10 Marks Question and Answers

1. Explain the types of transmission modes .

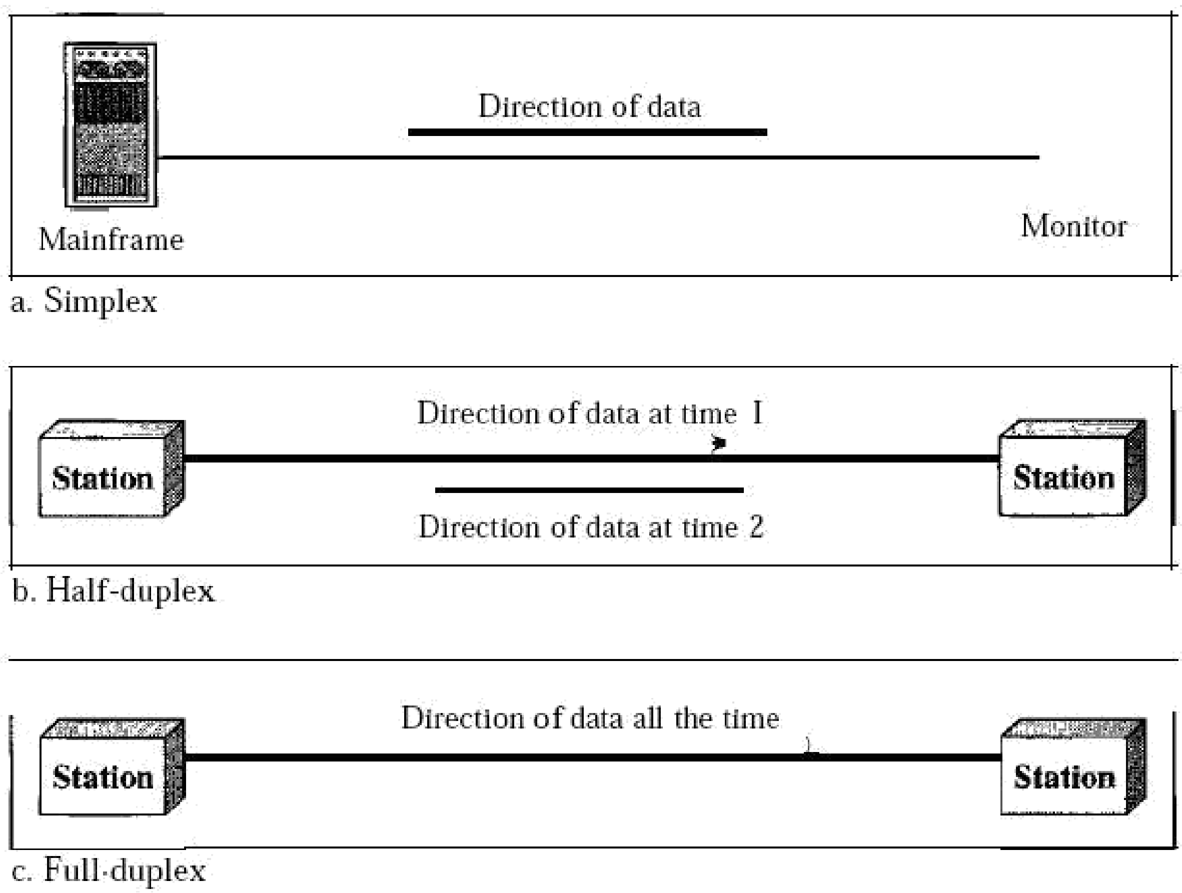
Communication between two devices can be simplex, half-duplex, or full-duplex.

Simplex

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.

Keyboards and traditional monitors are examples of simplex devices. The keyboard can only introduce input; the monitor can only accept output.

The simplex mode can use the entire capacity of the channel to send data in one direction.



Half-Duplex

In half-duplex mode, each station can both transmit and receive, but not at the same time. When one device is sending, the other can only receive, and vice versa.

The half-duplex mode is like a one-lane road with traffic allowed in both directions. When cars are traveling in one direction, cars going the other way must wait.
In a half-duplex transmission, the entire capacity of a channel is taken over by whichever of the two devices is transmitting at the time.

Full Duplex

In full-duplex mode, both stations can transmit and receive simultaneously.

The full-duplex mode is like a two way street with traffic flowing in both directions at the same time.

One common example of full-duplex communication is the telephone network. When two people are communicating by a telephone line, both can talk and listen at the same time.

2. What is network topology ? Explain the different network topologies.

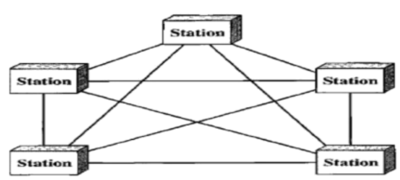
The term physical topology refers to the way in which a network is laid out physically: I/O or more devices connect to a link; two or more links form a topology.

There are four basic topologies possible: mesh, star, bus, and ring.

Mesh Topology

Mesh 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.

Node 1 must be connected to n - 1nodes, node 2 must be connected to n – 1 nodes, and finally node n must be connected to n - 1 nodes. We need n (n - 1) physical links.



Advantages

The use of dedicated links guarantees that each connection can carry its own data load, thus eliminating the traffic problems that can occur when links must be shared by multiple devices.

A mesh topology is robust. If one link becomes unusable, it does not incapacitate the entire system.

There is the advantage of privacy or security. When every message travels along a dedicated line, only the intended recipient sees it.

Point-to-point links make fault identification and fault isolation easy.

Disadvantages

Amount of cabling and the number of I/O ports required.

The sheer bulk of the wiring can be greater than the available space (in walls, ceilings, or floors) can accommodate.

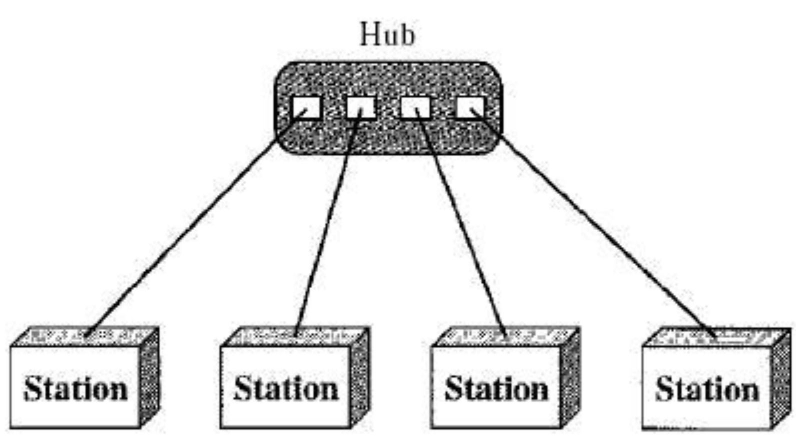
The hardware required to connect each link (I/O ports and cable) can be prohibitively expensive.

Star Topology

In a star topology, each device has a dedicated point-to-point link only to a central controller, usually called a hub.

The devices are not directly linked to one another. Unlike a mesh topology, a star topology does not allow direct traffic between devices.

The controller acts as an exchange: If one device wants to send data to another, it sends the data to the controller, which then relays the data to the other connected device.



Advantages

A star topology is less expensive than a mesh topology.

In a star, each device needs only one link and one I/O port to connect it to any number of others. This factor also makes it easy to install and reconfigure.

Far less cabling needs to be housed, and additions, moves, and deletions involve only one connection: between that device and the hub.

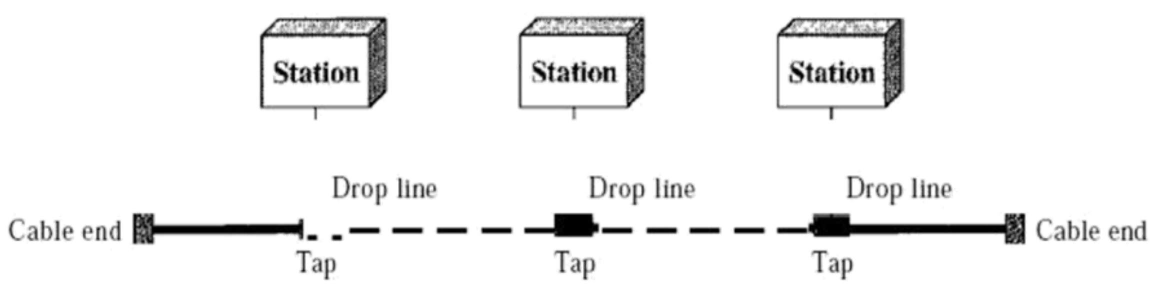
Other advantages include robustness. If one link fails, only that link is affected. All other links remain active.

Disadvantages

The dependency of the whole topology bon one single point, the hub. If the hub goes down, the whole system is dead.

Although a star requires far less cable than a mesh, each node must be linked to a central hub.

Bus Topology



Advantages

Bus topology includes ease of installation.

A bus uses less cabling than mesh or star topologies.

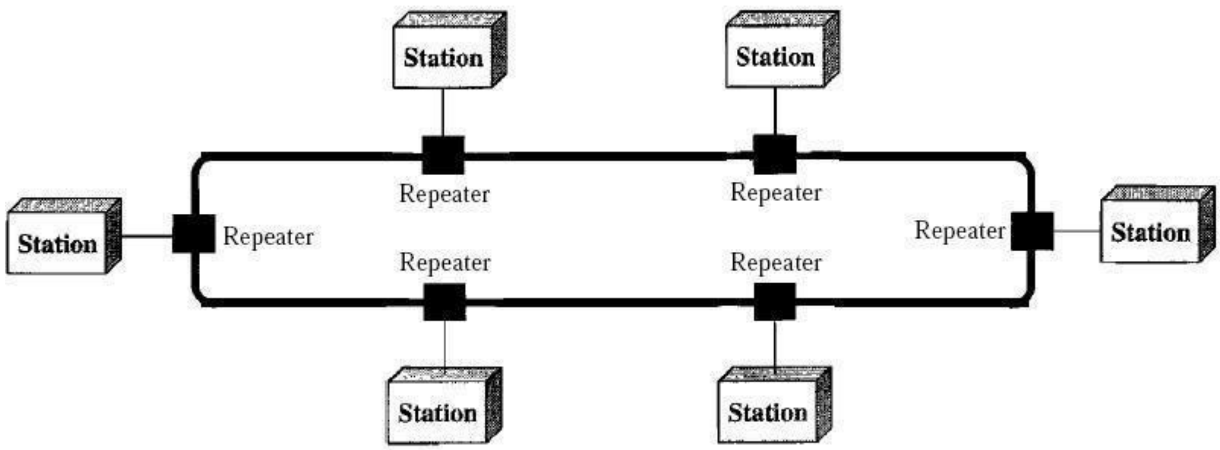
Disadvantages

Difficult reconnection and fault isolation.

A fault or break in the bus cable stops all transmission, even between devices on the same side of the problem.

