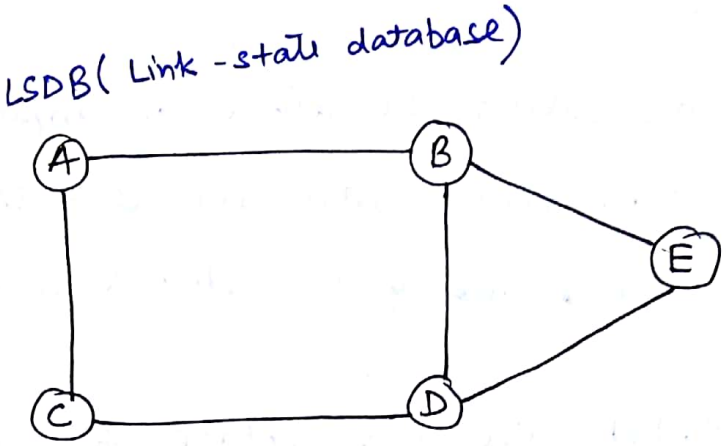
Link state routing algorithm :-



- Every router will have the link state information. All routers will elect one root router and will send there LSP packets to the root router.

- LSDB contains complete information of the network i.e no. of routers, no. of links, links up and down and the LAN networks.

- Using flooding LSDB packet is given to all routers.

- Once the link is broken, it is known to all routers immediately with the help of LSDB packet. So no router will forward the data via the broken link. So there is no count-to-infinity problem.

- Timestamp is also used with LSDB and LSP packet.

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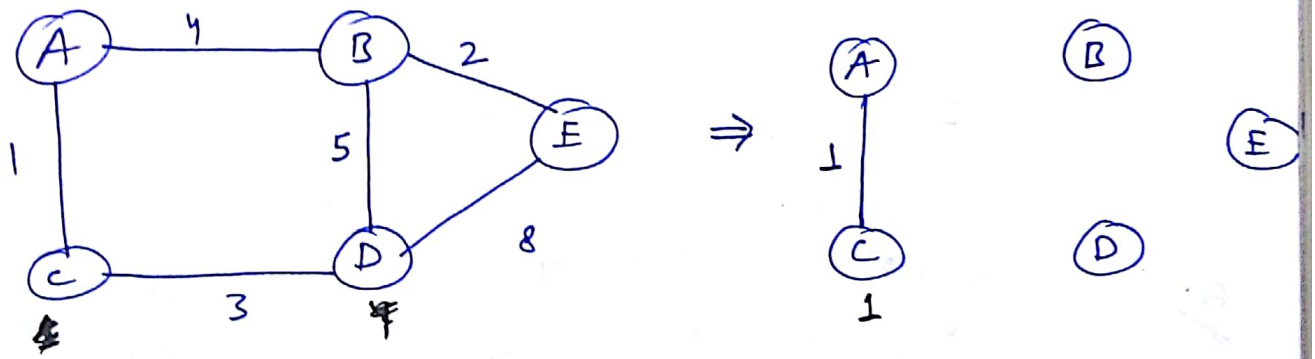
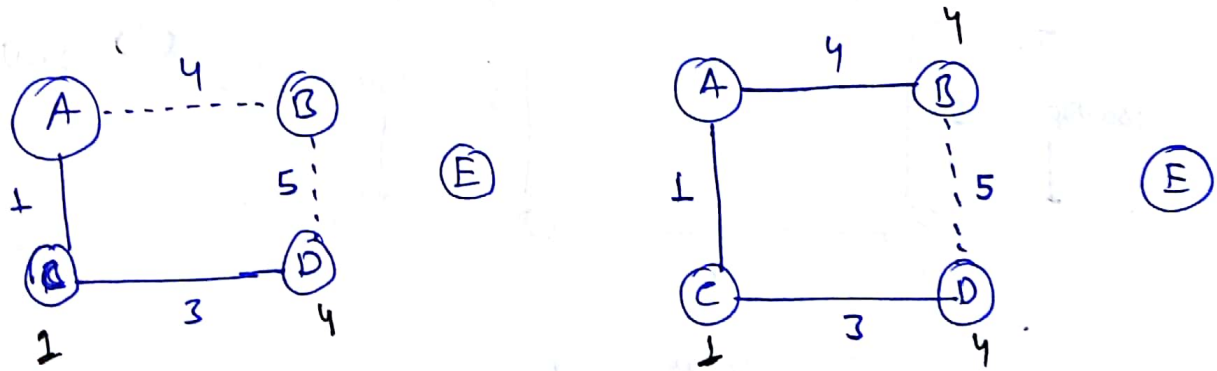
- LSDB packet should be generated periodically with the latest information of the network. Then all routers will update the correct information.

