

~~BCS-OHI~~ DEC-2022



- Q1. what is MD5 Digest ? Explain the steps for the process of generating 128 bit MD5 digest from any given number and key.

* MD5 :- . one-way ~~en~~ cryptographic hash function.

- 128-bit digest size for every single input.
- Initially designed for digital signatures
- Designed in 1991 by Ronald Rivest

* Step 1 :- Padding Bits :-

- Total bits must always be 64 bits short of ~~msg~~ any multiple of 512.
- The first bit added is '1', and the rest are all zeroes.

* Step 2 :-

- Length is expressed in the form of 64 bits.
- Resultant string will now be a multiple of 512 .
- used to increase Complexity of the function .

* Step 3: Initialize MD Buffer :-

- The entire message is broken down into blocks of 512 bits each.
- 4 buffers are used of 32 bit each.
- They are 4 words named A, B, C and D.
- The first iteration has fixed hexadecimal values.

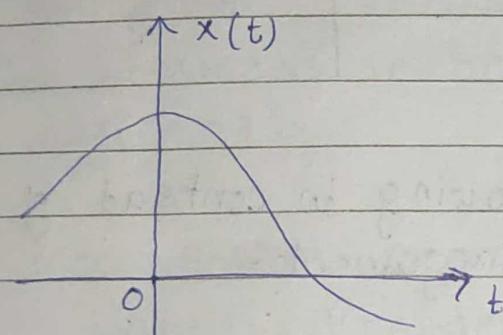
* Step 4: Process Each Block :-

- There are 4 rounds of operations.
- The constant value is an array of 64 elements, with 16 elements being used every round.
- * Different for each round.
- * Used to increase randomness of the hash as an upgrade over MD4.

Q2. How is sampling done from analog signals. Explain through an illustration.

Ans. Two types of signal continuous time signal and discrete time signal.

- we should convert continuous time signal to discrete time signal.
- This Problem solve by the Sampling theorem , it provide a mechanism it is a bridge in between continuous time signal and discrete time signal.



Q3. Discuss the working of ARP and RARP.
Also differentiate between the two.

Ans. ARP

- Stands for address resolution protocol.

- Through ARP(32 bit) IP address mapped into (48-bit) MAC address.

RARP

- Stands for reverse address resolution Protocol.

- Through RARP,(48 bit) MAC add. mapped into (32 bit) IP add.

- ARP table is managed by local host
- RARP table is maintained by RARP server.
- receiver's MAC address is fetched.
- IP address is fetched
- ARP table uses ARP reply for its update.
- RARP table uses RARP reply Configuration of IP address.

Q4. Discuss the following in context of network management.

i). Configuration management.

Any

- Network Provisioning in circuit network has different.
- Network Provisioning in ~~broadband~~ broadband and WAN communication using ATM technique is involved with VP-VC concept.

- Architecture of ATM circuit @ could be either centralised or distributed on whether the circuit is PVC or SVC
- As a network increases the network topology needs to be updated automatically.

g ii). Accounting management .

- Ans. Any form of accounting which enables a business to be conducted more efficiently.
- Information can help manager identify Problems , solve Problem and evaluate performance
 - concerned with accounting information that is useful to management.

Q5. what are the two categories of ICMP messages ? Give two examples of each.

Ans. ICMP messages are divided into two broad categories.

i). error-reporting messages.

ii). query messages.

→ Error-reporting messages :- one of the main responsibilities of ICMP is to report.

- Although technology has produced increasingly reliable transmission media, errors still exist and must be handled.

- Error correction is left to the higher level protocols.

→ Query messages :- It is used to diagnose some N/w problems.

• Echo Request and Reply :- Designed for the diagnostic purpose. These messages are used to determine whether two systems can talk / communicate with each other.

• These are messages are sent when ICMP queries about the status of the host some of common messages under this category are as follows.

Q6. Differentiate between Virtual circuit and Datagram.

Any.	Virtual Circuit	Datagram
	• Implemented in Data Link Layer.	• Implemented in Network Layer.
	• Connection Oriented	• Connection Less Network.
	• Not fixed dynamic Subnet	• Dynamic
	• Non-dedicated	• Internet
	• Data transfer usually in text form.	• Text form
	• Moderate	• No wasted

Q7. Explain the following features of IPv6.

i). Tunneling.