Ring topology

Ring Topology In a ring topology, each device has a dedicated point-to-point connection with only the two devices on either side of it. A signal is passed along the ring in one direction, from device to device, until it reaches its destination.



Advantages

A ring is relatively easy to install and reconfigure. Fault isolation is simplified.

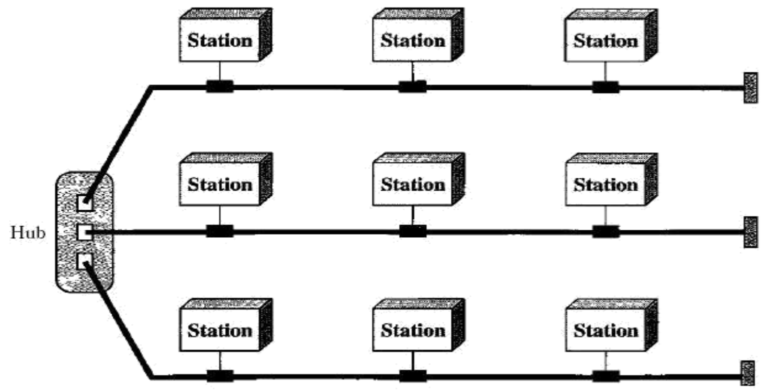
Disadvantages

Unidirectional traffic can be a disadvantage.

In a simple ring, a break in the ring (such as a disabled station) can disable the entire network.

Hybrid Topology

A network can be hybrid. For example, we can have a main star topology with each branch connecting several stations in a bus topology.



3. What are the different types of networks? Explain in detail.

Today when we speak of networks, we are generally referring to two primary categories: Local area networks (**LAN**) and wide-area networks (**WAN**).

The category into which a network falls is determined by its size.

A LAN normally covers an area less than 2 mi; a WAN can be worldwide. Networks of a size in between are normally referred to as metropolitan area networks and span tens of miles.

A **local area network** (LAN) is usually privately owned and links the devices in a single office, building, or campus. LANs are designed to allow resources to be shared between personal computers or workstations. The resources to be shared can include hardware (e.g., a printer), software (e.g., an application program), or data. A common example of a LAN, found in many business environments, links a workgroup of task-related computers, for example, engineering workstations or accounting PCs.

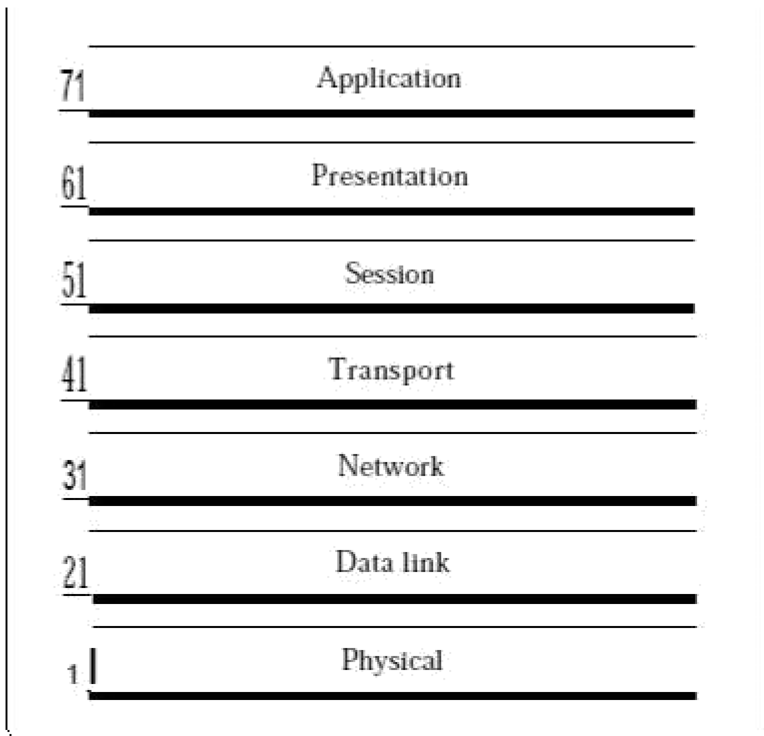
A **wide area network** (WAN) provides long-distance transmission of data, image, audio, and video information over large geographic areas that may comprise a country, a continent, or even the whole world.

A metropolitan area network (MAN) is a network with a size between a LAN and a WAN. It normally covers the area inside a town or a city. It is designed for customers who need a high-speed connectivity, normally to the Internet, and have endpoints spread over a city or part of city. A good example of a MAN is the part of the telephone company network that can provide a high-speed DSL line to the customer.

4. Explain the OSI reference model with neat diagram.(important question)

An open system is a set of protocols that allows any two different systems to communicate regardless of their underlying architecture.

The purpose of the OSI model is to show how to facilitate communication between different systems without requiring changes to the logic of the underlying hardware and software. The OSI model is not a protocol; it is a model for understanding and designing a network architecture that is flexible, robust, and interoperable.



Physical Layer

The physical layer coordinates the functions required to carry a bit stream over a physical medium. It deals with the mechanical and electrical specifications of the interface and transmission medium.

The physical layer is also concerned with the following:

> **Physical characteristics of interfaces and medium:** The physical layer defines the characteristics of the interface between the devices and the transmission medium. It also defines the type of transmission medium.

Representation of bits: The physical layer data consists of a stream of bits (sequence of Os or 1s) with no interpretation. To be transmitted, bits must be encoded into signals--electrical or optical. The physical layer defines the type of encoding (how Os and I s are changed to signals).

Data rate: The transmission rate-the number of bits sent each second-is also defined by the physical layer. In other words, the physical layer defines the duration of a bit, which is how long it lasts.

Synchronization of bits: The sender and receiver not only must use the same bit rate but also must be synchronized at the bit level. In other words, the sender and the receiver clocks must be synchronized.

Line configuration: The physical layer is concerned with the connection of devices to the media. In a point-to-point configuration, two devices are connected through a dedicated link. In a multipoint configuration, a link is shared among several devices.

Physical topology: The physical topology defines how devices are connected to make a network. Devices can be connected by using a mesh topology (every device is connected to every other device), a star topology (devices are connected through a central device), a ring topology (each device is connected to the next, forming a ring), a bus topology (every device is on a common link), or a hybrid topology (this is a combination of two or more topologies).

Transmission mode: The physical layer also defines the direction of transmission between two devices: simplex, half-duplex, or full-duplex. In simplex mode, only one device can send; the other can only receive. The simplex mode is a one-way communication. In the half-duplex mode, two devices can send and receive, but not at the same time. In a full-duplex (or simply duplex) mode, two devices can send and receive at the same time.

Data Link Layer

The data link layer transforms the physical layer, a raw transmission facility, to a reliable link. It makes the physical layer appear error-free to the upper layer (network layer).

Other responsibilities of the data link layer include the following:

Framing: The data link layer divides the stream of bits received from the network layer into manageable data units called frames.

Physical addressing: If frames are to be distributed to different systems on the network, the data link layer adds a header to the frame to define the sender and/or receiver of the frame. If the frame is intended for a system outside the sender's network, the receiver address is the address of the device that connects the network to the next one.

Flow control: If the rate at which the data are absorbed by the receiver is less than the rate at which data are produced in the sender, the data link layer imposes a flow control mechanism to avoid overwhelming the receiver.

Error control: The data link layer adds reliability to the physical layer by adding mechanisms to detect and retransmit damaged or lost frames. It also uses a mechanism to recognize duplicate frames. Error control is normally achieved through a trailer added to the end of the frame.

Access control: When two or more devices are connected to the same link, data link layer protocols are necessary to determine which device has control over the link at any given time.

Network Layer

The network layer is responsible for the source-to-destination delivery of a packet, possibly across multiple networks (links). Whereas the data link layer oversees the delivery of the packet between two systems on the same network (links), the network layer ensures that each packet gets from its point of origin to its final destination.

Other responsibilities of the network layer include the following:

Logical addressing. The physical addressing implemented by the data link layer handles the addressing problem locally. If a packet passes the network boundary, we need another addressing system to help distinguish the source and destination systems. The network layer adds a header to the packet coming from the upper layer that, among other things, includes the logical addresses of the sender and receiver. We discuss logical addresses later in this chapter.

Routing. When independent networks or links are connected to create internetworks (network of networks) or a large network, the connecting devices (called routers or switches) route or switch the packets to their final destination. One of the functions of the network layer is to provide this mechanism.

Transport Layer

The transport layer is responsible for process-to-process delivery of the entire message. A process is an application program running on a host. Whereas the network layer oversees source-to-destination delivery of individual packets, it does not recognize any relationship between those packets.

Other responsibilities of the transport layer include the following:

Service-point addressing: Computers often run several programs at the same time. For this reason, source-to-destination delivery means delivery not only from one computer to the next but also from a specific process (running program) on one computer to a specific process (running program) on the other. The transport layer header must therefore include a type of address called a service-point address (or port address). The network layer gets each packet to the correct computer; the transport layer gets the entire message to the correct process on that computer.

Segmentation and reassembly: A message is divided into transmittable segments, with each segment containing a sequence number. These numbers enable the transport layer to reassemble the message correctly upon arriving at the destination and to identify and replace packets that were lost in transmission.

Connection control: The transport layer can be either connectionless or connection oriented.

A connectionless transport layer treats each segment as an independent packet and delivers it to the transport layer at the destination machine. A connection oriented transport layer makes a connection with the transport layer at the destination machine first before delivering the packets. After all the data are transferred, the connection is terminated.

Flow control: Like the data link layer, the transport layer is responsible for flow control. However, flow control at this layer is performed end to end rather than across a single link.

Error control: Like the data link layer, the transport layer is responsible for error control. However, error control at this layer is performed process-to process rather than across a single link. The sending transport layer makes sure that the entire message arrives at the receiving transport layer without error (damage, loss, or duplication). Error correction is usually achieved through retransmission.

Session Layer

The services provided by the first three layers (physical, data link, and network) are not sufficient for some processes. The session layer is the network dialog controller. It establishes, maintains, and synchronizes the interaction among communicating systems. The session layer is responsible for dialog control and synchronization.

Specific responsibilities of the session layer include the following:

Dialog control: The session layer allows two systems to enter into a dialog. It allows the communication between two processes to take place in either half duplex (one way at a time) or full-duplex (two ways at a time) mode.

Synchronization: The session layer allows a process to add checkpoints, or synchronization points, to a stream of data. For example, if a system is sending a file of 2000 pages, it is advisable to insert checkpoints after every 100 pages to ensure that each 100-page unit is received and acknowledged independently. In this case, if a crash happens during the transmission of page 523, the only pages that need to be resent after system recovery are pages 501 to 523. Pages previous to 501 need not be resent.

Presentation Layer

The presentation layer is concerned with the syntax and semantics of the information exchanged between two systems.

