MSBTE BOARD SOLUTIONS

2 Marks Questions

1 Enlist four standard organizations.

Ans: List of standard organizations:

1) American National Standards Institute(ANSI)

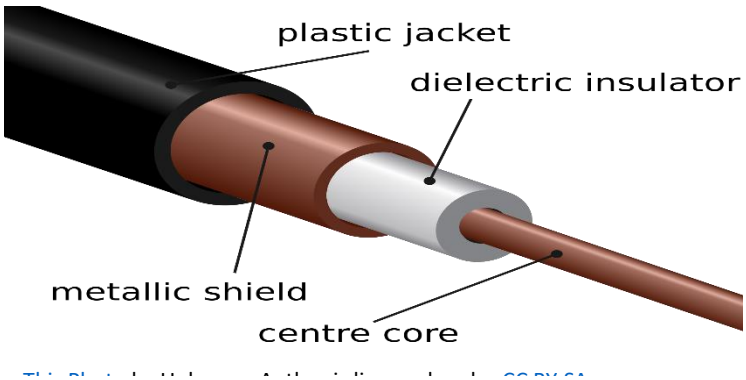
2) Electronic Industries Association(EIA)

3) International Telecommunications Union-Telecommunications Standards Sector(ITU-T)

4) Institute of Electrical and Electronics Engineers(IEEE)

5) International Standards Organization(ISO)

2 Draw a labeled diagram of coaxial cable



3 Define line of sight propagation.

Ans: Definition line of sight propagation:Line of sight propagation is a characteristic of electromagnetic radiation or acoustic wave propagation which means waves travel in a direct path from the source to the receiver. Electromagnetic transmission includes light emissions travelling in a straight line. The rays or waves may be diffracted, refracted, reflected or absorbed by atmosphere and obstructions with material and generally cannot travel over the horizon or behind obstacles

4 State advantages of multiplexing.

Ans: Advantages of multiplexing:

1.Simple and easy

2.Large capacities and scalable.

3.Signals from different sources can be sent together through a single common channel.

4.Signals may have varying speed.

5 State advantages of packet switching.

Ans: Advantages of packet switching:

1.Line efficiency is high since the link can be dynamically shared.

2.Stations can perform data rate conversions.

3.Packets can be stored and forwarded.

4.It has ability to prioritize the packets.

6 State any two drawbacks of parity checking for error detection.

Ans: Drawbacks of parity checking for error detection:

1. Can be used to detect single bit errors

2.Cannot detect location of errors.

3.Overheads are more.

7 Enlist generations of mobile telephone system.

Ans: Generations of mobile telephone system:

- First Generation
- Second Generation:2.5G, 2.75G
- Third Generation:3.5, 3.75G
- Fourth Generation

- Fifth Generation

8 Define Protocol. Why it is needed?

Ans: A protocol is defined as “a set of rules that governs the communication between computers on a network”.A protocol is needed for having communication between any two devices.

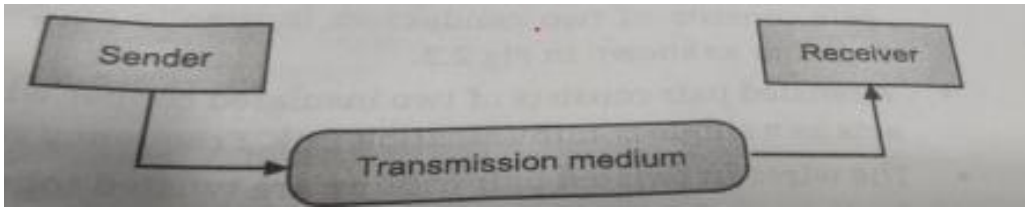
9 List types of Wireless Media.

Ans: The types of wireless media are as follows:

- Radio wave communication
- Microwave communication
- Infrared communication
- Satellite Communication

10 Define the term Communication medium.

Ans: It is defined as the physical path between transmitter and receiver.



11 Define multiplexing. List its types.

Ans: Multiplexing is the process in which multiple data streams, coming from different sources, are combined and transmitted over a single data channel or data stream.

The following three major multiplexing techniques are discussed:

- Frequency division multiplexing
- Wavelength division multiplexing

- Time division multiplexing

12 Define (i) FHSS, (ii) DSSS.

Ans: (i) **FHSS:** Frequency-hopping spread spectrum (FHSS) is a method of transmitting radio signals by rapidly switching a carrier among many frequency channels, using a pseudorandom sequence known to both transmitter and receiver.

(ii) **DSSS:** Direct Sequence Spread Spectrum (DSSS) is a spread spectrum technique whereby the original data signal is multiplied with a pseudo random noise spreading code that generates a redundant bit pattern for each transmitted bit.

13 List features of 4G and Volte.

Ans: **Feature of 4G:**

- 4G has high speed ,high capacity ,and low cost per bit
- 4G has global access, service portability and scalable mobile services
- 4G has seamless switching and a variety of Quality of service driven services
- 4G has better scheduling and call admission control techniques

Features of Volte:

- Set up of the transmission path between the terminal and IMS
- Security features for user authentication providing
- Providing the core functionality for the establishment and termination of the call.
- Support to call forwarding, caller ID presentation and restriction, call waiting and

multiparty conference.

14 Draw OSI model.

7 Layers of OSI reference Model

15 Define Protocol. State key elements of Protocol.

Ans: A protocol is defined as “a set of rules that governs the communication between computers on a network”.

The key elements of protocol are as follows:

1.Syntax

2.Semantics

3.Timing

16 List different types of guided media.

Ans: The different types of guided media are

1. Twisted pair cable
2. Co-axial cable.
3. Fiber -optic cable

17 Define switching. List its types.

Ans: The process by which nodes forward data at one of its inputs to one of its outputs is known as switching.

The types of switching are:

1. Circuit Switching
2. Packet switching

18 List any four functions of Data link layer.

Ans: The functions of Data link layer are as follows:

1. Link establishment and termination
2. Physical addressing
3. Frame sequencing
4. Frame Acknowledgment
5. Error control
6. Flow control

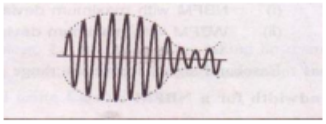
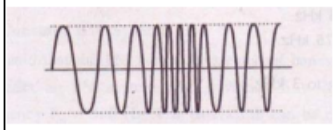
19 Enlist various IEEE standards for wireless communication. (any four)

Ans: The various IEEE standards for wireless communication are as follows:

- 802.11
- 802.11a
- 802.11b
- 802.11n
- 802.11ac

4 Marks Questions

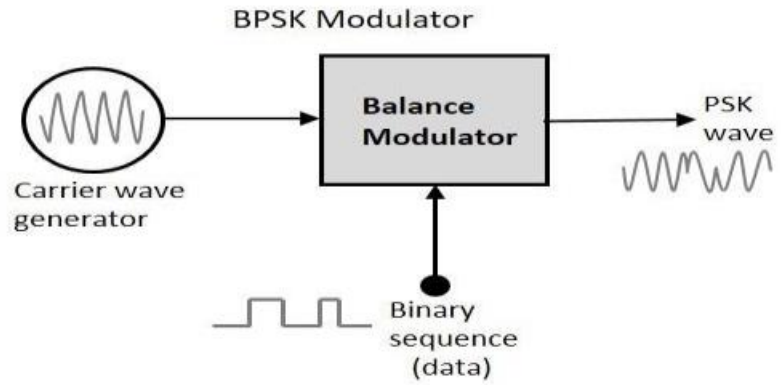
1 Compare amplitude modulation and frequency modulation (4 points).

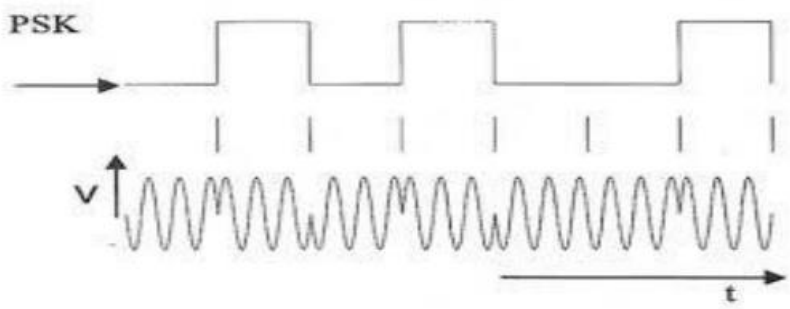
Parameter	Amplitude modulation (AM)	Frequency modulation (FM)
Definition	Amplitude modulation (AM) is the process of changing the amplitude of a high frequency carrier signal in proportion with the instantaneous value of the modulating signal keeping frequency &Phase constant.	Frequency modulation (FM) is the process of changing the frequency of carrier signal in proportion with the instantaneous value of the modulating signal keeping Amplitude &Phase constant.
Waveform	AM wave: 	FM wave: 
Bandwidth	BW= $2f_m$(f_m -frequency of modulating signal)	Bandwidth =2 $[\delta + f_m]$ (f_m - frequency of modulating signal)
Noise immunity	Less	More
Modulation index	$m_a = \frac{V_m}{V_c}$ V_m - Amplitude of modulating signal V_c- Amplitude of carrier signal	$m_f = \frac{\delta}{f_m}$ δ – frequency deviation f_m - frequency of modulating signal
Frequencies used for transmission	535 – 1700 KHz	88.1 – 108.1 MHz

2 Explain process of phase shift keying.

Ans: Phase-shift keying (PSK) is a digital to analog modulation scheme based on changing, or modulating, the initial phase of a carriersignal. PSK is used to represent digital information, such as binary digits zero (0) and one (1).The modulation of PSK is done using a balance modulator, which multiplies the two signals applied at the input. For a zero binary input, the phase will be 180° and

for a high input, the phase reversal is of 0°. Following is the diagrammatic representation of PSK Modulated output wave along with its given input.

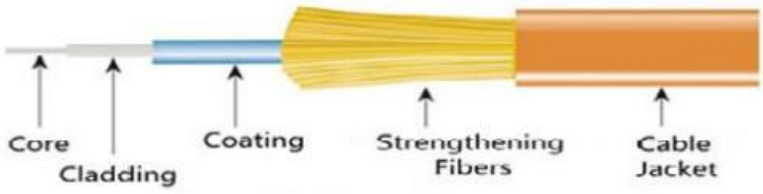




The output sine wave of the modulator will be the direct input carrier or the inverted (180° phase shifted) input carrier, which is a function of the data signal.
Amplitude and frequency of the original carrier signal is kept constant.

3 Draw a labeled diagram of fiber optic cable and state its advantages.

(Note: Any other relevant diagram can also be considered



Advantages of fiber optic cable:

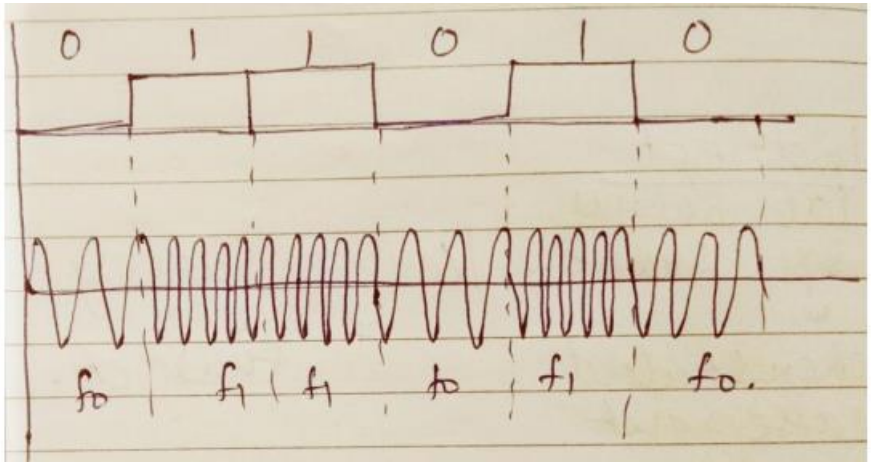
1.Higher data rate
2.Large Bandwidth
3.Less signal attenuation
4.Light weight.
5.More reliability
6.Long distance.
7.Higher security.

4 Differentiate between circuit switching and packet switching.

Circuit switching	Packet switching
1.Dedicated transmission path	1.No dedicated path
2.Continuous transmission of data.	2.Transmission of packets.
3.Messages are not stored.	3.Packets may be stored until delivered.
4.Fixed bandwidth	4.Dynamic bandwidth
5.After call setup, no overhead bits.	5.Overhead bits in each packet.

5 Draw a BFSK waveform to represent the following bit stream 0 1 1 0 1 0.

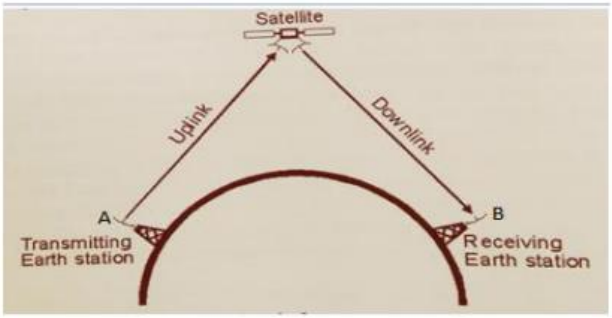
Ans:



6 Draw and explain block diagram of satellite communication.

(Note: Any other relevant block diagram may also be considered).

Ans: Satellites are the bodies that revolve around the earth just in same way moon revolves around the earth. Satellite communication is similar to terrestrial microwave communication except that satellite acts as one of the station. Satellite performs the functions of an antenna and the repeater together. Ground station A sends information to ground station B via the satellite.