Ans. Tunneling is an internetworking strategy that is used when source and destination network of same type are connected a network of different type.

- To understand tunneling, let an Ethernet is to be connected to another Ethernet a wan as shown in figure as follows:
- This wan network layer packet is then addressed to multi-protocol router R2.

ii). Dual IP stack.

Ans. Dual stack allows both IPv4 and IPv6 to co-exist.

- most new network devices are dual stack ready.
- Interface is considered dual stack when both IPv4 and IPv6 are configured on it

IPv6.

Source
Same
orkIt can
showet
rotocol

d

Dual

Stack

Q8. what is TCP's sliding window. Explain silly window syndrome with the help of a diagram.

Ans.

TCP's Sliding window :-

- To maintain efficiency, TCP uses a "sliding window".
- Sliding windows allows the sender to transmit multiple segments within the TCP windows size without receiving an acknowledgement.
- A device can send successive segment without waiting for an acknowledgement that a previous segment has been received.
- TCP typically acknowledges every other segment.

*

Silly window Syndrome :-

- Silly window Syndrome is a problem that can degrade the TCP performance.
- This Problem occurs when the sender transmits data in large blocks,

but on interactive application on the receiver side read data 1 byte at a time.

- Initially the receiver buffer is full.

Q9. Explain Time Division multiplexing. Discuss the adv. and dis adv. of TDM. Also given application of TDM.

Ans. The sampled PAM waveform is off for most of the time.

- During the off period, the channel can be used to transmit samples of other waveforms.
- The concept of Interleaving samples from several signals into a single waveform is called TDM.

* Advantages *

- TDM systems are more flexible than FDM.

- TDM having simple circuit
- Problem of cross talk in not servers.

* Disadvantages *

- Synchronization is required.
- complex to implement.
- High bit rate is ~~not~~ required

* Applications *

- It is use in ISDN
- It is use in PSTN
- It is use in wire telephone.

10. Circuit Switching and Packet Switching.
 Any. Circuit Switching | Packet Switching

<ul style="list-style-type: none"> • A Physical connection is required b/w sender and receiver. • more reliable • Each packet follows the same route. • Packet arrive in order fixed 	<ul style="list-style-type: none"> • No Physical connection is required • less reliable • Different Packets can follow to different path. • Packets may arrive out of order. • dynamic.
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Q11. IPv4 and IPv6.

Ans.

IPv4

- The length of IPv4 is 32 bit.
- In IPv4 around 4 billion unique IP address are generated (2^{32})
- The range of IPv4 address is 0 to 255.
- It consists of 4 octets, each has 8 bits.
- IPv4 is numeric address separated by . (dot).
- IPv4 has total Five classes.

IPv6

- The length of IPv6 is 128 bit.
- In IPv6 around trillion unique IP address are generated (2^{128})
- The range of IPv6 address is 0 to FFFF (65535)
- It consists of 8 octets, each has 16 bit.
- IPv6 is alphanumeric number separated by (:).
- It does not have any class.

Q12. RSA.

Ans. RSA :- Rivest-Shamir- Adleman developed in 1978.

- It is an asymmetric cryptographic algo (2keys) & public and private key concept is used here.
 - The RSA is made from the initial letters of the surnames of Ron Rivest, Adi Shamir, and Leonard Adleman.
- Public key :- Known to all users in network.
- Private key :- Kept secret, not sharable to all.

Q13. OSI Model.

A1. OSI 'open system interconnection' model it has been developed by Standard Organization ISO (International organization for standardization) in the year 1984.

Note :- 1). It is a 7 layer architecture where each layer having specific functionality.

2). All these 7 layer work collaboratively to transmit the data from one n/w to another n/w across the globe.

BCS-041 June 2022

Q1 Briefly discuss the term CRC.