- In Link state routing algorithm every router will get the complete information by giving subset or integral information.

Shortest path tree or Dijkstra's algo:-





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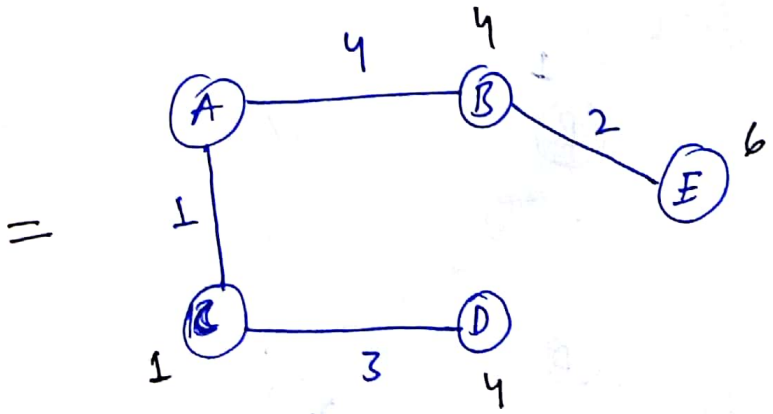

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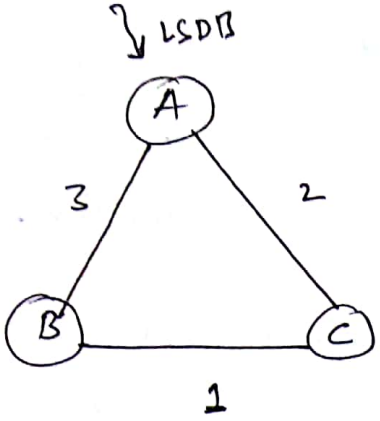
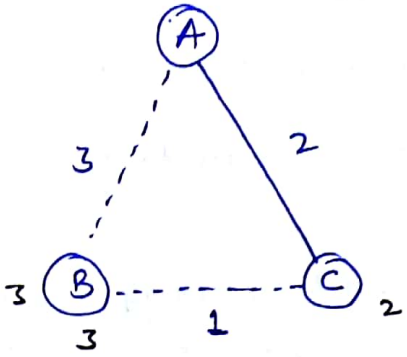
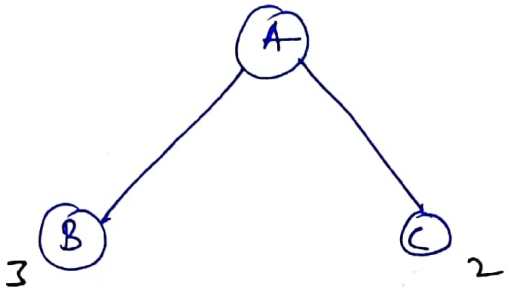
Q/

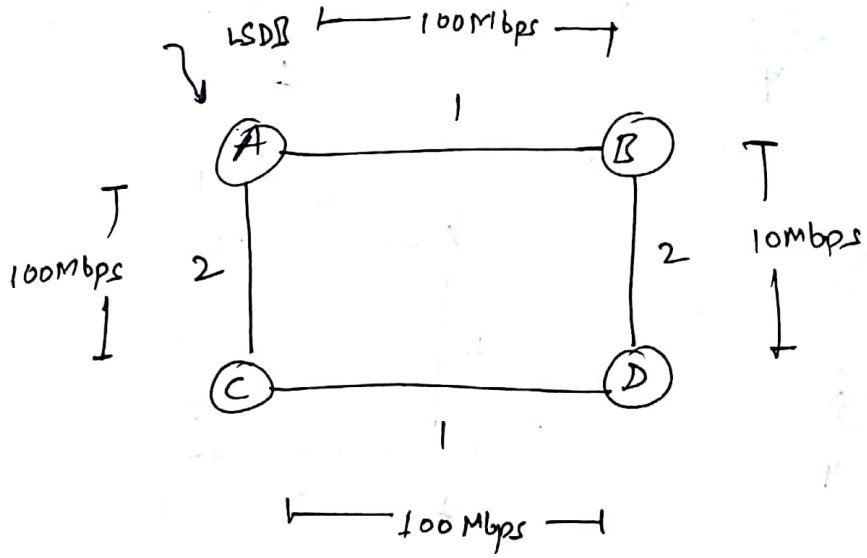




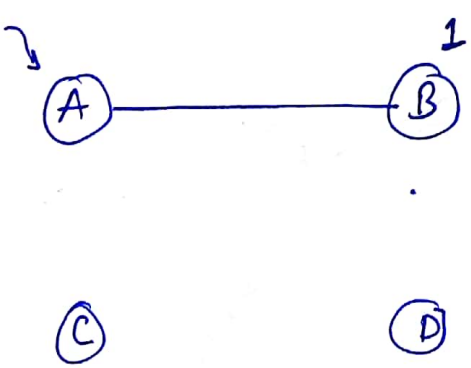
so, no. of hop count is used in such case