Two frequency bands are used for signals from earth to satellite (uplink) and from satellite to earth (downlink). Satellite takes uplink signal coming from sender, processes it and converts to downlink frequency and transmit it towards earth. The coverage area over which the signal of satellite is available is called as footprint of satellite.

7 Compare DSSS with FHSS.

Compare	DSSS	FHSS
Definition	PN sequence of large bandwidth is multiplied with narrow band data signal.	Data bits are transmitted in different frequency slots which are changed by PN sequence.
Modulation method	M-ary FSK	BPSK
Acquisition time	Short	Long
Effect of distance	More	Less

8 Explain the process of CRC with respect to following example. If G (X) = 110010 and M (X) = 101 then calculate CRC for above stream.

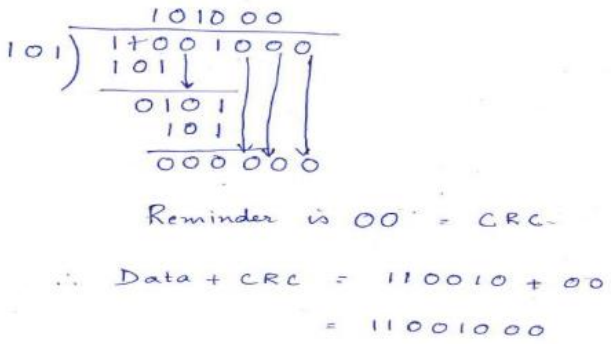
Ans: Procedure:- data bits= G(X)=110010 divisor=M(X)=101 Here divisor is 3 bits so we need to append 2 zeroes (2 bit) to the data bits for division. Division carried is the normal binary division. Result is calculated by the following condition:

1. If the remainder after division process is zero , it indicates that the data bits has no errors and the data bit is acceptable

2. If the remainder after division is non-zero , it indicates that the data bits has errors and we have to append the remainder bits to the original data bits and then send the data again. This remainder bits are called as the CRC. So the data bits transmitted will be DATA + CRC

DATA BITS	CRC

Consider the given example, lets perform division process for CRC. Here the divisor is 3 bits hence we append 2 zeroes to the data bits, so the data bits will be 11001000 this will be divided by 101.

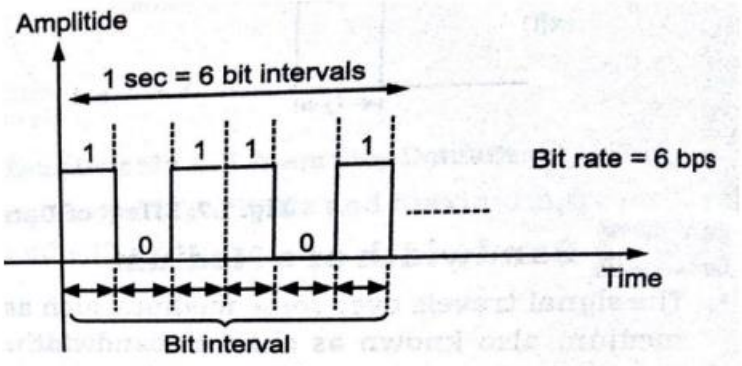


Since remainder is 0 there is no error in the data.

9 Explain the following concept with neat diagram:

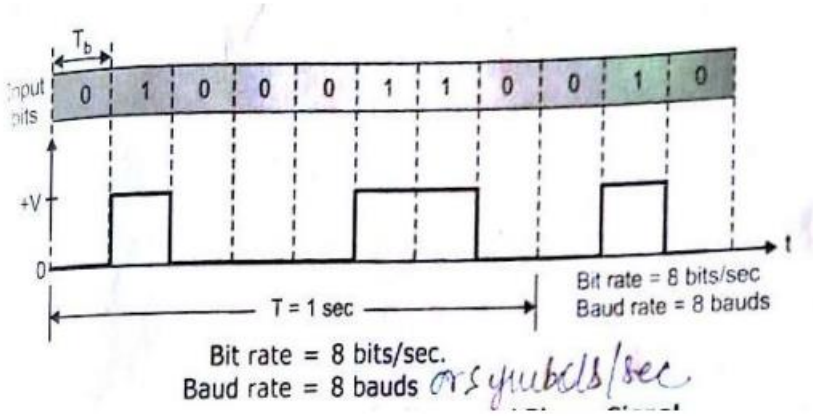
i) Bit Rate ii) Baud Rate

Ans: i) Bit Rate: Bit rate is the number of bits transmitted in one second. It is represented as bits per second(bps).



Bit Rate

ii) Baud Rate: Baud rate is defined as the number of signal units per second. It is always less than or equal to bit rate. It is represented as bauds or symbols/second.



Baud Rate

10 "In satellite communication different frequency bands are used for uplink and downlink". Explain.

Uplink frequency is used for transmission of signals from earth station transmitter to satellite. Downlink frequency is used for transmission of signals from satellite to earth station receiver.Both the frequencies are different because:

1. The satellite transmitter generates a signal that would jam its own receiver if both uplink and downlink shared same frequency.

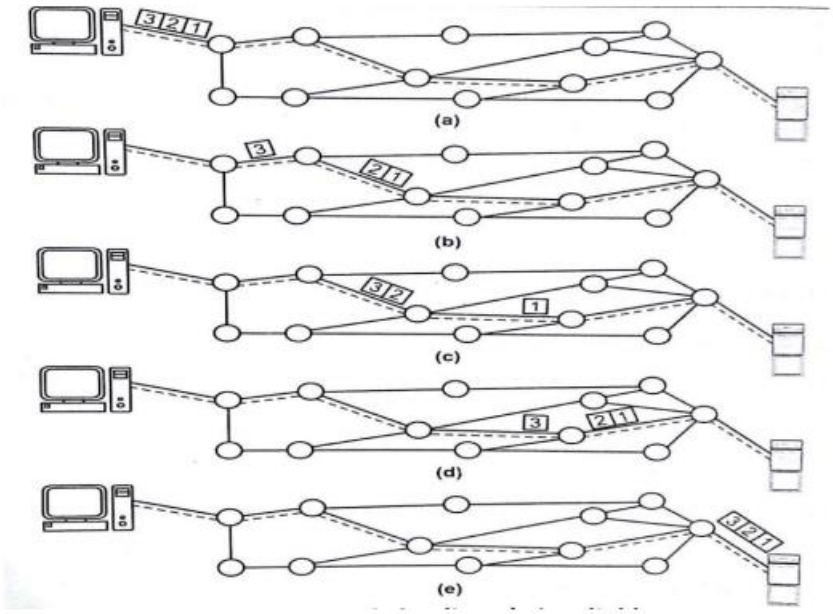
2. Trying to receive and transmit an amplified version of the same uplink waveform at same satellite will cause unwanted feedback or ring around from downlink antenna back to the receiver.

3. Frequency band separation allows the same antenna to be used for both receiving and transmitting simplifying satellite hardware.

11 Explain virtual circuit approach of switching used in computer networks.

Ans: In virtual circuit approach a logical connection is established between sending and receiving devices called virtual circuits. This connection remains the same and is retained unless and until the complete communication takes place. During the entire communication, data is transmitted through the same connection and once the communication is finished the logical connection is

dissolved or terminated or disconnected. It is then ready for creating connection for communication of some different nodes. In this type of approach packets are forwarded more quickly. E.g.consider a network in which sender wants to send the data .this can be diagramatically represented as follows:



Virtual circuit approach

12 Assuming even parity technique find the parity bit for following frames:

i) 0000010 ii) 1111000

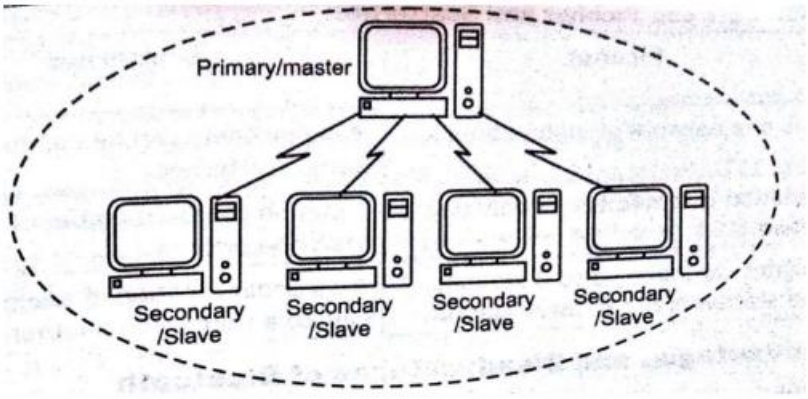
iii) 1010101 iv) 1011011

Ans:

Sr. No	Data	Parity bit
1	0000010	1
2	1111000	0
3	1010101	0
4	1011011	1

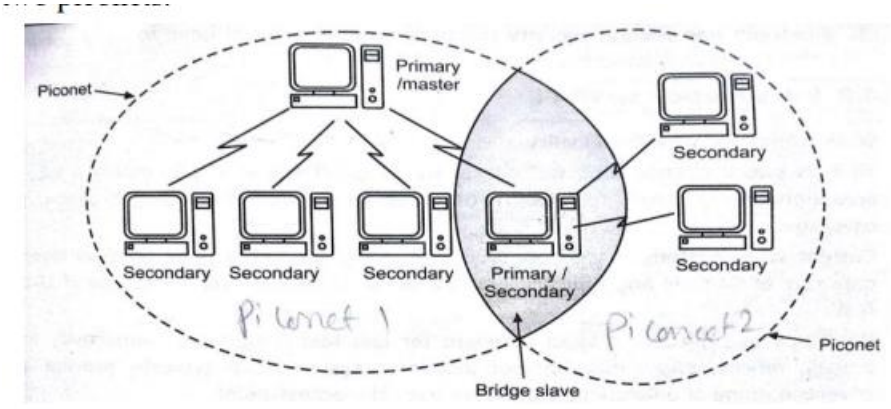
13 Explain the concept of pico net and scatter net of Bluetooth.

Ans: Piconet:- It is a Bluetooth network that consists of one primary (master) node and seven active secondary (slave)nodes. It can have 8active nodes within the distance of 10 meter. Communication between primary and secondary can be one-to-one or one-to-many. All communication is between master and slave. There can be only one primary or master station in each piconet.



PICONET

Scatternet:- Scatternet is formed by combining various piconets. Slave in one piconet acts as a master or primary in other piconet.A node can receive messages from master in first piconet and deliver the messages to its slave I other piconet where it is acting as master. This node is called bridge slave. This node cannot be the master of two piconets



Scatternet

14 Calculate the baud rate for the given bit rate and type of modulation:

(i) 4000 bps, FSK (ii) 6000 bps, ASK

For baud rate (S), we know that the formula is

S=N/r

N=S*r

Where N is bit rate, S is baud rater=no. of bits in signal elements. We need to calculate r for each case

r=Log 2 L.

i) 4000 bps, FSK:

r=log2 2=1

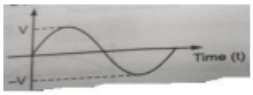
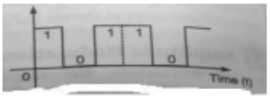
S=4000bps/1=4000bauds.

ii) 6000bps, ASK:

For ASK, r=log2 2=1

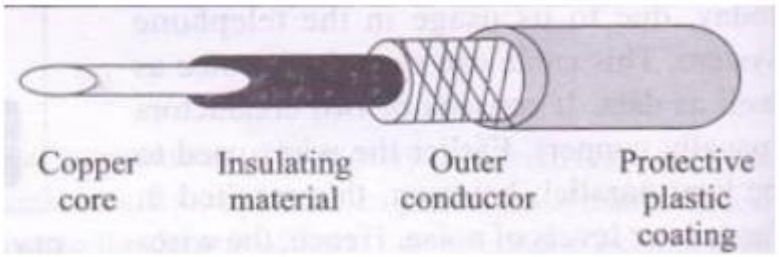
S=6000bps/1=6000bauds

15 Compare analog signal and digital signal.

Sr. No.	Terms	Analog signal	Digital signal
1	Signal	Analog signal is a continuous signal which represents physical measurements.	Digital signals are discrete time signals generated by digital modulation.
2	Waves	Denoted by sine waves 	Denoted by square waves 
3	Representation	Uses continuous range of values to represent information.	Uses discrete or discontinuous values to represent information.
4	Example	Human voice in air, analog electronic devices.	Computers, CDs, DVDs, and other digital electronic devices.
5	Flexibility	Analog hardware is not flexible	Digital hardware is flexible in implementation.
6	Uses	Can be used in analog devices only. Best suited for audio and video transmission.	Best suited for computing and digital electronics.
7	Security	Less secure	More secure
8	Power	Analog instrument requires large power.	Digital signal requires negligible power.
9	Cost	Low cost and portable.	Cost is high and not easily portable.
10	Impedance	Low	High order of 100 megaohm
11	Bandwidth	Less bandwidth required data transmission.	Higher bandwidth is required for data transmission.

16 Draw and explain Coaxial cable.

Ans:



The co-axial cable is also called as coax. It has an inner central conductor made up of solid material like copper or aluminum. The inner conductor is surrounded by an insulating sheath which in turn is enclosed in an outer conductor (shield).Outer conductor is made up of braided sheath. This acts not only as second conductor for completing the circuit but also act as shield against noise. The outer conductor is covered by a plastic cover mostly made up of PVC to provide insulation and protection. It was developed for analog telephone networks. It is used to carry more than 10,000 voice channels at a time. Most popularly used in the cable TV system.

