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BCS502

Fifth Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025
Computer Networks

Time: 3 hrs.

Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. M : Marks , L: Bloom's level , C: Course outcomes.

		Module – 1	M	L	C
Q.1	a.	What is data communication? List and explain characteristics and components of communication model.	06	L1	CO1
	b.	Define switching. Explain Circuit Switched Network and Packet Switched Network.	06	L2	CO1
	c.	With neat sketch, explain different layers of TCP/IP protocol suite.	08	L2	CO1
		OR			
Q.2	a.	What are guided transmission media? Explain twisted pair cable in detail.	06	L1	CO1
	b.	What is Virtual Circuit Network (VCN)? With neat diagram, explain three phases involved in VCN.	08	L1	CO1
	c.	Write a note on Encapsulation and decapsulation at Source Host for TCP/IP protocol suite.	06	L2	CO1
		Module – 2			
Q.3	a.	Define Redundancy. Explain CRC encoder and CRC decoder operation with block diagram.	08	L2	CO2
	b.	Distinguish between Flow Control and Error Control. Explain Stop and Wait Protocol.	08	L2	CO2
	c.	List and explain Control Fields of I-frames, S-frames and U-frames.	04	L2	CO2
		OR			
Q.4	a.	What is Hamming distance? With example, explain Parity Check Code.	06	L1	CO2
	b.	Define Framing. Explain character oriented framing and bit-oriented framing.	06	L1	CO2
	c.	With flow diagram, explain CSMA/CA.	08	L2	CO2
		Module – 3			
Q.5	a.	Explain virtual-circuit approach to route the packets in packet-switched network.	10	L2	CO3
	b.	Illustrate the working of OSPF and BGP.	10	L3	CO3
		OR			
Q.6	a.	Explain IPv6 datagram format.	10	L2	CO3
	b.	Write an Dijikstra's algorithm to compute shortest path through graph.	06	L1	CO3
	c.	Write a note on Routing Information Protocol (RIP) algorithm.	04	L2	CO3
		Module – 4			
Q.7	a.	Explain Go-Back-N protocol working.	10	L2	CO4
	b.	With neat sketch, explain three-way handshaking of TCP connection establishment.	10	L2	CO4

		OR			
Q.8	a.	With an outline, explain selective repeat protocol.	10	L2	CO4
	b.	List and explain various services provided by User Datagram Protocol (UDP).	10	L2	CO4
		Module – 5			
Q.9	a.	Briefly explain Secure Shell (SSH).	10	L2	CO4
	b.	Write a note on Request message and response message formats of HTTP.	10	L2	CO4
		OR			
Q.10	a.	With neat diagram, explain the basic model of FTP.	04	L2	CO4
	b.	Describe the architecture of electronic mail (e-mail).	06	L3	CO4
	c.	Briefly explain Recursive Resolution and Iterative Resolution in DNS.	10	L2	CO4

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Fifth Semester B.E Examination

Dec 2024/ Jan 2025

Computer Networks (BCS 502)

1 a) What is Data communication? List and explain characteristics and components of communication model.

Soln: Data communications are the exchange of data between two devices via some form of transmission medium such as wire cable

characteristics:

1) **Delivery:** System must deliver data to the correct destination.

2) **Accuracy:** The system must deliver the data accurately

3) **Timeliness:** System must deliver data in a timely manner

4) **Jitter:** refer to the variation in the packet arrival time

components:
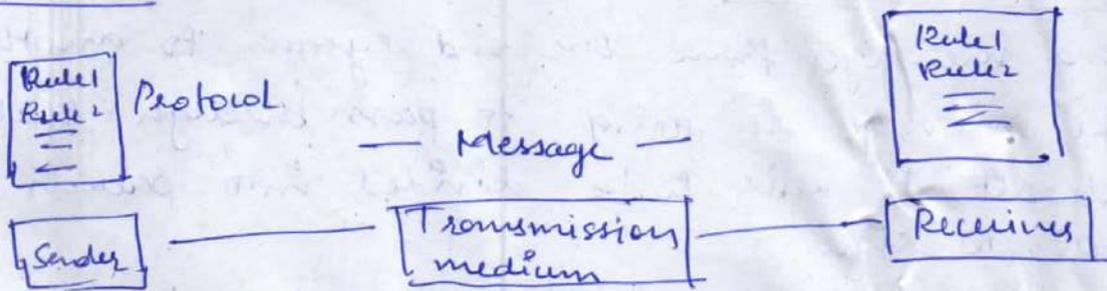
① **Message:** is the information to be communicated.

② **Sender:** is the device that sends the data message

③ **Receiver:** is the device that receive message.

④ **Transmission Medium:** is the physical path by which a message travels from sender to the receiver.

⑤ **Protocol:** is a set of rules that governs data commu

b) Define switching. Explains circuit switched Network & packet switched Network.

sol^n: Switching is a technique used in networks to transmit data between devices or nodes by choosing a path through intermediate devices. Switches are devices capable of creating temporary connections between two or more devices linked to the switch.

→ Circuit switched networks: consist of a set of switches connected by physical links, in which each link is divided into n channels.

* A connection between two stations is a dedicated path of one or more links.

* Each connection uses only one dedicated channel on each link.

* It take place at physical layer.

* Before starting of communication, stations must reserve the resources that are used during communi...

→ Packet Switching: In communication we need to send messages from one end system to another. If the message is going to pass through packet switched network, it needs to be divided into packets of fixed or variable size.
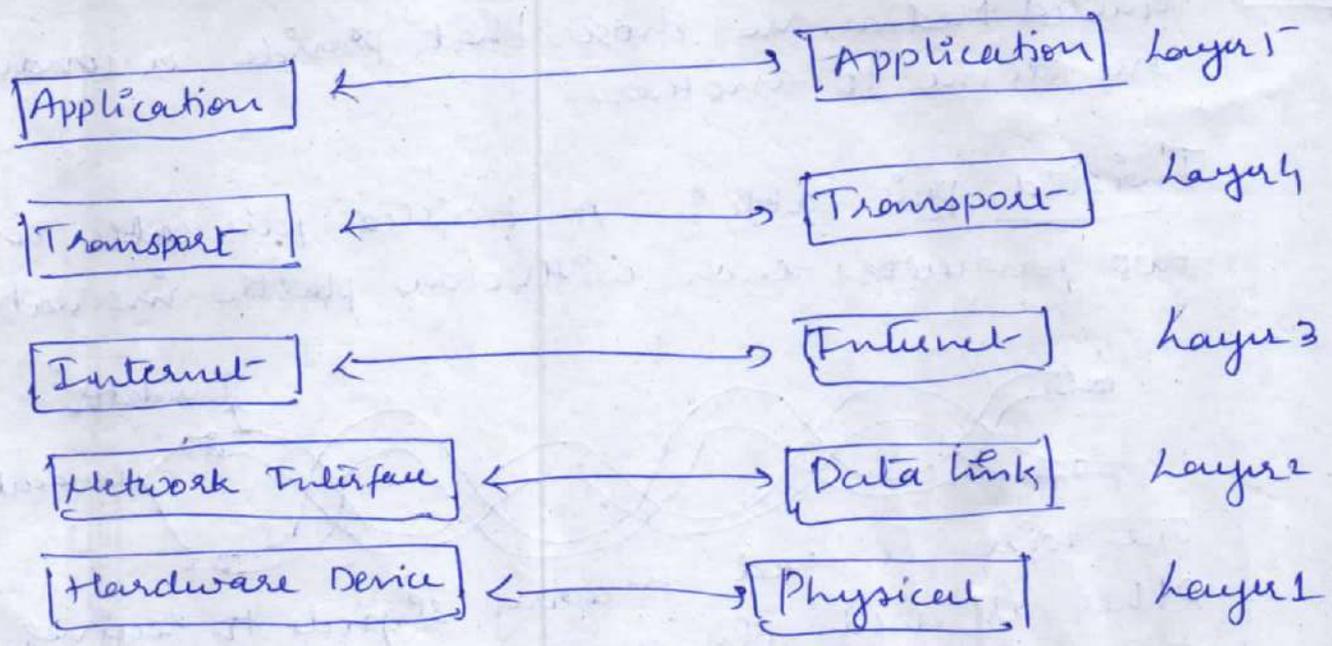
→ NO resource allocation for a packet, hence no reserved bandwidth. Resources are allocated on demand.

