CC-8

2022

1)

a) Bit Rate: Bit rate, refers to the number of bits transmitted or processed per unit of time. Bit rate indicates the speed at which data is transmitted, recieved or processed in a system. For example, a bit rate of 1Mbps means that One million bits of data are transmitted or processed in one second.

Baud rate: Baud rate, also known as symbol rate, represents the number of signal or symbol changes per second in a communication channel. It is typically expressed in baud or bauds. In modern encoding schemes like those used in digital modulations, multiple bits can be represented by each symbol or signal change allowing for higher data transfer rates than the baud rate.

b) Multiplexing done for several reasons:

① Bandwidth efficiency: By multiplexing multiple data streams onto a single link or channel, the available bandwidth can be utilized more efficiently.

② Increased network capacity: Multiplexing enables networks to handle a higher volume of traffic by

accommodating multiple data streams concurrently.

③ Cost optimization: Multiplexing can be cost effective in networking environments.

④ Flexible resource allocation: Multiplexing provides flexibility in allocating network resources.

⑤ Support for different protocols and services: Multiplexing allows different protocols and services to coexist and be transmitted over the same network infrastructure.

⑥ Improved network performance: Multiplexing techniques often incorporate features such as error correction, synchronisation, and flow control mechanisms.

c) Coaxial cable is superior to twisted pair cable because:

① Higher bandwidth: Coaxial cable has a larger diameter and a single solid core conductor which allows it to transmit signals at higher frequencies with less attenuation or signal loss.

② Longer transmission distances: Coaxial cable can support longer transmission distances than twisted pair cable without requiring signal amplification or repeaters.

③ Better shielding and immunity: Coaxial cable has superior shielding capabilities compared to twisted pair cable. It consist of an inner conductor, an insulating layer, a metallic shield and an outer insulating layer. This reduces electromagnetic interference and hence reduces cross talk.

④ Simplified installation: Coaxial cable often requires less installation complexity compared to certain types of twisted pair cable.

d) ~~What is minimum H~~

Minimum Hamming Distance:

This is a concept used in coding theory to measure the error detecting or error correcting capability of a code. In simple terms, it refers to the minimum number of bits positions in which any two valid codewords of a code differ.

~~The Hamming~~

In a set of equal lengths, the minimum hamming distance is the smallest hamming distance between all possible pairs of strings in that set.

$S = \{010, 011, 101, 111\}$

$010 \oplus 011 = 001$, $d(010, 011) = 1$

$010 \oplus 101 = 111$, $d(010, 101) = 3$

$010 \oplus 111 = 101$, $d(010, 111) = 2$

$011 \oplus 101 = 110, d(011, 101) = 2$

$011 \oplus 111 = 100, d(011, 111) = 1$

$101 \oplus 111 = 010, d(011, 111) = 1$

$d_{min} = 1$

e) A single bit error refers to alteration of only 1 bit in a sequence of bits. It means during transmission only one bit is flipped or changed from its original value. For example changing '0' to '1' or vice versa.

A burst error involves the simultaneous alteration of multiple consecutive bits in a data stream. The number of bits affected in burst error can vary, ranging from a few bits to many consecutive bits.

f) Difference between switch and hub:

(1) A hub operates at the physical layer of the OSI model and works by broadcasting incoming data packets to all connected device.

A switch operates at the data link layer. It examines the destination MAC address of incoming packet and forward them to the appropriate device.

② A hub broadcasts all received data packets, this leads to collisions, resulting in lower efficiency and increased network congestion.

A switch forwards data packets based on the destination MAC address and improves network performance by reducing collision & maximizing available bandwidth.

③ Hubs have limited scalability and flexibility.

Switches offer better scalability and flexibility.

g) FDM is well suited for analog signal because it divides the available frequency spectrum into smaller frequency bands. Each analog signal is modulated onto separate carrier frequencies and signals are combined using multiplexer. So multiple analog signals coexist simultaneously on the same communication channel. The demultiplexer at the recieving end separates the signals.