17 Draw and explain WDM.

Ans: WDM is an analog multiplexing technique to combine optical signals.

Principle: Very narrow bands of light from different sources are combined to make a wider band of lights & at the receiver, the signal are separated by demultiplexer. WDM is designed to use the high data rate capability of fiber optic cable. The optical fiber data rate is higher that the data rate of metallic transmission cable. Using a fiber optic cable for one single line wastes available bandwidth.

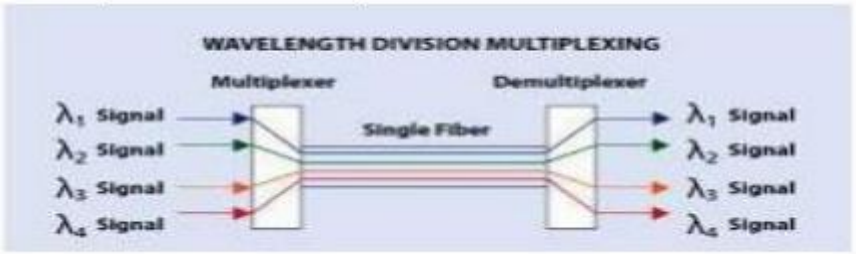
Multiplexing allows us to connect several lines into one.

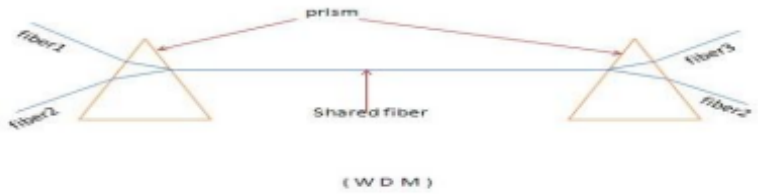
- WDM is conceptually same as FDM, except that the multiplexing & demultiplexing involve the optical signals transmitted through fiber optic cable. Very narrow band of lights of differential wavelengths are combined to make wide band of light. All wavelength travels through signal cable.

- At receiver, the signals are separated by demultiplexer.

 Combining & splitting of light sources are easily handled by prism. Prism bends a beam of light based on angle of incidence & frequency**.**

Using this technique, multiplexer can be made to combine several input beams of light, each containing narrow band of frequencies into one output beam of wider band of frequencies. Demultiplexer does reverse process.





(WDM)

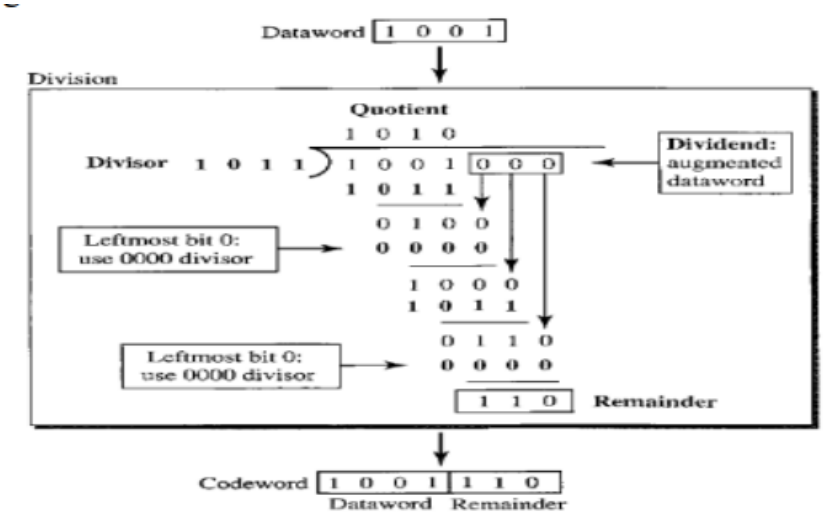
18 Explain the process of Cyclic Redundancy Check (CRC) with suitable example.

Ans: CRC Encoder:

In the encoder, the dataword has k bits (4 here); the codeword has n bits (7 here). The size of the dataword is augmented by adding $n - k$ (3 here) 0s to the right-hand side of the word. The n-bit result is fed into the generator. The generator uses a divisor of size $n - k + 1$ (4 here), predefined and agreed upon. The generator divides the augmented data word by the divisor (modulo-2 division). The quotient of the division is discarded; the remainder $r2\ r1\ r0$ is appended to the dataword to create the codeword.

Example:

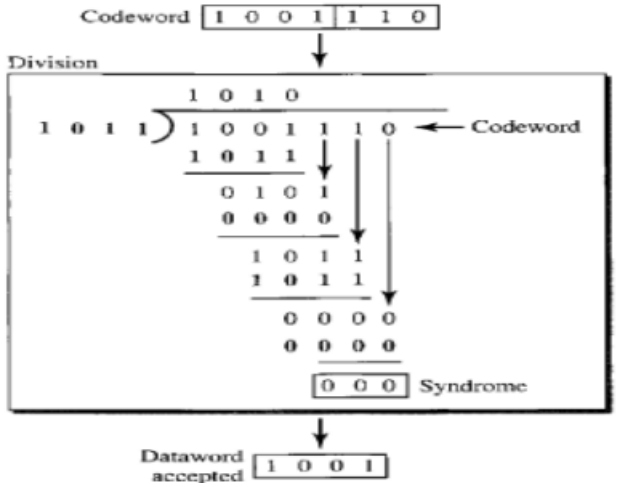
The encoder takes the data word and augments it with $n - k$ number of 0s. It then divides the augmented dataword by th divisor, as shown in Figure.



CRC Decoder:

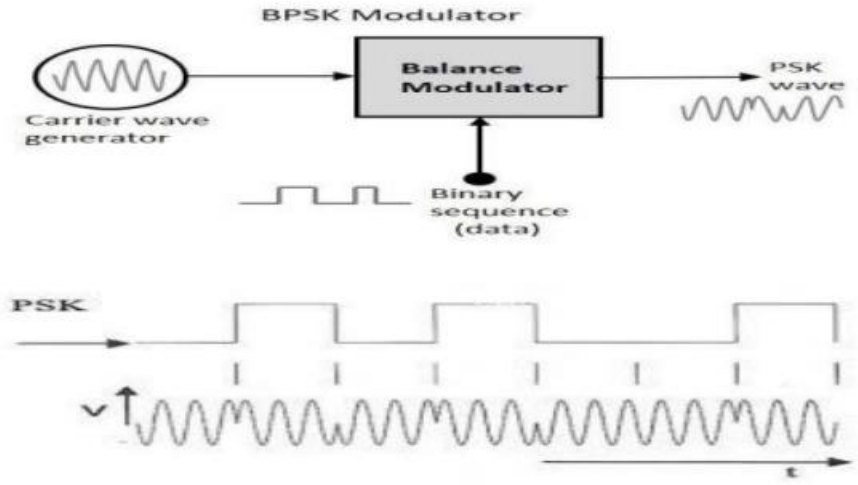
The codeword can change during transmission. The decoder does thesame division process as the encoder. The remainder of the division is the syndrome. If the syndrome is all 0s, there is no error; the data word is separated from the received codeword and accepted. Otherwise, everything is discarded.

Example:



19 Draw and explain PSK with waveforms.

Ans: Phase-shift keying (PSK) is a digital to analog modulation scheme based on changing, or modulating, the initial phase of a carrier signal. PSK is used to represent digital information, such as binary digits zero (0) and one (1).The modulation of PSK is done using a balance modulator, which multiplies the two signals applied at the input. For a zero binary input, the phase will be 180° and for a high input, the phase reversal is of 0°. Following is the diagrammatic representation of PSK Modulated output wave along with its given input. The output sine wave of the modulator will be the direct input carrier or the inverted (180° phase shifted) input carrier, which is a function of the data signal. Amplitude and frequency of the original carrier signal is kept constant.



20 Draw and explain fiber optic cable.

Ans: The optical fiber consists of three parts.

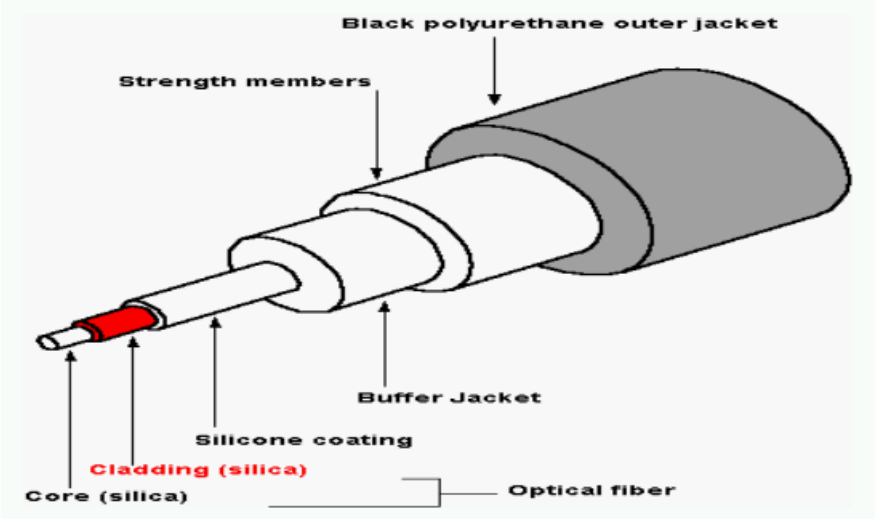
1. Glass core: - The innermost layer in an optical fiber cable is the glass core. The light rays pass through this innermost glass core. Cladding layer: - The innermost glass layer is covered by the cladding layer. This layer is also made up

of glass. But the refractive index of this layer is less than that of core layer. The cladding layer performs the following functions: 1.It provides strength to the optical fiber cable.

2. The cladding layer acts like a mirror. It will reflect the light rays and will not allow them to escape outside the fiber. 3. When many optical fibers are packed in one cable the cladding layer avoids the interference between the light rays in the adjacent fibers.

3. Jacketlayer or Protective layer: - i. Outmost layer in an optical fiber. ii. Provides mechanical strength to the optical cable. iii. Provides protection against environmental factors.Core and cladding are typically made of glass or plastic. Most important specification of the core is the index of refraction which is the value for light bending passing through the material and for the speed of that light could travel through material with. Cladding is having lower refractive index than the core. It allows light to stay inside the fiber and not escape into cladding, since it will be reflected.Coating is simply a protective layer that is protecting core and cladding from the fracture.

Whether the fiber is single mode or multi-mode is defined by the thickness of the fiber optic stand. Thin core would support only single pathway for the light. Thicker core means more angles for input signal, thus being able to transmit data in multiple paths and modes.



21 Calculate minimum number of bits in a PN sequence if we use FHSS with a channel bandwidth of B = 5KHz and Bss = 120 KHz.

Ans: The no. of hops= 120 KHz/5KHz = 24

So we need Log224=4.58≈5bits.

Hence minimum no. of bits in a PN sequence=5bits

22 Explain selective reject ARQ.

Ans: Selective Repeat is part of the automatic repeat-request (ARQ). With selective repeat, the sender sends a number of frames specified by a window size even without the need to wait for individual ACK from the receiver as in Go-Back-N ARQ. The receiver may selectively reject a single frame, which may be retransmitted alone; this contrast with other forms of ARQ, which must send every frame from that point again. The receiver accepts out-of-order frames and buffers them. The sender individually retransmits frames that have timed out.The sender sends packet of window size N and the receiver acknowledges all packet whether they were received in order or not.

In this case, the receiver maintains a buffer to contain out-of-order packets and sorts them. The sender selectively re-transmits the lost packet and moves the window forward.

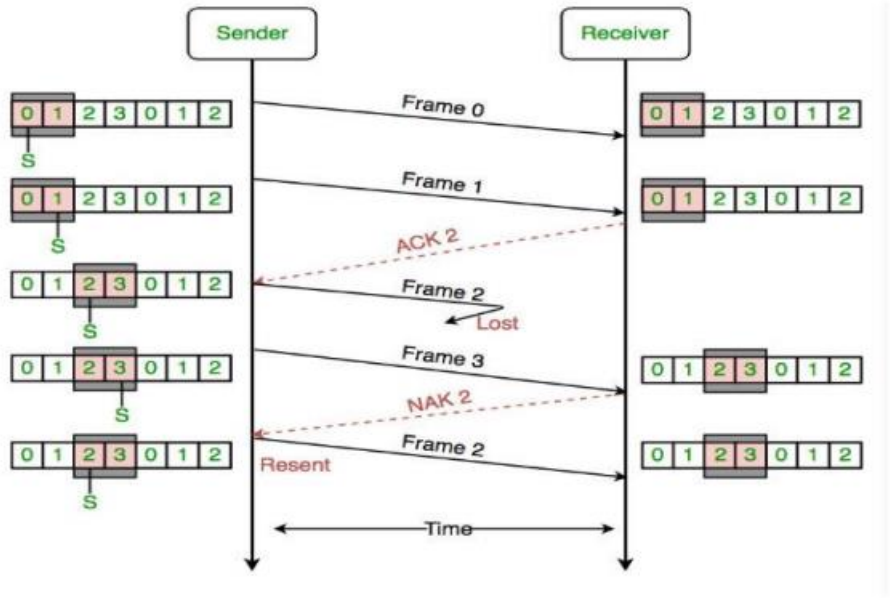
 Sender can transmit new packets as long as their number is with W of all unACKed packets.

 Sender retransmits un-ACKed packets after a timeout – Or upon a NAK if NAK is employed.

 Receiver ACKs all correct packets.

 Receiver stores correct packets until they can be delivered in order to the higher layer.

 In Selective Repeat ARQ, the size of the sender and receiver window must be at most one-half of 2^m.