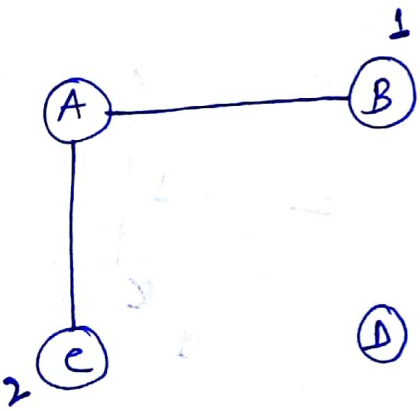


Q.



(i) delay
(ii) hop
(iii) B.W





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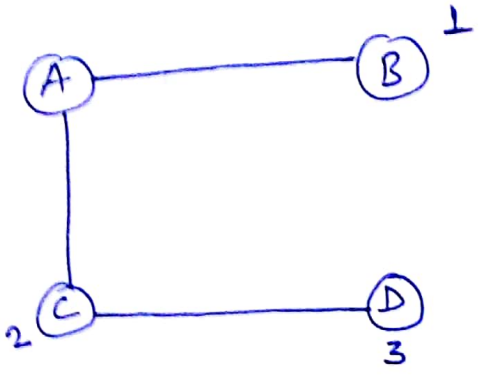


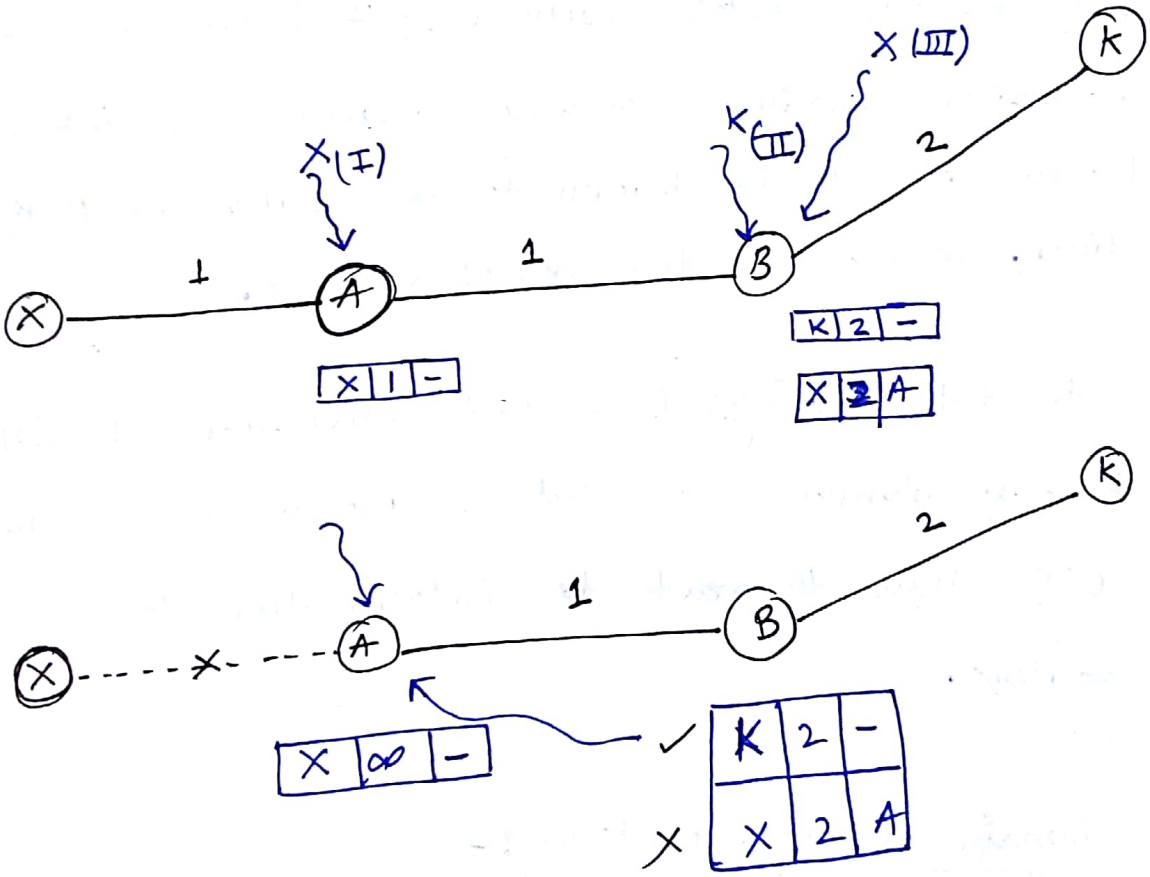
As B.W of ACD is 100 Mbps

whereas BW of BD is 10 Mbps

so, CD is used.

* So Before going with flooding of LSDB, whole has to be converted to tree using this algo.

Distance vector router with split horizon:-



B will only send | K | 2 | - |, | X | 2 | A | will not be send as B already taken that into from A so B will not send it.