→ Each packet is treated independently of all others.

→ Switching will be done at the network layer.

c) With neat sketch, explain different layers of TCP/IP protocol suit.

Ans

```
[Application]  ←————————————→  [Application] Layer 5

[Transport]   ←————————————→  [Transport]  Layer 4

[Internet]    ←————————————→  [Internet]   Layer 3

[Network Interface] ←——————→  [Data link]  Layer 2

[Hardware Device]   ←——————→  [Physical]   Layer 1
```

Layers in TCP/IP protocol suit

① Physical layer : is responsible for carrying bits in a frame across link. It is lowest level in TCP/IP protocol suit communication between devices is still ilogical.

② Data link layer : an internet is madeup of several links connected by routers. The routers are responsible for choosing the best links. DLL is responsible for taking datagram and moving it across link.

③ Network layer : is responsible for creating connection between the source computer and destination computer. The communication at the network layer is host to host.

④ Transport layer : The logical connection at the transport layer is end to end. Host gets the message from application layer, encapsulates it in a transport layer packet and sends it.

⑤ Application layer : The logical connection is end to end. Communication is between to processes.

Q2)

a) What are guided transmission media? Explain twisted pair cable in detail.

Soln: Guided Media are those that provide a conduit from one device to another.

Twisted pair cable: A twisted pair cable consist of two conductors each with own plastic insulation.
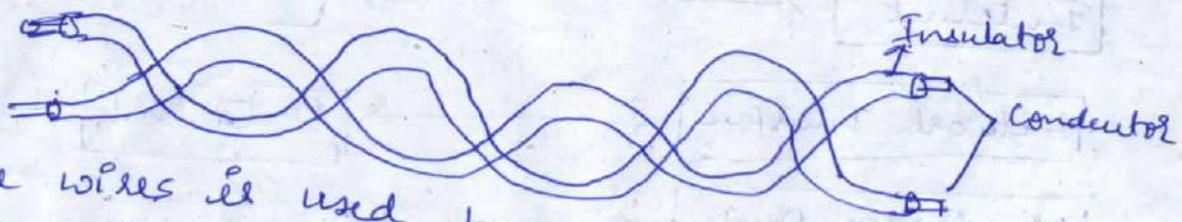
One wires is used to carry signals to reciver & the Other is used only as a ground reference. Twisting makes it probbable that both wires are equally affected by externally influence. Hence the reciver can calculate the difference between the two & recceives no unwanted signals.

The most common twisted pair cable used in communi cation is unshielded twisted pair. The most common UTP connector used is RJ45. These are used in telephon lines to provide voice & data channels. They are also Used as DSL lines in telephone lines.

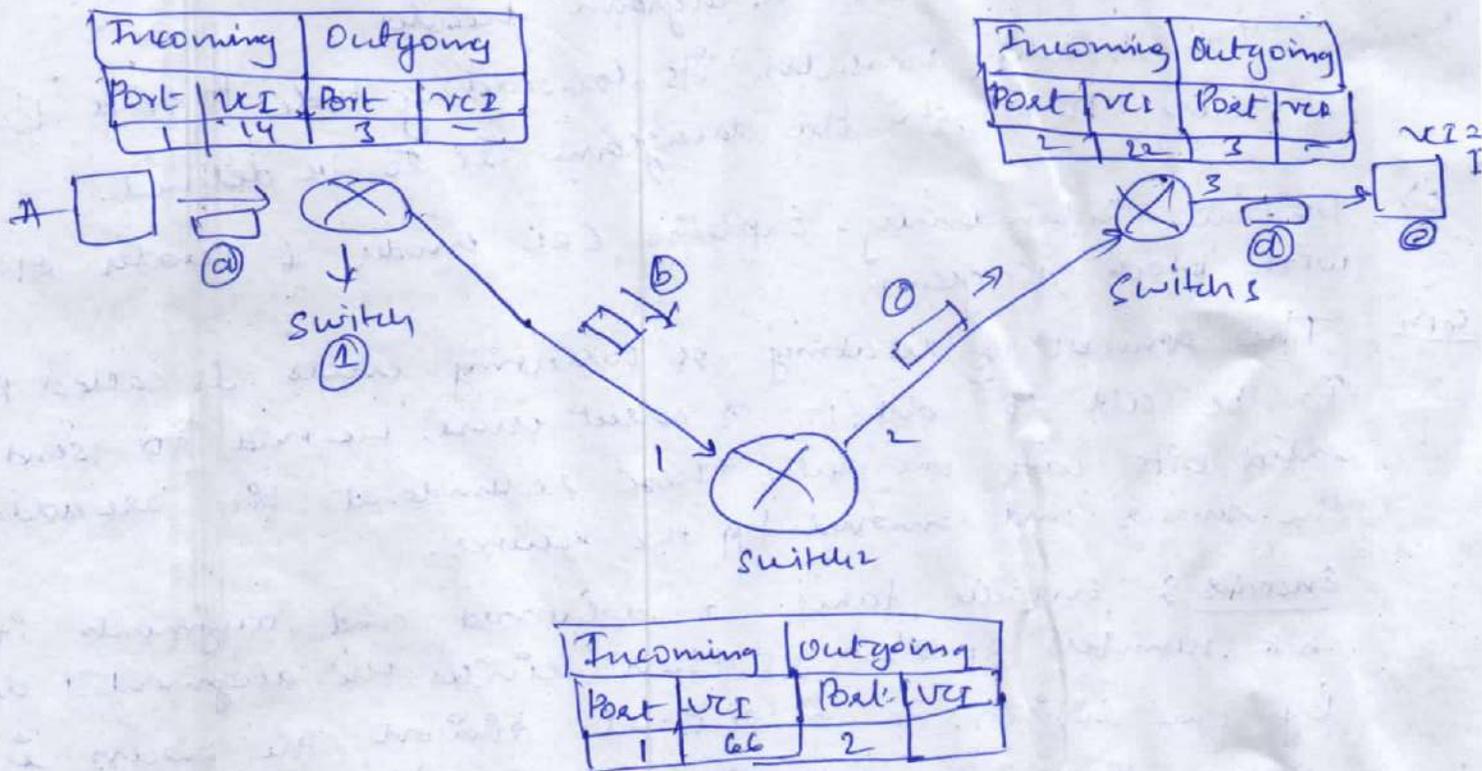b) What is Virtual Circuit Network? With neat diagramm, explain three phases involved VCN.