23 Draw Bluetooth architecture. Explain function of various layers.Bluetooth Architecture.

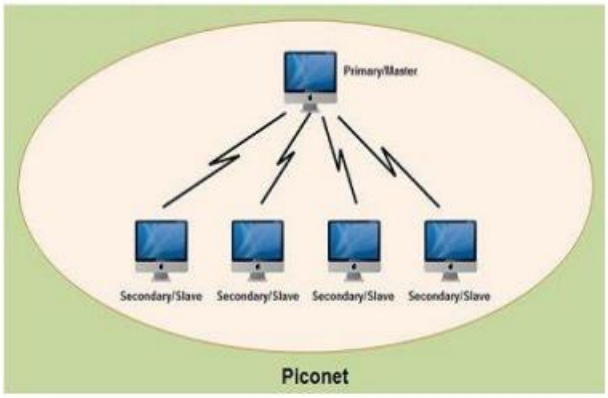
Ans: Bluetooth architecture defines two types of networks:

1. Piconet
2. Scatternet

1. Piconet:

• Piconet is a Bluetooth network that consists of one primary (master) node and seven active secondary (slave) nodes.

• Thus, piconet can have upto eight active nodes (1 master and 7 saves) or stations within the distance of 10 meters.

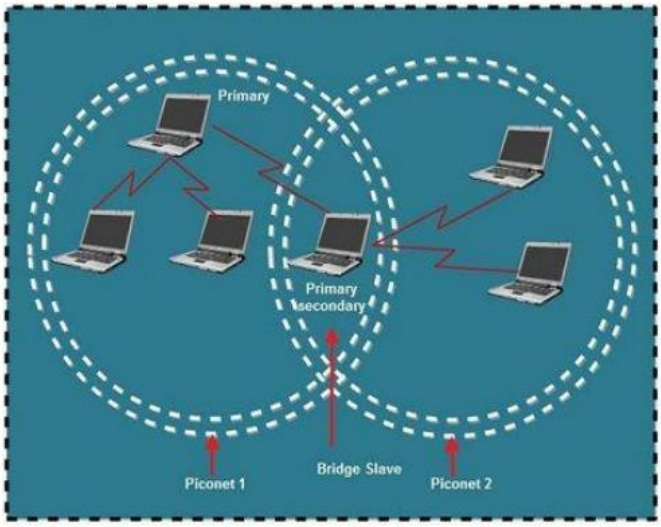


2. Scatternet:

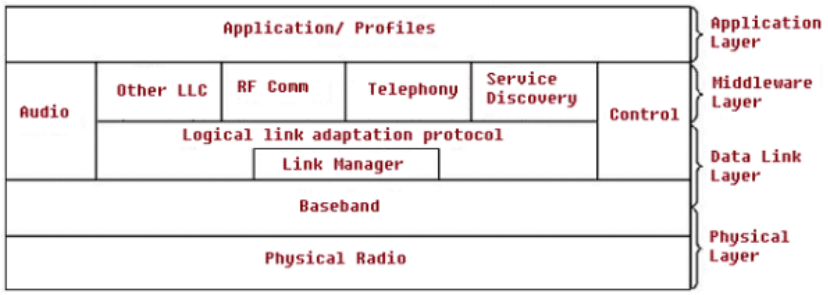
• Scattemet is formed by combining various piconets.

• A slave in one piconet can act as a master or primary in other piconet.

• Such a station or node can receive messages from the master in the first piconet and deliver the message to its slaves in other piconet where it is acting as master. This node is also called bridge slave.



Function of various layer:
(one function of each layer expected)



Radio Layer

• The Bluetooth radio layer corresponds to the physical layer of OSI model.

• It deals with ratio transmission and modulation.

• The radio layer moves data from master to slave or vice versa.

• It is a low power system that uses 2.4 GHz ISM band in a range of 10 meters.

Baseband Layer

• Baseband layer is equivalent to the MAC sublayer in LANs.

• Bluetooth uses a form of TDMA called TDD-TDMA (time division duplex TDMA).

• Master and slave stations communicate with each other using time slots.

• The master in each piconet defines the time slot of 625 µsec.

• In TDD- TDMA, communication is half duplex in which receiver can send and receive data but not at the same time.Logical Link, Control Adaptation Protocol Layer (L2CAP)

• The logical unit link control adaptation protocol is equivalent to logical link control sublayer of LAN.

• The various function of L2CAP is:

1. Segmentation and reassembly

• L2CAP receives the packets of upto 64 KB from upper layers and divides them into frames for transmission.

• It adds extra information to define the location of frame in the original packet.

• The L2CAP reassembles the frame into packets again at the destination.

2. Multiplexing

• L2CAP performs multiplexing at sender side and demultiplexing at receiver side.

• At the sender site, it accepts data from one of the upper layer protocols frames them and deliver them to the Baseband layer.

• At the receiver site, it accepts a frame from the baseband layer, extracts the data, and delivers them to the appropriate protocol layer.

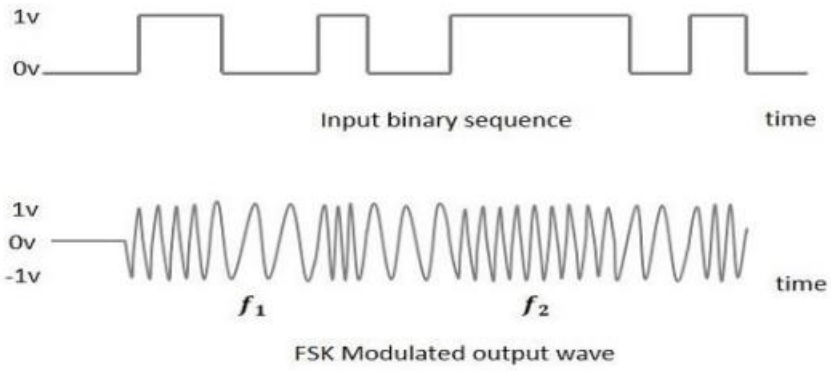
3. Quality of Service (QOS)

• L2CAP handles quality of service requirements, both when links are established and during normal operation.

• It also enables the devices to negotiate the maximum payload size during connection establishment.

24 Explain the process of FSK modulation with diagram.

Ans: In FSK, frequency of sinusoidal carrier is shifted between two discrete values. One of these frequencies (f1) represents a binary 1 and other value (f2) represents binary 0.There is no change in amplitude of carrier. It consists of voltage controlled oscillators (VCO) which produce sinewaves at frequencies f1 and f0. Corresponding to "binary 0 "input, the VCO produces a sinewave of frequency f0 whereas corresponding to binary 1 input VCO produces a sinewave of frequency f1.



25 Explain any four standard organizations.

Ans: 1. ISO (International organization for standardization: The ISO is a multinational body whose membership is drawn mainly from the standards creating committees of various governments throughout the world. The ISO is active in developing cooperation in the realms of scientific, technological and economic activity.

2. International Telecommunication Union-Telecommunication Standards Sector (ITU-T): The United nations responded by forming as part of its International Telecommunication Union (ITU), a committee the consultative Committee for International Telegraphy and Telephony (CCITT). This committee was devoted to research and establishment of standards for telecommunications in general and for phone and data systems.

3. American National Standards Institute (ANSI): ANSI is private non-profit organization affiliated with U.S. federal government.All ANSI activities are undertaken for the welfare of the united states and its citizen occupying primary importance.

4. Institute of Electrical and Electronics engineers (IEEE): IEEE is the largest professional engineering society in the world International in scope, it aims to advance theory, creativity, and product quality in the fields of electrical engineering, electronics and radio as well as in all related branches of engineering.

5. Electronic Industries Association (EIA): Aligned with ANSI, EIA is a nonprofit organization devoted to the promotion of electronics manufacturing concerns. Its activities include public awareness education and lobbying efforts in addition to standards development

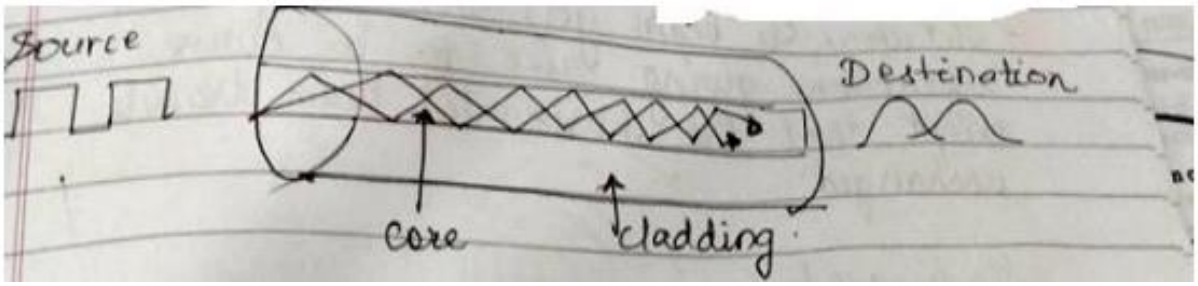
26 Explain propagation modes in fiber optic cable with neat diagram.

Ans: The different propagation modes in fiber optic cable are as follows:

⍰ Multimode step index fiber:

In multimode step index fiber, the core has one density and the cladding has another density. Therefore at the interface, there is a sudden change that is why it is called step index.

Multiple beams take different paths on reflection as shown in figure. The beam that strikes core at a smaller angle that has to be reflected many more times than the beam that shifted the core at a larger angle to reach other end. This means that at the destination, all beams do not reach simultaneously. It is used for short distances.

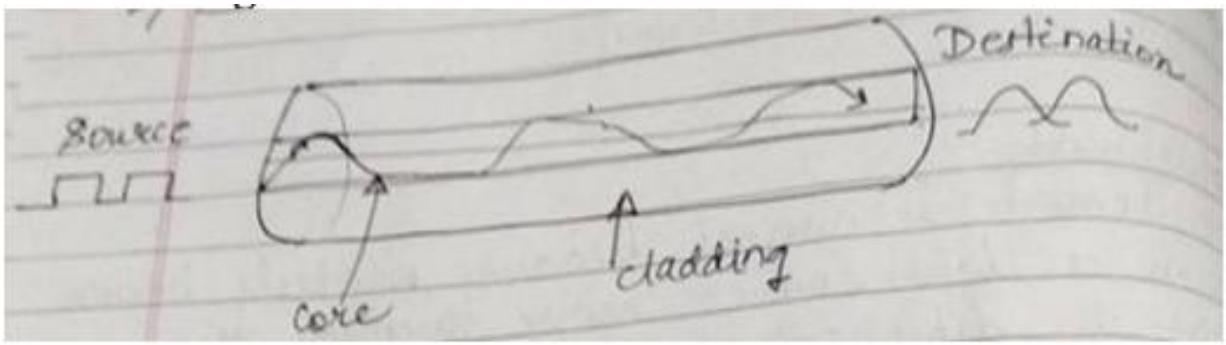


⍰ Multimode graded-index fiber:

⍰ In this, core itself is made of a material of varying densities.

⍰ The density is the highest at the core and gradually decreases towards the edge.

⍰ Therefore, a beam gas through gradual refraction giving rise to a curve except that the horizontal beam travels unchanged.



Single-mode:

It uses step-index fiber and a highly focused source of light that limits beam to a small range of angles, all close to horizontal.

It is manufactured with much smaller diameter than that of multimode fiber and with substantially lower density.

The decrease in density results in a critical angle i.e. close enough to 900to make propagation of beams almost horizontal

27 Explain datagram approach for packet switching.

Ans: In the datagram approach of packet switching, each packet is considered as a totally independent packet from all others. Even when there are multiple packets sent by the same source to same destination for the same message, each packet is independent of all other packets from point of view of network and can follow different path. Figure Illustrate packet switching in datagram networks approach. Hence, computer A is sending four packets to another computer D. These four packets belong to the same original message, but travel via different routes and also can arrive at the destination D in a different order than how the source A has sent them.

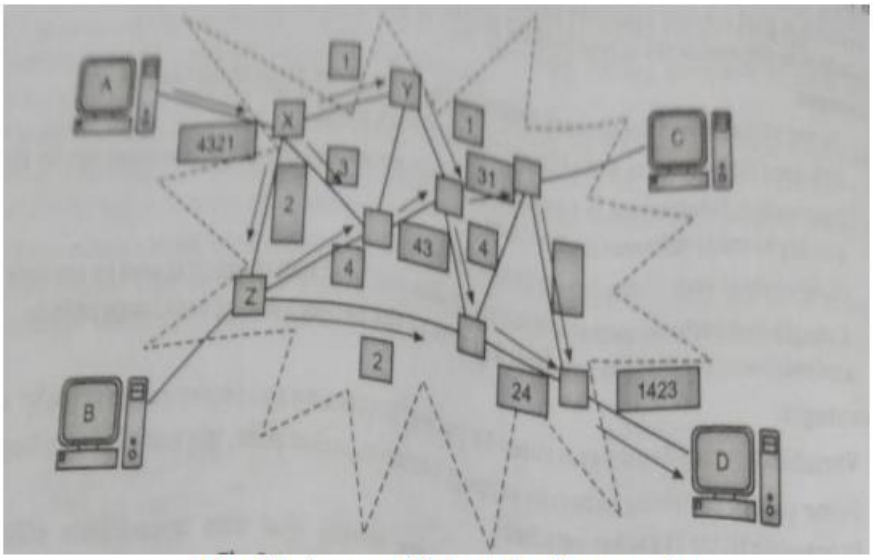


Fig: Datagram Networks Approach

- Therefore, the destination node needs to have a buffer memory to store all the packets and resequence them to form original message.
- Figure shows a datagram networks approach.
- It is obvious that each packet must have a header containing the source and destination address, packet number, the CRC etc.
- The reasons that the packet travel via. different routes is that the routing decisions are taken for every packets separately, each time at every node, as the packet travels from one node to the next.

