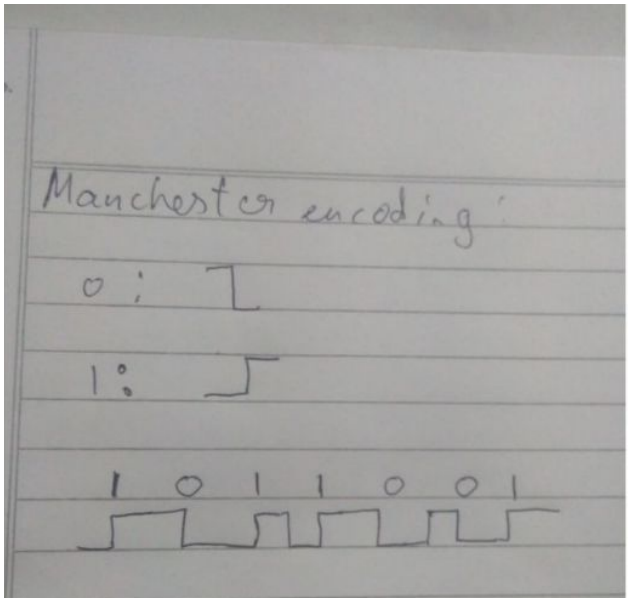
1. What is baseline wandering and how does Manchester encoding help in solving this problem? Explain by drawing the Manchester encoding for the data: 1011001.

Ans:-In decoding, a digital signal, the receiver calculates a running average of the received signal power. The running average is also known as the “baseline”. A long string 0s or 1s can cause a drift in the baseline (baseline wandering) and make it difficult for the receiver to decode correctly.
Manchester encoding (first published in 1949) is a synchronous clock encoding technique used by the physical layer to encode the clock and data of a synchronous bit stream. In this technique, the actual binary data to be transmitted over the cable are not sent as a sequence of logic 1's and 0's (known technically as Non Return to Zero (NRZ)). Instead, the bits are translated into a slightly different format that has a number of advantages over using straight binary encoding



2. Four 1-kbps connections are multiplexed together. A unit is 1 bit. Find (1) the duration of 1 bit before multiplexing, (2) the transmission rate of the link, (3) the duration of a time slot, and (4) the duration of a frame.

Four 1-Kbps connections are multiplexed together. A unit is 1 bit. Find (1) the duration of 1 bit before multiplexing, (2) the transmission rate of the link, (3) the duration of a time slot, and (4) the duration of a frame?

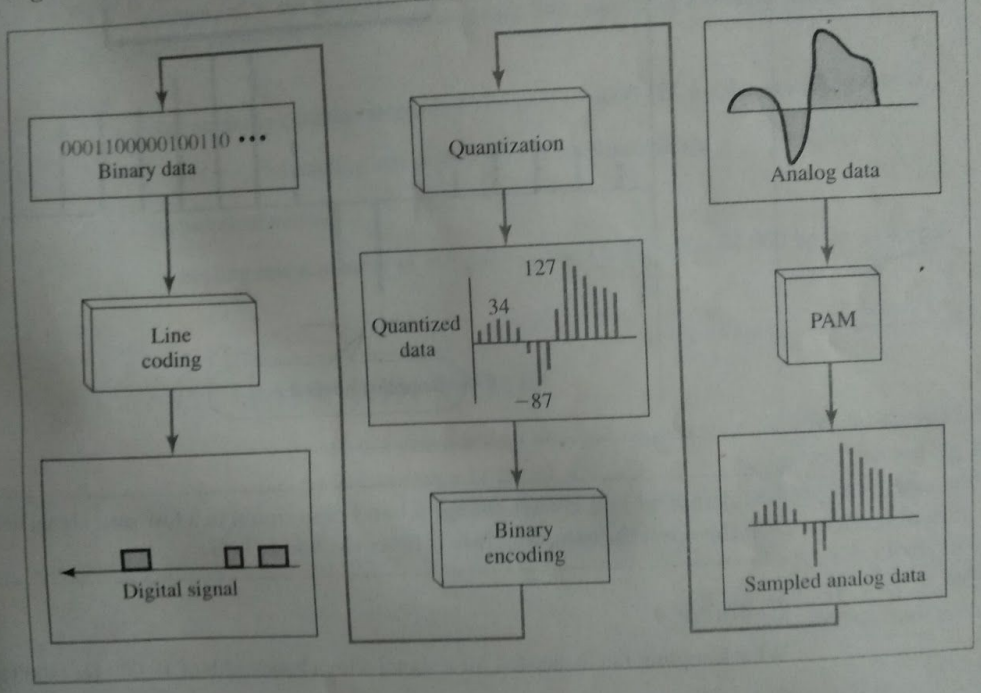
Solution

We can answer the questions as follows:

1. The duration of 1 bit is 1/1 Kbps, or 0.001 s (1 ms).
2. The rate of the link is 4 Kbps.
3. The duration of each time slot 1/4 ms or 250 μs.
4. The duration of a frame 1 ms.

3. Name the steps of PCM and state very briefly (with diagram) the activity of each step.

Figure 4.22 *From analog signal to PCM digital code*



Sampling Rate: Nyquist Theorem

4. A telephone line normally has a bandwidth of 3000Hz assigned for data communication. The signal to noise ratio is usually 3162. Find the channel capacity.

regular telephone line. A telephone line normally has a bandwidth of 3000. The signal-to-noise ratio is usually 3162. For this channel the capacity is calculated as

$$C = B \log_2 (1 + \text{SNR}) = 3000 \log_2 (1 + 3162) = 3000 \log_2 3163$$
$$= 3000 \times 11.62 = 34{,}860 \text{ bps}$$

This means that the highest bit rate for a telephone line is 34.860 kbps. If we want to send data faster than this, we can either increase the bandwidth of the line or improve the signal-to-noise ratio.