Specific responsibilities of the presentation layer include the following:

Translation: The processes (running programs) in two systems are usually exchanging information in the form of character strings, numbers, and so on. The information must be changed to bit streams before being transmitted. Because different computers use different encoding systems, the presentation layer is responsible for interoperability between these different encoding methods. The presentation layer at the sender changes the information from its sender-dependent format into a common format. The presentation layer at the receiving machine changes the common format into its receiver-dependent format.

Encryption: To carry sensitive information, a system must be able to ensure privacy. Encryption means that the sender transforms the original information another form and sends the resulting message out over the network. Decryption reverses the original process to transform the message back to its original form.

Compression: Data compression reduces the number of bits contained in the information. Data compression becomes particularly important in the transmission of multimedia such as text, audio, and video.

Application Layer

The application layer enables the user, whether human or software, to access the network. It provides user interfaces and support for services such as electronic mail, remote file access and transfer, shared database management, and other types of distributed information services.

Bit Rate

Most digital signals are non periodic, and thus period and frequency are not appropriate characteristics. Another term-bit rate is used to describe digital signals.

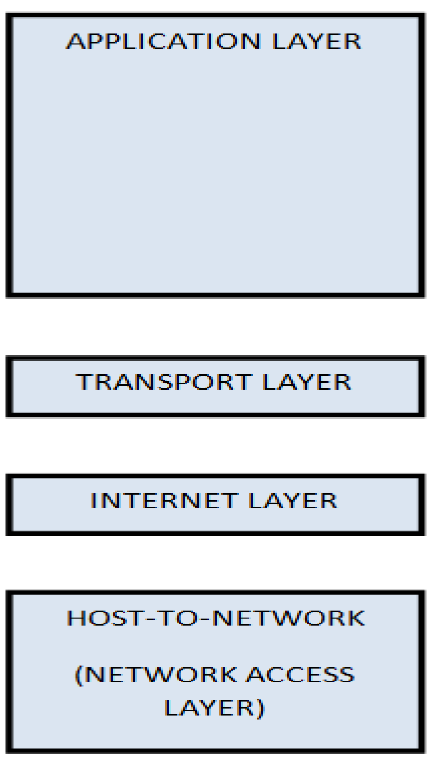
The bit rate is the number of bits sent in 1s, expressed in bits per second (**bps**).

5.Explain the tcp/ip reference model with neat diagram (important question)

TCP/IP means Transmission Control Protocol and Internet Protocol. It is the network model used in the current Internet architecture as well. Protocols are set of rules which govern every possible communication over a network. These protocols describe the movement of data between the source and destination or the internet.These protocols offer simple naming and addressing schemes.

TCP/IP that is Transmission Control Protocol and Internet Protocol was developed by Department of Defence Project Research Agency (ARPA, later DARPA) as a part of a research project of network interconnection to connect remote machines.The features that stood out during the research, which led to making the TCP/IP reference model were:

- Support for a flexible architecture. Adding more machines to a network was easy.
- The overall idea was to allow one application on one computer to talk to(send data packets) another application running on different computer.



Host-to-network layer

- Lowest layer of the all.
- Protocol is used to connect to the host, so that the packets can be sent over it.
- Varies from host to host and network to network.
  It is equivalent to the combination of physical and datalink layer.

Internet layer

- Selection of a packet switching network which is based on a connectionless internetwork layer is called a internet layer.
- It is the layer which holds the whole architecture together.
- It helps the packet to travel independently to the destination.
- Order in which packets are received is different from the way they are sent.
- IP (Internet Protocol) is used in this layer.

Transport layer

- It decides if data transmission should be on parallel path or single path.
- Functions such as multiplexing, segmenting or splitting on the data is done by transport layer.
- The applications can read and write to the transport layer.
- Transport layer adds header information to the data.
- Transport layer breaks the message (data) into small units so that they are handled more efficiently by the network layer.
  Transport layer also arrange the packets to be sent, in sequence.

Application layer
- TELNET is a two-way communication protocol which allows connecting to a remote machine and run applications on it.

- FTP(File Transfer Protocol) is a protocol, that allows File transfer amongst computer users connected over a network. It is reliable, simple and efficient.
- SMTP(Simple Mail Transport Protocol) is a protocol, which is used to transport electronic mail between a source and destination, directed via a route.
- DNS(Domain Name Server) The Domain Name System (**DNS**) is a hierarchical decentralized naming system for computers, services, or other resources connected to the Internet or a private **network**

6. What is Nyquist signaling rate for noiseless channel ?

For a noiseless channel, the Nyquist bit rate formula defines the theoretical maximum bit rate

BitRate = 2 x bandwidth x $l0g_2$ L

In this formula, bandwidth is the bandwidth of the channel, L is the number of signal levels used to represent data, and Bit Rate is the bit rate in bits per second.

Example:

Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with two signal levels. The maximum bit rate can be calculated as

BitRate =2 x 3000 x $\log_2 2$ =6000 bps

7. What is Shannon capacity for Noisy Channel ?

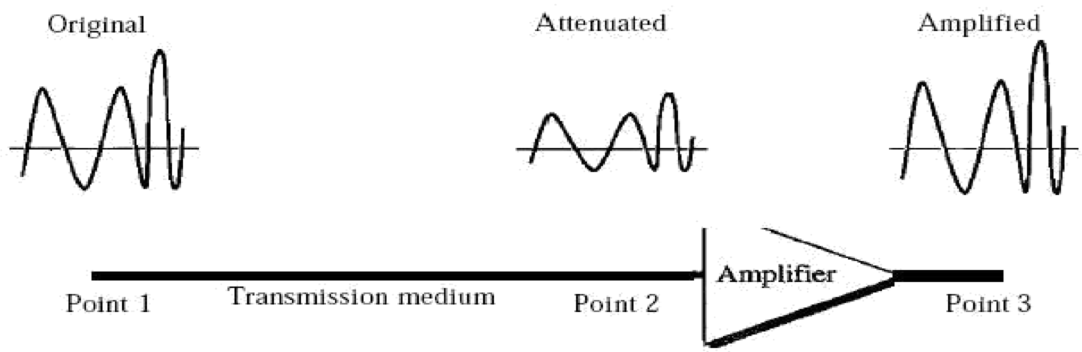
In reality, we cannot have a noiseless channel; the channel is always noisy. In 1944, Claude Shannon introduced a formula, called the Shannon capacity, to determine the theoretical highest data rate for a noisy channel:

Capacity =bandwidth X $\log_2$ (1 +SNR)

In this formula, bandwidth is the bandwidth of the channel, SNR is the signal-to-noise ratio, and capacity is the capacity of the channel in bits per second. Note that in the Shannon formula there is no indication of the signal level, which means that no matter how many levels we have, we cannot achieve a data rate higher than the capacity of the channel. In other words, the formula defines a characteristic of the channel, not the method of transmission.

8. What is Attenuation ?

Attenuation means a loss of energy. When a signal, simple or composite, travels through a medium, it loses some of its energy in overcoming the resistance of the medium. That is why a wire carrying electric signals gets warm, if not hot, after a while. Some of the electrical energy in the signal is converted to heat. To compensate for this loss, amplifiers are used to amplify the signal.



Decibel

To show that a signal has lost or gained strength, engineers use the unit of the decibel.

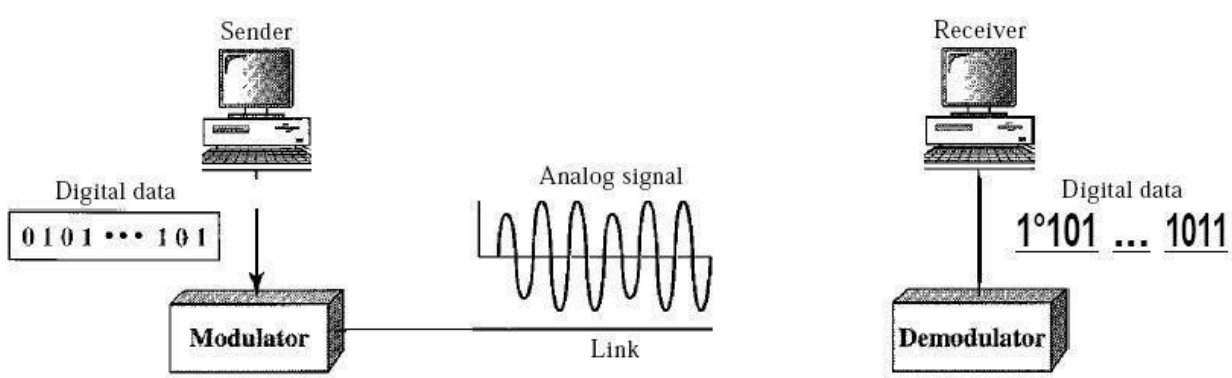
The decibel (dB) measures the relative strengths of two signals or one signal at two different points.

Note that the decibel is negative if a signal is attenuated and positive if a signal is amplified. Variables PI and P2 are the powers of a signal at points 1 and 2, respectively.

$$dB = 10 \log_{10} \frac{P_2}{P_1}$$

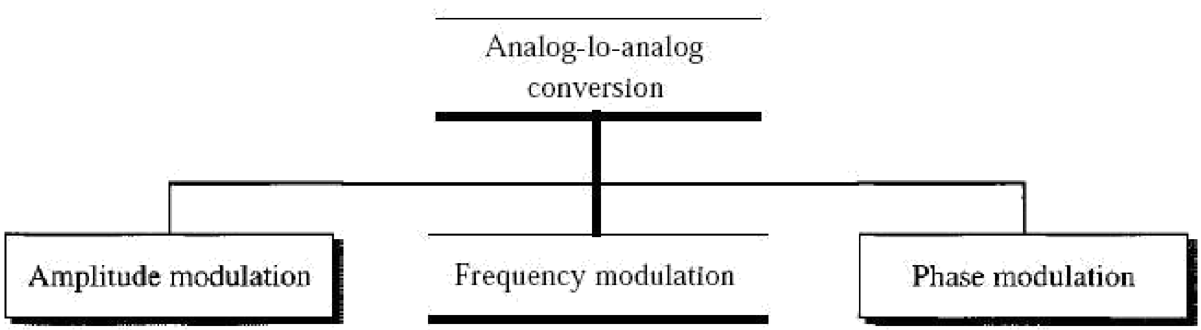
9. Explain AM , FM and PM

Digital-to-analog conversion is the process of changing one of the characteristics of an analog signal based on the information in digital data.