~~Ques~~ Determine the CRC for the data Polynomial $x^5 + x^4 + x^2 + 1$ with generator Polynomial $x^3 + 1$.

$$\text{Ans} \quad \text{Data} = x^5 + x^4 + x^2 + 1$$

$$G(x) = x^3 + 1$$

$$\begin{aligned} \text{Data} &= 1x^5 + 1x^4 + 0x^3 + 1x^2 + 0x + 1 \\ &= 110101 \end{aligned}$$

(X)

$$G(x) = 1x^3 + 0x^2 + 0x + 1$$

$$= 1001$$

$$\begin{array}{r}
 \text{1111} \\
 \text{1001} \quad \text{110101000} \\
 \text{0100} \quad | \quad | \quad | \quad | \\
 \text{1000} \quad | \quad | \quad | \\
 \hline
 \text{0001100} \\
 \text{1001} \\
 \hline
 \text{01010} \\
 \text{1001} \\
 \hline
 \text{0101} \\
 \text{1001} \\
 \hline
 \text{01011}
 \end{array}$$

Sender send to receiver.

$= 110101011$
 1001 110101011
 1001 1001
 01000 |||
 1001 |||
0001101
 1001
 01001
 1001
0000 NO errors Δ

Q2. Differentiate between classful addressing and classless addressing. Explain how ~~classless~~ addressing results in decrease in table size.

Ans. ~~Classful Addressing or~~
Classful Addressing :-

- IPv4 addressing used the concept of classes. This architecture is known as classful addressing.
- In the classful addressing, there are 5 classes in which the address space is divided A, B, C, ~~D~~ and E.

- Each class occupies some fraction of the address space.

* Classless Addressing *

- The classful addressing leads to address depletion. That's the big issue for this schema and that's why it is not used nowadays.
- The classless IPv4 addressing does not divide the address space into classes like classful addressing.
- The same way the classless addressing also divides the IPv4 address into two parts Prefix and suffix.

Q3. what is a Congestion Control Mechanism?
Discuss & show start phase of TCP congestion control mechanism through an illustration.

Ans Congestion control:- Congestion in a network may if the load on the network

is greater than capacity of network.

- congestion control refers to the mechanism and techniques to control the congestion.
- when too many packets arrive a part of the packet-switched network the performance degrade this is Congestion.

* Slow start Phase of TCP congestion *

- Sender calculates a congestion window for a receiver.
- Start with a congestion window size Equal to one Segment.
- Exponential increasing of the congestion window up to the congestion threshold, then linear increase.
- Congestion window starts again with one segment.

- Q4. what do 10Base-T and 100Base-T stand for. Also, differentiate between the two.

Ay . The 10Base-T system was the first popular twisted pair ethernet system.

- The 10Base-T system is designed to support the transmission of 10 mbps Ethernet signals "voice-grade" category 3 twisted-pair cables.
- Ethernet interface with a built in 10 Base-T transceiver.
- Repeater hub equipped with 10Base-T ports.

* 100 Base-T *

- Fast Ethernet provides 100 mbps speed and introduced in 1995.
- 100 Base-T4, 100 Base-TX, 100 Base-FX
- Fast Ethernet generate more delay comparatively.
- The ~~10km~~ coverage limit of fast Ethernet is up to 10km.
- Fast Ethernet is the successor of 10Base-T.

Q5. Compare ring topology and mesh topology in terms of the following parameters.

Ans.	Ring Topology	Mesh Topology
1).	In ring topology every node is connected to its left and right side nodes.	In mesh topology the nodes are connected to each other completely via dedicated link.
2).	There are N link in ring topology, if there are N nodes present	There are $\frac{N(N-1)}{2}$ links in mesh topology, if there are N nodes.
3).	Ring topology is poor extensible.	Mesh topology is also poor extensible.
4).	Ring topology is used in LAN.	Mesh topology is generally suited to WAN.
5).	The ring topology implementation is easy compared to mesh topology.	The mesh topology is complicated to implement.
6).	Ex:- used in WLAN used in MAN and more.	zigbee z-wave Networks in military device and more.

Q6. What is Count to infinity Problem.