5. Bit rate can be increased as much as wanted by increasing the number of signal levels as per the calculations given by Nyquist theorem for noiseless channel. Comment.

6. We want to digitize a human voice. What is the bit rate, assuming 8 bits per sample?

The human voice normally contains frequencies from 0 to 4000 Hz.
Sampling rate = 4000 x 2 = 8000 samples/s
Bit rate = sampling rate x number of bits per sample = 8000 x 8 = 64,000 bps = 64 Kbps

7. Compare and contrast a circuit switched network and a packet switched network.

"In a circuit-switched network, data are not packetized; data flow is somehow a continuation of bits that travel the same channel during the data transfer phase. In a packet-switched network data are packetized; each packet is somehow an independent entity with its local or global addressing information."

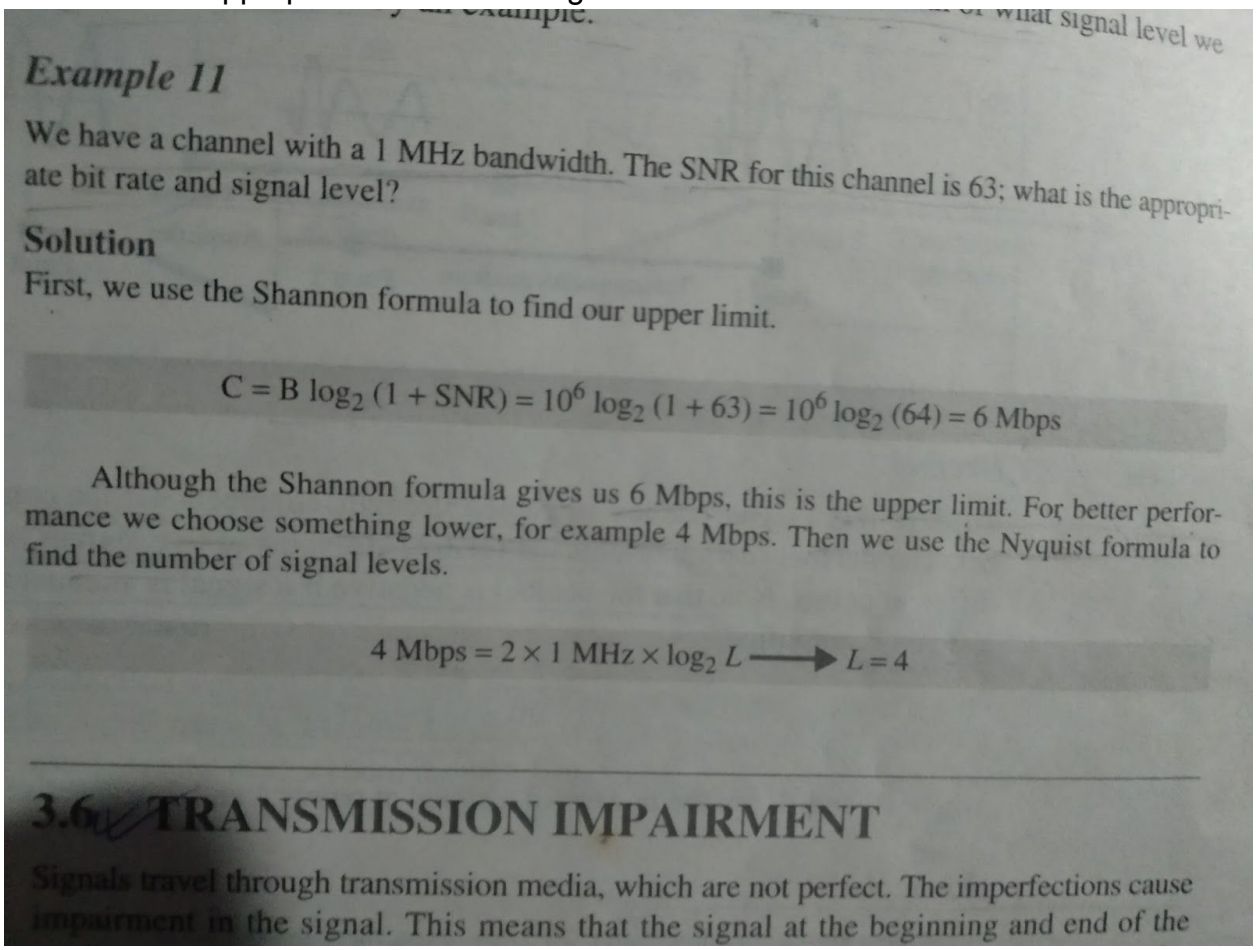
8. Explain what is the purpose of multiplexing (FDM is for analog signals and TDM is for digital signal)?

Multiplexing basically involves taking multiple signals and combining them into one signal for transmission over a single medium, such as a telephone line. The input signals can be either analog or digital. The purpose of multiplexing is to enable signals to be transmitted more efficiently over a given communication channel, thereby decreasing transmission costs.

9. Twisted pair offers better bandwidth than untwisted pair. How?

   Purpose of twisting the wire is to reduce the electrical interference from the similar pairs in surroundings. The performance of the wire improves with the increase in the number of twist per foot.

10. We have a channel with 1-MHz bandwidth. The SNR for this channel is 63. What are the appropriate bit rate and signal level.



Example 11

We have a channel with a 1 MHz bandwidth. The SNR for this channel is 63; what is the appropriate bit rate and signal level?