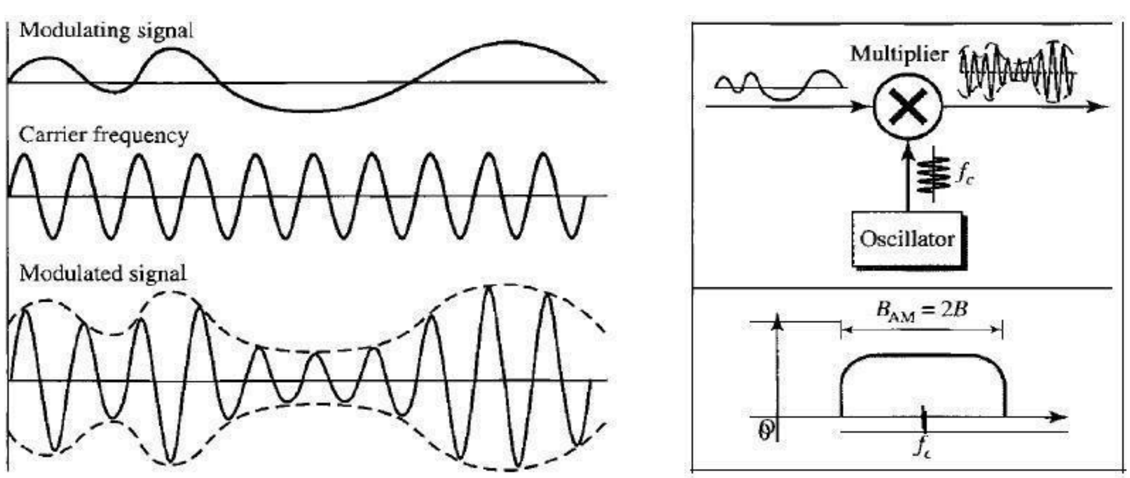
Analog-to-analog conversion, or analog modulation, is the representation of analog information by an analog signal. One may ask why we need to modulate an analog signal; it is already analog. Modulation is needed if the medium is band pass in nature or if only a band pass channel is available to us. An example is radio. The government assigns a narrow bandwidth to each radio station. The analog signal produced by each station is a low-pass signal, all in the same range. To be able to listen to different stations, the low-pass signals need to be shifted, each to a different range.

Analog-to-analog conversion can be accomplished in three ways: amplitude modulation (AM), frequency modulation (FM), and phase modulation (PM).



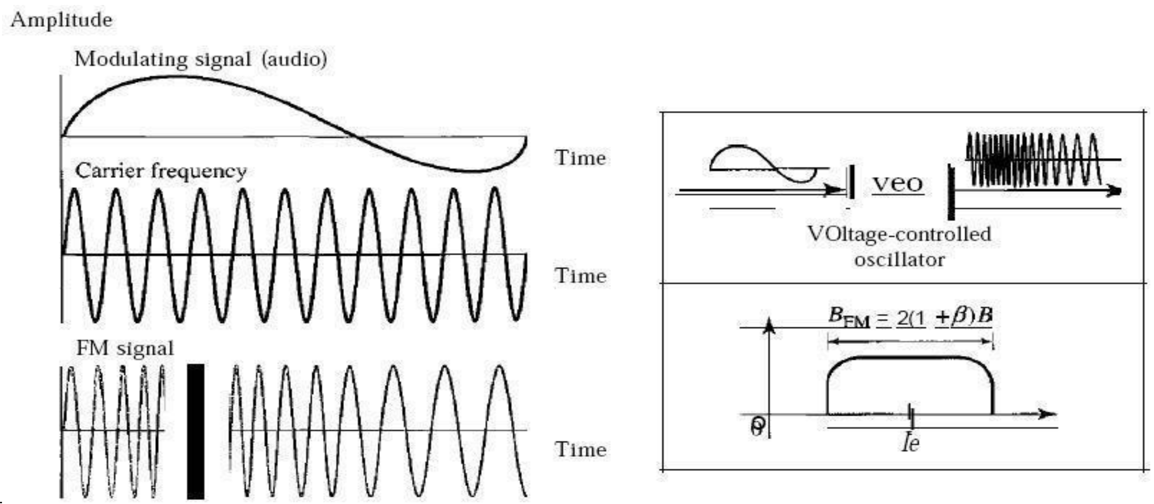
Amplitude Modulation

In AM transmission, the carrier signal is modulated so that its amplitude varies with the changing amplitudes of the modulating signal. The frequency and phase of the carrier remain the same; only the amplitude changes to follow variations in the information. Below Figure shows how this concept works. The modulating signal is the envelope of the carrier.



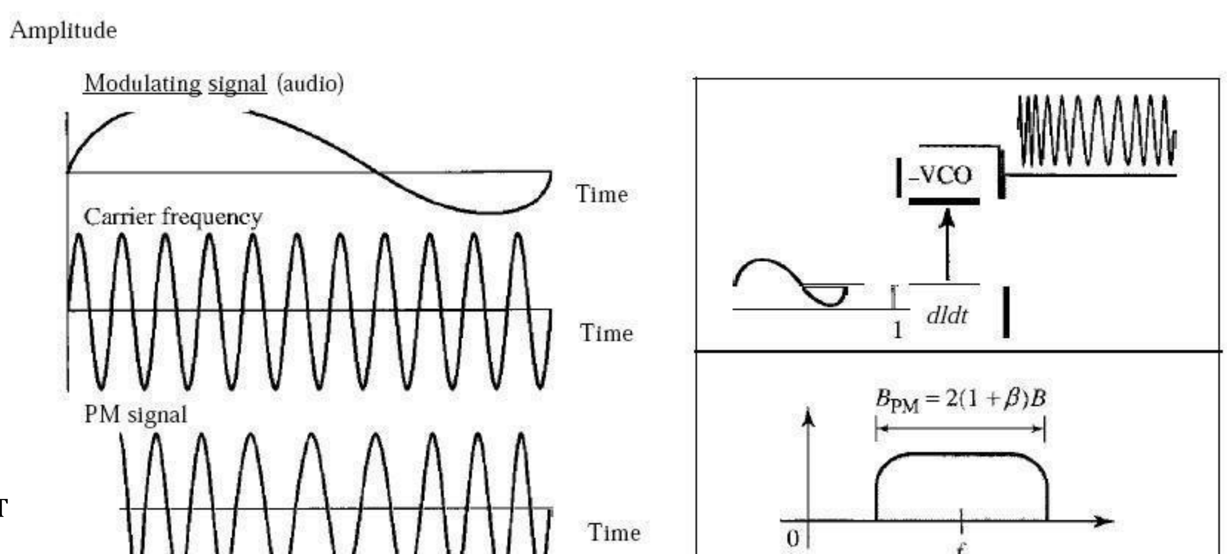
Frequency Modulation

In FM transmission, the frequency of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal. The peak amplitude and phase of the carrier signal remain constant, but as the amplitude of the information signal changes, the frequency of the carrier changes correspondingly.



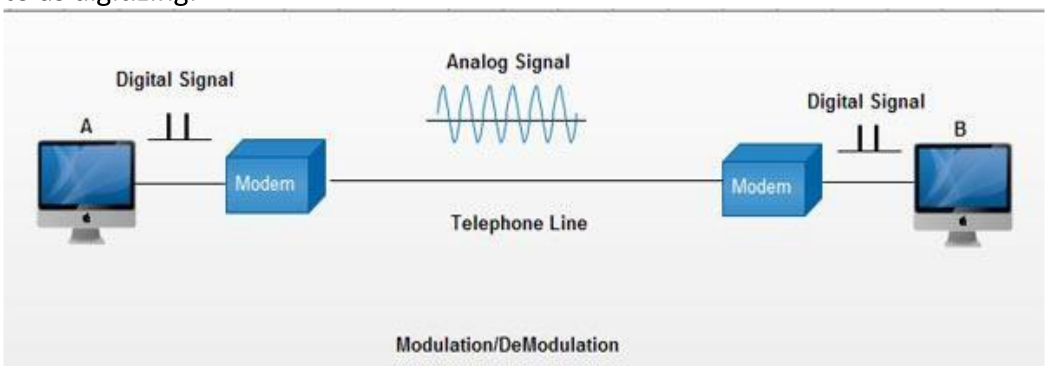
Phase Modulation

In PM transmission, the phase of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal. The peak amplitude and frequency of the carrier signal remain constant, but as the amplitude of the information signal changes, the phase of the carrier changes correspondingly. In FM, the instantaneous change in the carrier frequency is proportional to the amplitude of the modulating signal; in PM the instantaneous change in the carrier frequency is proportional to the derivative of the amplitude of the modulating signal.



10. Explain the concept of MODEM.

- Modem is abbreviation for Modulator – Demodulator. Modems are used for data transfer from one computer network to another computer network through telephone lines.
- The computer network works in digital mode, while analog technology is used for carrying massages across phone lines.
- Modulator converts information from digital mode to analog mode at the transmitting end and demodulator converts the same from analog to digital at receiving end.
- The process of converting analog signals of one computer network into digital signals of another computer network so they can be processed by a receiving computer is referred to as digitizing.



Modems can be of several types and they can be categorized in a number of ways.
Categorization is usually based on the following basic modem features:

- 1. Directional capacity: half duplex modem and full duplex modem.
- 2. Connection to the line: 2-wire modem and 4-wire modem.
- 3. Transmission mode: asynchronous modem and synchronous modem.

Categories of modem

- External modem
- Internal modem

  Any external modem is attached to any computer has an RS-232 port.
  An internal modem comes as an expansion board that can be inserted into a vacant expansion slot.

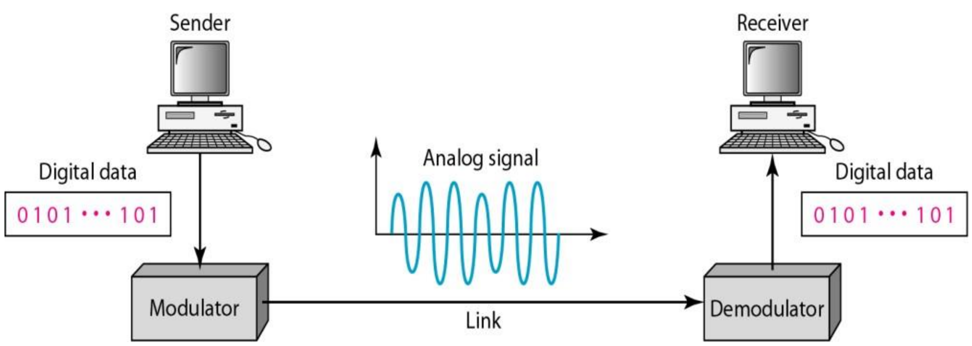
Types of modem

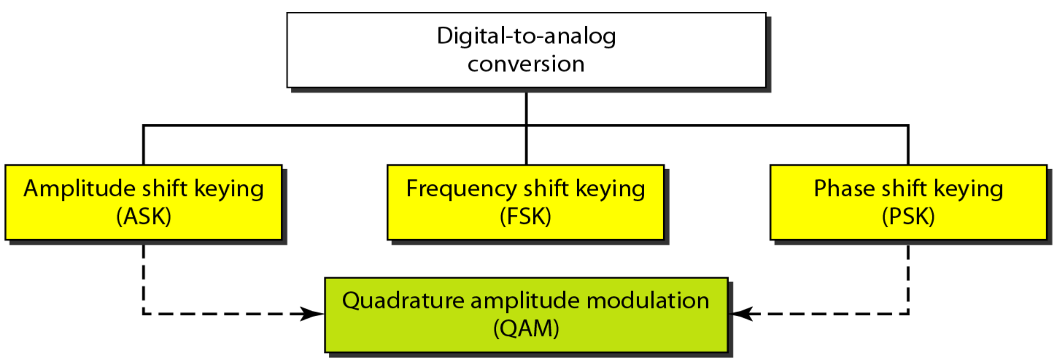
- Standard fax modem
- Digital cable modem
- ISDN modem
- Digital subscribes line modem
- Satellite modem