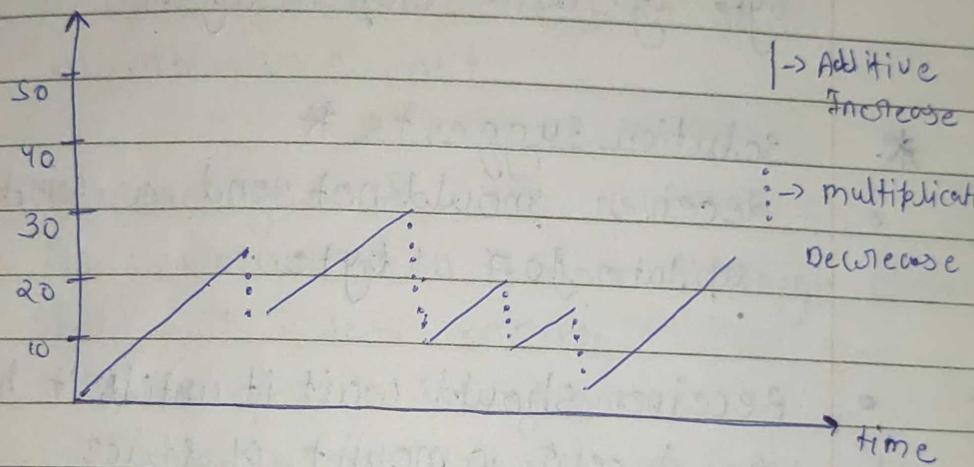
A2.

- The setting of routes to best Path across the network is called convergence
- Although it converges to the correct answer, it may do so slowly.
- In particular, it reacts rapidly to good news, but leisurely to bad news.
- To see how fast good news propagates, consider the five-node network, where the delay metric is the number of hops.
- Suppose A is down initially and all the other routers know this. In other words, they have all recorded the delay to A as infinity.

Q7. Explain the multiplicative decrease process, with respect to congestion control.

Ans:

- Multiplicative Decrease
- For each packet loss, the sender decreases its congestion window by one half of its current value.
- The congestion window size is not allowed to fall below one segment.



Q8. what is silly window syndrome ? what are the proposed solution to this syndrome.

Ans: Silly window syndrome is a problem that arises due to poor implementation of TCP. It degrades TCP performance and makes the data transmission extremely inefficient. The problem is called so because.

The window size shrink to such an extent that the data being

smaller than TCP Header.

* What are the causes?

- Sender window transmitting one byte of data repeatedly.
- Receiver window accepting one byte of data repeatedly.

* Solution suggests

- Receiver should not send a window update for 1 byte.
- Receiver should wait until it has a decent amount of space available.
- Receiver should then advertise that window size to the sender.

Q9. Discuss the pros and cons of a wireless communication system.

Ans. Advantages :-

- 1). Wireless network is easy to expand and ~~set~~ setup.

2. wireless network is more flexible and adaptable compared to a wired network.
3. wireless network is easy to carry and re-install in another place.
4. It has good mobility of usage.
5. In wireless communication low maintenance cost.

* Disadvantages *

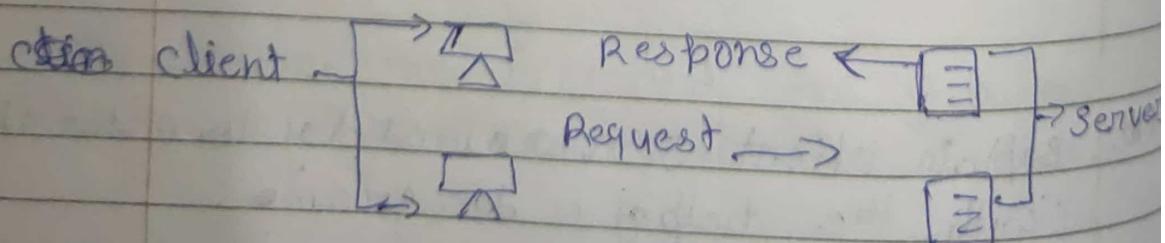
- 1). As communication is done through open space, it is less secure.
 - 2). More open to interference.
 - 3). Transmission speed is comparatively less.
 - 4). wireless networks can be easily hacked.
 - 5). More open to interference.
- Q10. Explain client-server model of ~~network~~ network, with the help of a diagram.

Ans Client-Server-model :-

- The Client-Server model is ~~not~~ just one way for the computers to communicate the web.

- The client-server is based on a centralized structure.
- There is another way to communicate a decentralized structure.
- It is The peer-to-Peer model.
- A client is a machine or a program that we use to make requests through the web.
- A server is a program that listens for our requests and responds to them.

~~client → [] & request~~



Q11. Explain X.25 architecture, with help of a diagram.

Ans. X.25 is a Protocol that was developed by ITU.