Solution

First, we use the Shannon formula to find our upper limit.

$$C = B \log_2 (1 + SNR) = 10^6 \log_2 (1 + 63) = 10^6 \log_2 (64) = 6 \text{ Mbps}$$

Although the Shannon formula gives us 6 Mbps, this is the upper limit. For better performance we choose something lower, for example 4 Mbps. Then we use the Nyquist formula to find the number of signal levels.

$$4 \text{ Mbps} = 2 \times 1 \text{ MHz} \times \log_2 L \longrightarrow L = 4$$

3.6 TRANSMISSION IMPAIRMENT

Signals travel through transmission media, which are not perfect. The imperfections cause impairment in the signal. This means that the signal at the beginning and end of the

11. Compare OSI and TCP/IP model.

OSI(Open System Interconnection)	**TCP/IP(Transmission Control Protocol / Internet Protocol)**

1. OSI is a generic, protocol independent standard, acting as a communication gateway between the network and end user.	1. TCP/IP model is based on standard protocols around which the Internet has developed. It is a communication protocol, which allows connection of hosts over a network.
2. In OSI model the transport layer guarantees the delivery of packets.	2. In TCP/IP model the transport layer does not guarantees delivery of packets. Still the TCP/IP model is more reliable.
3. Follows vertical approach.	3. Follows horizontal approach.
4. OSI model has a separate Presentation layer and Session layer.	4. TCP/IP does not have a separate Presentation layer or Session layer.
5. Transport Layer is Connection Oriented.	5. Transport Layer is both Connection Oriented and Connection less.
6. Network Layer is both Connection Oriented and Connection less.	6. Network Layer is Connection less.
7. OSI is a reference model around which the networks are built. Generally it is used as a guidance tool.	7. TCP/IP model is, in a way implementation of the OSI model.
8. Network layer of OSI model provides both connection oriented and connectionless service.	8. The Network layer in TCP/IP model provides connectionless service.

9. OSI model has a problem of fitting the protocols into the model.	9. TCP/IP model does not fit any protocol
10. Protocols are hidden in OSI model and are easily replaced as the technology changes.	10. In TCP/IP replacing protocol is not easy.
11. OSI model defines services, interfaces and protocols very clearly and makes clear distinction between them. It is protocol independent.	11. In TCP/IP, services, interfaces and protocols are not clearly separated. It is also protocol dependent.
12. It has 7 layers	12. It has 4 layers

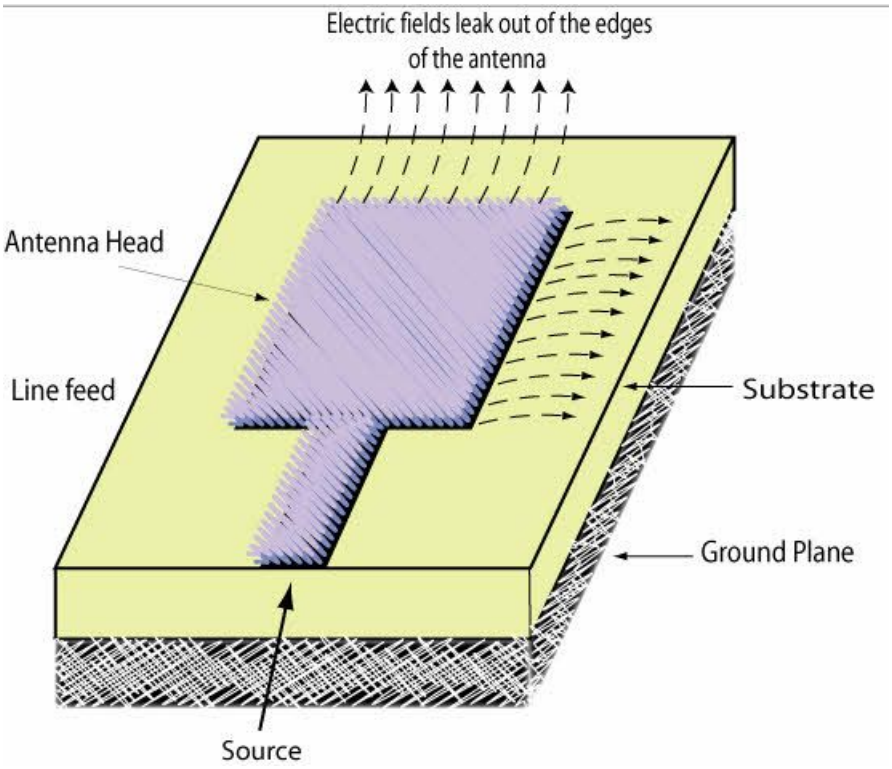
12. What are the antennas used for microwave communication: Name the antennas, draw them, write briefly how they work

Classification of microwave antennas:

1. Micro strip patch antenna
2. Horn antenna
3. Parabolic antenna
4. Plasma antenna
5. MIMO antenna

All the above types of antennas, their importance and applications are briefly discussed below.

1. Micro Strip Patch Antenna



Micro strip patch antenna

These antennas are also known as patch antennas. A micro strip patch antenna consists of a radiating patch that is bonded to a dielectric substrate on one side and has a ground plane on the other side.