11. Explain ASK, FSK , and PSK with neat diagram

Digital to Analog conversion

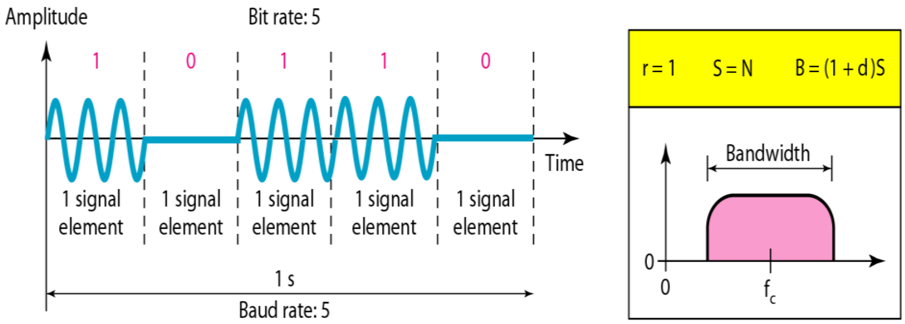
- Digital data needs to be carried on an analog signal.
- A carrier signal (frequency f_c) performs the function of transporting the digital data in an analog waveform.





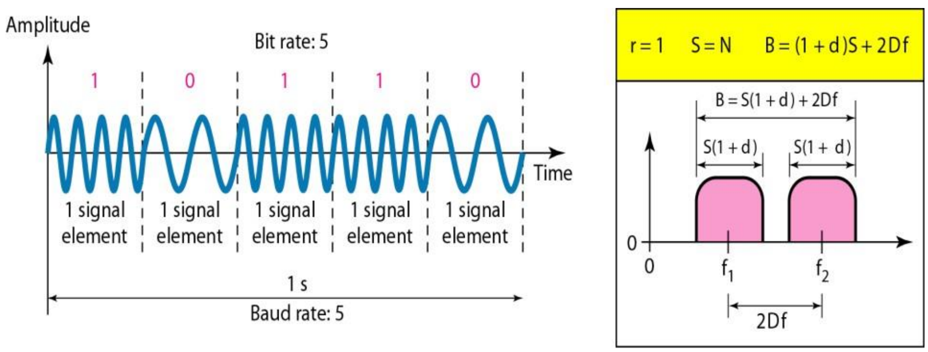
Amplitude Shift Keying (ASK)

- ASK is implemented by changing the amplitude of a carrier signal to reflect amplitude levels in the digital signal.
- For example: a digital “1” could not affect the signal, whereas a digital “0” would, by making it zero.



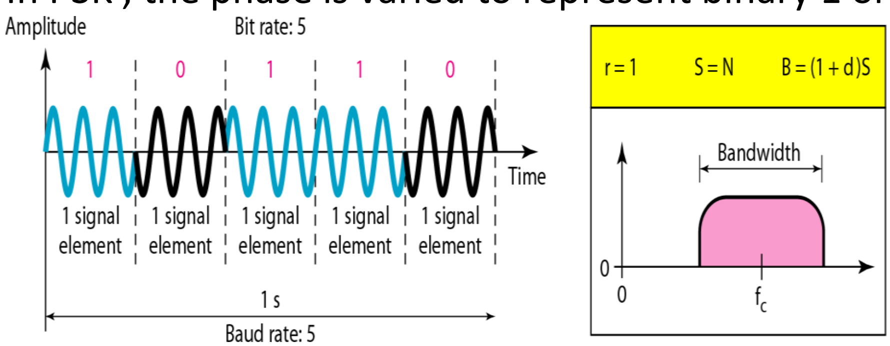
Frequency Shift Keying

The two binary values are represented by two different frequencies



Phase Shift Keying

- The phase of carrier signal is shifted to represent the data.
- In PSK , the phase is varied to represent binary 1 or 0.



12. Explain the various types of multiplexing

Whenever the bandwidth of a medium linking two devices is greater than the bandwidth needs of the devices, the link can be shared.

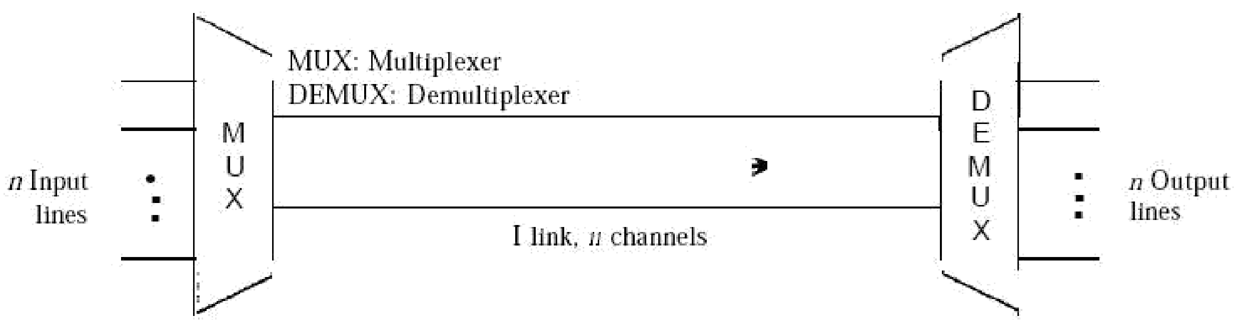
Multiplexing is the set of techniques that allows the simultaneous transmission of multiple signals across a single data link.

As data and telecommunications use increases, so does traffic. We can accommodate this increase by continuing to add individual links each time a new channel is needed; or we can install higher-bandwidth links and use each to carry multiple signals.

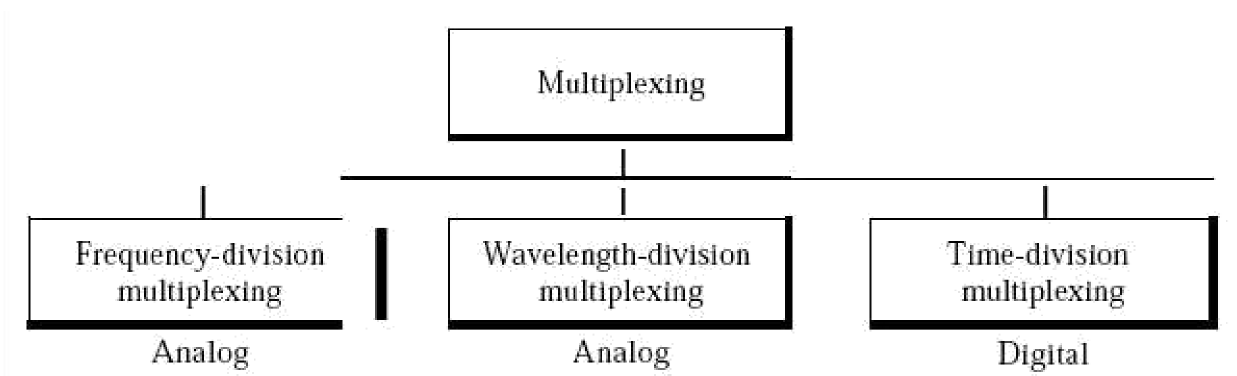
In a multiplexed system, n lines share the bandwidth of one link.

The lines on the left direct their transmission streams to a multiplexer (MUX), which combines them into a single stream (many-to-one).

The word channel refers to the portion of a link that carries a transmission between a given pair of lines. One link can have many (n) channels.



There are three basic multiplexing techniques: frequency-division multiplexing, wavelength-division multiplexing, and time-division multiplexing. The first two are techniques designed for analog signals, the third, for digital signals.



Frequency-Division Multiplexing (FDM)

Frequency-division multiplexing (FDM) is an analog technique that can be applied when the bandwidth of a link (in hertz) is greater than the combined bandwidths of the signals to be transmitted.

In FDM, signals generated by each sending device modulate different carrier frequencies. These modulated signals are then combined into a single composite signal that can be transported by the link.

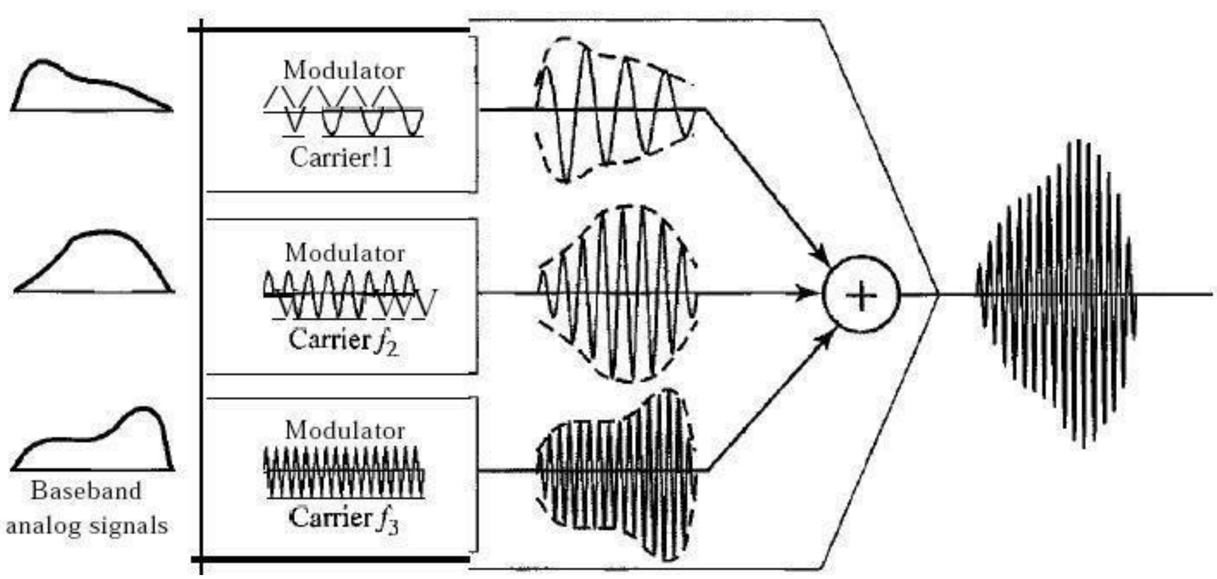
Carrier frequencies are separated by sufficient bandwidth to accommodate the modulated signal.