Sd4: A virtual circuit Network is a cross between a circuit switched & a datagram network.

Phases involved in VCN:

① Setup phase: A path is established between the source & the destination. Each switch/router in the path stores VCI. Resourcess like buffer may be reserved.

② **Data Transfer Phase :** Once circuit is established packets are transfered along the same path. each packet carries VCI instead of full address. Delivery is orderly & reliable if the path is stable

③ **Teardown phase :** After data transmission is complete virtual network is released. All switches delete vci entries and releases resources reserved.

Incoming		Outgoing	
Port	VCI	Port	VCI
1	14	3	—

Incoming		Outgoing	
Port	VCI	Port	VCI
2	22	3	—

Switch②

Switch①

Switch2

Incoming		Outgoing	
Port	VCI	Port	VCI
1	66	2	

c) Write a note on Encapsulation and decapsulation at source Host for TCP/IP protocol suit.

Soln: Encapsulation at source the source Host includes,

→ At application layer, the data be exchanged is referred as message. The message is passed to the transport layer.

→ the transport layer takes the message as payload, the load that the transport layer should add, header, info needed for flow, error control, congestion control.

→ The network layer takes the segment, adds its own header containing source & destination host, fragmentation information generating the datagram.

→ The DLL takes the network layer packet as data or payload and adds its own heady, which contain the link layer addresses of the host

Decapsulation :

→ After the set of bits are delivered to the data link layer if decapsulates the datagram from frame

→ the ntw layer only inspects the source & destination addresses in the datagram header.

→ the header consults its forwarding table, to find the next hop to which the datagram is to be delivered.

3) Define Redundancy. Explains CRC encoder & decoder operation with block diagrams.

Sol⁄ The concept of detecting or correcting errors is called Redunda To be able to detect or correct errors, we need to send some entra bits with our data. These redundant bits are added by the sender and removed by the receiver.

Encoder : Encoder takes a dataword and augments it with n-k numbers of 0's. It then divides the augmented dataword by the divisor. As in decimal division, the process is done step by step. In each step, a copy of the divisor is XORed with 4 bits of the dividend. The result of the XOR operal is 3 bits, which is used for the next step after 1 extra bit is pulled down to make it 4 bits long.

```
              1001 → Dataword            1011 → Divisor
        1010    → Discard
  1011 )100 11000)  ← dividend
        1011 ↓|||
        00100||
        0000↓||
        01000|
        1011↓
        00110
        0000
         110  → remainder
```

codeword |1001|110|
Dataword + reminder

Decoder : The codeword can change during transmission
The decoder does the same division process as the encoder
the reminder of the division is the syndrome. If the syndrome
is all 0's, there is no error with a high probability.

b) Distinguish between Flow control & Error control. Explain
Stop & wait Protocol.

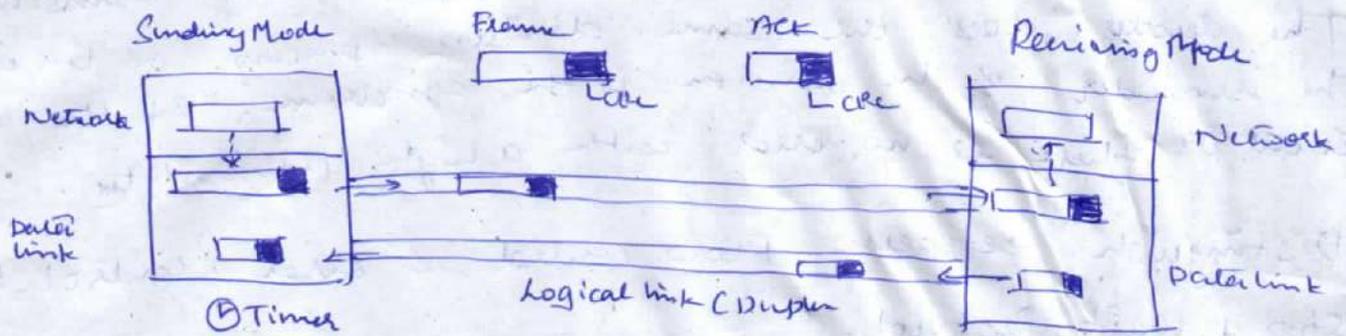Sol :- Flow control : controls the rate of data transmission between
sender & receiver.

* Prevents the receiver from being overwhelmed by too much
data.

* Deals with buffer management

* Uses techniques like stop & wait, sliding window ec
XON - OFF.

* Do not al with corrupted frames.

Error control :

* Detects corrects errors in transmitted data

* Ensure accurate & reliable data

* Uses A4 NACK

* Uses e detection codes like CRC

* May involve retransmission of corrupted data.

Stop on wait Protocol : is the simplest reliable data
link ol combining both flow control & error control.

* In protocol sender sends one frame at a time
awts for acknowledgement (Ack) before sending next
fra

* it corrupted errors frames, we need to add CRC
& data frame.

Sending Mode   Frame   ACK   Receiving Mode

Network   Lce   L crc   Network

Data link   Data link

⊕ Timer   Logical link (Duplex)

* **Sender states:** The sender is initially is ready state, b it can move between the ready and blocking state.

* **Ready state:** When the sender is in this state, it is only waiting for a packet from the network layer. Sender creates a frame, starts a timer & sends a ~~frame~~ frame.

* **Blocking State:**

→ If a time out occurs, the sender resend the saved copy of the frame and restarts timer.

→ If a corrupted ACK arrives, the sender stops the timer & discards the saved copy.

* **Receiver:** The receiver is always the ready state.

→ If the error free frame arrives, the message in the frame is delivered to the network & ACK is sent
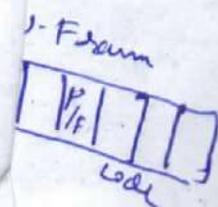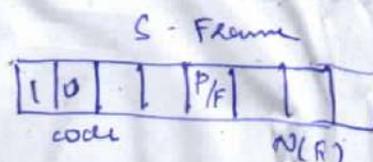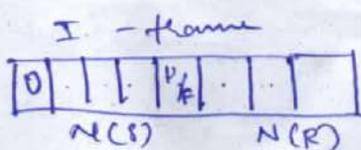
→ If a corrupted frame arrives the it is discarded.

* **ACK Reception or Timeout:**

→ ACK arrives before time expires, so stops the timer toggles its sequence number & returns ady to send the frame.

→ Timeout occurs → sender retransmits the frame & restart the timer.

c) List and explain control Fields of DL frame

I-frame, S-frame & U-Frames.

Soln:

I - frame   S - Frame

N(S)   N(R)   code   N(R)

U-Frame

code

* **Parity Check code:** It is familiar error detecting c
It is linear block code. k-bit data word is changed t
an n-bit codeword where n = k+1, the extra bit call
parity bit is selected to make total no of 1's in the
codeword even.

* The minimum hamming distance, $d_{min} = 2$, which
means that code is single bit error detecting code.

* The calculation is done in modular arithmatic, the
encoder uses generator that takes a copy of k bit data w
& generates a parity bit r_0.
i.e $r_0 = a_3 + a_2 + a_1 + a_0$ (modulo 2)

if the no of 1's is even the result is 0, if the no. of
1's is odd the result is 1.

b) Define hamming. Explain character oriented framing
and bit oriented framing.

