- • Mesh Topology
- • Tree Topology
- • Hybrid Topology

1. BUS TOPOLOGY



- All the nodes (file server, workstations, and peripherals) on a bus topology are connected by one single cable.
- A bus topology consists of a main run of cable with a terminator at each end. All nodes (file server, workstations, and peripherals) are connected to the linear cable.
- Popular on LANs because they are inexpensive and easy to install.

Advantages of Bus Topology

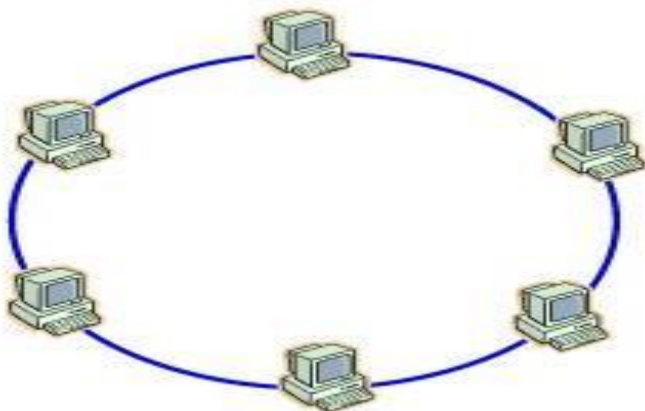
- It is Cheap, easy to handle and implement.
- Require less cable
- It is best suited for small networks.

Disadvantages of Bus Topology

- The cable length is limited. This limits the number of stations that can be connected.
- This network topology can perform well only for a limited number of

2. Ring Topology

- In a ring network, every device has exactly two neighbours for communication purposes.
- All messages travel through a ring in the same direction.
- A failure in any cable or device breaks the loop and can take down the entire network.
- To implement a ring network we use the Token Ring technology
- A token, or small data packet, is continuously passed around the network. When a device needs to transmit, it reserves the token for the next trip around, then attaches its data packet to it.



Advantage of Ring Topology

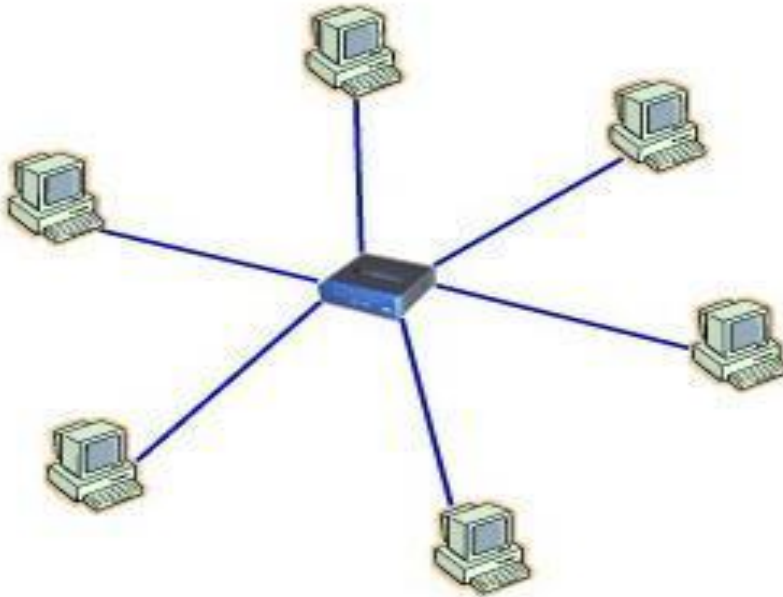
- Very orderly network where every device has access to the token and the opportunity to transmit.
- Easier to Manage than a Bus Network
- Good Communication over long distances
- Handles high volume of traffic

Disadvantages of Ring Topology

- The failure of a single node of the network can cause the entire network to fail.
- The movement or changes made to network nodes affects the performance of the entire network.

3. Star Topology

- In a star network, each node (file server, workstations, and peripherals) is connected to a central device called a hub.
- The hub takes a signal that comes from any node and passes it along to all the other nodes in the network.
- Data on a star network passes through the hub, switch, or concentrator before continuing to its destination.
- The hub, switch, or concentrator manages and controls all functions of the network.
- The star topology reduces the chance of network failure by connecting all of the systems to a central node.