TDM is suitable for digital data because it divides the available time slot of the communication channel among different digital signals. Each signal is given a specific time

slot during which it can transmit its data. At the re· Digital signals are sampled and divided into time slots, which are then combined into a continuous stream. At the receiving end, the stream is demultiplexed and the signals are extracted based on their assigned time slots.

h) The network layer, third layer of OSI model has functions:

① Addressing and identification: The network layer assigns IP address to devices in a network. Network layer protocols manage the mapping of IP address with the MAC address.

② Routing: The network layer is responsible for determining the optimal path or route that data packets should take from the source to destination.

③ Logical connectivity: The network layer establishes logical connection between hosts in different networks.

④ Fragmentation & Reassembly: The network layer can break large data packets into smaller fragments to facilitate transmission across networks with smaller Maximum Transmission Unit (MTU) sizes.

⑤ Quality of service (QoS): The network layer provides mechanism to implement QoS.

2)

a) Signals travel through medium which is not perfect. This impairment causes signal impairment. Three causes are:

① Attenuation: It means loss of energy in the signal as it has to overcome the resistance of medium while it travels.

② The decibel measures the relative strength of two signals or one signal at two different points.

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

$$= 20 \log_{10} \frac{V_2}{V_1}$$

② Distortion: Distortion means that the signal changes its form or shape. Distortion can occur in a composite signal made of different frequencies. Each signal component has its own propagation speed and delay in arriving at final destination. Differences in delay may create a difference in phase if the delay is not exactly same as the period duration.

③ Noise: Noise is another type of impairment.

Thermal noise is the random motion of electrons in a wire.

Induced noise comes from source such as motors & applications.

Crosstalk is the effect of one wire on the other.

Impulse noise is a spike (signal with high energy in a very short time) that comes from power lines, lightning and so on.

b) Advantages of FM over AM:

① Improved signal quality: FM is less susceptible noise than AM and interference. Amplitude variation caused by the noise in AM is minimalized in FM as FM encodes information in the frequency variation.

② Higher signal bandwidth: FM offers a wider signal bandwidth compared to AM as it uses a wide range of frequencies for the transmission of the signal.

③ Constant Amplitude: AM maintains a constant amplitude through out the transmission. AM's amplitude is proportional to the amplitude of the modulating signal. The constant amplitude of FM simplifies transmitter design.

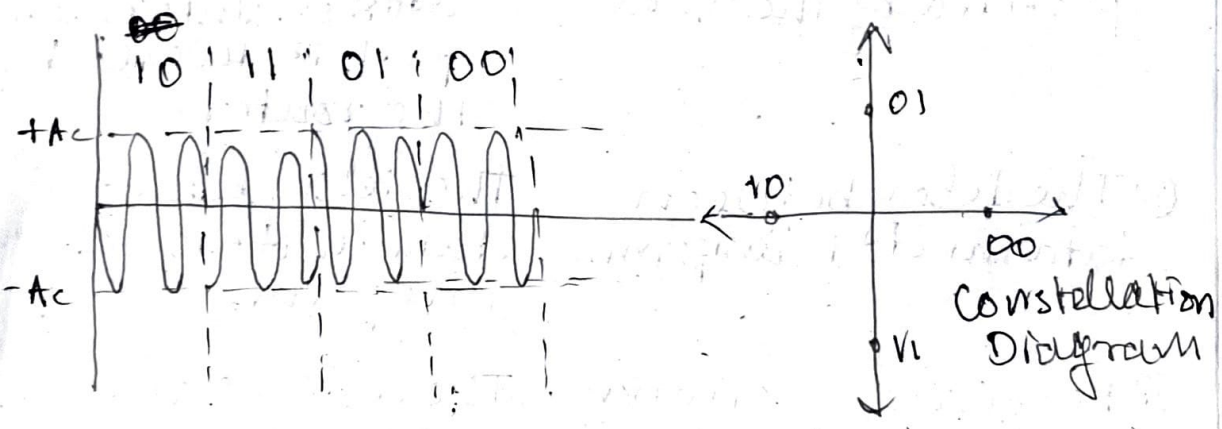
④ Lower Atmospheric interference: FM signals are less affected by atmospheric disturbance compared to AM signals. The sky wave propagation in AM signals can be influenced by changes in atmospheric conditions, resulting in fluctuations or fading.