ITU - International Telecommunication Union.

- X.25 is a connection-oriented protocol.
- It allows multiple logical channels can be set on a single physical line.
- It is used for network for ATMs and credit card verification.
- It allows multiple logic channels to use the same physical line.
- It also permit Data exchange between terminals with different communication speed.
- X.25 has three Protocol layers
 - Physical layer
 - Data link layer
 - Packet layer

~~30-09-21~~

← BCS-041 → Dec - 2021 →

Q1. Differentiate between Parallel and Serial Communication. Give an example of each.

Ans.

Serial Transmission

- Serial Transmission is the type of transmission in which a single communication link is used to transfer the data.
- In case of serial transmission, only one bit is transferred at one clock pulse.
- It is cost efficient.

Parallel Transmission

- Parallel Transmission is the mode of transmission in which multiple parallel links are used that transmit each bit of data.
- In case of parallel transmission, all bits are transferred at one clock pulse.

- it is not cost efficient.

- Serial Transmission is preferred for

- Parallel Transmission is preferred only

Long distance transmission

short distance.

- Serial Transmission is less complex.
- Parallel Transmission is more complex.

Q2. compare PoP and IMAP.

Ans.

POP

- POP stands for Post office Protocol
- POP is simple and only mails can be downloaded from your inbox to local computer.
- POP supports single device to access the mail at a time.
- mail cannot be create, update, delete on mail Server using POP.

IMAP

- IMAP stand for Internet Message Access Protocol.
- IMAP is complex and allows to see all the folders on the mail Server.
- IMAP supports multiple devices which can access the mail at a time.
- IMAP allows to create/ update/ delete mails on mail Server.

Q3. What are Quality of Services of network
List any two techniques to improve QoS.

A1.. Quality of Services in the case of networking make ability of a provider reliable service to the traffic over various technologies including Ethernet, wireless, IP, etc.

- QoS is case of network congestion, must keep in record various elements causing this congestion.
- It may be to the reason of low bandwidth or high traffic on a single route.
- Routing Protocol being used heavily impact the quality of service of networking.

* Techniques to improve QoS,

- Scheduling
- Traffic Shapping
- Resource Reservation
- Admission Control.

Q4. Differentiate between Pure ALOHA and slotted ALOHA. If the throughput of Pure ALOHA is $S = G\alpha e^{-2G}$, show that the maximum throughput (S_{max}) is 0.184.

Ay. Pure Aloha

- In Pure Aloha, any station can transmit data at any time.

- Time is continuous and is not globally synchronized.

- The probability of successful transmission of a data packet
 $S = G\alpha e^{-2G} \alpha$

- maximum efficiency
 $= 18.4\%$

- Does not reduce the number of collisions.

Slotted Aloha

- In slotted Aloha, any station can transmit data at the beginning of a time slot.

- Time is discrete and is globally synchronized

- The probability of successful transmission of Data Packet
 $S = G\alpha e^{-G}$