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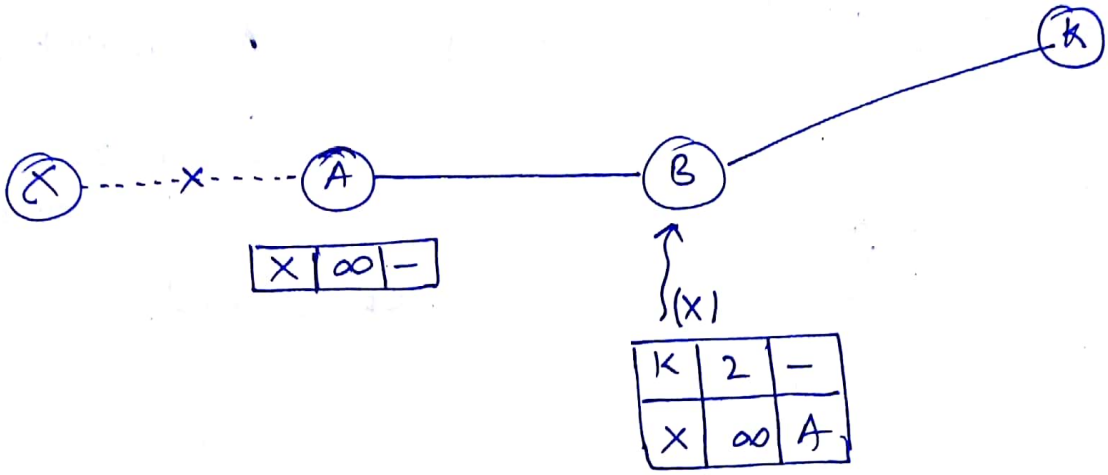
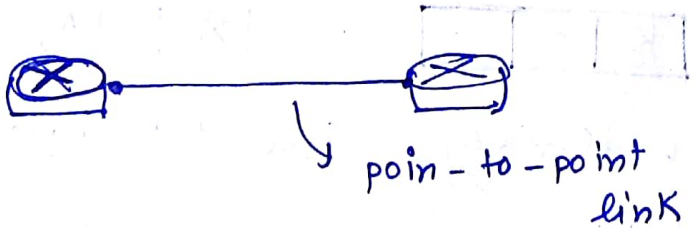


- Don't send the ~~route~~ route information back to the node from where this node has learned.

- Using distance vector with a split horizon is a slow conversion algorithm, because whenever a link is broken it will be known to all routers in O(n) time, where n is the no. of routers.

- Link state routing is a fast conversions algorithm. because whenever a link is broken it will take O(1) time to reach ~~to~~ information to all routers.