Circuit Switching	(2) Packet Switching
① It has 3 phases: i) Connection Establish-ment ii) Data transfer iii) Connection released	Here direct data transfer takes place.
② Each data unit knows entire path address provided by the source.	Each data unit knows the final destination address. Intermediate path is decided by the routers.
③ The delay between data units is uniform.	The delay between data units is not uniform.
④ Resource reservation is the feature of circuit switching because path is fixed.	There is no resource reservation as bandwidth is shared among users.
⑤ More wastage of resources	Less wastage of reso-urces.
⑥ It does not support store and forward transmission.	It supports store and forward transmission.
⑦ Circuit switching in network is imp-lemented at the physical layer.	It is implemented at the datalink layer and network layer.
⑧ Congestion can occur during the connection phase	Congestion can occur during the data trans-fer phase.

3)
a)

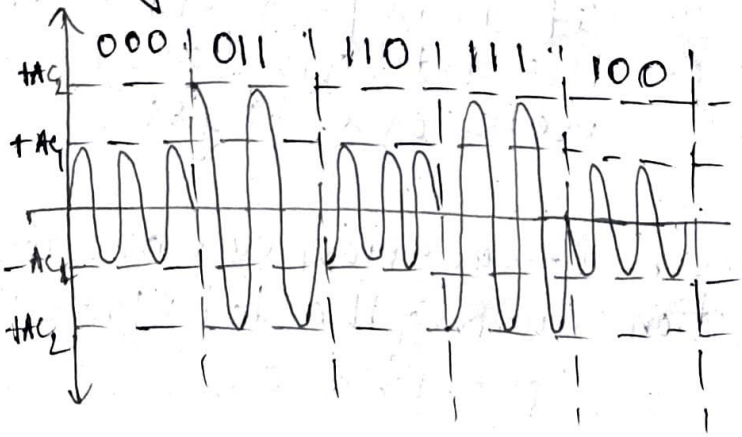
i) **QPSK**

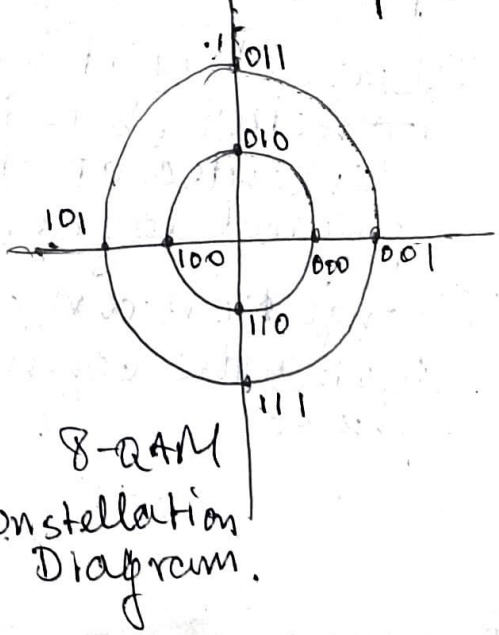
It is a method to transmit digital data into analog form. Here separate digital element is represented by different phase of analog signal. To carry 2 bits at a time by one signal element we need four phases to represent 00, 01, 10, 11 and for 3 bits we need 8 phases and so on.



ii) **QAM**

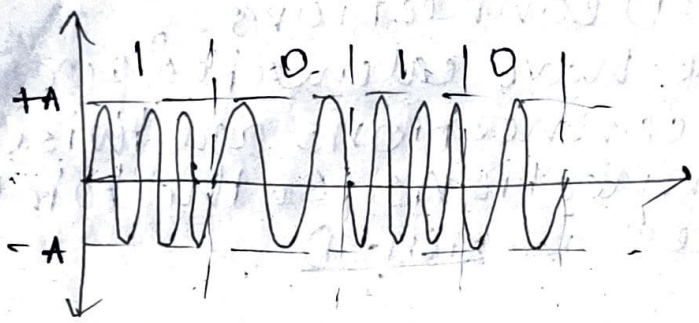
It is another method for transmitting digital using analog carrier signal. Here both phase and amplitude used to carry digital data. For eg for 8-QAM we need 2 type of amplitude and 4 phases to transmit 3 bits per signal element.