These bandwidth ranges are the channels through which the various signals travel. Channels can be separated by strips of unused bandwidth-guard bands-to prevent signals from overlapping.

In addition, carrier frequencies must not interfere with the original data frequencies.

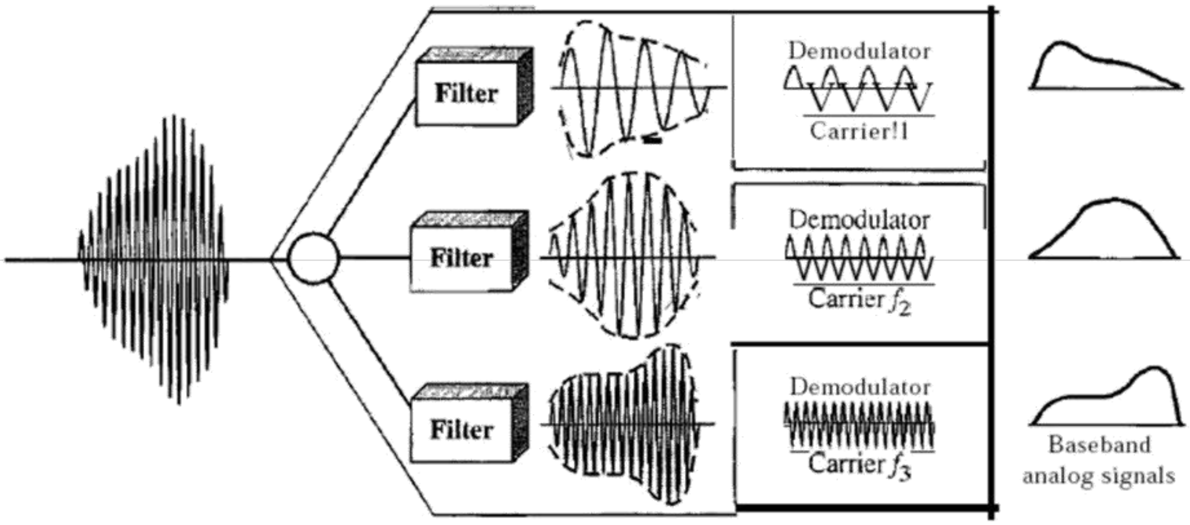
Multiplexing Process

Each source generates a signal of a similar frequency range. Inside the multiplexer, these similar signals modulate different carrier frequencies f1, f2, and f3). The resulting modulated signals are then combined into a single composite signal that is sent out over a media link that has enough bandwidth to accommodate it.



Demultiplexing Process

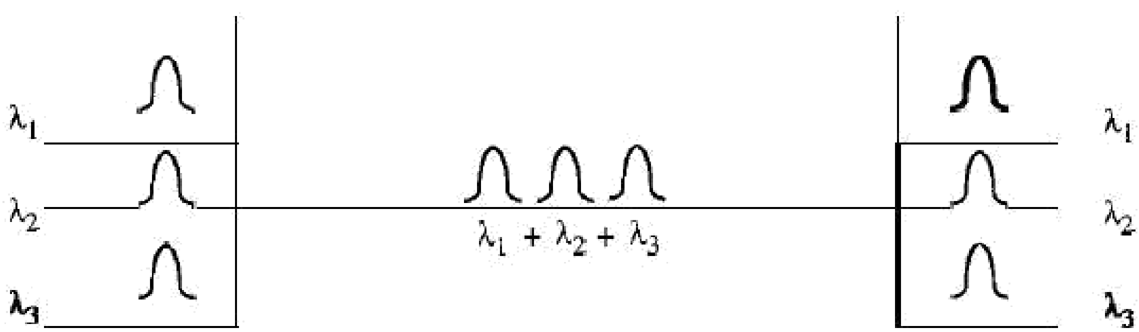
The de-multiplexer uses a series of filters to decompose the multiplexed signal into its constituent component signals. The individual signals are then passed to a demodulator that separates them from their carriers and passes them to the output lines.



Wavelength-Division Multiplexing (WDM)

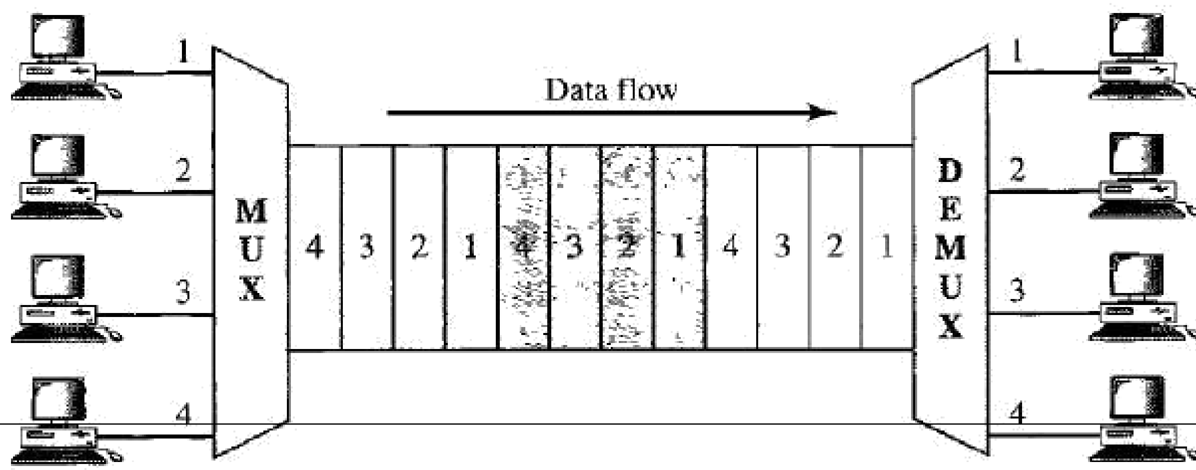
Wavelength-division multiplexing (WDM) is designed to use the high-data-rate capability of fiber-optic cable. The optical fiber data rate is higher than the data rate of metallic transmission cable. Using a fiber-optic cable for one single line wastes the available bandwidth. Multiplexing allows us to combine several lines into one.

WDM is conceptually the same as FDM, except that the multiplexing and de-multiplexing involve optical signals transmitted through fiber-optic channels. The idea is the same: We are combining different signals of different frequencies. The difference is that the frequencies are very high.



Time-Division Multiplexing (TDM)

Time-division multiplexing (TDM) is a digital process that allows several connections to share the high bandwidth of a link Instead of sharing a portion of the bandwidth as in FDM, time is shared. Each connection occupies a portion of time in the link.



13. Explain the concept of SONET multiplexing .

The first generation of equipment for optical fiber transmission was proprietary and no standards were available for the interconnection of equipment from different vendors.
To meet the urgent need for standards to interconnect optical transmission system, the Synchronous Optical Network (SONET) standards were developed in North America.
The CCIT later developed a corresponding set of standards called Synchronous Digital Hierarchy(SDH) which was used in Europe and many other countries.
SONET/SDH is a Synchronous network. A single clock is used to handle the timing of transmissions and equipment across the entire network.
SONET, a multiplexed transport mechanism as can be used as the carrier for broadband services, particularly ATM and B-ISDN.

Synchronous Transport Signal
SONET defines a hierarchy of signaling levels called synchronous transport signal (STS's).
Each STS level (STS-1 to STS-192) supports a certain data rate, specified in megabits per second.
The physical links defined to carry each level of STS are called optical carriers (OCs).

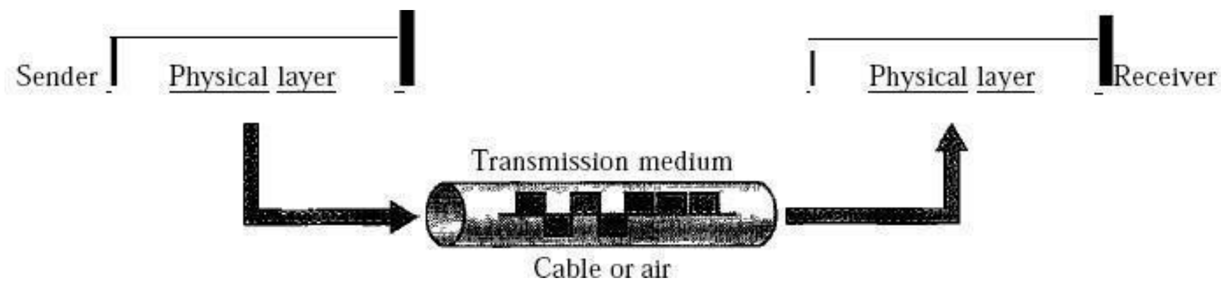
Sonet Mulitplexing
Lower rate STSs can be multiplexed to make them compatible with higher rate systems.

For example, three STS-1s can be combined into one STS-3s can be multiplexed into one STS-12, and so on. The general format STS-n is made up of lower rate STSs. However, that in actual practice lower rate STSs is interleaved.

14. Explain the Shielded twisted pair (STP) and Unshielded twisted pair(UTP)

A transmission **medium** can be broadly defined as anything that can carry information from a source to a destination.

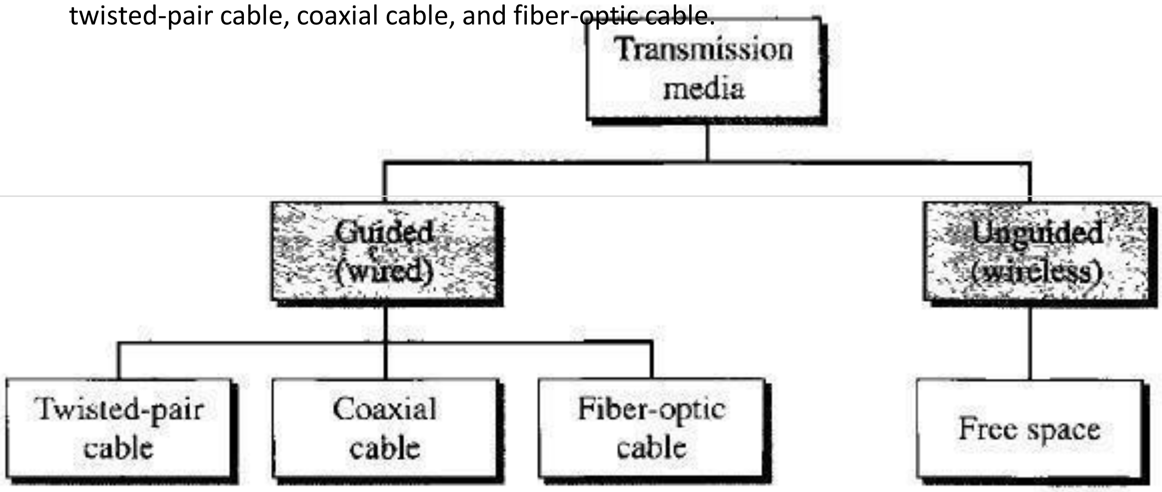
For example, the transmission medium for two people having a dinner conversation is the air. The air can also be used to convey the message in a smoke signal or semaphore. For a written message, the transmission medium might be a mail carrier, a truck, or an airplane.