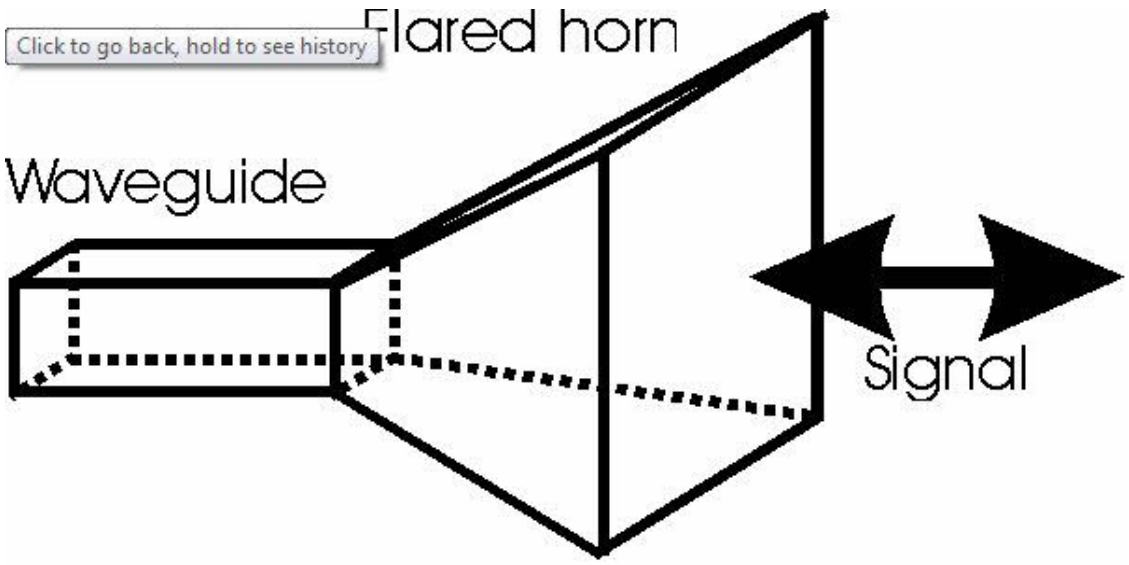
The patch is generally composed of conducting materials like copper or gold. The operational frequency of these antennas range between 100 MHz and 100 GHz. Due to the advantages like less weight, low volume and low fabrication cost, these antennas can be manufactured in large quantities.

The micro strip patch antennas are well-known for their performance and extent of usage. The usage of micro strip antennas in the wide range could take over the usage of conventional antennas in applications.

There are several applications that use the micro-strip patch antennas, such as global positing satellites, cellular phones, personal communication system and paging devices.

2. Horn Antenna

The Horn antenna or Microwave Horn is an antenna consisting of a waveguide whose end walls are flared outside to form a megaphone like structure, as shown in the below figure. These horns are widely used as antennas at ultra-high frequencies and microwave frequencies that are well above 300 MHz.



Horn antenna

These are used to measure the gain of other antennas as calibrating antennas and directive antennas for devices like automatic door openers and microwave-radio meters.

The advantages of the horn antenna include moderate directivity, low-standing wave ratio and broad bandwidth. The gain of horn antenna ranges upto 25 db.These are extensively used at microwave frequency when the power gain needed is moderate.

3. Parabolic antenna

A parabola antenna is an antenna that uses a parabolic reflector, a curved surface with cross sectional shape of a parabola to direct the radio waves. The shape of the antenna is in the form of a dish; therefore, it is popularly known as dish antenna or parabolic dish. High directivity is the main advantage of the parabolic antenna.


Parabolic antenna

These antennas find their applications as high gain antennas for point-to-point communication and also as radio telescopes. In addition to this, the parabolic antennas are also used as radar antennas because in radars there is a need for transmitting a narrow beam of radio waves to local objects like ships, airplanes, etc.

4. Plasma Antenna

Plasma antenna

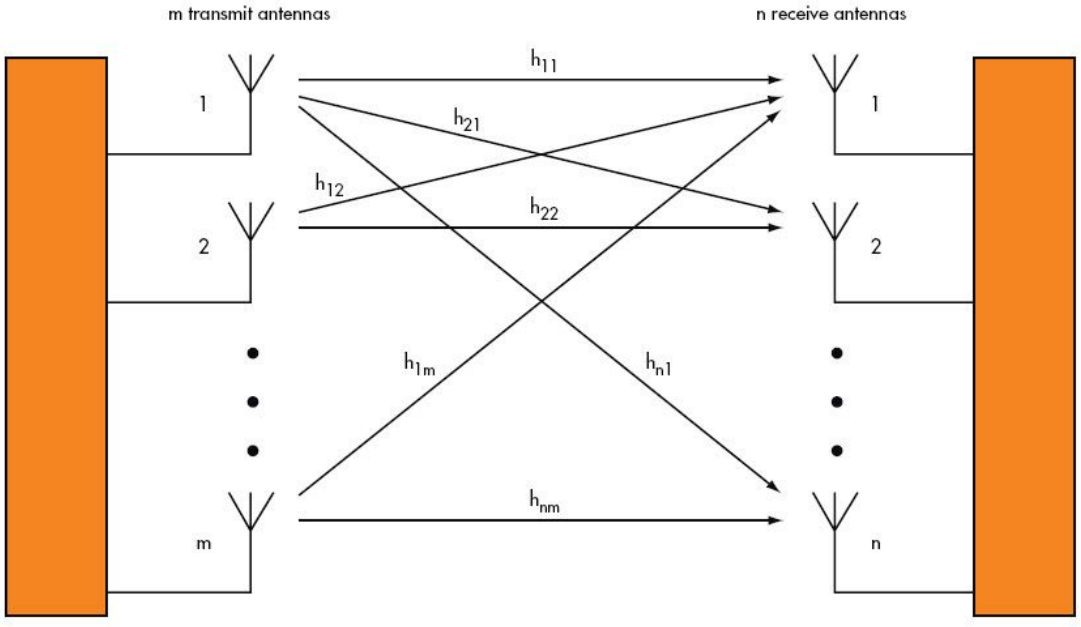
A plasma antenna is a type of radio antenna in which the plasma is used as a development element instead of the metal elements that are used in traditional antenna. It uses ionized gas as a conducting material because this gas ionizes when transmission or reception takes place.