01) Framing is the data link layer seperates a message
from one source to a destination by adding a sender
add & destination address.

Character oriented Framing: data to be carried are 8bits.
* header carries error detection redend bits are multiple
8 bits.

seperate one frame from next, an 8 bit flag is added
the beginning & the end of a frame.
Data section is stuffed with an extra byte called ESC 4
has predefined bit pattern.

Flag	Header			...			Trailer	Flag
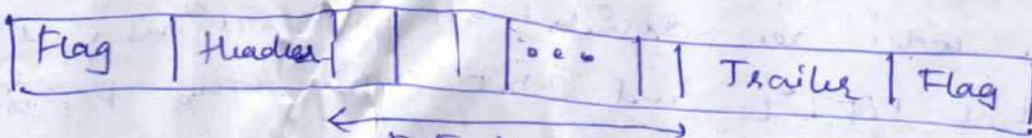
← Data from upper layer

* control Field for I-frames : I frame stands for information
Frame & it is used to carry user data. from network layer
across data link.

→ It includes, flow & error control information.

→ First bit defines the type, & set to 0.

→ Next three bits called N(c) define sequence no of the
frame, i.e. 0 to 7.

→ Last three bits called N(R) corresponds Ack no.

* control Field for S - Frames :

→ Supervisory frames are used for flow and error control

→ Do not have information fields.

→ First two bits are 10 indicating S frame.

→ Last three bits called N(R) correspond Ack or NACK.

→ last 2 bits called code are used to define the type of
S-frame

  * Receiver ready (RR): If the value of the code subfield
  is 00 it is an RR S-frame. This kind, frame ack
  the receipt of a safe & sound frame.

  * Receiver Not ready (RNR): value of the code subfield is
  It ack the receipt of a frame & it announ that
  receiver is busy & cannot receive more f

  * Reject (REJ): value of the subfield is 01. The Nak
  frame, that can be used in Go back N ARQ to a NAK
  efficiency of the process by informing the peer isnd.

  * control field for U-Frames : used for exchange
  management & control information, between conne
  * U frame codes are divided into two sections. 2 e.e.
 before the P/F bit and 3 bit suffix after P/F bit fix

49) What is Hamming distance? with example in
Parity check code.

Sol⁰: The Hamming distance between two words is the no
of differences between the corresponding bits.

Bit-Oriented Framing : the data section of a frame is a sequence of bits to be interpreted by upper layer as text, graph etc. It uses 8 bit flag as a delimeter to seperate/define begining & end of frame.

* 1 bit stuffing to prevent the pattern similar to flag.
* This bit is eventually removed from the data by the receiver.

c) With flow diagram, explain CSMA/CD.
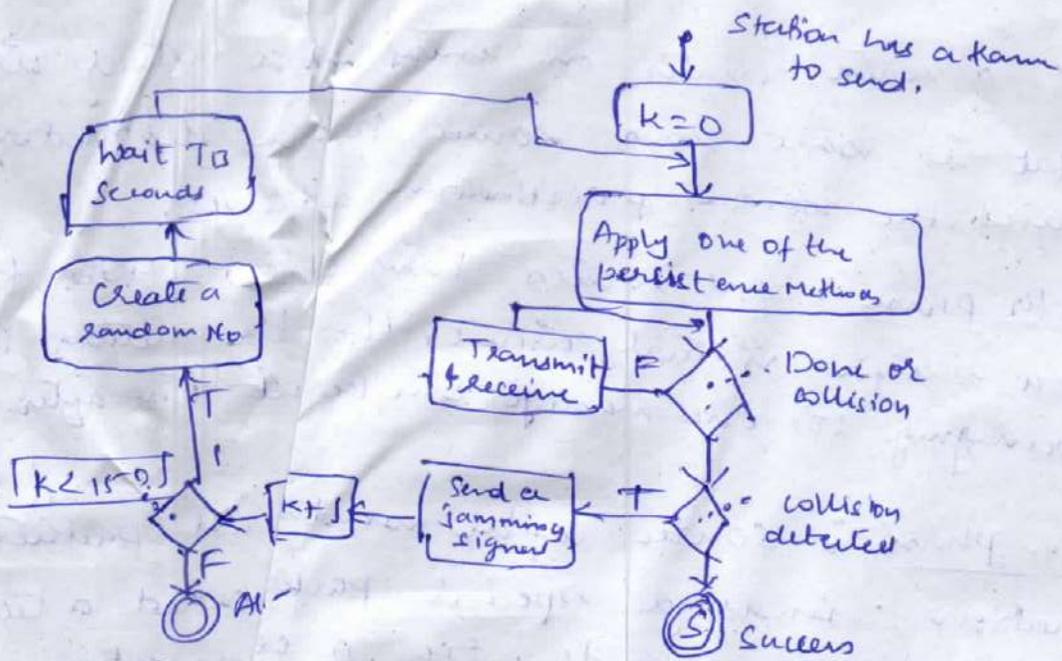
* Carrier sense multiple access with collision detection (CSMA/CD) augmentation algorithm to handle the collision.
* A station monitors the medium after it sends a frame to see the transmission was successful. If so, the station is finish, if there is a collision frame is sent again.

5a) Explain val circuit approach to route the packets in packetswitched network.

Soln: In a connection oriented service, there is a relationship between packets belonging to a message. A virtual connection should setup to define the paths for the datagrams. To use a connection oriented service, there phase process are setup, data transfer & teardown.
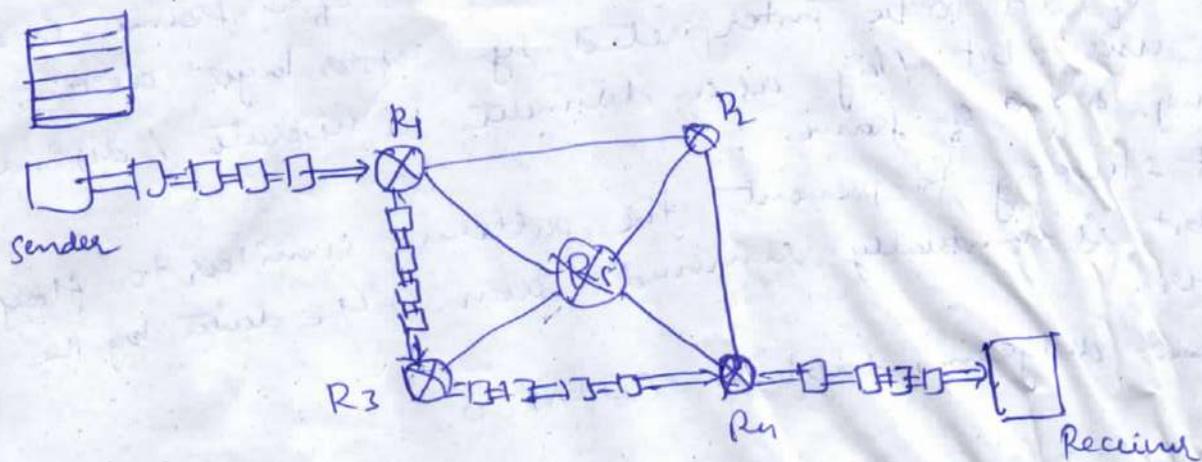
setup phase: a router creates an entry for a virtual circuit.