Advantages of Star Topology

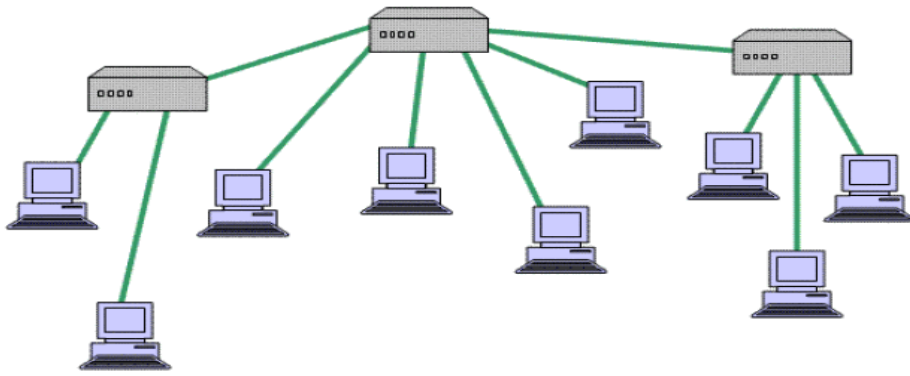
- Easy to manage
- Easy to locate problems (cable/workstations)
- Easier to expand than a bus or ring topology.
- Easy to install and wire.
- Easy to detect faults and to remove parts.

Disadvantages of Star Topology

- Requires more cable length than a linear topology.
- If the hub or concentrator fails, nodes attached are disabled.
- More expensive because of the cost of the concentrators.

4.Tree Topology

- A tree topology (hierarchical topology) can be viewed as a collection of star networks arranged in a hierarchy.
- This tree has individual peripheral nodes which are required to transmit to and receive from one other only and are not required to act as repeaters or regenerators.
- The tree topology arranges links and nodes into distinct hierarchies in order to allow greater control and easier troubleshooting.
- This is particularly helpful for colleges, universities and schools so that each of the connect to the big network in some way.



Advantages of a Tree Topology

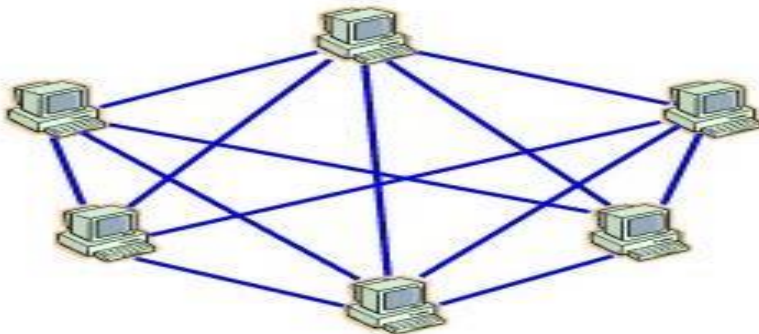
- Point-to-point wiring for individual segments.
- Supported by several hardware and software vendors.
- All the computers have access to the larger and their immediate networks.

Disadvantages of a Tree Topology

- Overall length of each segment is limited by the type of cabling used.
- If the backbone line breaks, the entire segment goes down.
- More difficult to configure and wire than other topologies.

5. Mesh Topology

- In this topology, each node is connected to every other node in the network.
- Implementing the mesh topology is expensive and difficult.
- In this type of network, each node may send message to destination through multiple paths.
- While the data is travelling on the Mesh Network it is automatically configured to reach the destination by taking the shortest route which means the least number of hops.



Advantage of Mesh Topology

- No traffic problem as there are dedicated links.
- It has multiple links, so if one route is blocked then other routes can be used for data communication.
- Points to point links make fault identification easy.