28 Calculate the baud rate for the given bit rate and type of modulation:

Ans: (i) 5000 bps, ASK (ii) 4000 bps, FSK

For baud rate (S), we know that the formula is:

S=N/r.

N = S * r

Here, N is Bit rate, S is the Baud rate

r = number of bits in signal elements

So, at first we need to calculate r for each case.

We know,r = log2L

i)For ASK, r = log22 = 1

S=5000 bps/1=5000 baud

ii) For FSK, r = log22 = 1

S=4000bps/1=4000 baud

29 Explain the construction of Shielded Twisted Pair Cable.

Ans: STP is similar to UTP but with each pair covered by an additional copper braid jacket or foil wrapping. This shielding helps to protect the signals on the cables from external interference. Shielding provides a means to reflect or absorb electric fields that are present around cables. Shielding comes in a variety of forms from copper braiding or copper meshes to aluminized.

STP is more expensive than UTP but has the benefit of being able to support higher transmission rates over longer distances.

STP is heavier and more difficult to manufacture, but it can greatly improve the signaling rate in a given transmission scheme Twisting provides cancellation of magnetically induced fields and currents on a pair of conductors.

Magnetic fields arise around other heavy current-carrying conductors and around large electric motors. Various grades of copper cables are available, with Grade 5 being the best and most expensive.

STP is used in IBM token ring networks.

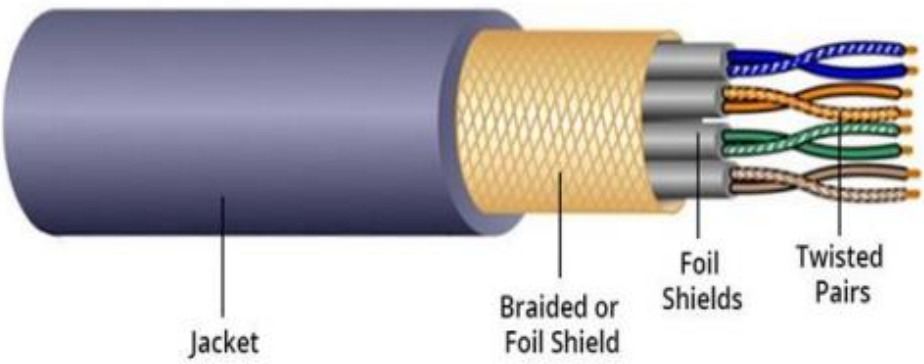


Figure: Construction of Shielded Twisted Pair

30 Five channels each with 200kHz bandwidth are multiplexed using FDM. Find minimum bandwidth of the link if guard band of 10kHz is used.

Ans: Five channels each with 200 kHz bandwidth are multiplexed using FDM.

For five channels, we need at least four guard bands.

Guard Bands of 10 KHz is used.

This means that the required bandwidth is atleast

5*200+4*10=1040 KHz.

31 Assuming odd parity, find the parity bit for each of the following data unit:

(i) 1011010 (ii) 0010110

(iii) 1001111 (iv) 1100000

Ans: Odd parity refers to number of „1" present in a byte to be transmitted should be odd.

(i) 1011010:

Step 1: Count the number of „1"s in the byte

Answer: 4

Step 2: compute the parity bit

Answer: 1011010 1

Since the total number of 1‟s is 4, the odd parity will have a value of „1‟.

(ii) 0010110:

Step 1: Count the number of „1‟s in the byte

Answer: 3

Step 2: compute the parity bit

Answer: 0010110 0

Since the total number of 1‟s is 3,the odd parity will have a value of „0‟.

(iii) 1001111:

Step 1: Count the number of „1‟s in the byte

Answer: 5

Step 2: compute the parity bit

Answer: 1001111 0

Since the total number of 1‟s is 5, the odd parity will have a value of „0‟

(iv)1100000:

Step 1: Count the number of „1‟s in the byte

Answer: 2

Step 2: compute the parity bit

Answer: 1100000 1

Since the total number of 1‟s is 2, the odd parity will have a value of „1‟.

32 A signal carries five bits in each signal element. If 1600 signal elements are sent per second, find the baud rate and bit rate in kbps.

Ans: Baud rate is number of signal elements per second.

Bit rate is the number of bits per second.

We also know that S=N/r where S is the baud rate, N is the bit rate

and r is the bits in each signal element.

In this case 1600 signal elements are sent per second.

So baud rate is 1600.

Now S=1600, r=5 and N is unknown.

So N=S*r=1600*5=8000 bps or 8 kbps.

Therefore the bit rate is 8kbps.

33 Explain the reason for using different frequency bands for uplink and downlink in satellite communication.

Ans: The uplink frequency is the frequency which is used for transmission of signals from earth station transmitter to the satellite.The downlink frequency is the frequency which is used for transmission of signals from the satellite to the earth station receiver.

Uplink frequency is different from downlink frequency for following reason:

 The satellite transmitter generates a signal that would jam its own receiver; if both uplink and downlink shared the same frequency.

 Trying to receive and transmit an amplified version of the same uplink waveform at same satellite will cause unwanted feedback or ring around from the downlink antenna back into the receiver.

 Frequency band separation allows the same antenna to be used for both receiving and transmitting, simplifying the satellite hardware.

 To overcome the above-mention difficulties satellite repeaters must involve some form of frequency translation before power amplification. So, Uplink frequency is different from downlink frequency

34 Explain the process of asynchronous TDM with example.Asynchronous TDM:

Ans: 1. It is also known as statistical time division multiplexing.

2. Asynchronous TDM is called so because is this type of multiplexing, time slots are not fixed i.e. the slots are flexible.

3. Here, the total speed of input lines can be greater than the capacity of the path.

4. In synchronous TDM, if we have n input lines then there are n slots in one frame. But in asynchronous it is not so.

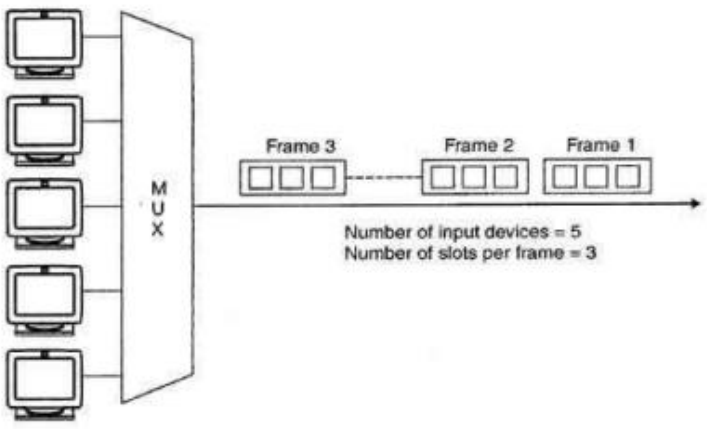
5. In asynchronous TDM, if we have n input lines then the frame contains not more than m slots, with m less than n (m < n).

6. In asynchronous TDM, the number of time slots in a frame is based on a statistical analysis of number of input lines.

7. In this system slots are not predefined, the slots are allocated to any of the device that has data to send.

8. The multiplexer scans the various input lines, accepts the data from the lines that have data to send, fills the frame and then sends the frame across the link.

9. If there are not enough data to fill all the slots in a frame, then the frames are transmitted partially filled.



Asynchronous TDM

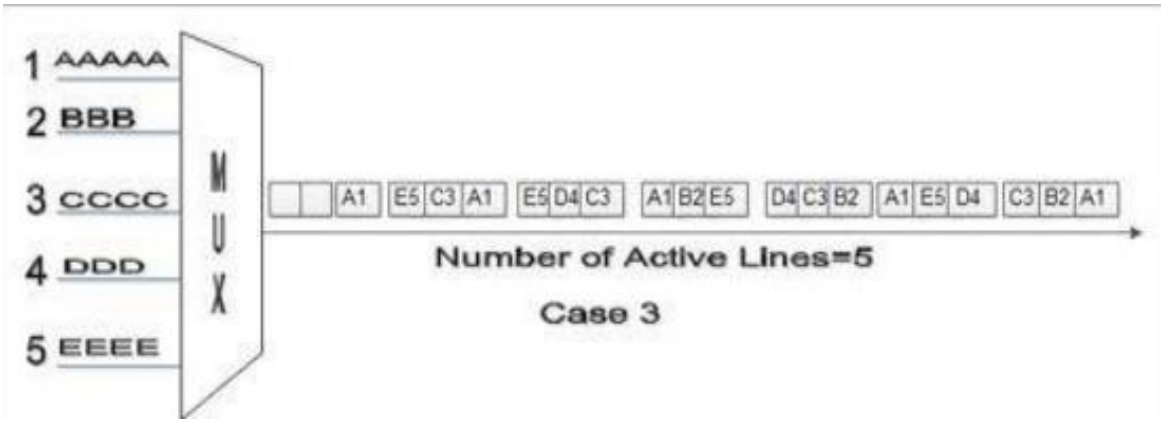
Example:

Asynchronous Time Division Multiplexing is depicted in fig. Here we have five input lines and three slots per frame.

1. In Case 1, only three out of five input lines place data onto the link i.e. number of input lines and number of slots per frame are same.

2. In Case 2, four out of five input lines are active. Here number of input line is one more than the number of slots per frame.

3. In Case 3, all five input lines are active.In all these cases, multiplexer scans the various lines in order and fills the frames and transmits them across the channel. The distribution of various slots in the frames is not symmetrical. In case 2, device 1 occupies first slot in first frame, second slot in second frame and third slot in third frame.



35 Explain the process of Checksum with example. Checksum:

Ans: Checksum is an error detection method.Error detection using checksum method involves the following steps

Step-01:At sender side,

 If m bit checksum is used, the data unit to be transmitted is divided into segments of m bits.

 All the m bit segments are added.

 The result of the sum is then complemented using 1‟s complement arithmetic.

 The value so obtained is called as checksum.

Step-02:

 The data along with the checksum value is transmitted to the

receiver.

Step-03:

At receiver side,

 If m bit checksum is being used, the received data unit is divided

into segments of m bits.

 All the m bit segments are added along with the checksum value.

 The value so obtained is complemented and the result is checked.Then, following two cases are possibleCase-01: Result = 0 If the result is zero,

 Receiver assumes that no error occurred in the data during the transmission.

 Receiver accepts the data. Case-02: Result ≠ 0 If the result is non-zero,

 Receiver assumes that error occurred in the data during the transmission.

 Receiver discards the data and asks the sender for retransmission.

Checksum Example:

Consider the data unit to be transmitted is10011001111000100010010010000100

Consider 8 bit checksum is used.

Step-01:

At sender side,

The given data unit is divided into segments of 8 bits as-

10011001	11100010	00100100	10000100

Now, all the segments are added and the result is obtained as-

- 10011001 + 11100010 + 00100100 + 10000100 = 1000100011
- Since the result consists of 10 bits, so extra 2 bits are wrapped around.
- 00100011 + 10 = 00100101 (8 bits)
- Now, 1"s complement is taken which is 11011010.
- Thus, checksum value = 11011010

Step-02:

- The data along with the checksum value is transmitted to the receiver.

Step-03:

At receiver side,

- The received data unit is divided into segments of 8 bits.
- All the segments along with the checksum value are added.
- Sum of all segments + Checksum value = 00100101 + 11011010 = 11111111
- Complemented value = 00000000
- Since the result is 0, receiver assumes no error occurred in the data and therefore accepts it.

36 In Bluetooth communication calculate the length of frame for following scenarios:

(i) Three slot (ii) Five slot

Assume data rate = 1 mbps

Ans: In Bluetooth communication, when the link speed or data rate is

1Mbps each slot length is 625µs or 1600 hops/sec

Packets can be of 1, 3, 5 slots.

i) Since each slot length is 625µs,

Total length of the frame containing three slots is 625*3=1875µs,

Or 1600*3=4800 hops/sec

ii) Since each slot length is 625µs,

Total length of the frame containing five slots is 625*5=3125µs,

Or 1600*=8000 hops/sec.