In telecommunications, transmission media can be divided into two broad categories: **guided and unguided**. Guided media include **twisted-pair cable**, **coaxial cable**, and **fiber-optic cable**. Unguided medium is free space. Below Figure shows this taxonomy.

Guided Media

Guided media, which are those that provide a conduit from one device to another, include twisted-pair cable, coaxial cable, and fiber-optic cable.

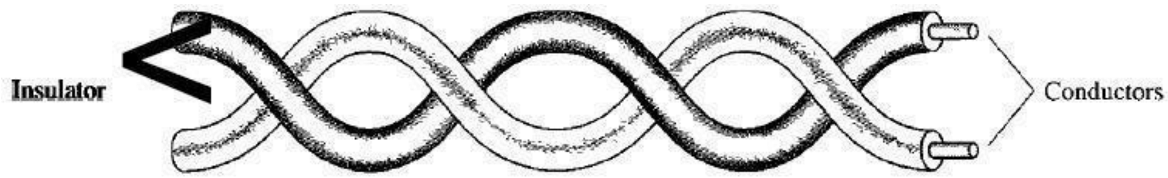


A signal traveling along any of these media is directed and contained by the physical limits of the medium. Twisted-pair and coaxial cable use metallic (copper) conductors that accept and transport signals in the form of electric current.

Optical fiber is a cable that accepts and transports signals in the form of light.

Twisted-Pair Cable

A twisted pair consists of two conductors (normally copper), each with its own plastic insulation, twisted together, as shown in below figure.



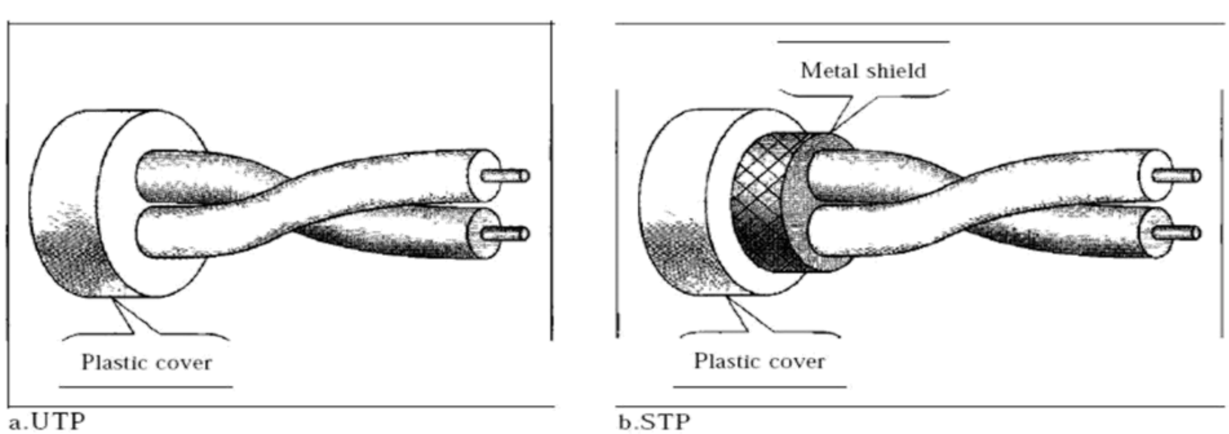
One of the wires is used to carry signals to the receiver, and the other is used only as a ground reference. The receiver uses the difference between the two.

In addition to the signal sent by the sender on one of the wires, interference (noise) and crosstalk may affect both wires and create unwanted signals.

Unshielded Versus Shielded Twisted-Pair Cable

The most common twisted-pair cable used in communications is referred to as unshielded twisted-pair (UTP).

IBM has also produced a version of twisted-pair cable for its use called shielded twisted-pair (STP).



STP cable has a metal foil or braided mesh covering that encases each pair of insulated conductors. Although metal casing improves the quality of cable by preventing the penetration of **noise** or crosstalk, it is **bulkier** and **more expensive**.

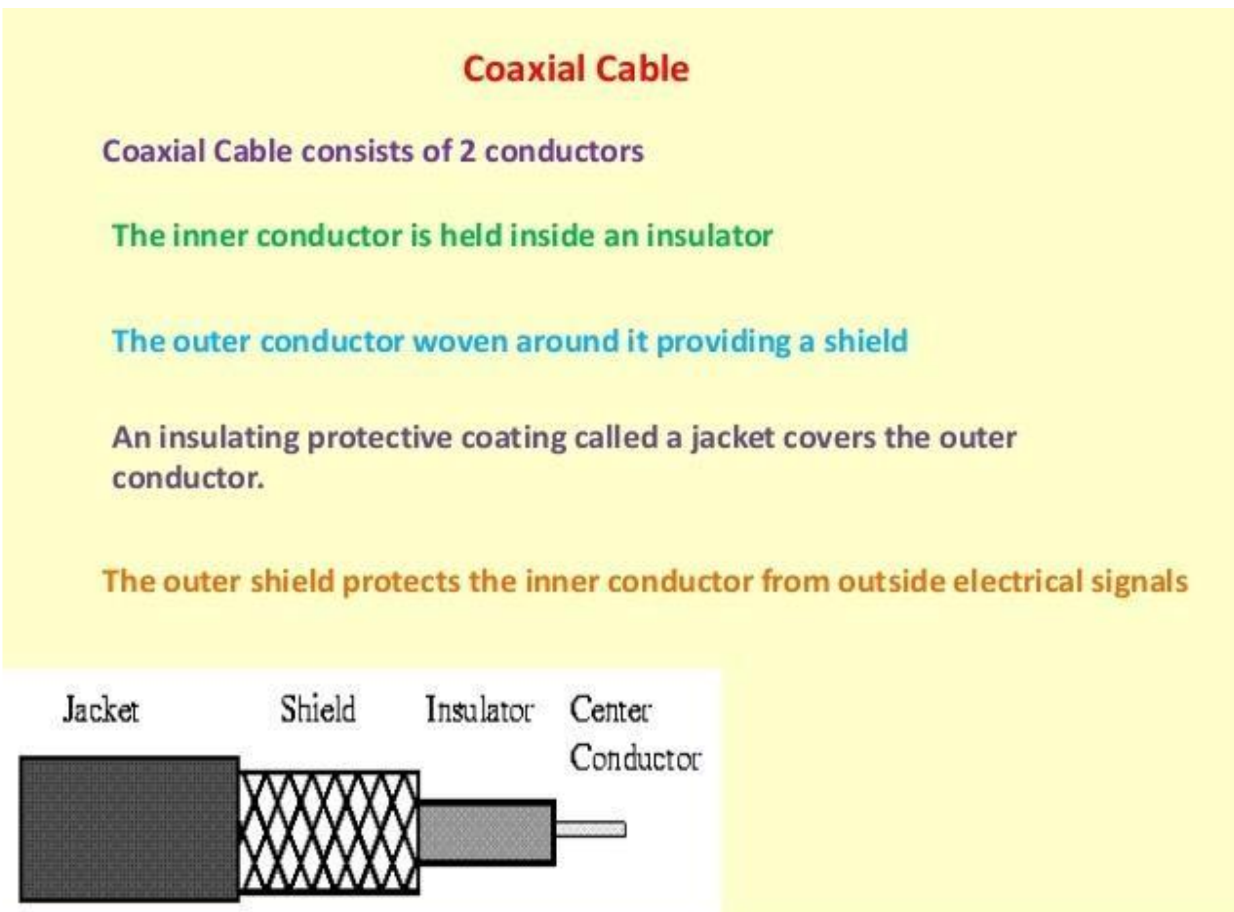
Applications

Twisted-pair cables are used in telephone lines to provide voice and data channels.

The local loop-the line that connects subscribers to the central telephone office – commonly consists of unshielded twisted-pair cables.

The DSL lines that are used by the telephone companies to provide high-data-rate connections also use the high-bandwidth capability of unshielded twisted-pair cables.

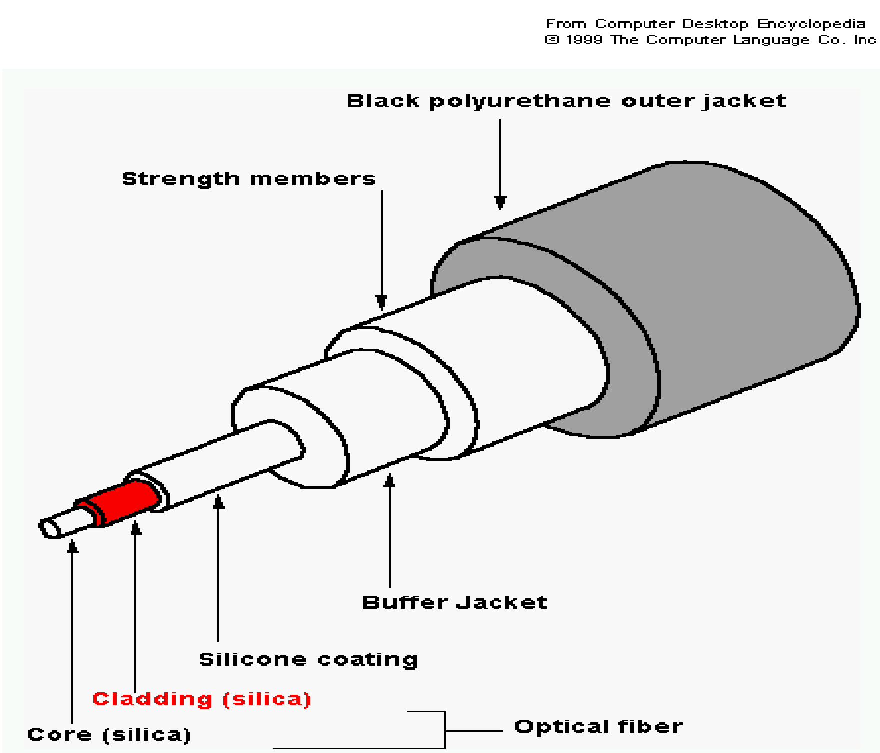
15. Explain the coaxial cable in detail



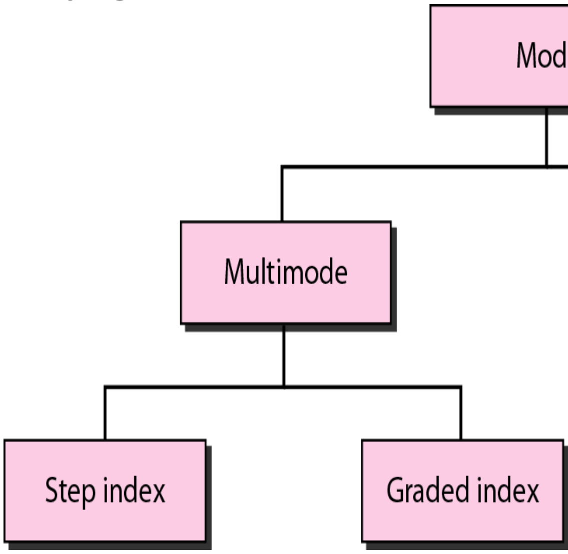
- A coaxial cable is a type of shielded and insulated copper cable that is used in computer networks and to deliver cable TV services to end users.
- The outer conductor acts as a shield against noise and crosstalk. The outer conductor is enclosed and whole cable is protected by a plastic cover.
- The distance between the outer conductor and inner conductor plus the type of material used for insulating the inner conductor determine the cable properties.
- The most standard coaxial cable connector BNC (Bayone – Neill concelman)connector.
- BNC connector is used to connect to the end of the cable to a device(Such as TV).
- Used in cable TV networks
- Used in analog telephone networks
- Used in Ethernet LAN.