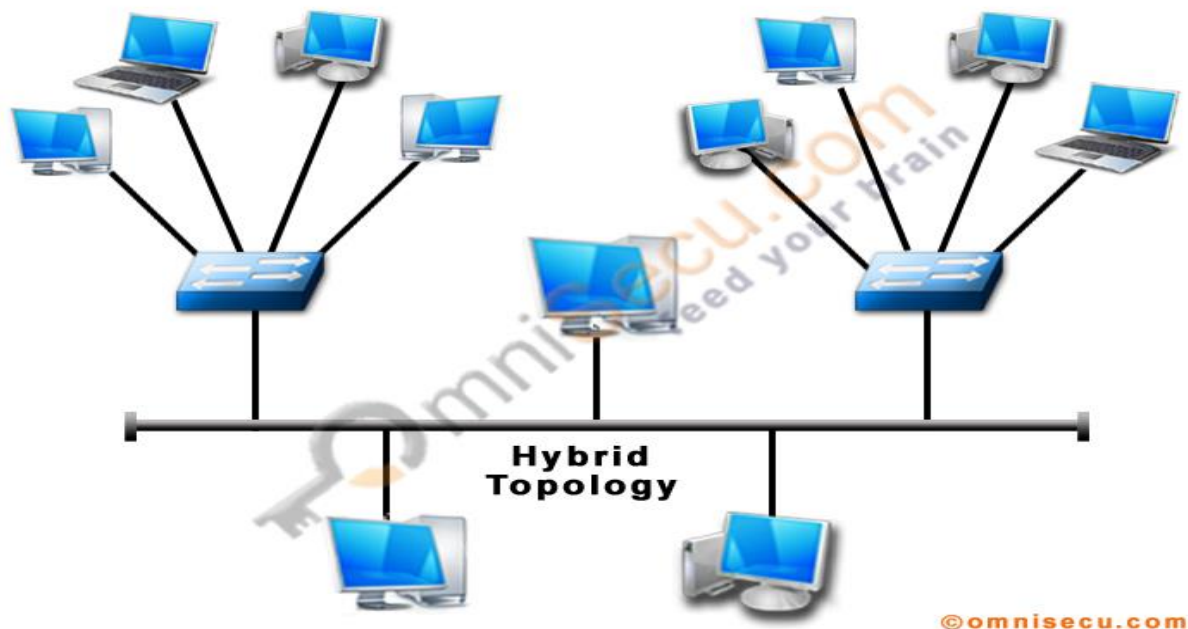
Disadvantage of Mesh Topology

- There is mesh of wiring which can be difficult to manage.
- Installation is complex as each node is connected to every node.
- Cabling cost is high.

6. Hybrid Topology

- A combination of any two or more network topologies.

- A hybrid topology always accrues when two different basic network topologies are connected.
- 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

- It is extremely flexible.
- It is very reliable.

Dis • Expensive

***Computer Protocols- TCP/IP-:**

Protocols:

If computers wish to communicate with one another, they have to know in advance exactly how information is to be exchanged and precisely what the format will be. Therefore, standard methods of transmitting and processing various kinds of information are used and these methods are called "protocols". Protocols are established by international agreement and ensure that computers everywhere can talk to one another. There are a variety of protocols for different kinds of information and functions

TCP/IP-:

TCP (Transmission Control Protocol) and IP (Internet Protocol) are two different procedures that are often linked together. The linking

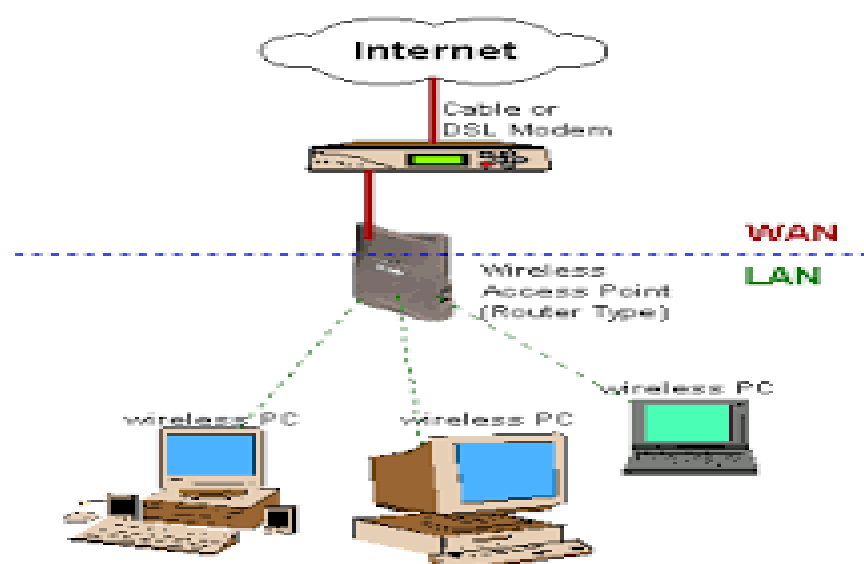
of several protocols is common since the functions of different protocols can be complementary so that together they carry out some complete task. The combination of several protocols to carry out a particular task is often called a "stack" because it has layers of operations. In fact, the term "TCP/IP" is normally used to refer to a whole suite of protocols, each with different functions. This suite of protocols is what carries out the basic operations of the Web. TCP/IP is also used on many local area networks.

Internet Protocol (IP) is the method used to route information to the proper address. Every computer on the Internet has to have its own unique address known as the [IP address](#). Every packet sent will contain an IP address showing where it is supposed to go.