iii) FSK

It is another method for transmitting digital data by using various frequencies of carrier analog signal. Here for 0 we use lower frequency & for 1 we use higher frequency.



b) The advantages of fibre optic cable is —

i) High data transfer speed: fiber optic cable can carry data at much higher speed range of Gbps.

ii) Long Transmission Distances: It can transmit data over long distances without significant signal degradation or loss.

iii) Immunity to Electromagnetic Interference: It is immune to EMI because it transmit data using light.

iv) Secure Data transmission: It offers a high level of security for data transmission.

v) Light weight and space efficient: It is thinner and lighter than traditional copper cables.

vi) Non flammable: It is made of glass & plastic making them non-flammable.

c) In mesh topology with n number of devices we need $\frac{n(n-1)}{2}$ ~~com~~ number of links as

For each device we need to connect to (n-1) devices. and for n devices we get n * (n-1) connections.

As we have calculated for both end so the connections are twise the original connections; So the total link needed is $\frac{n(n-1)}{2}$.

4)

b) Here the dataword is of 10 bits and the codeword will be of 13 bits as 1 bit less than the divisor bits will be used as remainder.

```
          1001000111
1011 ) 1010011110000
       1011
       ----
        0010
        0000
        ----
         0101
         0000
         ----
          1011
          1011
          ----
           0001
           0000
           ----
            0011
            0000
            ----
             0110
             0000
             ----
              1100
              1011
              ----
               1110
               1011
               ----
                1010
                1011
                ----
                 001
```

∴ The CRC is 001

5)
a) Channelization (or channel partition, as it sometimes called) is a multiple access method in which the available bandwidth ~~is~~ of link is shared in time, frequency or through code, among different stations.

Channelization is of three types:

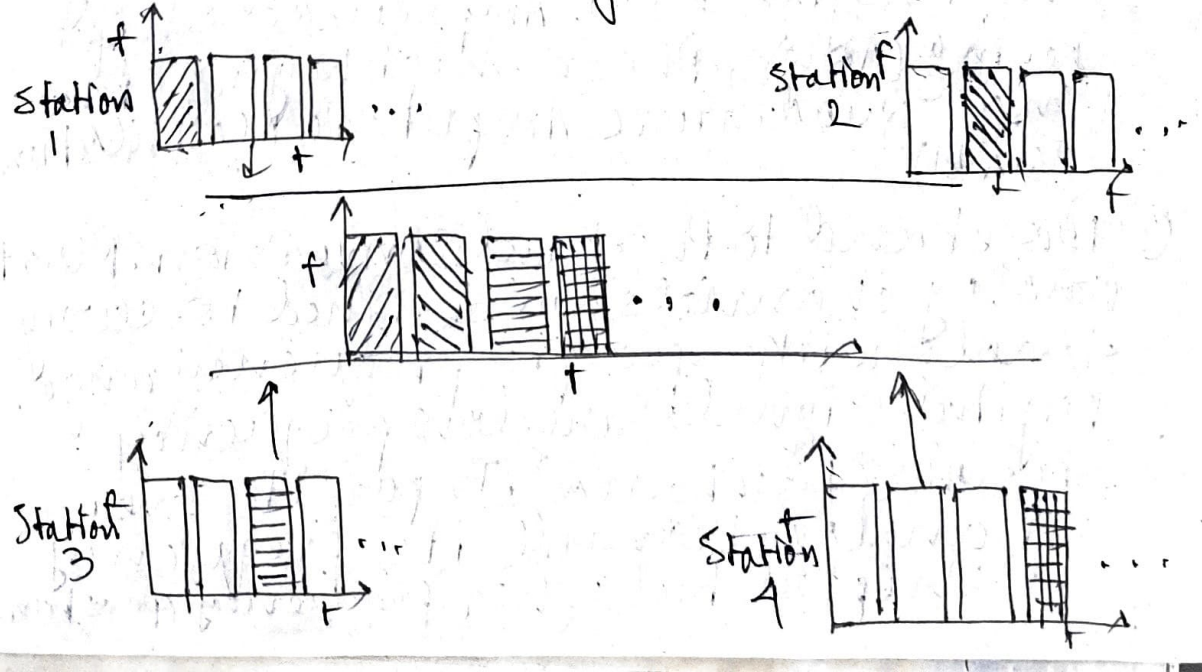
① FDMA: Here the available bandwidth is shared on the base of frequency. Every station is alloted with a certain range of frequency.