6 Marks Questions

1 Differentiate between twisted pair coaxial cable and fiber optic cable (any 4 points).

Sr. No.	Twisted pair cable	Coaxial cable	Fiber optic cable
1	Transmission of signals of takes place in the electrical form over the metallic conducting wires.	Transmission of signals takes place in the electrical form over the inner conductor of the cable.	Signal transmission takes place in an optical form over a glass fiber.
2	In this medium the noise immunity is low.	Coaxial having higher noise immunity than twisted pair cable.	Optical fiber has highest noise immunity as the light rays are unaffected by the electrical noise.
3	Twisted pair cable can be affected due to external magnetic field.	Coaxial cable is less affected due to external magnetic field.	Not affected by the external magnetic field.
4	Cheapest medium	Moderate Expensive	Expensive
5	Low Bandwidth	Moderately high bandwidth	Very high bandwidth
6	Attenuation is very high	Attenuation is low	Attenuation is very low
7	Installation is easy	Installation is fairly easy	Installation is difficult

2 Explain the following flow and error control techniques:

i) Stop and wait

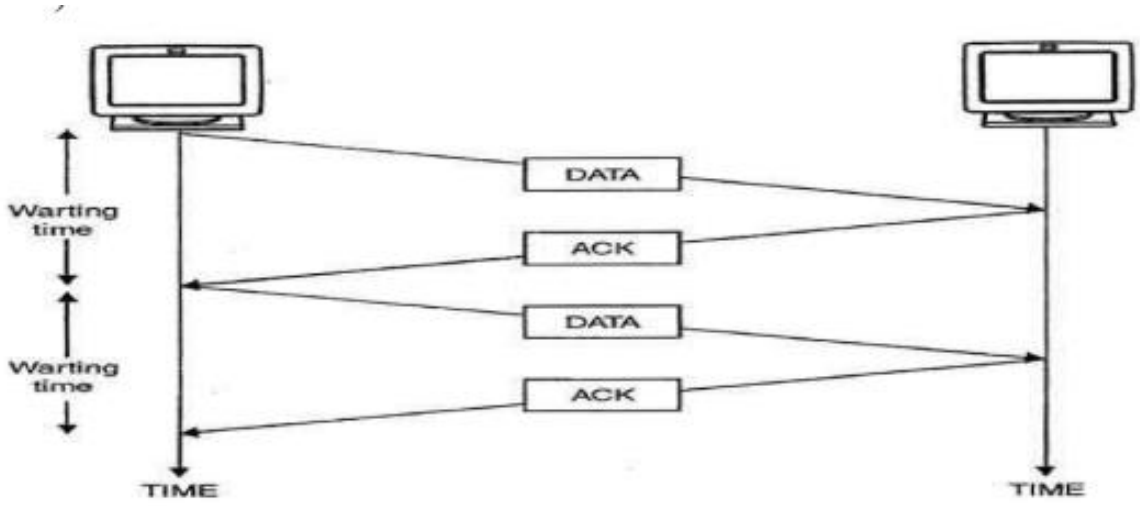
ii) Go back N ARQ.

Ans: i) Stop and wait:In this method of flow control, the sender sends a single frame to receiver & waits for an acknowledgment.

• The next frame is sent by sender only when acknowledgment of previous frame is received.

• This process of sending a frame & waiting for an acknowledgment continues as long as the sender has data to send.

• To end up the transmission sender transmits end of transmission (EOT) frame.



Stop & Wait Method.

ii) Go-Back-N ARQ:

In Go-Back-N ARQ method, both sender and receiver maintain a window.

 The sending-window size enables the sender to send multiple frames without receiving the acknowledgement of the previous ones.

 The receiving-window enables the receiver to receive multiple frames and acknowledge them. The receiver keeps track of incoming frame's sequence number.

 When the sender sends all the frames in window, it checks up to sequence number it has received positive acknowledgement.

 If all frames are positively acknowledged, the sender sends next set of frames.

 If sender finds that it has received NACK (negative acknowledgement) or has not receive any ACK for a particular frame, it retransmits all the frames after which it does not receive any positive ACK.

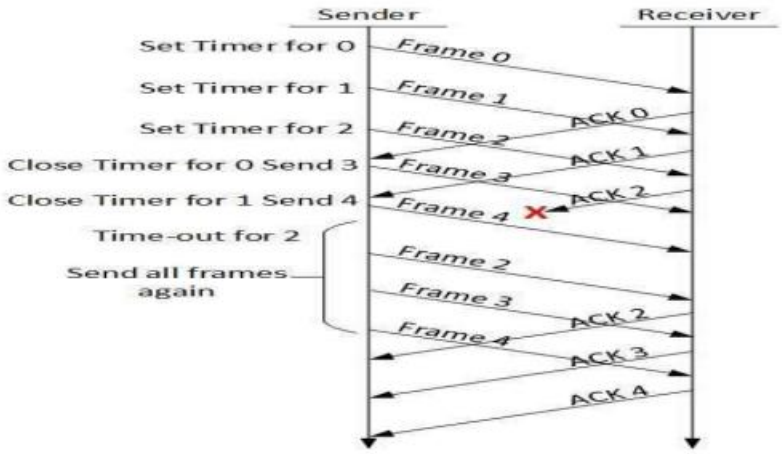


Fig: Go-Back-N ARQ

3 Compare first, second, third and fourth generation mobile telephone systems (any 3 points).

Technology	1G	2G/2.5G	3G	4G
Bandwidth	2Kbps	14-64kbps	2Mbps	200Mbps
Technology	Analog cellular	Digital cellular	Broadband width/CDMA/IP Technology	Unified IP and seamless combo of LAN/WAN/WLAN
Service	Mobile telephony	Digital voice, Short messaging	Integrated high quality audio, video and data	Dynamic information access, variable devices.
Multiplexing	FDMA	TDMA/CDMA	CDMA	CDMA
Switching	Circuit	Circuit/circuit for access network and air	Packet except for air interface	All packet

		interface		
Core Network	PSTN	PSTN	Packet network	Internet

4 Explain the following multiplexing techniques with block diagram:

i) TDM ii) FDM

Ans: i) TDM (Time Division Multiplexing):

1.TDM is the digital multiplexing technique.

2. In TDM, the channel/link is divided on the basis of on the basis of time.

3. Total time available in the channel is divided between several users.

4. Each user is allotted a particular time interval called time slot or time slice during which the data is transmitted by that user.

5. Thus each sending device takes control of entire bandwidth of the channel for fixed amount of time.

6. In TDM the data rate capacity of the transmission medium should be greater than the data rate required by sending or receiving devices.

7. In TDM all the signals to be transmitted are not transmitted simultaneously. Instead, they are transmitted one-by-one.

8. Thus each signal will be transmitted for a very short time. One cycle or frame is said to be complete when all the signals are transmitted once on the transmission channel.

9. The TDM system can be used to multiplex analog or digital signals, however it is more suitable for the digital signal multiplexing.

10. The TDM signal in the form of frames is transmitted on the common communication medium.

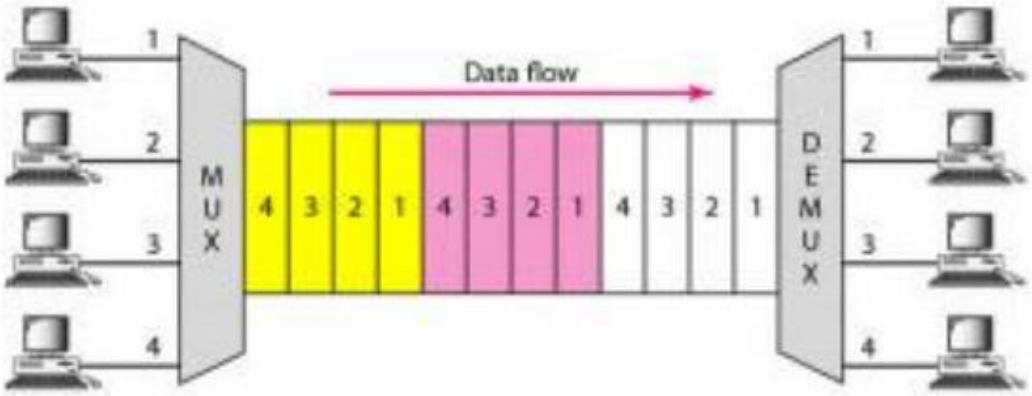


Fig. Time Division Multiplexing

ii) FDM(Frequency-Division Multiplexing):

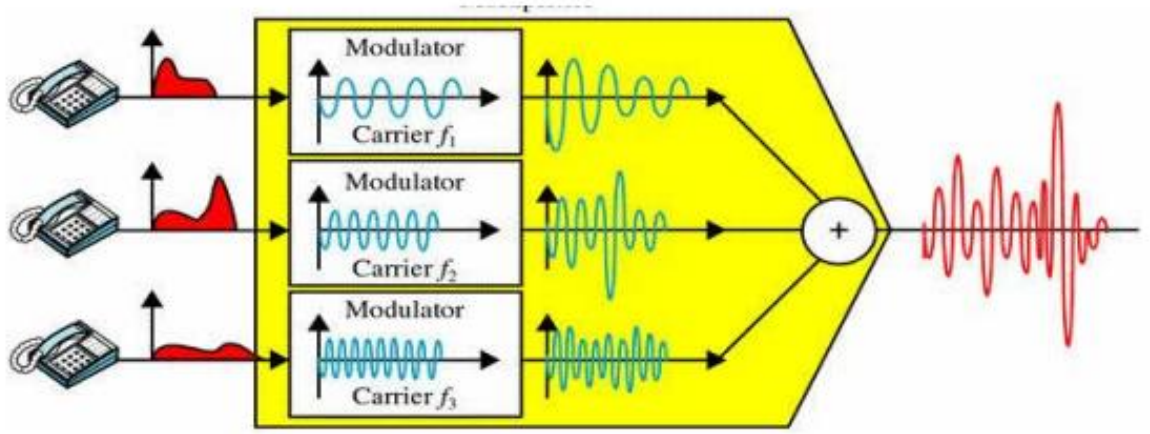
1.FDM is a scheme in which numerous signals are combined for transmission on a single communications line or channel.

2. It is analog multiplexing technique. Each signal is assigned a different frequency (sub channel) within the main channel. It requires channel synchronization.

3.FDM requires that the bandwidth of a link should be greater than the combined bandwidths of the various signals to be transmitted. Thus each signal having different frequency forms a particular logical channel on the link and follows this channel only. These channels are then separated by the strips of unused bandwidth called guard bands. These guard bands prevent the signals from overlapping as shown in

Fig.

4.In FDM, signals to be transmitted must be analog signals. Thus digital signals need to be converted to analog form, if they are to use FDM



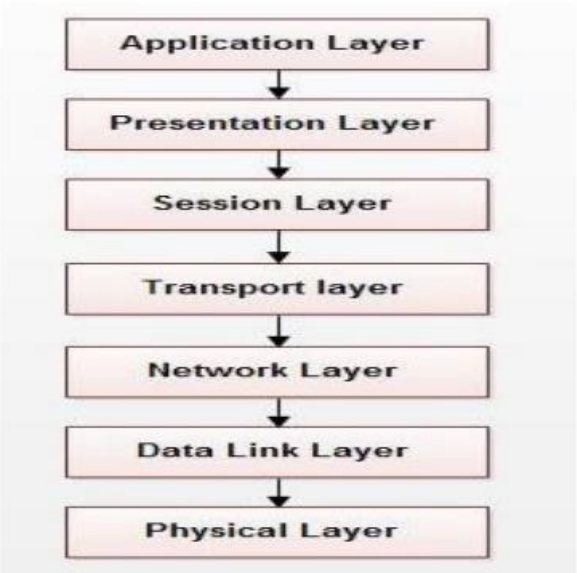
5 Explain the layered architecture of ISO-OSI model along with functions of each layer.

Ans: Layered Architecture of ISO-OSI Model:

1.The basic idea of a layered architecture is to divide the ISO-OSI model into small pieces. Each layer adds to the services provided by the lower layers in such a manner that the highest layer is provided a full set of services to manage communications and run the applications.

2. A basic principle is to ensure independence of layers by defining services provided by each layer to the next higher layer without defining how the services are to be performed.

3.In an n-layer architecture, layer n on one machine carries on conversation with the layer n on other machine. The rules and conventions used in this conversation are collectively known as the layer-n protocol.



7 Layers of OSI reference Model

ISO-OSI model has 7 layered architecture.
Functions of each layer are given below

Layer1 :Physical Layer

 It activates, maintains and deactivates the physical connection

 It is responsible for transmission and reception of the unstructured raw data over network.

 Voltages and data rates needed for transmission is defined in the physical layer.

 It converts the digital/analog bits into electrical signal or optical signals.

 Data encoding is also done in this layer.

Layer2: Data Link Layer

1. Data link layer synchronizes the information which is to be transmitted over the physical layer.

2. The main function of this layer is to make sure data transfer is error free from one node to another, over the physical layer.

3. Transmitting and receiving data frames sequentially is managed by this layer.

4. This layer sends and expects acknowledgements for frames received and sent respectively. Resending of nonacknowledgement received frames is also handled by this layer.

Layer3:The Network Layer

1. Network Layer routes the signal through different channels from one node to other.

2. It acts as a network controller. It manages the Subnet traffic.

3. It decides by which route data should take.

4. It divides the outgoing messages into packets and assembles the incoming packets into messages for higher levels.

Layer 4: Transport Layer

1. Transport Layer decides if data transmission should be on parallel path or single path.

2. Functions such as Multiplexing, Segmenting or Splitting on the data are done by this layer

3. It receives messages from the Session layer above it, convert the message into smaller units and passes it on to the Network layer.

4. Transport layer can be very complex, depending upon the network requirements.

Transport layer breaks the message (data) into small units so that they are handled more efficiently by the network layer.

Layer 5: The Session Layer

1. Session Layer manages and synchronize the conversation between two different applications.

2. Transfer of data from source to destination session layer streams of data are marked and are resynchronized properly, so that the ends of the messages are not cut prematurely and data loss is avoided.

Layer 6: The Presentation Layer

1. Presentation Layer takes care that the data is sent in such a way that the receiver will understand the information (data) and will be able to use the data.

2. While receiving the data, presentation layer transforms the data to be ready for the application layer.

3. Languages(syntax) can be different of the two communicating systems. Under this condition presentation layer plays a role of translator.

4. It performs Data compression, Data encryption, Data conversion etc.

Layer 7: Application Layer

1. Application Layer is the topmost layer.

2. Transferring of files disturbing the results to the user is also done in this layer. Mail services, directory services, network resource etc are services provided by application layer.

3. This layer mainly holds application programs to act upon the received and to be sent data.

6 Two channels one with a bit rate of 100 Kbps and another with

bit rate of 200 Kbps are to be multiplexed.