The Plasma antenna can be used for both transmission and reception of the radio signals as they are capable of operating upto 90GHz frequency range.

The plasma antenna has high frequency cutoff .It can transmit and receive high and low-frequency signals while not interacting with the high frequency signals. The applications of the plasma antenna are high speed digital communications, electronic intelligence, RFID, 4G and radar systems.

5. MIMO antenna

In radio, multiple inputs and multiple outputs or MIMO are used, and therefore, the multiple antennas are used at both the transmitter and receiver ends to improve communication's performance. It is one of the smart antenna technologies.

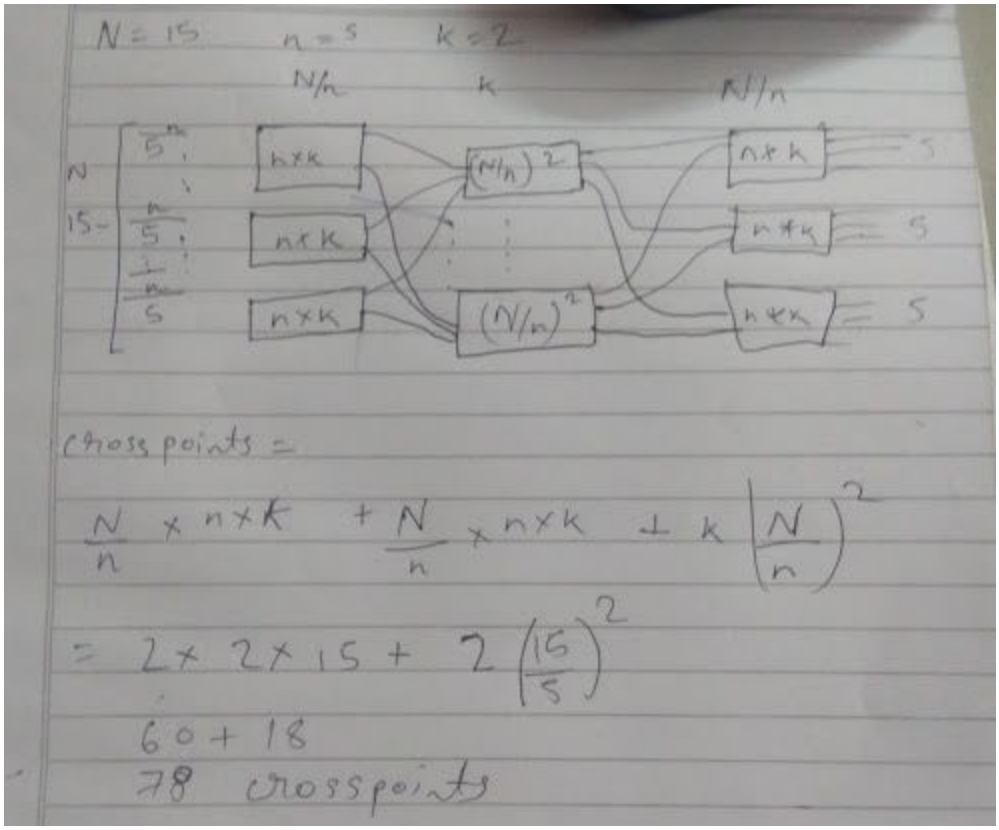


MIMO antenna

The multiple antennas in MIMO can be exploited in two ways: one is for the creation of highly effective antenna directivity, and the other is for transmitting the parallel data streams to increase the capacity of the system. The applications of the MIMO antennas are mesh networks and RFID systems.

13. With the help of a diagram calculate the delay in a packet switched datagram network.

14. Design a three stage, 15X15 switch (N=15), with n=5, k=2. What will be the total no. of cross-points? Explain.



15. A 7 bit dataword 1101010 is to be sent by using Hamming code error detection and correction method. Show how the receiver corrects an error which occurs in the 6th bit position from the right.

16. In Go-back-N ARQ, sender window size < 2^m." Is it correct? Justify.

17. Explain in detail about the state transition diagram of PPP.
18. Of x + 1, x^3 which g(x) value guarantees that a single-bit error will be caught? Explain your answer with relevant analysis (preferably using polynomial expression).

    x+1 guarantees that a single bit error will be caught.
    Received codeword=c(x)+e(x)
    Received codeword/g(x)=c(x)/g(x)+e(x)/g(x)
    c(x), the original codeword with the extra zeroes, is already divisible by g(x).
    Thus, if e(x) is not divisible by g(x), the error can be detected. All single-bit errors are of the form x^i (where the error occurs at the ith position). x^3 divides x^i expressions if i>=3, but x+1 does not divide x^i for any value of i. Hence, the answer!

19. Taking 1100, 1110, 1010 as data (3 blocks each of 4 bits) show the steps that happen at the sender and the receiver side if Checksum is used as the method of error detection.

20. To increase reliability redundant links can be used between bridges. However, that poses a problem as well. What is the problem and how does spanning tree bridge solve the problem?