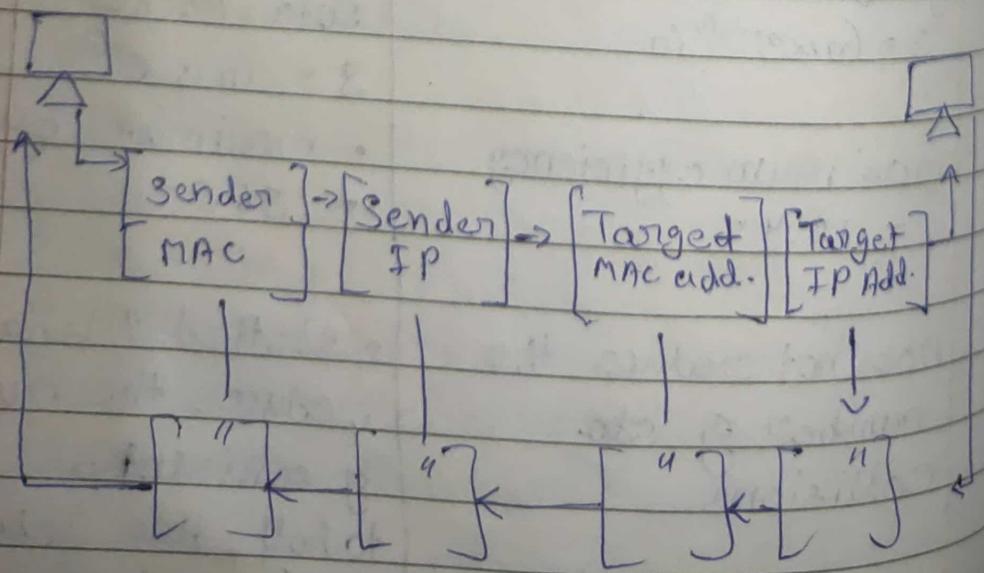
- maximum efficiency
 $= 36.8\%$

- Slotted Aloha reduces the number of collisions to half, thus doubles the efficiency.

Q5. Explain the working of ARP, using a diagram. How does ARP differ from RARP. Explain.

Ans. ARP :- Address Resolution Protocol is a communication Protocol that works on the TCP/IP Layer.

- ARP helps to get the MAC address of the connected router or gateway from the IP address.
- ARP is a request-response protocol in which one device sends a request to another device asking for some information.
- Before sending an IP packet, the sender must know the destination MAC address.



* RARP:

- Reserve Address Resolution Protocol is used by a device that know its MAC address but does not know its IP Address in a local area network.
- when a new machine is set up, then its RARP client requests the IP address from the gateway router.
- Assuming that a entry has been set up in the router table, the reserve ARP server will return the IP Address.

Q6. ~~Q5~~ Discuss the importance of DHCP and BootP at the application layer of TCP/IP.

A6.

BootP

- BootP stands for Bootstrap Bootstrap Protocol.
- BootP has no support for temporary IP Address.

DHCP

- DHCP stands for dynamic Host configuration Protocol.
- DHCP server support temporary IP Addressing but for limited period of time.

- | | |
|--|---------------------------------------|
| • BootP does not support DHCP client. | • DHCP server supplies BootP clients. |
| • Configuration has to be done manually. | • Configuration is automatic. |
| • mobile devices are not supported. | • DHCP supports mobile device |

Q7. Write the step by step working of link state routing. Also, compare it with distance vector routing.

Ans. Link state Routing:-

- In Link state Routing, the routers share the knowledge of only their neighbouring routers.
- Link state routing calculates the best route on the basis of least cost.
- Link state routing is complex and requires trained network administrator.

- Link state routing update only the link state.
- In link state routing, The nodes can have hierarchical structure.

* Distance Vector Routing *

- Each router Periodically share its knowledge about the entire network with its neighbours.
- Distance vector routing calculates the best route based on the distance.
- Distance vector routing is simple to implement and manage.
- Distance vector routing update full routing table.
- Distance vector routing algorithm does not have hierarchical structure.

Q8. Circuit switching :-

Az

- Each Data unit know the entire Path address is provided by the source.

- In circuit switching, Data is processed at source system only.
- Circuit switching is more reliable.
- Path is fixed for data transmission.
- There are 3 phases :-
 → connecting establishment
 → data transfer
 → connection released

Q9. 3G Network.

A2. specifications by the International Telecommunication Union.

- The first 3G services were available in 1998.
- It provides high speed transmission having data transfer rate more than 0.2 mbps.
- It offers advanced multimedia access like playing music, ~~video~~ video television services etc.
- Global streaming services are ~~available~~ available for both voice and data.

← BCS-041 June - 2021 →

Q1. Which type of communication, digital or analog, is better for computers.
Justify your answer.

Ans.

Digital Computer

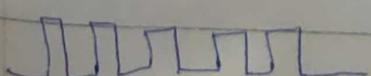
1). Digital computer work on discontinuous / discrete data.

2). Digital computer basically work by counting and adding the binary digits.

3). Digital computer represents data in binary format (0 and 1).

4). more accurate and reliable.

5). Data flows in the form of pulses.



Analog Computer

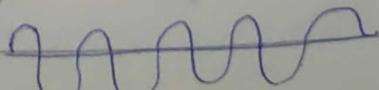
1). Analog computers works on continuous data.

2). Analog Computer work by measuring analog / electrical signal.

3). Analog Computer represents data as physical quantities current etc.

4). Analog computers are not as accurate as digital computer.