→ Request packet is sent from source to the destination. The packet carries the source & destination addresses.

Data transfer phase: All routers have loaded their forwarding table for a specific virtual circuit, then the network layer packets belonging to one message can be sent one after another.

Tear down phase: source after send all packets to the destination, sends a special pack called a teardown packet. Destination, responds with a termination packet. All routers delete the corresponding entry from their table.

5b) Illustrate the working of OSPF & B

Sol⁴: Open Shortest Path First is an intradomain routing protocol based on link state routing tool.

Metric: the cost of reaching a destination from the host is calculated from the source router to the destination network. Each link can be signed a weight based on the throughput, round trip, reliability & soon.

Forwarding table: Each OSPF router can a forwarding table after finding the shortest path between itself and the destination using dijkstra's algorithm.

Link state Advertisement : OSPF is based on link state routing algorithm, which requires that a router advertise the state of each link to all neighbors for the formation. There are five types of link advertisements.

→ Router link : router link advertises the existence of a router as a node.

→ Network link : network link advertises the network as a node.

→ Summary link to network : done by area border router, advertises the summary of links collected by backbone to an area.

→ Summary link to AS : done by an AS router that advertises the summary links from other AS to the backbone area of the AS.

→ External link : done by an AS router to announce the existence a single network outside the AS to backbone area to bdisseminated in to the areas.

*Border Gray Protocol (BGP) : is the only interdomain routing protol used in the Internet today. It is based on the p-vector algorithm.

* To ena each router to route a packet to any network in the enet, external BGP (eBGP) is used, on each border router.

* The sternal BGP (iBGP) is used on routers.

* A of client + server processes continuously communicate other to exchange messages. Two routers that run BGP processes are called BGP peers & BGP speakers.

* variation allows two physically connected border routers no different AS's to form pairs of eBGP speakers & ange messages.

P uses the service of TCP on the well known port 179 it creates a session between any possible pair of ters inside on autonomous system.

Q.60) Explain IPv6 Datagram Format.

Soln:- IPv6 Datagram :-
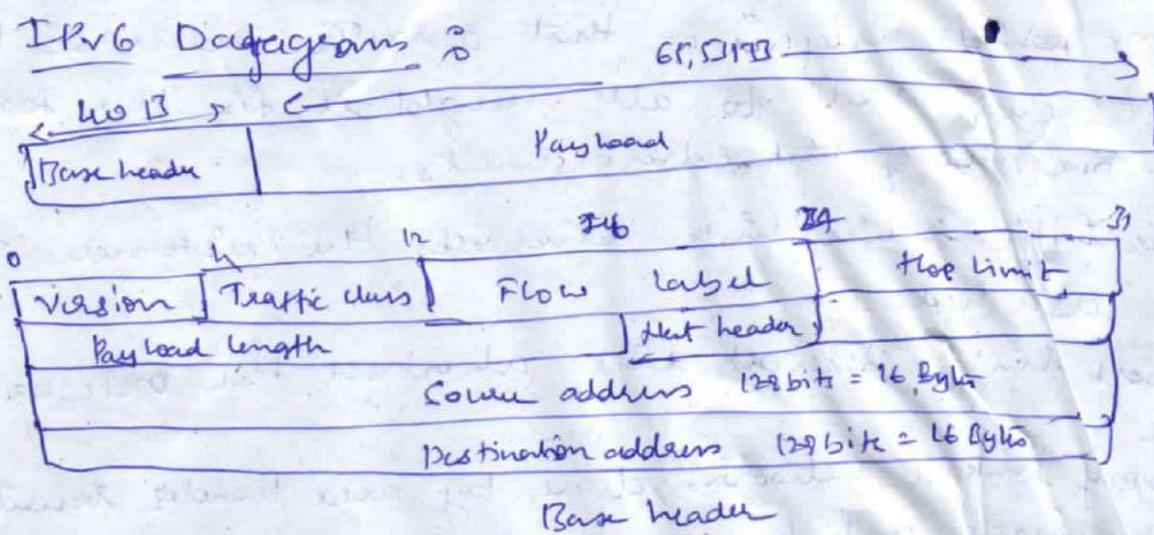
Base header

* Better header packet:- new header format, in which options seperated from base header.
* New Options :- to allow for additional functionalities.
* Allowance for extension:- IPv6 is designed to allow th extension of the protocol if required by new technolo,
* Version:- 4bit version field.
* Traffic class:- 8 bit traffic class to distinguish payload with different delivery requirements.
* Flow control:- 20bit designed to provide ial handling for particular flow of data.
* Payload length:- 2 Byte payload length + defines the length of the IP datagram, including head
* Next header :- 8 bit field, defining the of first extension header
* Hop limit :- 8bit, serves the purpose of t Live.
* Source & destination addresses: 16 byte source, nation Internet addresses.
* Payload: 65,535 Bytes of payload.

6b) Write an Dijikstra's algorithm to compute shortest path through graph.

Solⁿ: Dijkstra's Algorithm:

```
Dijikstra ()
{
    Tree = {root}
    for (y=1 to N)
    {
        if ( y is the root)
            D[y] = 0
        else if ( y is neighbor)
            D[y] = C[root][y]
        else
            D[y] = ∞
    }

    repeat
    {
        find a node w with D[w] minimum among all nodes in T
        Tree = Tree U [w}
        for (every node x, which is neighbor of w & not in Tree)
        {
            D[x] = min {D[x], (D[w] + C[w][x])}
        }
    } until (all nodes included in tree)
```
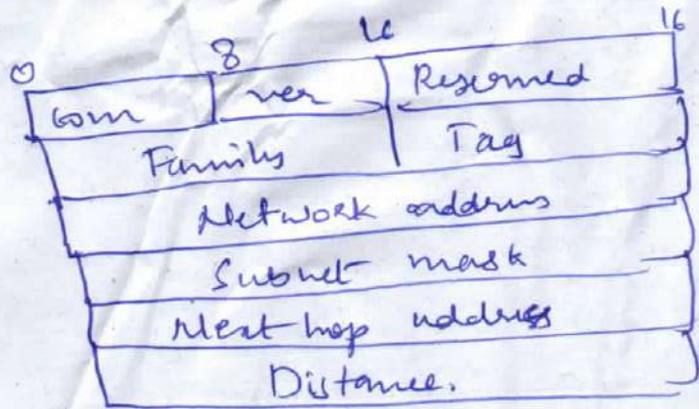
c) Write a short on outing Information Protocol (RIP).

Ans: Routing Information Protocol (RIP) is one of the most widely used interdomain routing protocols based on distance vector routing algorithm.

* As needs to know how to forward a packet to different networks instead of reaching other nodes.

* RIP is implemented as a process that uses the services of UDP on a wellknown port no. 520.

* Two RPP messages a client & a server, like any other processes need to exchange messages.

Com	ver	Reserved
Family		Tag
Network address		
Subnet mask		
Next hop address		
Distance.		

Q7

a) Explain Go-Back N protocol working

Sol: The key to to Go-Back-N is that we can send several packets before receiving acknowledgments, but the receiver can only buffer one packet. We keep a copy of the sent packets until the acknowledgment arrive.