② TDMA: Here the available bandwidth can be accessed only by 1 station and every station is given a particular time slot to transmit data.

③ CDMA: Here the ~~it~~ link is shared by all stations on the basis of code that is generated by data.

④ TDMA (Time Division Multiple Access)

In time division multiple access the stations share the bandwidth of the channel in time. Each station is allocated a time slot during which it can send data. Each station ~~sends~~ transmits its data in its assigned time slot.



The main problem in TDMA is achieving synchronisation among different stations. Each station need to know the beginning of its slot and the location of it. This may be difficult as propagation delay may be introduced when the stations are spreard over a large area.

TDMA is a access method in the data link layer. The data link layer in each station tells its physical layer to use its allocated time slot. There is no any physical multiplexer at the physical layer.

b) Transmitting digital data over an analog channel involves the process of modulation. Modulation is the technique of converting digital data into analog signal that can be transmitted over analog communication channel.

The steps in transmitting digital data over analog channel are as follows

① Digital to Analog Conversion: The first step is to convert digital data into analog signals. This is done by modulation technique such as Frequency shift keying (FSK), Amplitude shift keying (ASK), Phase shift keying (PSK) and Quadrature Amplitude Modulation (QAM)

② Baseband to Passband conversion: Most analog channels are designed to carry signals with specific frequency range. Digital signals are low frequency signals (baseband). To pass it over an analog channel its frequency is shifted to higher frequency (passband)

③ Transmission over analog channel: The analog modulated signals are transmitted over the analog channel. The analog channel may be weird medium such as a coaxial cable or a fibre optic cable or wireless medium, such as radio waves or micro waves.

④ Reception and Demodulation: At the receiving end, the analog modulated signals ~~its~~ are captured by the receiver and the receiver then demodulates the ~~dat~~ received analog signals to extract the original digital data.

6)

a) ARP (Address Resolution Protocol) and RARP (Reverse Address Resolution Protocol) are essential protocols used in computer networks to facilitate the communication between devices within the local ~~area~~ network.

① ARP:

The main purpose of ARP is to resolve IP addresses (logical addresses) to their corresponding MAC addresses (physical addresses) in a local area. To send data through data link layer the sending device need to know the MAC address of the receiving device. To fetch the MAC address sending device broadcast message asking who has the IP address and after that the receiving device responds with its MAC address. Devices build and maintain an ARP cache ~~to~~ to store IP-to-MAC address mapping for future use.

(2) RARP:

RARP serves opposite purpose of ARP. RARP resolves MAC addresses to IP addresses. It is typically used in diskless booting systems, where devices need to obtain their IP addresses when booting up. During the boot process the device broadcasts the MAC address and requests an IP address. Using RARP. The RARP server in the local network responds with the corresponding IP address based on the device's MAC address.

b) Dynamic Routing algorithms are preferred over static routing algorithms in networks because:

① Adaptability to Network changes: Dynamic routing algorithms can adapt to changes in the network topology such as link failures, congestion, or the addition/removal of network devices. Dynamic routing protocols update their routing tables to find the most efficient paths for data transmission.