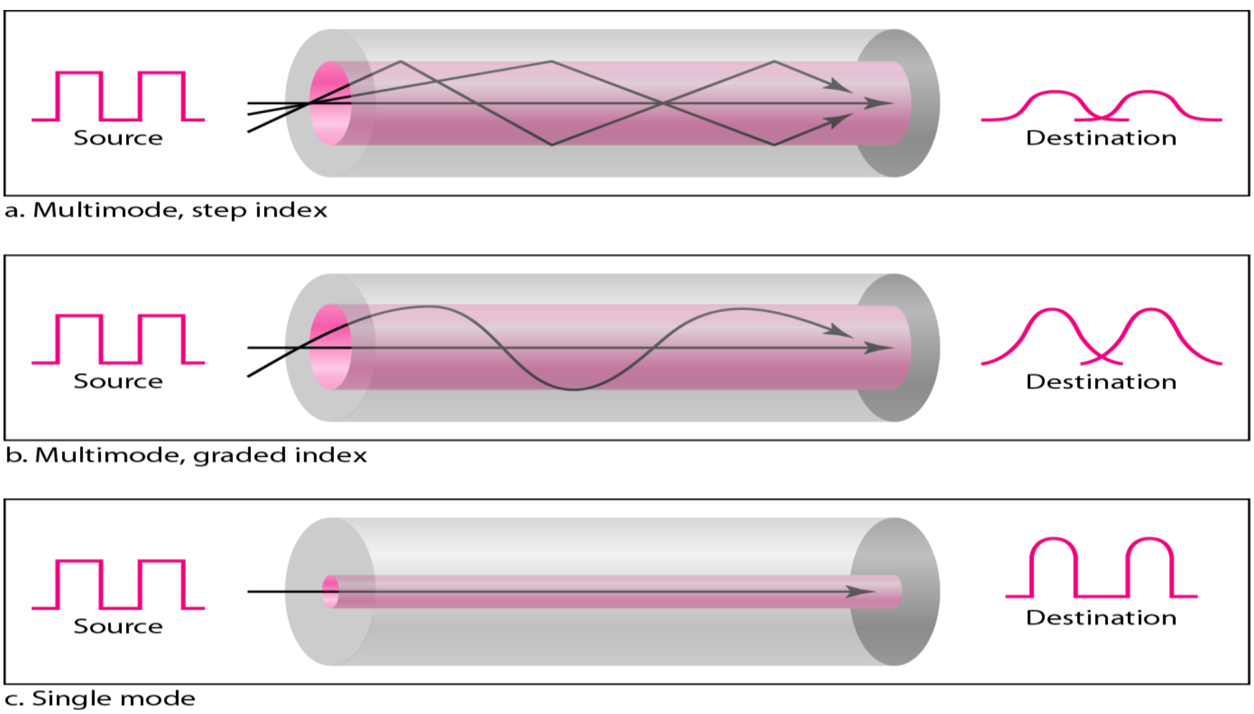
16. Explain fiber optic in detail

- Optical fiber transmission systems were introduced in 1970. It offered greater advantages over copper based digital transmission systems.
- a thin flexible fiber with a glass core through which light signals can be sent.
- Fiber optic cable has the ability to transmit signals over much longer distances.
- Optical fiber are immune to interference and cross talk



Propogation mode





- **A fiber optic cable is made of center glass core surrounded by a concentric layer of glass(cladding).**
- **The information is transmitted thru the glass core in the form of light.**
- **An important characteristic of fiber optic is refraction. Refraction is the characteristic of a material to either pass or reflect the light. When a light passes thru the medium, it bends as it passes from one medium to another.**
- **Wave length Division Multiplexing is an effective approach to explore the bandwidth that is available in optical fiber. In WDM multiple wave length are used to carry several information simultaneously over the same fiber.**

Advantages

- **It supports higher bandwidth**
- **It runs greater distance.**
- **Electromagnetic noise cannot affect fiber optic cables**
- **Usage of glass makes more resistant than copper**

Disadvantages

- **Installation and maintenance is difficult.**
- **Unidirectional light propagation. Two fibers are used for bidirectional propagation.**
- **The cable and the interfaces are more expensive.**

17. Write short notes on unguided media

Unguided media transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication. Signals are normally broadcast through free space and thus are available to anyone who has a device capable of receiving them.

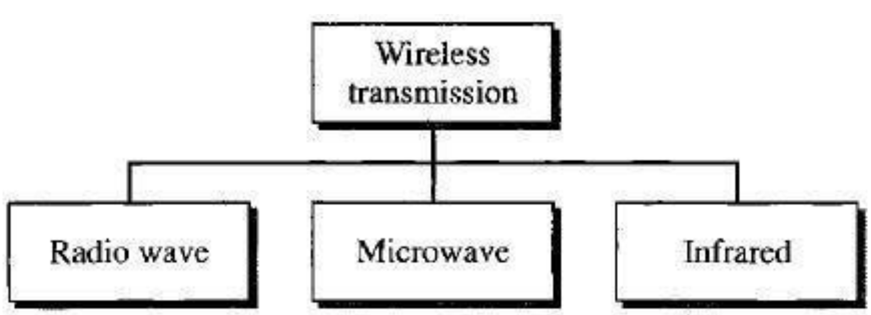
Unguided signals can travel from the source to destination in several ways: **ground propagation**, **sky propagation**, **and line-of-sight propagation,** as shown in Figure.

in **ground propagation**, radio waves travel through the lowest portion of the atmosphere, hugging the earth.

In **sky propagation**, higher-frequency radio waves radiate upward into the ionosphere (the layer of atmosphere where particles exist as ions) where they are reflected back to earth.

In **line-or-sight propagation**, very high-frequency signals are transmitted in straight lines directly from antenna to antenna.

We can divide wireless transmission into three broad groups: radio waves, microwaves, and infrared waves.



Radio Waves

Although there is no clear-cut demarcation between radio waves and microwaves, electromagnetic waves ranging in frequencies between 3 kHz and 1 GHz are normally called **radio waves**; waves ranging in frequencies between 1 and 300 GHz are called **microwaves**.

Radio waves, for the most part, are omni-directional. When an antenna transmits radio waves, they are propagated in all directions. This means that the sending and receiving antennas do not have to be aligned.

The omni-directional property has a disadvantage, too. The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signals using the same frequency or band.

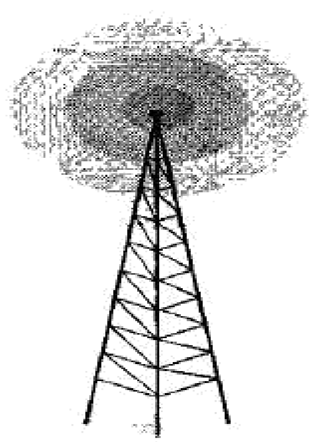
Radio waves, particularly those waves that propagate in the sky mode, can travel long distances. This makes radio waves a good candidate for long-distance broadcasting such as AM radio.

Omni directional Antenna

Radio waves use omni directional antennas that send out signals in all directions. Based on the wavelength, strength, and the purpose of transmission, we can have several types of antennas.

Applications

The omni directional characteristics of radio waves make them useful for multicasting, in which there is one sender but many receivers. AM and FM radio, television, maritime radio, cordless phones, and paging are examples of multicasting.



Microwaves

Electromagnetic waves having frequencies between I and 300 GHz are called microwaves.

Microwaves are unidirectional.

When an antenna transmits microwave waves, they can be narrowly focused. This means that the sending and receiving antennas need to be aligned. The unidirectional property has an obvious advantage. A pair of antennas can be aligned without interfering with another pair of aligned antennas.

The following describes some characteristics of microwave propagation:

Microwave propagation is **line-of-sight**. Since the towers with the mounted antennas need to be in direct sight of each other, towers that are far apart need to be very tall. The curvatures of the earth as well as other blocking obstacles do not allow two short towers to communicate by using microwaves. Repeaters are often needed for long distance communication.

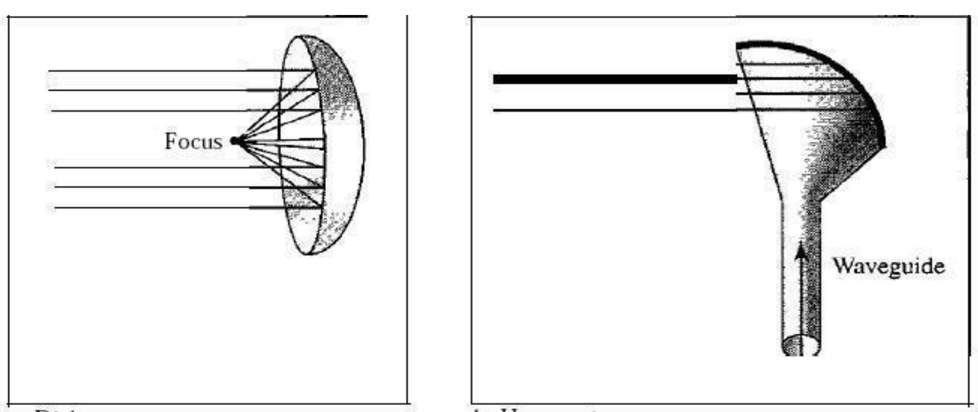
Very high-frequency microwaves cannot penetrate walls. This characteristic can be a disadvantage if receivers are inside buildings.

The microwave band is relatively wide, almost 299 GHz. Therefore wider sub bands can be assigned, and a high data rate is possible.

Use of certain portions of the band requires permission from authorities.

Unidirectional Antenna

Microwaves need unidirectional antennas that send out signals in one direction. Two types of antennas are used for microwave communications: the parabolic dish and the home.



a. Dish antenna b. Horn antenna

Applications

Microwaves, due to their unidirectional properties, are very useful when unicast (one-to-one) communication is needed between the sender and the receiver.

They are used in cellular phones, satellite networks and wireless LANs.