Logical channels
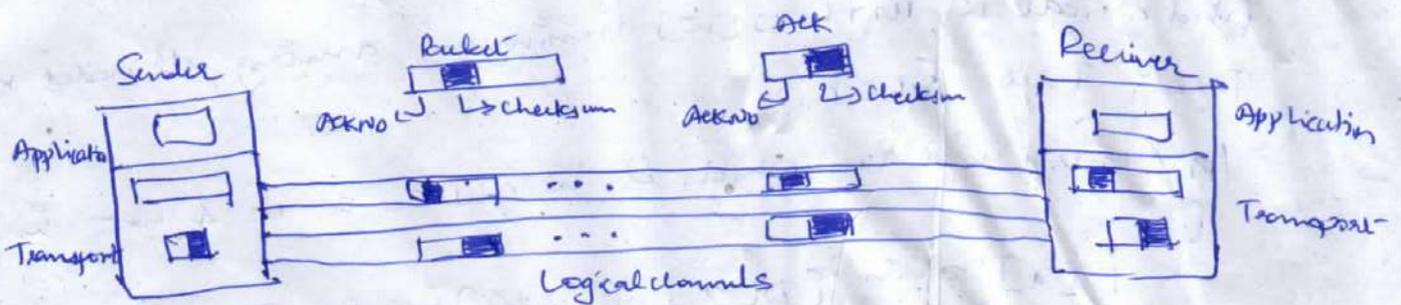
* Acknowledgment No. in this protocol is cumulative & defines the sequence no. of the next packet expected.

* The send window is an imaginary box that sequence numbers of the data packets that can be in transit or can be sent.

* The receive window makes sure but the correct data packets are received and that the correct acknowledgments are sent.

* The size of the receive window always 1. The receiver always looking for the arrival of specific packet.

* Any packet arriving out of order is discarded and needs to resent.

* Although there can be a timer for each packet that is sent, protocol uses only one.
* When timer expires, the sender resends all outstand[ing] packets.

7b) With neat sketch, explains three-way handshaking of TCP connection establishment.

O/P:
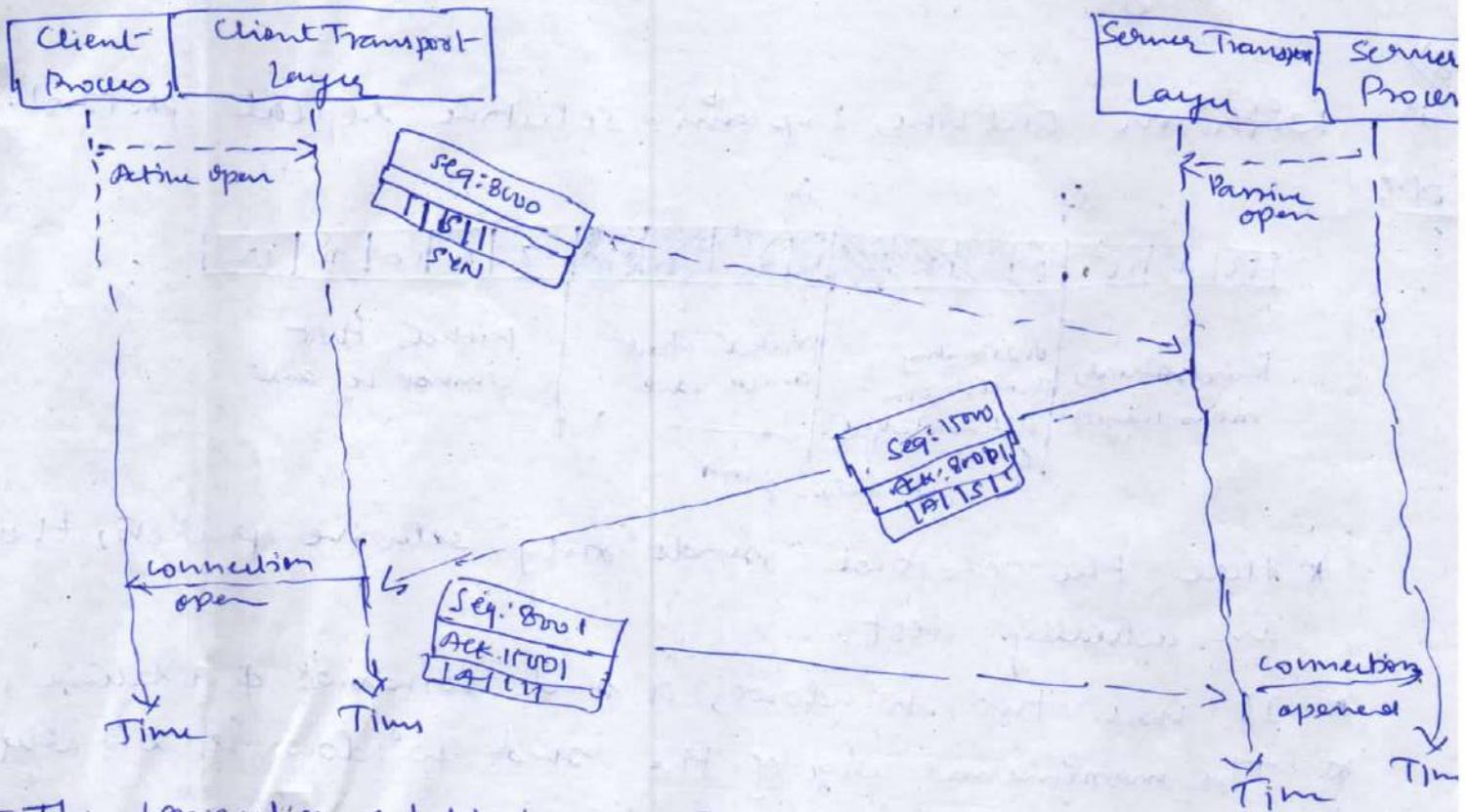
* The connection establishment in TCP is called three way handsh[aking]
* An application program called client makes an connection with another application program called server, using TCP as a transport layer Protocol.
* Process starts with a server, the server program tells its TCP that it ready to accept a connection, called passiv[e] open.
* Client issues a request for an active open. A client wishes to connect a to an open server tells its TCP to connect to a particular server.
* Client sends the first segment, SYN, in which only SYN flag is set. The client chooses a random no. as the first sequence no & sends this number to the server.

* The server sends the second packet, SYN + ACK segment with two flag bits set as SYN + ACK. Server uses this segment to initialize a sequence no for numbering the byt sent from client to server.

* Client sends the third segment, an ACK, which - Acknowledges the receipt of the second segment with the ACK flag.

8)
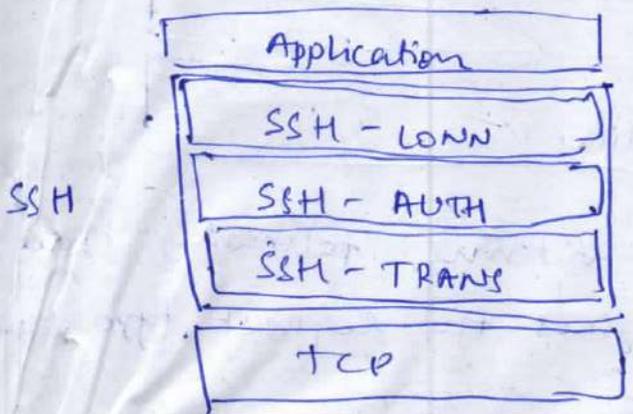a). With an outline, explain selective repeat protocol.