② Load balancing: Dynamic routing adjust the routing paths according to the real time traffic conditions, leading to better load balancing and improve overall network performance.

③ Faster convergence: When a new link is added, dynamic protocols quickly recalculates the fastest path and accordingly update the routing table. reduces downtime and minimizing disruptions.

④ Scalability: Dynamic routing is more scalable than ~~see~~ static routing. As the network grows dynamic routing can efficiently manage a large number of network devices and adapt to the increased complexity without manual intervention.

⑤ Fault tolerance: Dynamic routing algorithms offer better fault tolerance. It guarantees when a link fails, the data can still reach to its destination through alternative paths.

⑥ Support for Different metrics: Dynamic routing protocols can consider different metrics like bandwidth, delay, cost or load when calculating the best path for data transmission.

c) The DNS (Domain Name System) is crucial for the internet's functioning. It translates user friendly domain names (eg. www.example.com) into numerical IP addresses (eg. 192.2.1); facilitating easy access to internet resources. It enables load balancing and redundancy by associating multiple IP addresses with a single domain, optimizing performance and ensuring high availability. It supports dynamic IP address assignment and provides seamless user experience.

An intranet is a private network that uses internet technologies such as TCP/IP and web browsers to provide collaboration and communication within an organization, typically behind a firewall.

7) a)

TCP	UDP
① TCP is a connection oriented protocol. Connection oriented means the device establishes connection before transmitting data and should close connection after transmission.	UDP is a datagram oriented protocol. This is because there is no overhead for opening a connection, terminating a connection.
② TCP is reliable as it guarantees the delivery of data to the destination router.	The delivery of data to the destination cannot be guaranteed.
③ TCP provides extensive error checking mechanism. It is because it provides flow control and acknowledgement of data.	UDP has only the basic error checking mechanism using checksums
④ An acknowledgment segment is present in TCP header.	No acknowledgment segment.
⑤ Sequencing of data is a feature of TCP.	There is no sequencing of data in UDP.
⑥ Retransmission of lost packets is possible in TCP.	Here retransmission of lost packets is not possible.
⑦ TCP has a (20-60) bytes variable length header.	UDP has a 8 bytes fixed length header.
⑧ It doesn't support broadcasting.	It supports broadcasting.

b) SMTP (Simple Mail Transfer Protocol) is a widely used communication protocol for sending and relaying email messages between email servers.

① Sending email:
When a user composes and sends an email using email client, the email client uses SMTP to send the email to the sender's outgoing mail server (SMTP server).

② Address Resolution: Before sending the email the SMTP server resolves the recipient's email domain name to its corresponding mail exchange (MX) server.

③ Email Delivery:
After establishing connection with the recipient's MX server, the email is sent and the recipients MX server receives and stores the email in appropriate mail box.

④ Relaying email:
If the recipient's email domain is not hosted on the same server as the senders email domain, the senders SMTP server relay the email via intermediate SMTP server until it reaches recipient's MX server.

⑤ Error handling and security: If the recipient's server is not available or any issue occur, SMTP provides error messages and it provides authentication mechanism to enhance security.

The purpose of a transparent bridge is to connect and interconnect the multiple network segments in local area network while allowing data to pass through seamlessly without any configuration or interv-ention required by the connected devices. It operates at data link layer. It learn and maintain a table of MAC addresses and their associated port locations to efficient ly forward the tranfic between diffe rent LAN segments.

Bandwidth refers to the maximum data transfer rate or capacity of a communication channel or medium representing the amount of data that can be transmitted in a given time. It is typically measured in bits per second (bps) and determines the speed and efficiency of data transmission over the medium.

8) a) Persistent CSMA

① It will continuously sense channel for transmission of frames.

② In this method there are highest number of collisions observed

③ Delay low load is small because frames are sent only in idle state.