21. Consider a 50-kbps satellite channel with a 500-msec round-trip propagation delay. Frame size is 1000 bit. Find the following:-

a) If stop and wait protocol is used in the above channel, calculate for what percentage of time will the sender be idle.
b) If sliding window protocol is used, what should be the ideal window size of the sender

22. With diagram show the frame exchange in CSMA/CA and mention in brief the utility of RTS, CTS frames and NAV.

23. What is the use of a supervisory frame in HDLC**.**

24. Explain the working principle of CDMA with suitable example.
25. Explain CSMA/CD with the help of a flowchart. In CSMA/CD to detect a collision what should be the minimum frame size?
26. If an Ethernet destination address is 05:01:02:03:04:05, what is the type of address (unicast, multicast or broadcast) ?
27. Router J has 4 neighbours A, I, H,K. The following list summerizes the various delay:

JA: 8	JI:10	JH:12	JK:6
A to G: 18	I to G: 31	H to G: 6	K to G: 31

28. Using distance vector routing protocol determine the routing table entry for J to the router G. Explain count to infinity problem with suitable example.

29. What is flooding? What is the problem associated with flooding? How selective flooding solve that problem?

30. An organization is granted the block 130.34.12.64/26. The organization needs to have four subnets. What are the subnet addresses and the range of addresses for each subnet? Draw the diagram.

31. Explain with suitable example how address translation is done by using a NAT router (use only one IP address).

32. What is the purpose of subnetting? Find the netid and the hostid of the following IP addresses :
i) 19.34.21.5
ii) 220.34.8.9

32. Differentiate between ARP and RARP protocol.

Basis of Distinction	**ARP**	**RARP**
Name	Address Resolution Protocol	Reverse Address Resolution Protocol
Definition	Protocol that gets used by the Internet Protocol Services such as IPv4 to write down the IP network address along with the hardware address employed in the data link protocol.	A computer programming network protocol that has become obsolete but used to request the IP address of the network of equipment as asked by the client.
Capacity	The capacity of mapping 32-bit logical (IP) address to 48-bit physical address.	The potential of mapping 48-bit physical address to 32-bit logical (IP) address.
Job	The retrieval of address from the receiver	Retrieving the logical address from the computer for the server.

33. What is the difference between static and dynamic routing?

34. Name the steps of Link state routing protocol?

35. What is the use of the Age field in the link state packets?

36. Construct the link state packets for the following network.

37. Explain why classfull addressing became obsolete.

1. **Lack of Internal Address Flexibility:** Big organizations are assigned large, “monolithic” blocks of addresses that don't match well the structure of their underlying internal networks.

2. **Inefficient Use of Address Space:** The existence of only three block sizes (classes A, B and C) leads to waste of limited IP address space.

3. **Proliferation of Router Table Entries:** As the Internet grows, more and more entries are required for routers to handle the routing of IP datagrams, which causes performance problems for routers. Attempting to reduce inefficient address space allocation leads to even more router table entries.

Addressing Inflexibility

Issue #1 results primarily from the fact that in the “classful” system, big companies get assigned a rather large (Class B) or truly enormous (Class A) block of addresses, all of which is considered by the Internet routers a single “network” with one “network ID”. Now, imagine that you are running a medium-to-large-sized company with 5,000 computers, and you are assigned a Class B address for your network. Do you really have 5,000 computers all hooked into a single network? I sure as heck hope you don't! Yet you would be forced to try to fit all of these into a single IP “network” in the original “classful” method. There was no way to create an internal hierarchy of addresses.

38. An organization is granted a block of addresses with the beginning address 14.24.74.0/24. The organization needs to have 3 subblocks of addresses to use in its three subnets: one subblock of 10 addresses, one subblock of 60 addresses, and one subblock of 120 addresses. Design the subblocks.

39. What is a loop back address and why is it needed?

"Any traffic that a computer program sends to the loopback interface is immediately received on the same interface."

Basically, it's a fake network interface, useful for tests and stability.loopback, or a loop, is a hardware or software method which feeds a received signal or data back to the sender. It is used as an aid in debugging physical connection problems. As a test, many data communication devices can be configured to send specific patterns (such as *all ones*) on an interface and can detect the reception of this signal on the same port. This is called a loopback test and can be performed within a modem or transceiver by connecting its output to its own input. A circuit between two points in different locations may be tested by applying a test signal on the circuit in one location, and having the network device at the other location send a signal back through the circuit. If this device receives its own signal back, this proves that the circuit is functioning.

40. What is the use of ICMP?

41. “TCP is connection oriented protocol”- Does this mean every packet (of a message) in TCP follows the same path and reaches the destination in order? Explain.

TCP is connection oriented and IP is connectionless. But TCP is a transport layer protocol and connection oriented here means that it would take care of congestion control and order of delivery, reliable delivery. It would just make sure that packets are being transmitted between two processes. It does not care which path the packet follows as transport layer does not deal with routes and paths. That is the job of internet protocol.

IP is connectionless and it means the it may forward packets on different paths/routes on basis of availability and congestion. It is concerned about data delivery between end systems. It treats each packet differently and does not care whether the packet reach the destination or not.

For reliable delivery here TCP will take care, if the packet is not acknowledged to TCP, it will retransmit the packet.

42. What is a SYN flooding attack?

ANS:- Connection establishment procedure in TCP is susceptible to a serious security problem called SYN flooding attacks. This happens when a

malicious attacker sends a large number of SYN segments to a server, pretending that each of them is coming from a different client by faking the source ip address in the datagrams. The server assuming the clients issuing an active open ,allocates the necessary resources ,such as creating communication table and setting timers. The TCP server then sends SYN+ACK segments to fake clients, which are lost. During this time however a lot of resources are occupied without being used.Ifs, during this short time, the number of SYN segments is large, the server eventually runs out of resource and may crash. The Syn flooding attack belong to a security known as denial of service attack, in which an attacker monopolizes a system with so many service requests that the system collapses and denies service to every request.
Some implementations have strategies to alleviate the effects of a SYN attack. Some have imposed a limit on connection requests during a specific period of time. Others filter out datagrams coming from unwanted source addresses. One recent strategy is to postpone resource allocation until the entire connection is set up, using what is called cookie.