5). Data flow in form of sine waves.



Q2. What are 'Hash functions'? Why are they called 'one-way functions'? Explain.

Ans. A hash function accepts a variable message as input and produces a fixed-size message digest as output.

- Hash function does not take a ~~secret~~ secret key as input.
- To authenticate a message, the message digest is sent with the message in such a way that the message ~~dog~~ is authentic.

* Three methods in which the message can be authenticated.

- one-way hash function using conventional encryption.
- one-way function using Public-key encryption.
- one-way hash function using ~~secret~~ secret.

Q3. How does the number of twists in the VTR cable relate to its performance?

Q3. Name the two sublayers of Data Link Layer, and explain the characteristics of these layers.

A) i) Logical Link control (LLC sublayer) :-

- The primary function of LLC is to multiplex protocols over the MAC layer and de-multiplex while receiving.
- LLC provides hop-to-hop flow and error control.
- It allows multipoint communication over computer network.
- Frame sequence numbers are assigned by LLC.
- In case of acknowledged services, it tracks acknowledgements.

ii) MAC sublayer (media Access Control) :-

- It is responsible for encapsulating frames for transmission via the physical medium.

- It resolves the addressing of source station as well as the destination station.
- It also performs collision resolution and initiating transmission in case of collisions.
- It generates the frame check sequence and checks transmission errors.

Q4. Compare and contrast the amplitude modulation and phase modulation techniques. Discuss the limitations of each.

Ans.

<u>Amplitude modulation</u>	<u>Phase modulation</u>
<ul style="list-style-type: none"> • It is simple circuit. • Its modulation index varies from 0 to 1. • Amplitude Modulation is widely used. • It has better sound quality. 	<ul style="list-style-type: none"> • It has complex circuit. • Its modulation index is always greater than one. • Phase modulation is used in mobile system. • It has poor sound quality.

- Noise immunity is poor than PM.
- Signal to noise ratio is better than ~~Phase~~ Phase modulation.
- Noise immunity is better than in AM.
- Signal to noise ratio is poor than Amplitude modulation.

Q5. Explain the working of 3-way handshake used in TCP, using a suitable diagram.

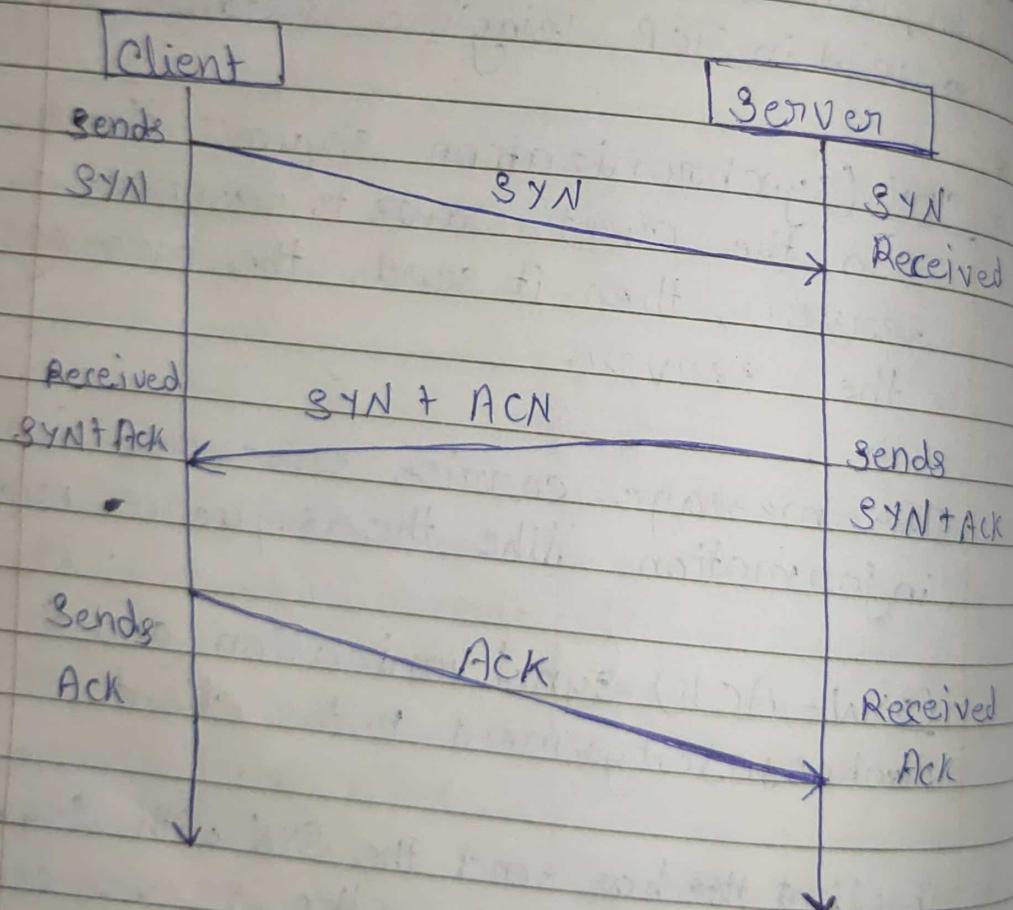
* SYN (Synchronization sequence number)