Intra domain routing protocol :-



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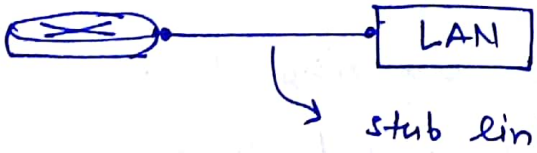
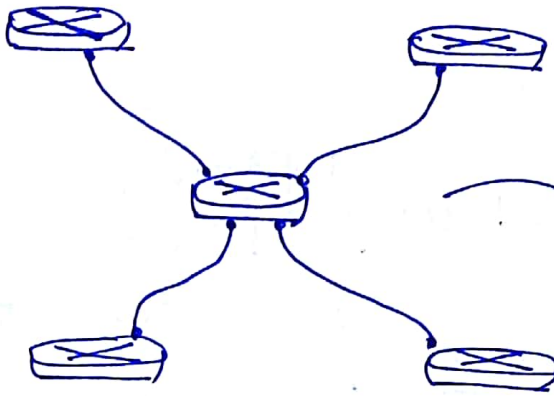
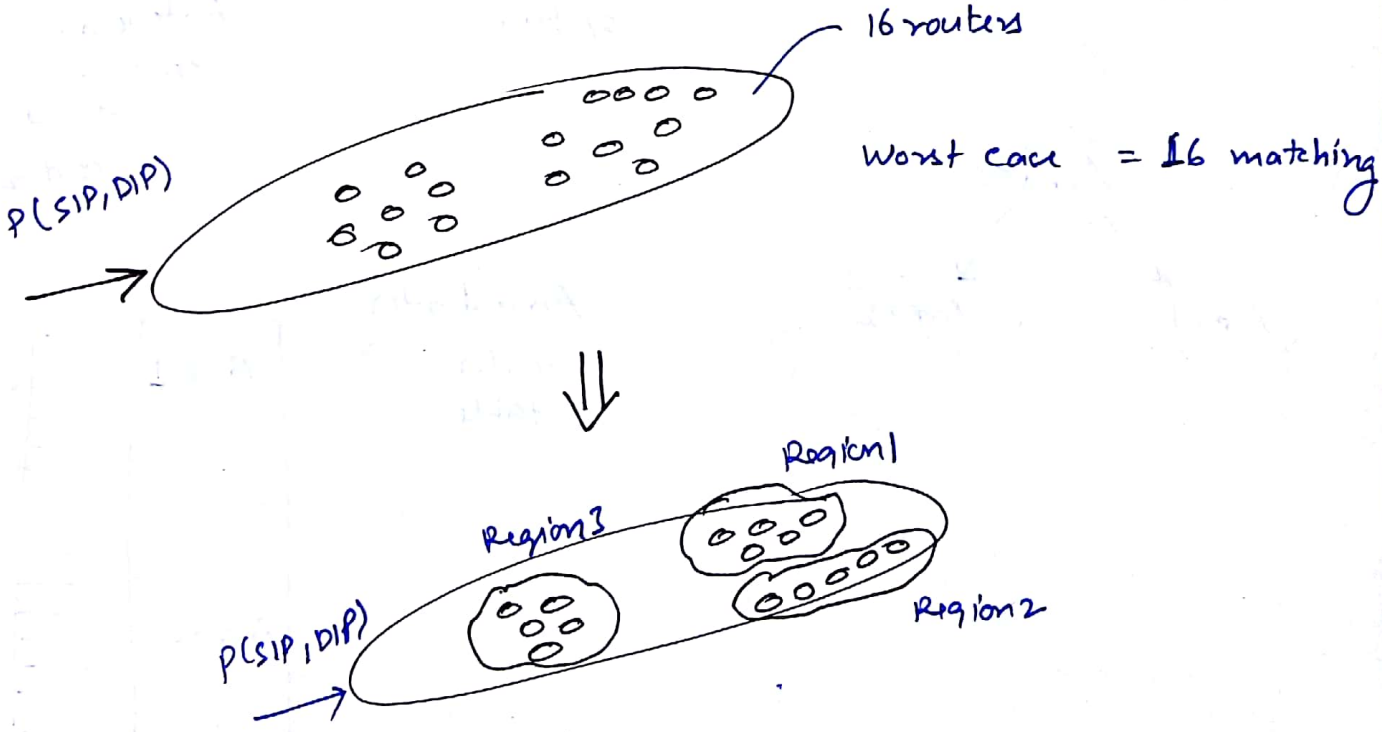