Answer the following questions:

i) Calculate size of frames in bits

ii) Calculate the frame rate

iii) Calculate the duration of frame

Ans: Channel 1 has a bit rate of 100Kbps. Channel 2 has a bit rate of 200Kbps Hence channel 2 is demultiplexed into 2 channels of 100Kbps each. Hence 3 channels of 100 Kbps are multiplexed effectively.

Let us consider that one slot of the channel 1 is allocated and two slots of the channel 2 is allocated in the frame .

i) Calculate size of frames in bits: Thus each frame carries 3 bits.

ii) Calculate the frame rate: The total bit rate of the multiplexed link is 300kbps. Each frame has 3 bits. The frame rate is100,000 frames per second (Any other assumption may also be considered).

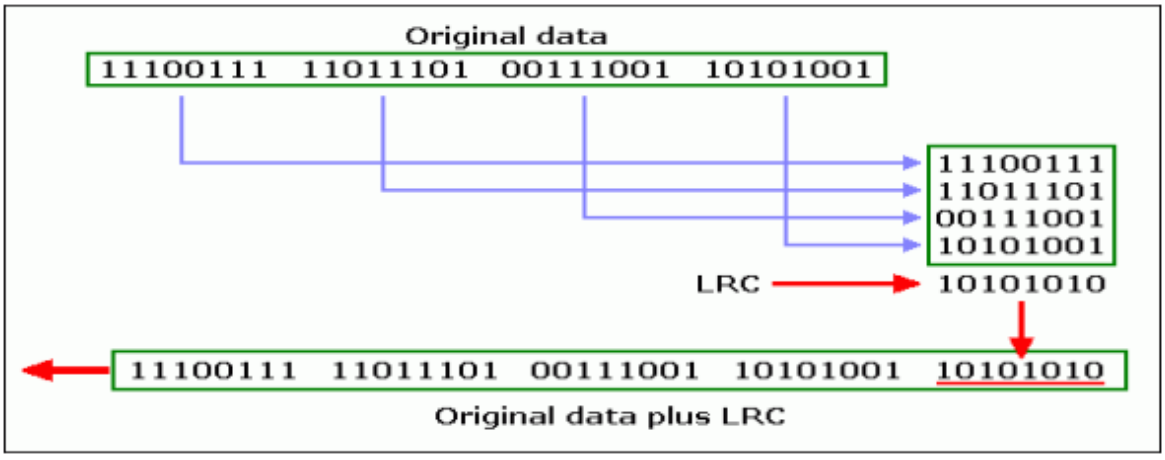
iii) Calculate the duration of frame: Thus the frame duration is 1/100,000s or 1s.

7 Explain LRC and VRC for error detection with suitable example.

Longitudinal Redundancy Check:

Ans: A longitudinal redundancy check (LRC) is an error-detection method for determining the correctness of transmitted and stored data.LRC verifies the accuracy of stored and transmitted data using parity bits. It is a redundancy check applied to a parallel group of bit streams. The data to be transmitted is divided into transmission blocks into which additional check data is inserted.

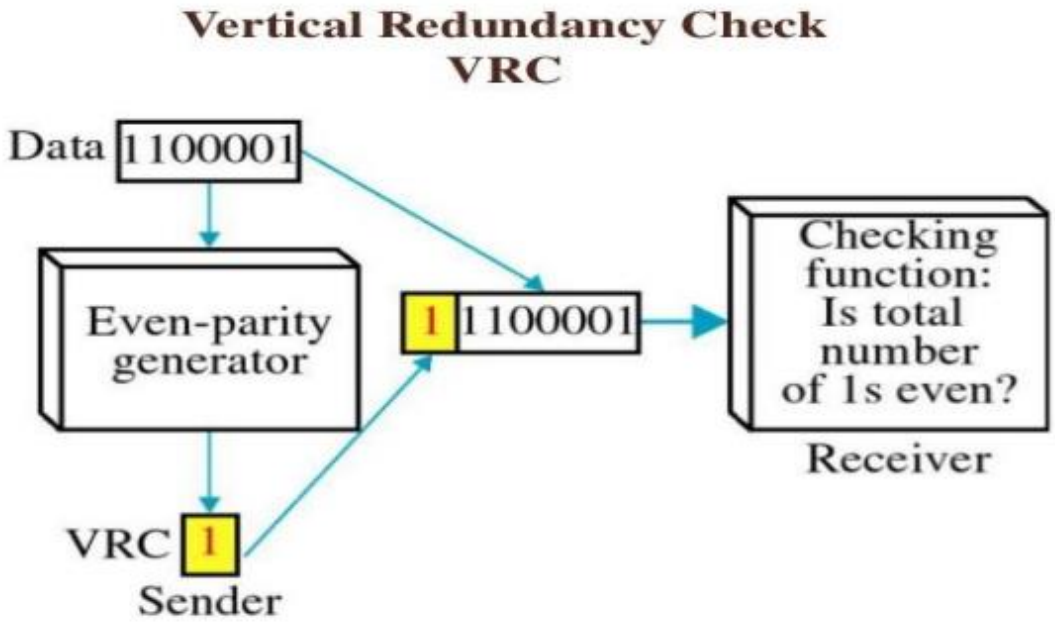
In this error detection method, a block of bits is organized in a table with rows and columns. Then the parity bit for each column is calculated and a new row of eight bits, which are the parity bits for the whole block, is created. After that the new calculated parity bits are attached to the original data and sends to the receiver.



Vertical Redundancy check:

Vertical redundancy check (VRC) is an error-checking method used on an eight-bit ASCII character. In VRC, a parity bit is attached to each byte of data, which is then tested to determine whether the transmission is correct. VRC is considered an unreliable errordetection method because it only works if an even number of bits is distorted.

In this error detection technique, a redundant bit called parity bit is appended to every data unit so that total number of 1's in the unit (including parity bit) becomes even. The system now transmits entire extended unit across the network link. At the receiver, all eight received bits are checked through even parity checking function. If it counts even 1's data unit passes. If it counts odd number of 1's, it means error has been introduced in the data somewhere. Hence receiver rejects the whole data unit. Similar way odd parity VRC can also be implemented. In this method, total number of 1's in should be odd before transmission



8 Explain WLAN with diagram. Also state its advantages and disadvantages.

Ans: A wireless local area network (WLAN) is a wireless distribution method for two or more devices that use high-frequency radio waves and often include an access point to the Internet. A WLAN allows users to move around the coverage area, often a home or small office, while maintaining a network connection.

The two types of services are

1. Basic services set (BSS)

2. Extended Service Set (ESS)

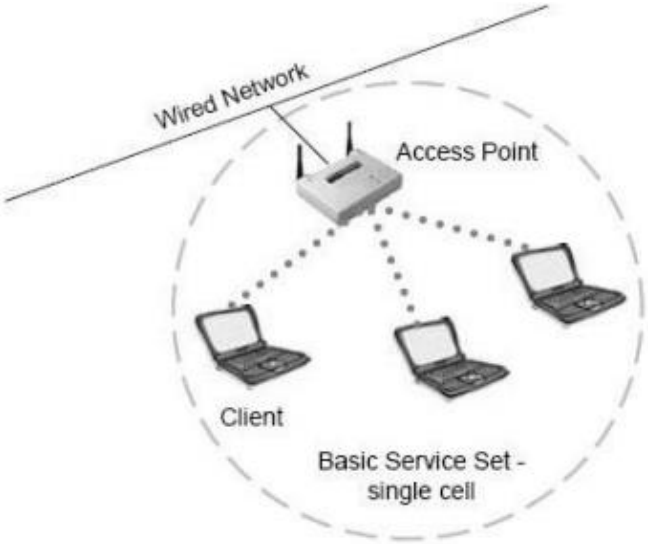
1. Basic Services Set (BSS)

• The basic services set contain stationary or mobile wireless stations

and a central base station called access point (AP).
• The use of access point is optional.

• If the access point is not present, it is known as stand-alone network. Such a BSS cannot send data to other BSSs. This type of architecture is known as adhoc architecture.

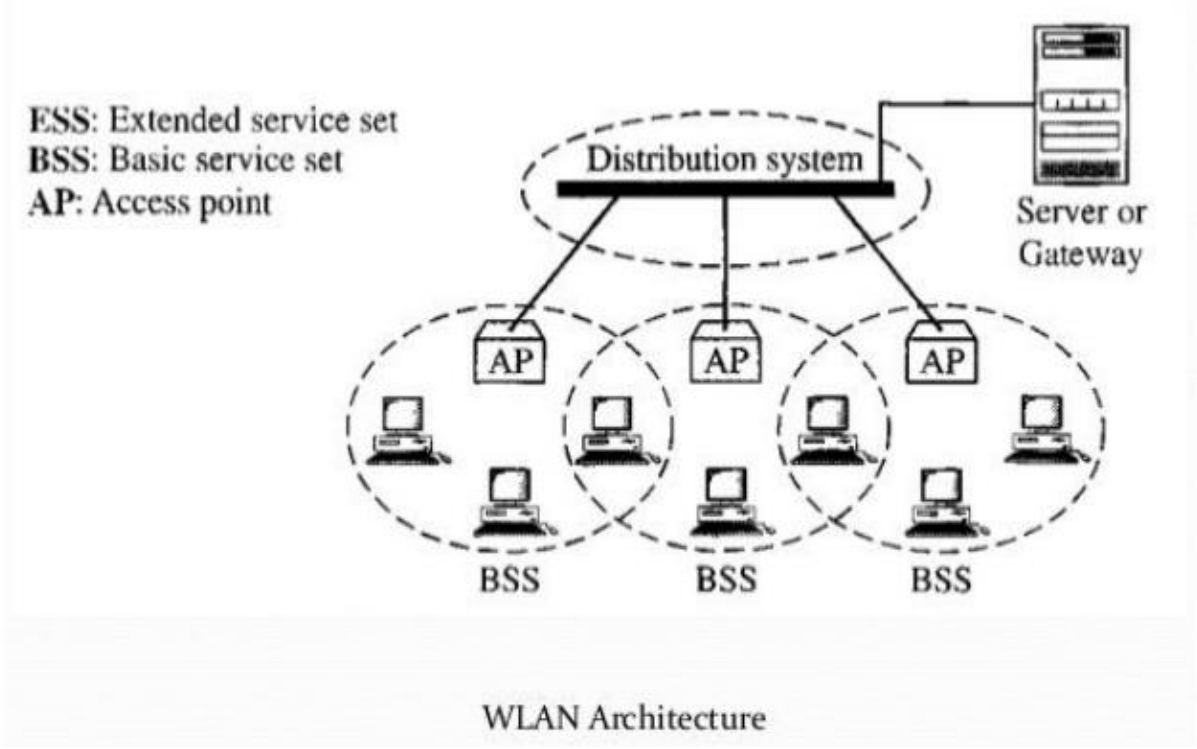
• The BSS in which an access point is present is known as an infrastructure network.



2. Extend Service Set (ESS)

• An extended service set is created by joining two or more basic

service sets (BSS) having access points (APs).



WLAN Architecture

Advantages of WLANs:

- They provide clutter-free homes, offices and other networked places.
- The LANs are scalable in nature, i.e. devices may be added or removed from the network at greater ease than wired LANs.
- The system is portable within the network coverage. Access to thenetwork is not bounded by the length of the cables.
- Installation and setup are much easier than wired counterparts.
- The equipment and setup costs are reduced.

Disadvantages of WLANs:

- Since radio waves are used for communications, the signals are noisier with more interference from nearby systems.
- Greater care is needed for encrypting information. Also, they are more prone to errors. So, they require greater bandwidth than the wired LANs.

 WLANs are slower than wired LANs.

9 Two channels one with a bit rate of 150 kbps and another with a bit rate of 140 kbps are to be multiplexed using pulse stuffing TDM with no synchronization bits. Answer the following questions.

(i) What is the size of a frame in bit?

(ii) What is the frame rate?

(iii) What is the duration of frame?

Ans: We need to add extra bits to the second source to make both rates = 150kbps.

Now we have two sources, each of 150 Kbps.

a. The frame carries 1 bit from each source. Frame size = 1 + 1 = 2 bits.

b. Each frame carries 1 bit from each 150-kbps source. Frame rate = 150,000 frames/s.

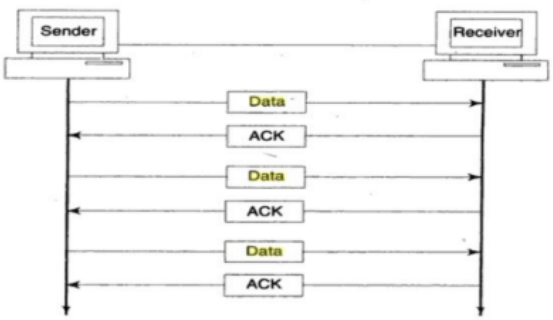
c. Frame duration = 1 /(frame rate) = 1 /150,000 = 6.66µs.