Solr.

$$S_{ize} = 2^{m-1}$$
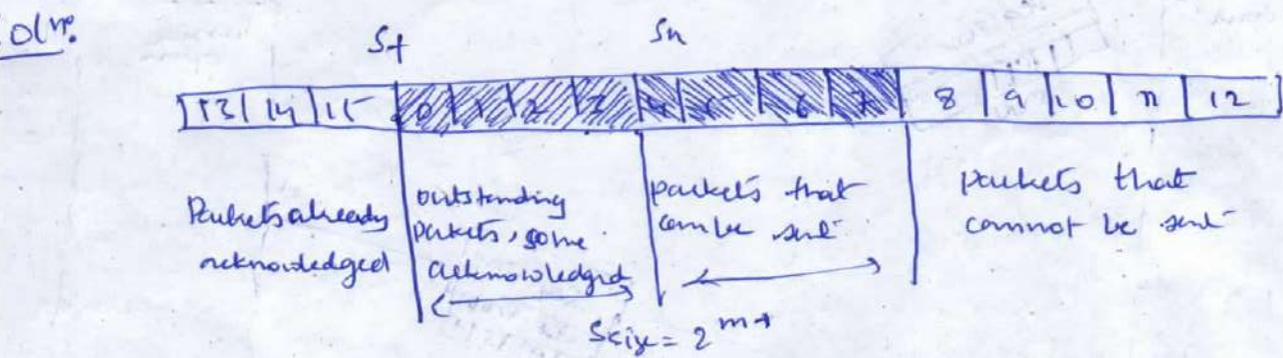
* Here, the protocol sends only selective packets, those th are actually lost.

* It uses two windows, a send window & a receive windo

* The maximum size of the send window is smaller & it set to 2^{m-1}.

* The maximum size of the receive window is depend on send window, allows packets to arrive in out of order & be kept until there is a set of consecutive packets to be delivered to the upper layer.

* It uses one timer for each outstanding packet. When timer expires, only the corresponding packet is resent.

* The acknowledgment no. defines the sequence no. of error free packet received.

8) b) List & explain various services provided by User Datagram Protocol (UDP).

Soln: UDP is a simple, connectionless transport layer protocol that provides process to process communication.

① Process to Process communication: UDP enables direct communication between two processes during on different host using port no.

② Connectionless service: No handshaking is done before sending data. Each datagram is in independent and there is no need to to establish a connection.

③ Minimum overhead: UDP adds only 8 byte header, hence less bandwidth usage, faster performance than TCP.

④ Unreliable transmission: UDP does not guarantee delivery of data, packets out of order, duplication of data packets.

⑤ No congestional control: UDP does not implement congestion control allowing high speed transmission of data, helpful in case of real time applications, VOIP, streaming etc.

⑥ Checksum based Error Detection: provides 16 bit checksum to detect errors in headers & data.

Ⓔ

9a) Briefly explain Secure Shell (SSH)

Solⁿ:

```
         ┌─────────────────────────┐
         │      Application          │
         │  ┌───────────────────┐    │
         │  │   SSH - LONN      │    │
  SSH    │  ├───────────────────┤    │
         │  │   SSH - AUTH      │    │
         │  ├───────────────────┤    │
         │  │   SSH - TRANS     │    │
         │  └───────────────────┘    │
         │  ┌───────────────────┐    │
         │  │       tcp         │    │
         │  └───────────────────┘    │
         └─────────────────────────┘
```

Secure Shell (SSH) is a secure application program that could be used as remote login & file transfer.

SSH Components:

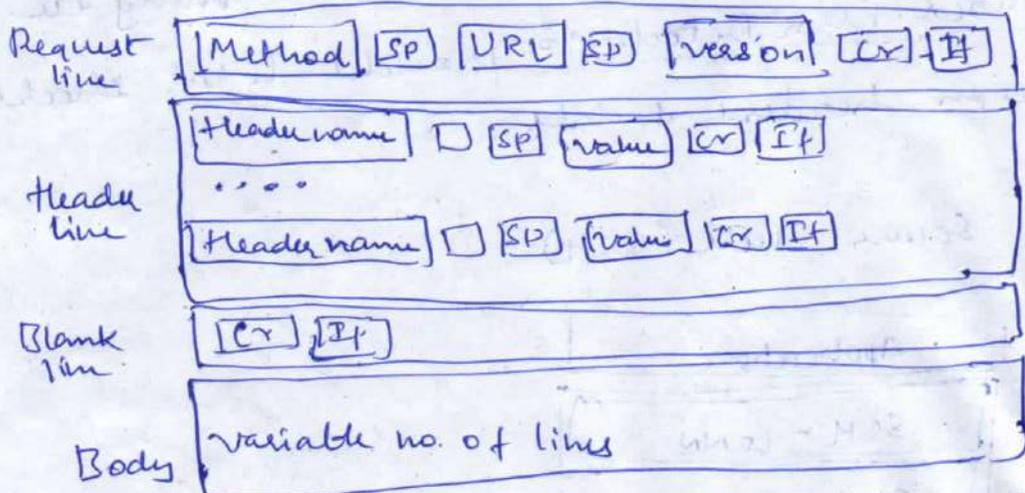① SCH Transport Layer Protocol (SSH-TRANS):
The client & server first uses the TCP protocol to establich an insecure connection. Then they exchange several security parameters to establich a secure channel on top of the TCP.

② SSH Authentication Protocol (SSH-AUTH): After a secure channel is established, the server is authenticated for the client, SSH call another procedure that can authenticate the client for the server. The Authenticate starts with a client, which sends a request message & server responds with success message.

③ SSH Connection Protocol (SSH-CONN): Provides services such as multiplexing. It takes secure channel establishe by protocols & lets client create multiple logical channels

b) Write a note on Request message & response message formats of HTTP.

HTTP Request Message:

Request line | [Method] [SP] [URL] [SP] [Version] [CR] [LF]

Header line | [Header name] [:] [SP] [value] [CR] [LF]
. . . .
[Header name] [:] [SP] [value] [CR] [LF]

Blank line | [CR] [LF]

Body | variable no. of lines

* The Request line contains following three parts
  Method: field defines the request type, such as GET me to send a request.
  POST method allows the client to post a new web page on the server. POST method used to send some information to the server to be added to web page or to modify the web page.

* URL : defines the address & name of the corresponding page.
* versions gives the version of the protocol.
* Header : includes key value pairs like HOST, user-agent

Response Message : consist of a status line, header line, blank line & some times body.
* status line contains : HTTP version, status code etc
* Header line contains additional information from server to the client, such as 404 Not found etc.