Hierarchal routing



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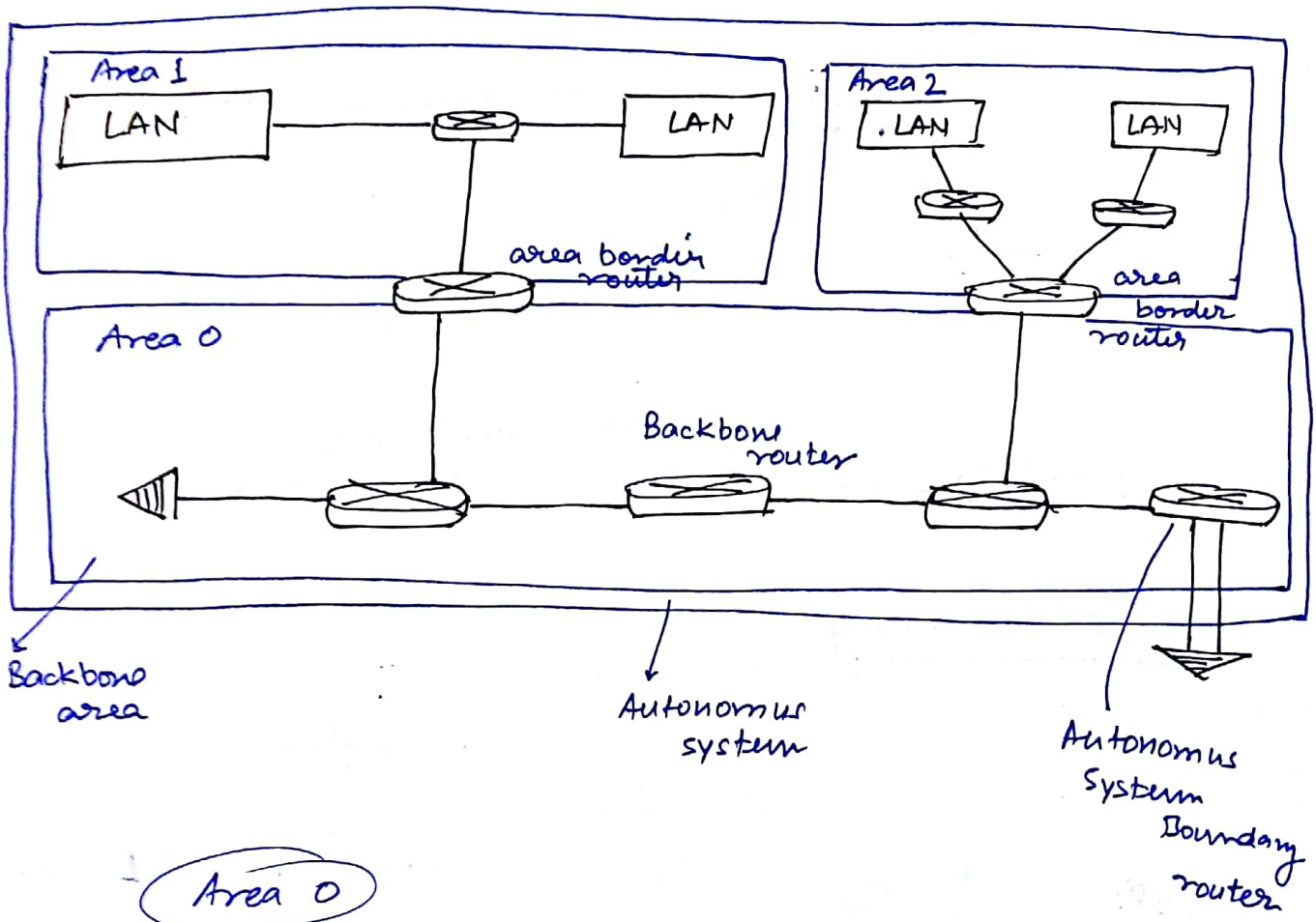
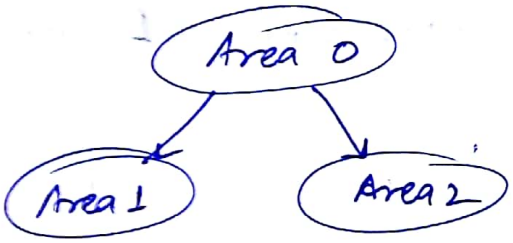
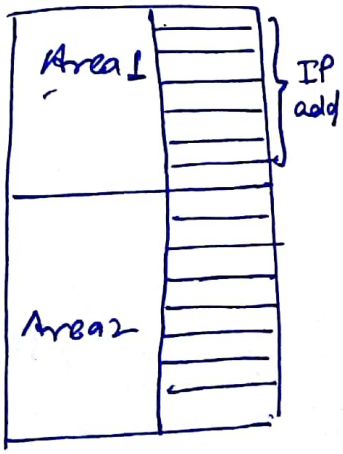
- Using hierarchal routing logically the table-size will reduce, so that searching time will be less and packet will be forwarded fastly.