10 Explain stop and wait ARQ with example.

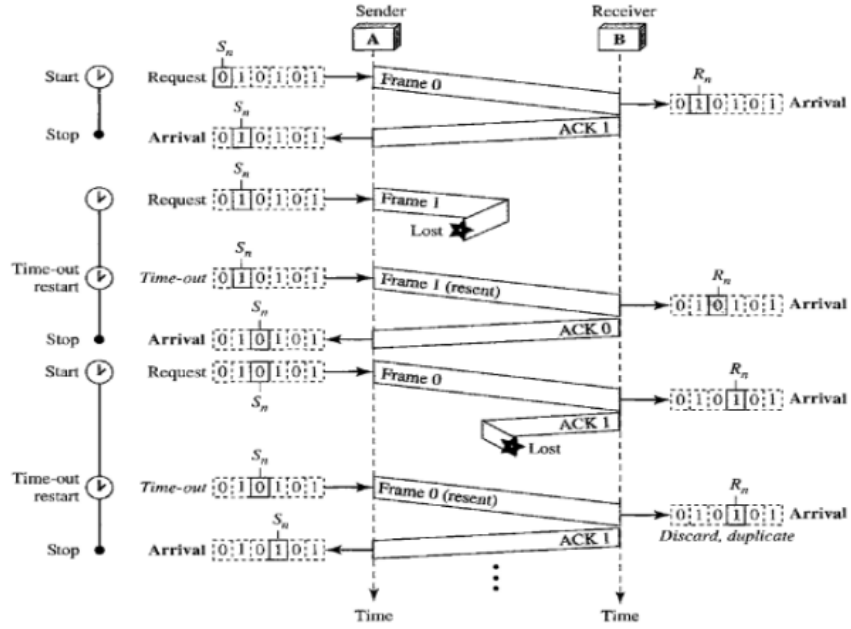
Ans: Stop and Wait:

This is a very simple method where in the sender sends one frame of data and necessarily waits for an acknowledgement (ACK) from the receiver before sending the next frame. Only after the sender receives and acknowledgement for a frame does it send the next frame. Thus, the transmission always takes the form Data-ACK-Data-ACK….etc, where the Data frames are sent by the sender, and the ACK frames are sent by the receiver back to the sender. This is shown in figure.

The stop-and wait- approach is pretty simple to implement. Every frame must be individually acknowledged before the next frame can be transmitted. However, therein also lies its drawback. Since the sender must receive each acknowledgement before it can transmit the next frame, it makes the transmission very slow.



Example:



11 In a digital medium with a data rate of 12 mbps. How many 64 kbps voice channels can be carried if DSSS is used with Barker sequence?

Ans: Solution:

12mbps=12000kbps

So number of 64kbps voice channels that can be carried if DSSS is used with Barker sequence:

12000/64=187.5 channels

12 Explain Microwave transmission with its advantages and disadvantages.

Ans: Microwave: Electromagnetic waves having frequencies between 1 and 300GHz 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.

 Very high-frequency microwaves cannot penetrate walls. This characteristics 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

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 wirelessLANs.

Advantages:

 Installation of towers and associated equipments is cheaper than laying down a cable of 100KM length.

 Less maintenance as compared to cables.

 Repeaters can be used. So effect of noise is reduced.

 No adverse effects such as cable breakage.

 Due to the use of highly directional antenna no interference is there.

 Size of transmitter and receiver reduces due to the use of high frequency.

Disadvantages: Signal strength at the receiving antenna reduces due to multipath reception
 The transmission will be affected by the thunderstorms and other atmospheric phenomenon.

13 Explain stop and wait ARQ with example.

Ans: Stop and Wait:

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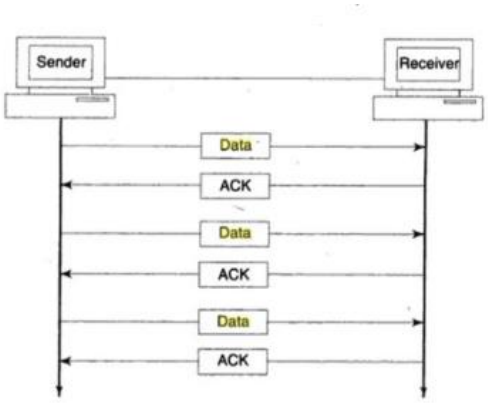
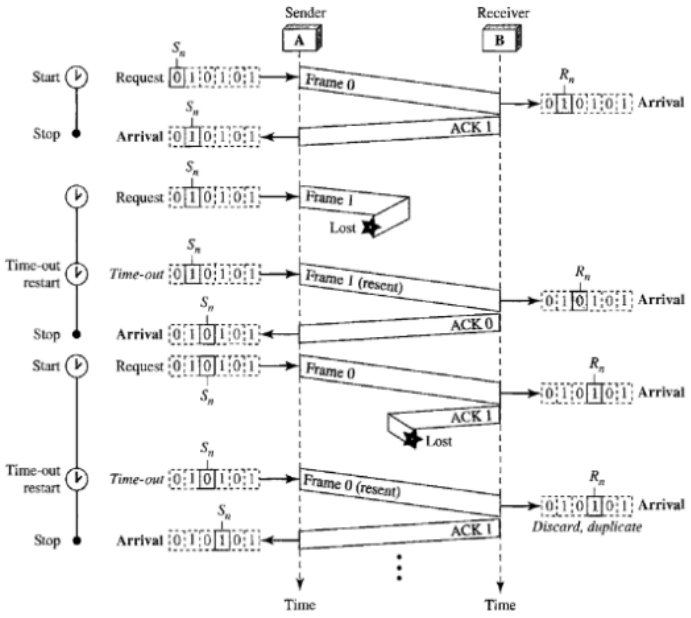




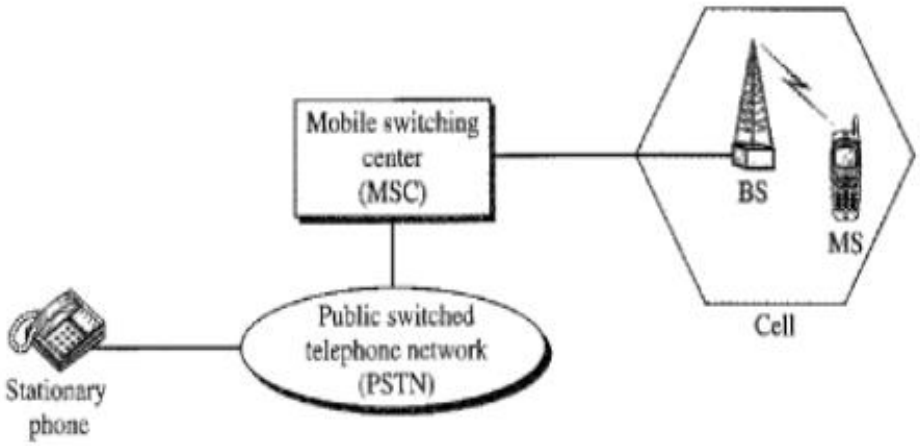
14 Draw and explain Mobile Telephone System Architecture.

Ans: Cellular telephony is designed to provide communications between two moving units, called mobile stations (MSs), or between one mobile unit and one stationary unit, often called a land unit. A service provider must be able to locate and track a caller, assign a channel to the call, and transfer the channel from base station to base station as the caller moves out of range.

To make this tracking possible, each cellular service area is divided into small regions called cells. Each cell contains an antenna and is controlled by a solar or AC powered network station, called the base station (BS). Each base station, in turn, is controlled by a switching office, called a mobile switching centre (MSC).

The MSC coordinates communication between all the base stations and the telephone central office. It is a computerized centre that is responsible of connecting calls, recording call information, and billing.

Cell size is not fixed and can be increased or decreased on the population of the area. The typical radius of a cell is 1 to 12mi. Highdensity areas require more, geographically smaller cells to meet traffic demands than do low-density areas. Once determined, cell size to optimized to prevent the interference of adjacent cell signals. The transmission power of each cell is kept low to prevent its signal from interfering with those of other cells.



15 Explain process of synchronous time division multiplexing with its advantages.

Ans: Synchronous TDM or TDM:

In the technique called synchronous TDM, also referred to as TDM, the time slice is allocated to a source node regardless of whether it wants to send some

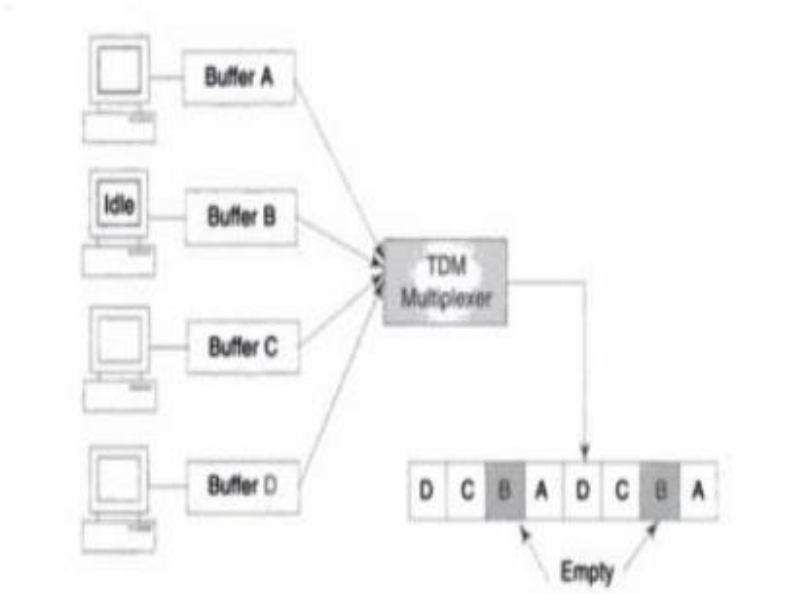
data or not. This is a fairly simple mechanism to identify, at a destination node, which data originated from which source node, since every source node has a fixed time slot. Therefore, the position of the data within the data frame specifies its origin. However, it can be a very wasteful scheme, because the time slot is allotted to a source node even if it has nothing to send.

A small buffer memory is associated with every source node. At any time, not all nodes may want to send some data. Regardless of this, the timing device in the multiplexer allocates some time for each node to transmit the data from its buffer, and then repeats this cycle. E.g. A-B-C-D-A-B-C-D etc. AS shown in the figure. By the time its turn comes next, if a node wants to transmit any data, it will have moved a small chunk to its buffer. If there is no data to be transmitted, the buffer will be empty but still the turn of the node will come.

Advantages:

 An order is maintained

 No addressing information is required, channel capacity should be large.

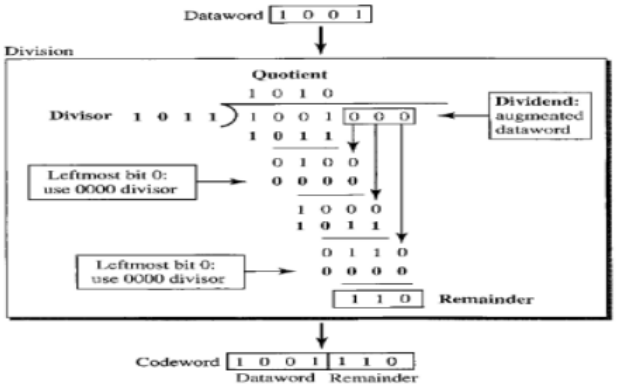


16 Explain process of CRC (Cyclic Redundancy Check) with example.

Ans: CRC Encoder:

In the encoder, the data word has k bits (4 here); the codeword has n bits (7 here). The size of the data word is augmented by adding $n - k$ (3 here) 0s to the right-hand side of the word. The n-bit result is fed into the generator. The generator uses a divisor of size $n - k + 1$ (4 here), predefined and agreed upon. The generator divides the augmented data word by the divisor (modulo-2 division). The quotient of the division is discarded; the remainder $r2\ r1\ r0$ is appended to the data word to create the codeword.

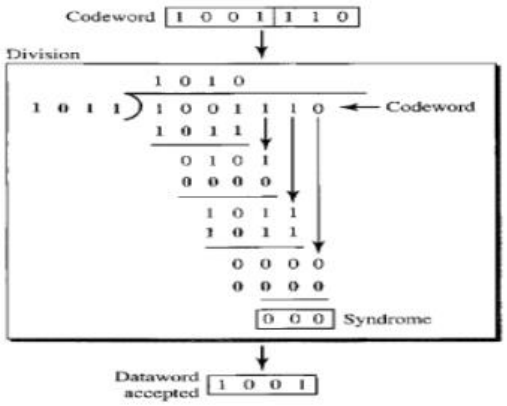
Example:Let us take a closer look at the encoder. The encoder takes the Data word and augments it with $n - k$ number of 0s. It then divides the augmented data word by the divisor, as shown in Figure.



CRC Decoder:

The codeword can change during transmission. The decoder does the same division process as the encoder. The remainder of the division is the syndrome. If the syndrome is all 0s, there is no error; the data word is separated from the

received codeword and accepted. Otherwise, everything is discarded. Example:



17 Explain DSSS mechanism with neat diagram.

Direct Sequence Spread Spectrum: The direct sequence spread spectrum (DSSS) technique also expands the bandwidth of the original signal, but the process is different. In DSSS, we replace each data bit with n bits using a spreading code. In other words, each bit is assigned a code of n bits, called chips, where the chip rate is n times that of the data bit.

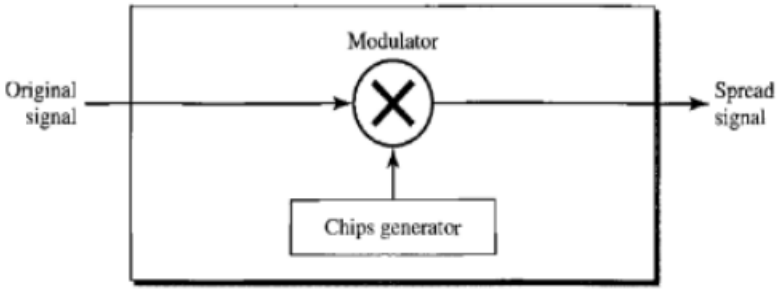


Figure: Concept of DSSS

As an example, let us consider the sequence used in a wireless LAN, the famous Barker sequence where n is 11. We assume that the original signal and the chips in the chip generator use polar NRZ encoding. Figure shows the chips and the result of multiplying the original data by the chips to get spread signal.