* cookies : When a client sends a request to a server, the browser looks in the cookies directory to see if it can find a cookie sent by that server.

as With neat diagram, explain the basic model of FTP.
oly: File Transfer Protocol (FTP) is a standard Protocol provided by TCP/IP for copying file from one host to another. The client has three components : user interface, control connection, client data transfer.
The server has two components : server control proce and server data transfer process.
The control connection uses very simple rules of communica
The control connection remains during the entire Interaction FTP session. the data connection is opened & closed for each file transfered activity.
Data connection uses the well known port 20 at the server site.
FTP can transfer following file types across data connection ASCII file, EBCDIC file etc.

b) Describe the architecture of Electronic mail (E-mail)
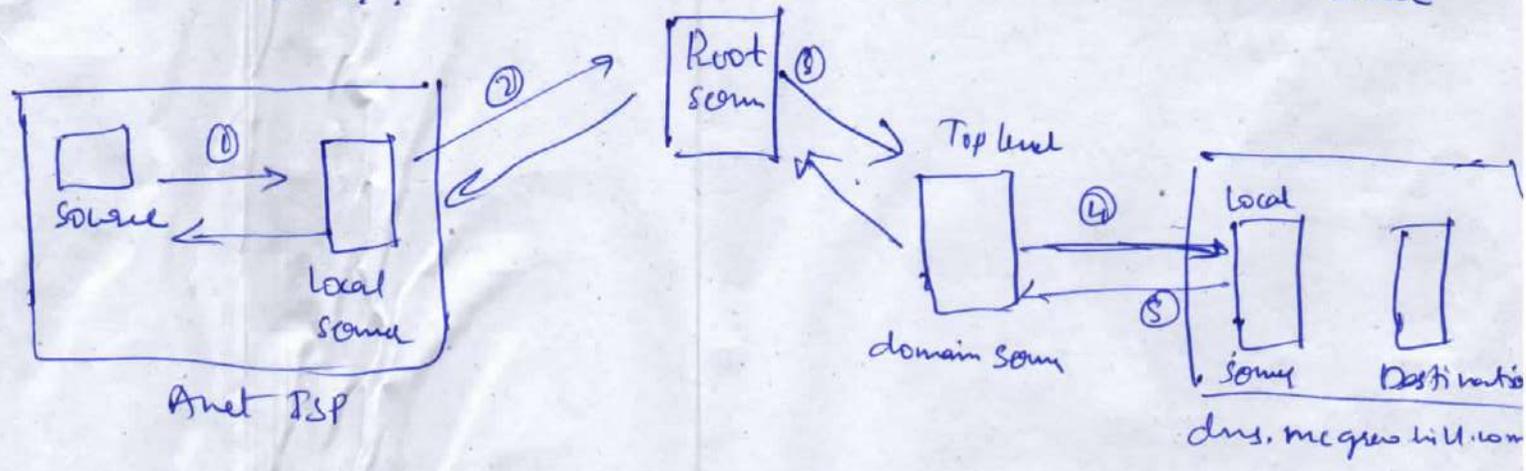
soln: E-mail allows users to exchange messages.

UA - User agent
MTA - message transfer agent
MAA - message access agent
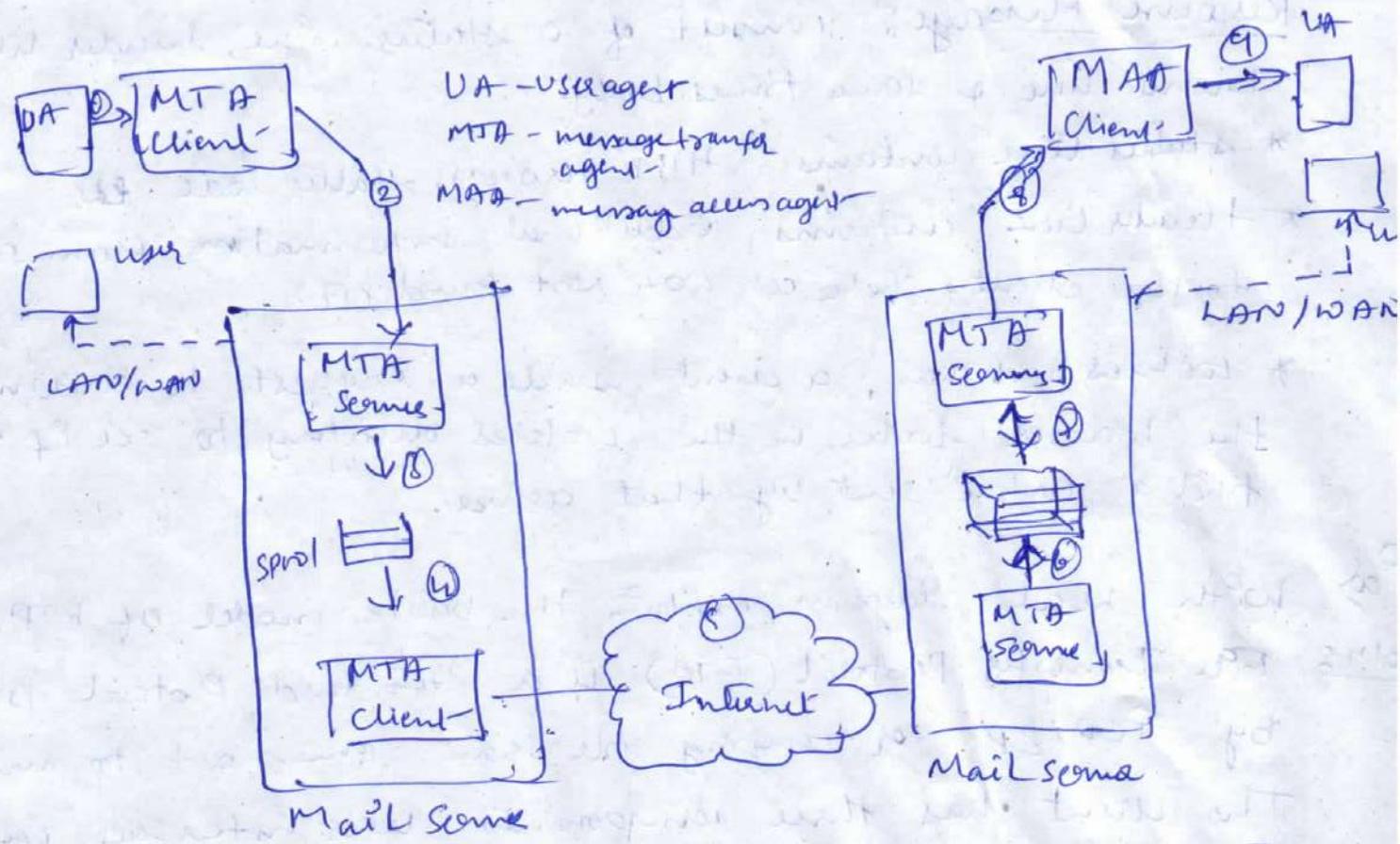
The sender & receiver of the mail, are, connected via LAN/WAN to two mail servers. Admin has created mail box for each user where the received messages are stored. User can run UA program to prepare the message and send it to their mail server. The mail server at at user queue to spool message waiting to be sent. The server need to run all the time because it does know when a client will ask for connections. The client on the hand can be triggered by the system where there is a message in a queue to be sent.

10c) Briefly explain Recursive Resolution & Interactive Resolution in DNS

Ans:

① **Recursive Resolution:** Client on the source host wants to find the IP address of a destination. ex: (engineering.mcgrewhill.com)

→ Client sends the query to local DNS server.

→ If local server does not know IP, it sends the query to root server

→ Root server forward it to the top-level domain server (.c

→ TLD server forward it to the authoritative server (dns. mcgrew-hill.com)

→ IP address is returned back through the same path.

② **Iterative Resolution:**

→ Each DNS server replies back with IP of the next server to query, instead of forwarding the request.

→ Client itself sends new query to each next level DNS server.

Source   ①→   Local Server   Anet ISP

Root Server ①

Top level ②

domain server ④

Local Server ⑤

Destination

dns. mcgrew hill.com

(Bhagat li ①)