43. Explain the use of Retransmission timer and Keep alive timer in TCP.

Ans:-The heart of error control mechanism is the retransmission of segments.When a segment is corrupted lost or delayed,it is retransmitted. In modern implementations, a segment is retransmitted on two occasions : when a retransmission timer expires or when the sender receives 3 duplicate ACKs.no retransmission occurs for segments that do not consume sequence number.In particular there is no transmission for AK segment.

TCP maintains one Retransmission Time-out Timer for all outstanding segments.When the timer matures the earliest outstanding segment is retransmitted even though lack of ACK can be due to delayed segment,a delayed ACK or a lost acknowledgement.

When a connection has been idle for a long time, the keepalive timer may go off to cause one side to check whether the other side is still there. If it fails to respond, the connection is terminated. This feature is controversial because it adds overhead and may terminate an otherwise healthy connection due to a transient network partition.

44. Does the sender maintain a window in TCP? If yes then what is the sender window size?

45. Write short notes on any 3 of the following:-
   a) TCP segment
   b) Open Loop Congestion control method (any 2)

c) Leaky bucket
d) Bluetooth

46. What is TCP silly window syndrome? How does Clark's and Nagle's algorithm help in minimizing the syndrome?
47. With suitable diagram explain slow start phase used by TCP to handle congestion.
48. Differentiate between backpressure and choke packet congestion control method.
49. Write down the differences between TCP and UDP protocol.
50. Explain with diagram how TCP terminate connection using three way handshaking.
51. Discuss with suitable diagram about the addressing mechanisms used by IEEE802.11.

52. Find the expressions for average delay and throughput for both pure ALOHA and slotted ALOHA. Compare their performances as well.
"In Selective-Repeat ARQ, sender window size > 2^{m-1}." Is it correct? Justify.

53. The sender has a sliding window size = 3. Go back and N protocol is used. Discuss the behaviour of the receiving sliding window under the following cases:
Case1 : Frame 2 is lost in transition
Case 2: Frame no. 2 is received by the receiver correctly but ACK is lost.

54.What are the problems of providing redundant path in a bridged network. How does a transparent bridge provide solution to this problem.

55. What do you mean by piggybacking?

The usual purpose of piggybacking is simply to gain free network access rather than any malicious intent, but it can slow down data transfer for legitimate users of the network. Furthermore, a network that is vulnerable to piggybacking for network access is equally vulnerable when the purpose is data theft, dissemination of viruses, or some other illicit activity. It's quite simple to access an unsecured wireless network: All you have to do is get into the range of a Wi-Fi hotspot's signal and select your chosen network from the options presented. However, unauthorized network access, even to free Wi-Fi, may be illegal. People have been fined for accessing hot spots from outside businesses, such as coffee shops, that provide free Wi-Fi for customers' use

56. A router with IP address 125.45.23.12 and Ethernet physical address 23:45:AB:4F:67:CD has received a packet for a destination with IP address 125.11.78.10. and Ethernet physical address AA:BB:A2:4F:67:CD. Show the entries in

the ARP request packet sent by the router. Encapsulate the ARP request packet in a data link frame. Fill in all the fields.

57. S opens a TCP connection with an initial sequence number (ISN) of 14535. Other party R opens the connection with an ISN of 21,732. Show the three TCP segments during the connection establishment.

58. How can you get twice the efficiency in Slotted ALOHA protocol compared to the Pure ALOHA protocol? Show your analysis.

59. What is the necessity of the Padding field in an Ethernet frame?

60. How can you prove that CRC cat catches all single and almost all double bit errors?

61. What is the difference between a shared Ethernet network versus a switched Ethernet network? Why is the Ethernet called a CSMA/CD protocol?

62. In calculation of Minimum Frame length for Ethernet, only 2 bytes are taken as address lengths (source or destination). But this address is of length 6 bytes. Why then we take 2 bytes only in case of minimum frame length consideration?

63. A router uses the following routing table:

Destination	Mask	Interface
144.16.0.0	255.255.0.0	eth0
144.16.64.0	255.255.224.0	eth1
144.16.68.0	255.255.255.0	eth2
144.16.68.64	255.255.255.224	eth3

A packet bearing a destination address 144.16.68.117 arrives at the router. On which interface will it be forwarded?

64. Internet is a two level hierarchy – Host & Subnet, please explain. Why is Internet said to be a Three level hierarchy nowadays?

65. What is the difference between Virtual Circuit and Circuit Switching? Is Virtual Circuit a type of Packet Switching technique?