***Connecting Devices - Hub, Repeater, Modem, Router**

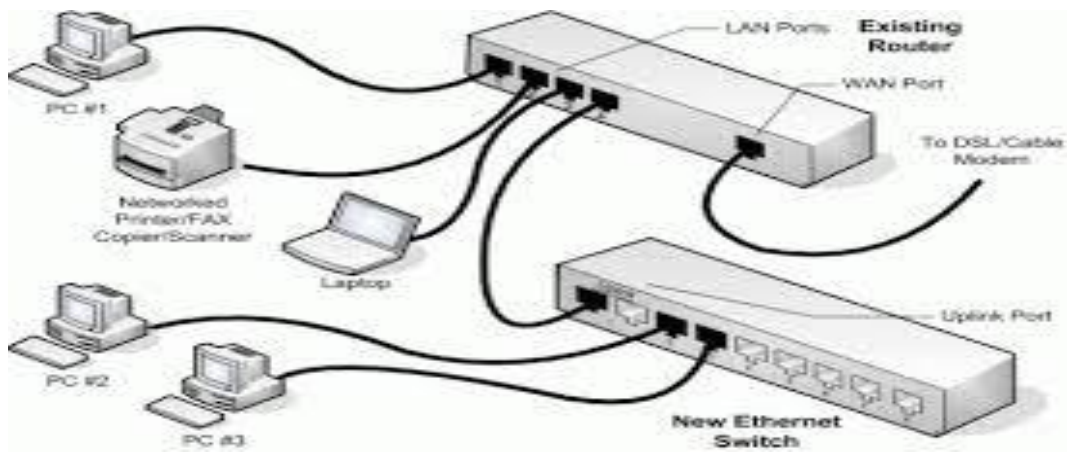
1. Modem

- A modem is a computer peripheral that allows you to connect and communicate with other computers via telephone lines.
- Modem means Modulation/ Demodulation.
- Modulation: A modem changes the digital data from your computer into analog data, a format that can be carried by telephone lines.
- Demodulation: The modem receiving the call then changes the analog signal back into digital data that the computer can digest.
- The shift of digital data into analog data and back again, allows two computers to speak with



2. Hub

A hub works in the physical layer of the OSI model. It is basically a non-intelligent device, and has no decision making capability. What a Hub basically does is take the input data from one of the ports and broadcast the information to all the other ports connected to the network.



To demonstrate its working, consider a 4 port network as shown in Fig 1. There are 4 computers connected to the 4 ports. Suppose, if Computer A wants to send some data to Computer B using a Hub, then, Computer A broadcasts the data on the network, and Computer B, being connected to the network, has access to the data. But, in this case all the other ports connected to the network has access to the data that is being transmitted by Computer A. This happens because, the Hub works in the Physical Layer and hence it does not know about the MAC addresses of the ports connected to the network. So, there is a lack of security in the Hub.

3.Repeater

A repeater is a device similar to the Hub, but has additional features. It also works in the Physical layer. The repeaters are used in places where amplification of input signal is necessary. But, the kind of amplification done by the repeater is different from the regular amplification by amplifiers. The regular amplifies everything fed into it. That means, if the input signal has noise induced into it, both the desired signal and noise signal are together amplified. But, in the case of a repeater, it regenerates the input signal, and amplifies only the desirable signal. Hence, the noise component of the signal is eliminated.

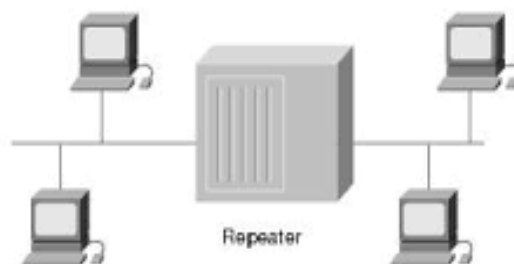


Fig 3: Repeater

The repeaters are necessary since, during the transmission of the signals over long distances, the signal has attenuation, delay distortions and noise, which lead in loss of data. Hence,

in order to prevent this, the regenerative repeaters are used. Hence, the repeater regenerates the faded signal. In addition, it has all the features of a Hub. One common problem between the repeaters and the Hubs are that only one transmission can take place on the network at a particular time. If multiple devices transmit data simultaneously, there will be data collision.

4.Routers

- Routers are networking devices that forward data packets between networks using headers and forwarding tables to determine the best path to forward the packets. Routers work at the network layer of the TCP/IP model or layer 3 of the OSI model. Routers also provide interconnectivity between like and unlike media (RFC 1812).
- A router is connected to at least two networks, commonly two LANs or WANs or a LAN and its ISP's network.