Non-persistent CSMA

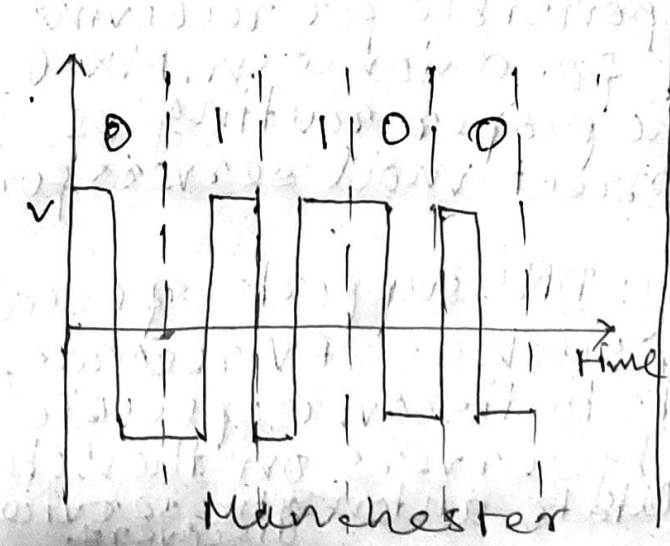
It will wait for random amount of time to check carrier.

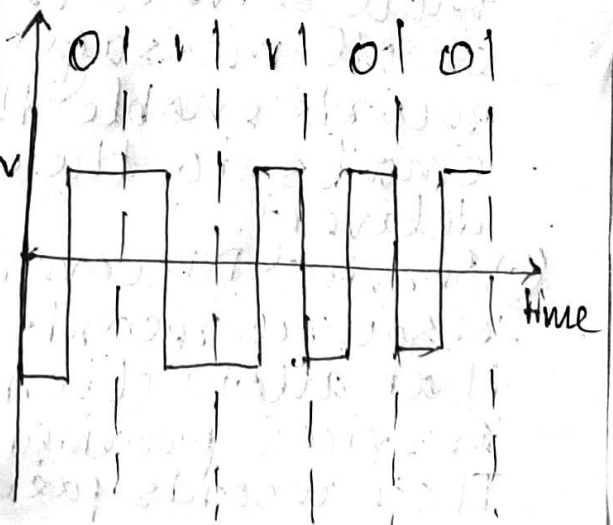
In this method, chance of collision are less than in 1-persistent.

Delay low load is longer as it only checks random-ly when channel is busy.

④ Delay high load is high due to collision.	Delay high ⑤ load is comparatively small.
⑤ The 1-persistent utilization is above ALOHA.	The non-persistent utilization is above 1-persistent because all stations are ~~not~~ not constantly checking the channel at the same time.
⑥ Here frame is sent when the channel is found idle.	Here channel may stay idle for some time because of random wait time.

b) Manchester encoding	Differential Manchester encoding
① Low to high-represents 1 and high to low represents 0.	No transition at the start of the bit period represent 1 and transition at the start of a bit period represents 0.
② ~~The~~ The idea of RZ & NRZ-L is combined to make is scheme.	The idea of RZ & NRZ-I is used here.
③ Used by IEEE 802.3 specification for Ethernet LAN.	Used by IEEE 802.5 specification for token ring LAN.





c) Functions of DNS:

① Domain name resolution: The primary function of DNS is to translate user-friendly domain names into numerical IP addresses that computers and network devices use to locate each other on the internet. This process is known as domain name resolution.

② Hostname to IP address Mapping: DNS maintains a distributed hierarchical database that contains mapping of domain names to their corresponding IP addresses.

③ Reverse DNS lookup: DNS also supports reverse domain name resolution, which involves finding the domain name associated with a given IP address.

④ Load Balancing: DNS can be used for load balancing by associating multiple IP addresses with a single domain name. When a client requests the IP address for a domain, the DNS server can return different IP addresses to distribute the traffic across multiple servers.

⑤ Mail Exchange (MX) Records: DNS supports mail exchange records that specify the mail servers responsible for receiving email messages for a domain. MX records enable the proper routing of emails to the correct mail servers for delivery.

⑥ Service Discovery: DNS supports special resource records, such as SRV records, that allow clients to discover specific services provided by servers on the network. These records facilitate automatic service discovery.