Area border router table ⇒



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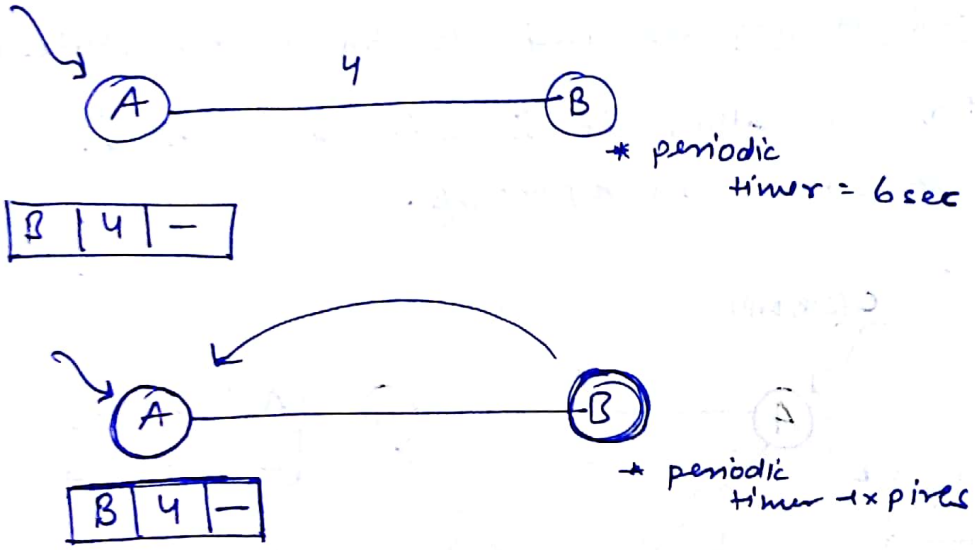
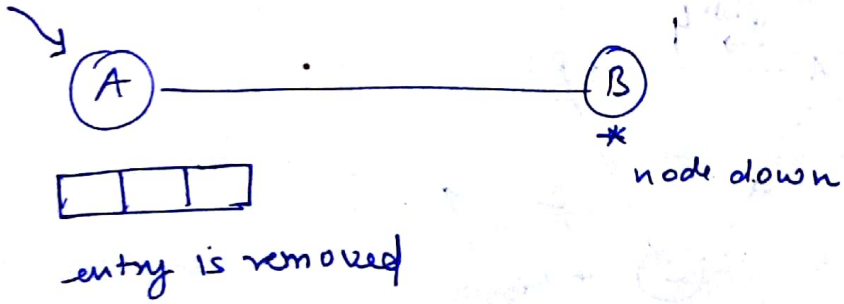
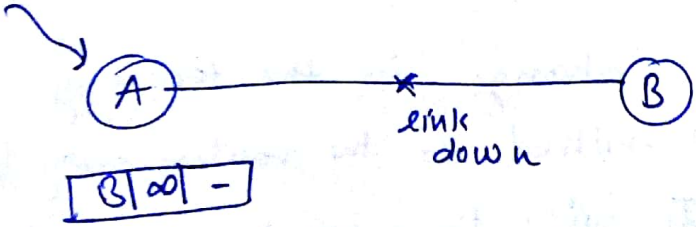
- The purpose of virtual link or passive link is to support fault tolerance.

- Area Border router is used for connecting Area 0 with other areas.

- Autonomus Border router is used for connecting other autonomus system.







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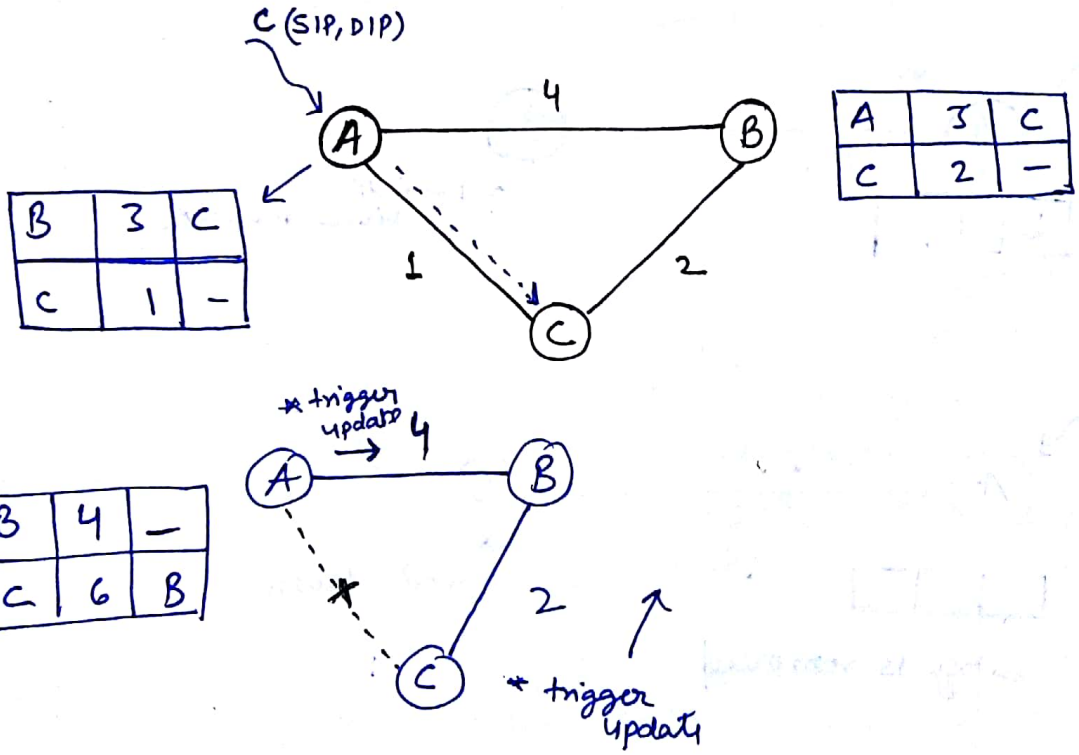
- Routers contains routing table in which it contains route information of routers. If route information is deleted or removed, then the router is crashed.