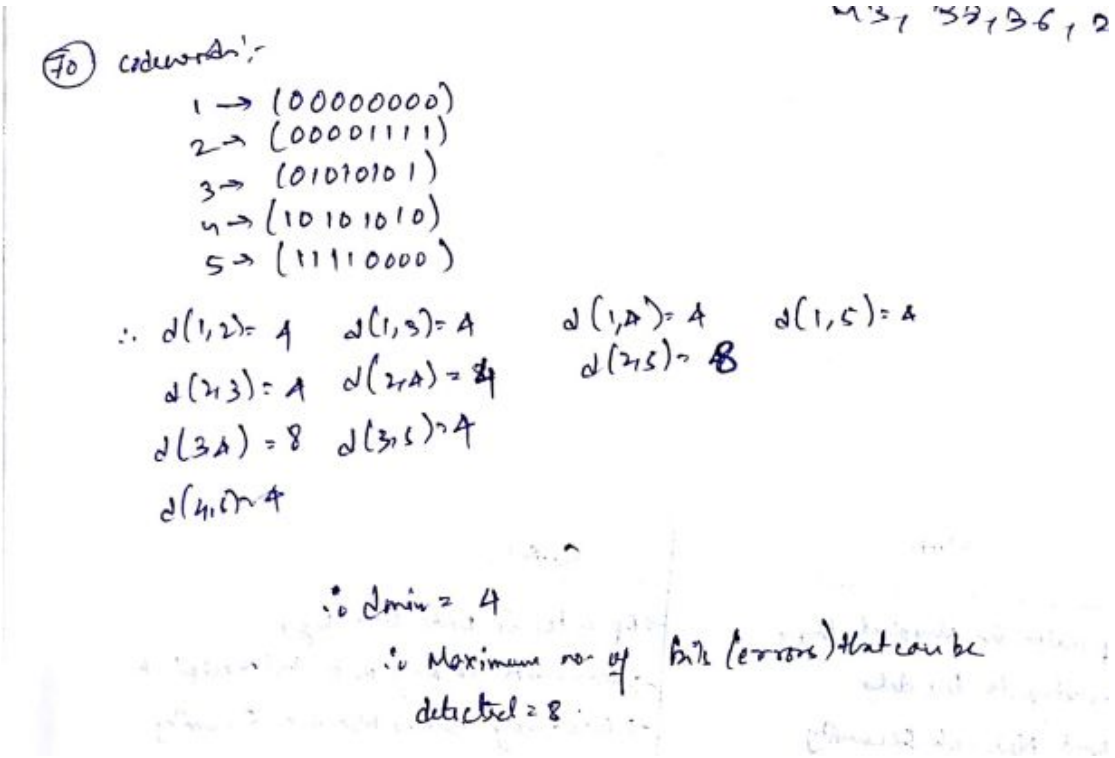
66. What is the difference between a hub and a switch?

67. What is the main strategy followed behind designing high speed modems?

68. Why is Longest Prefix matching required in CIDR?

69. Write down the differences between UDP and TCP.

70. An error correcting code has the following code words:
00000000, 00001111, 01010101, 10101010, 11110000.
What is the maximum number of bit errors that can be corrected?



Yaha par answer 3 hoga, if 4 = d min, then error bits = d min - 1 obligatory, Mohit chutiya hai.

Match with suitable option List-I (A)Node to node delivery (B)Reassembly of packets (C)Bit representation (D)Encryption

List-II
(I)Physical layer
(II)Presentation layer
(III)Data link layer
(IV)Transport layer

(a) A-IV,B-III,C-I,D-II (b) A-IV,B-III,C-II, D-I
(c) A-II,B-I,C-III,D-IV (d) A-III,B-IV,C-I,D-II

iska answer d hona cahiye cause reassembly of packets takes place in transport layer.. confirm it guys...

..... is a collision free technique.

(a) Token Passing (b) ALOHA
(c) CSMA/CD (d) CSMA

Error detection and correction at data link layer is done by

(a) CRC (b) Hamming code
(c) Bit stuffing (d) Checksum

Which class of IP address is reserved for multicast communication?

(a) Class A (b) Class B
(c) Class D (d) Class E

In analog to digital conversion according to the Nyquist theorem, the sampling rate must be at least ..... times the highest frequency contained in the signal.

(a) 1/2 (b) 3
(c) 3/4 (d) 2

ICMP resides at the same layer as which of the following protocol mentioned below ?

(a) TCP (b) UDP
(c) IP (d) ARP.

Baud means:

(a) The number of bits transmitted per unit time
(b) The number of bytes transmitted per unit time
(c) The rate at which the signal changes
(d) None of above.

Bluetooth uses:

(a) frequency hopping spread spectrum
(b) orthogonal frequency division multiplexing
(c) time division multiplexing
(d) frequency division multiplexing

In the slow-start algorithm, the size of the congestion window increases ..... until it reaches a threshold

(a) Exponentially (b) Additively
(c) Multiplicatively (d) logarithmically

A block of addresses are given to a small organization. One of the addresses is 205.16.37.39/28. What is the 1st address of the block?

(a) 205.16.37.32 (b) 205.16.37.47
(c) 205.16.37.254 (d) 192.168.39.0.

The total number of links required to connect *n* devices using Mesh topology?

(a) 2^n (b) n^2
(c) n(n+1)/2 (d) n(n-1)/2 d is correct

In go back and N ARQ sliding window protocol, the receiver window size is

(a) Greater than one (b) two
(c) one (d) none of these

Which detection method can detect a single bit error?

(b) CRC (b) single parity check
(c) Two dimensional parity check (d) all of these

Circuit switching takes place at which layer?

(a) Physical layer (b) data link layer
(c) transport layer (d) network layer

Digital signal has eight levels. How many bits are needed per level?

(a) 0 (b) 4
(c) 3 log 8 base 2 = 3 (d) 8

If a signal changes instantaneously its frequency is

(a) 0 (b) finite
(c) infinite (d) none of these

The value of SNRdb for a noiseless channel is

(a) 0 (b) finite
(c) infinite (d) none of these

Process to Process delivery is the function of..... layer

(a) Physical layer (b) data link layer

(c) transport layer	(d) network layer
[000,011,111,101] is a set of valid code words. Find out dmin. (a) 0	(b) 1
(c) 2	(d) 3
The hamming code is used for (a) Error detection	(b) error correction
(c) error encapsulation	(d) both (a) and (b)