- When the client wants to connect to the server, then it sends the message to the server.
- The message carries some additional information like the sequence number.
- (SYN - ACK) synchronization and acknowledgement to the client.
- If client has sent the SYN with Sequence number = 500, then the server will send the Ack using acknowledgement number = 501.
- The sequence number used for SYN will be different from the client's SYN.

* Acknowledgment (ACK) :-

- The client send the acknowledgement to the server after receiving the synchronization from the server.
- Now the Data can transmitted between the client and server sides.

* Diagram *



Q6. Calculate the CRC for a 10 bit sequence 101001110 with a ~~division~~ divisor of 1011.

A2. $D(x) = 1010011110000$

$g(x) = 1011$

$$\begin{array}{r}
 1001\ 0000111 \\
 1011) 1010011110000 \\
 1010 \\
 \underline{0010} \\
 \underline{0000} \\
 0001 \\
 \underline{0000} \\
 \hline
 1011 \\
 1011 \\
 \hline
 0000 \\
 0001 \\
 \hline
 0011 \\
 0000 \\
 \hline
 0110 \\
 0000 \\
 \hline
 1100 \\
 1011 \\
 \hline
 0110 \\
 1011 \\
 \hline
 001
 \end{array}$$

$D(x) = 1010011110001$

$g(x) = 1011$

$$\begin{array}{r}
 10010000111 \\
 1011) 1010011110001 \\
 1011 \\
 \underline{0000} \\
 \hline
 1011 \\
 1011 \\
 \hline
 0001 \\
 0000 \\
 \hline
 0110 \\
 0000 \\
 \hline
 1100 \\
 1011 \\
 \hline
 0110 \\
 0000 \\
 \hline
 1011
 \end{array}$$

Q7. Frequency Division multiplexing.

A)

* Advantages of FDM :-

- FDM is simpler and easy demodulation.
- Less expensive.
- FDM provides more latency.
- It is used for analogue signals.
- FDM system has high reliability.
- A large number of the signal can be transmitted simultaneously.

* Disadvantage of FDM :-

- It is suffering the Problem of cross talk.
- FDM requires more hardware.
- FDM system extremely expensive.
- FDM has not dynamic coordination.
- The communication must have very large bandwidth.
- A large number of modulator and filter required.
- FDM channel can get affected due to wideband fading.

Q8. CSMA/CD.

Ans. When frame is ready, the transmitting station checks whether the channel is idle or busy.

- If the channel is busy, the station waits until the channel became idle.
- If the channel is idle, the station starts transmitting and continually monitors the channel to detect collision.
- If a collision is detected, the station starts the collision resolution algorithm.
- The station resets the retransmission counters and completes frame transmission.

Q9. IEEE 802.3

Ans. It is a 7 bytes starting field that provides alert and timing pulse for transmission.

- It is 1 byte field that contains an alternating pattern of ones and zero ending with two ones.
- It is 2 bytes field that stores the number of bytes in the Data.
- It is 6 byte field containing the physical address.

address of the sending station.

Q10. Frame Relay.

Ans. It is an wan Protocol with high performance.

- It is connected wan to wan and lan to wan .
- operate at physical and Data Link layer
- It uses packet switched technology
- Does not guarantee reliable transmission of Rubdies packet.