- If the route into is made ∞ then link is breaked or down.

- Periodic timers are used to know the status of routers wheather it is alive or crashed, even there is no change in topology.



- whenever there is a change in the topology a trigger update will be transmitted so the routers may be immediately updati with the correct entries to find

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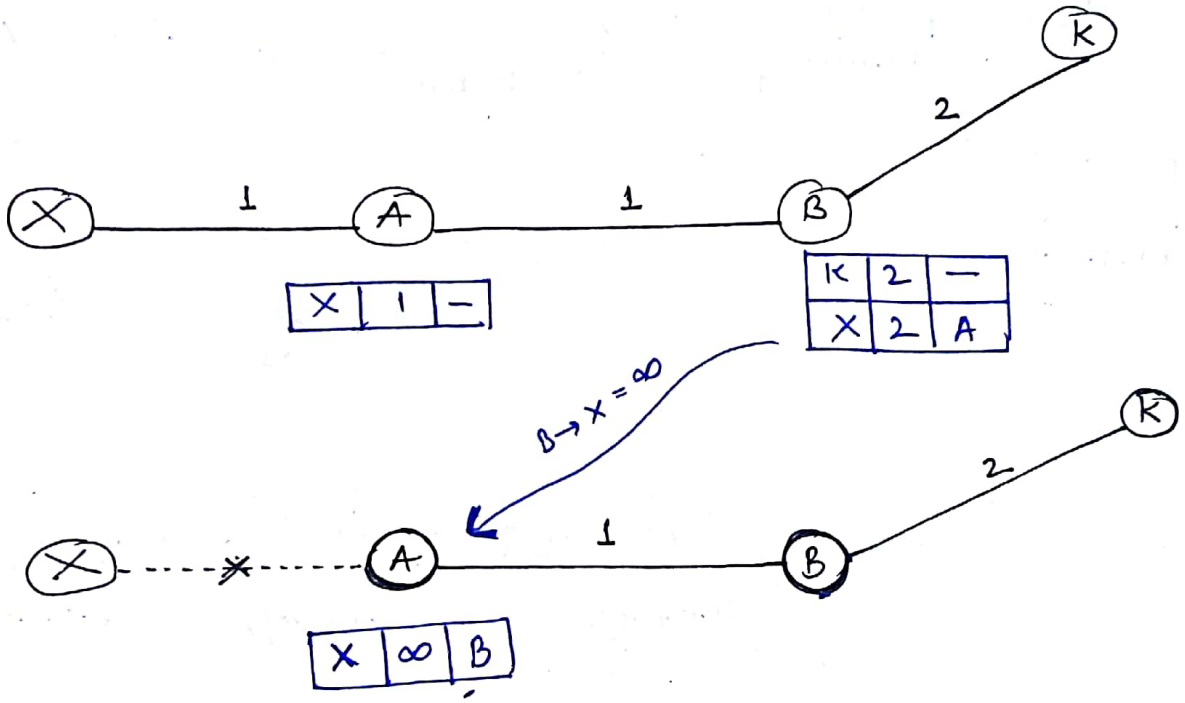
the alternative path for the remaining packets to reach the destination.

- trigger update may be considered or may not according to the requirement of router.

Distance vector routing with poission Reverse :-



- send the route information back-to-the node as ∞.
- Using this technique can solve the count-to-infinity problems.

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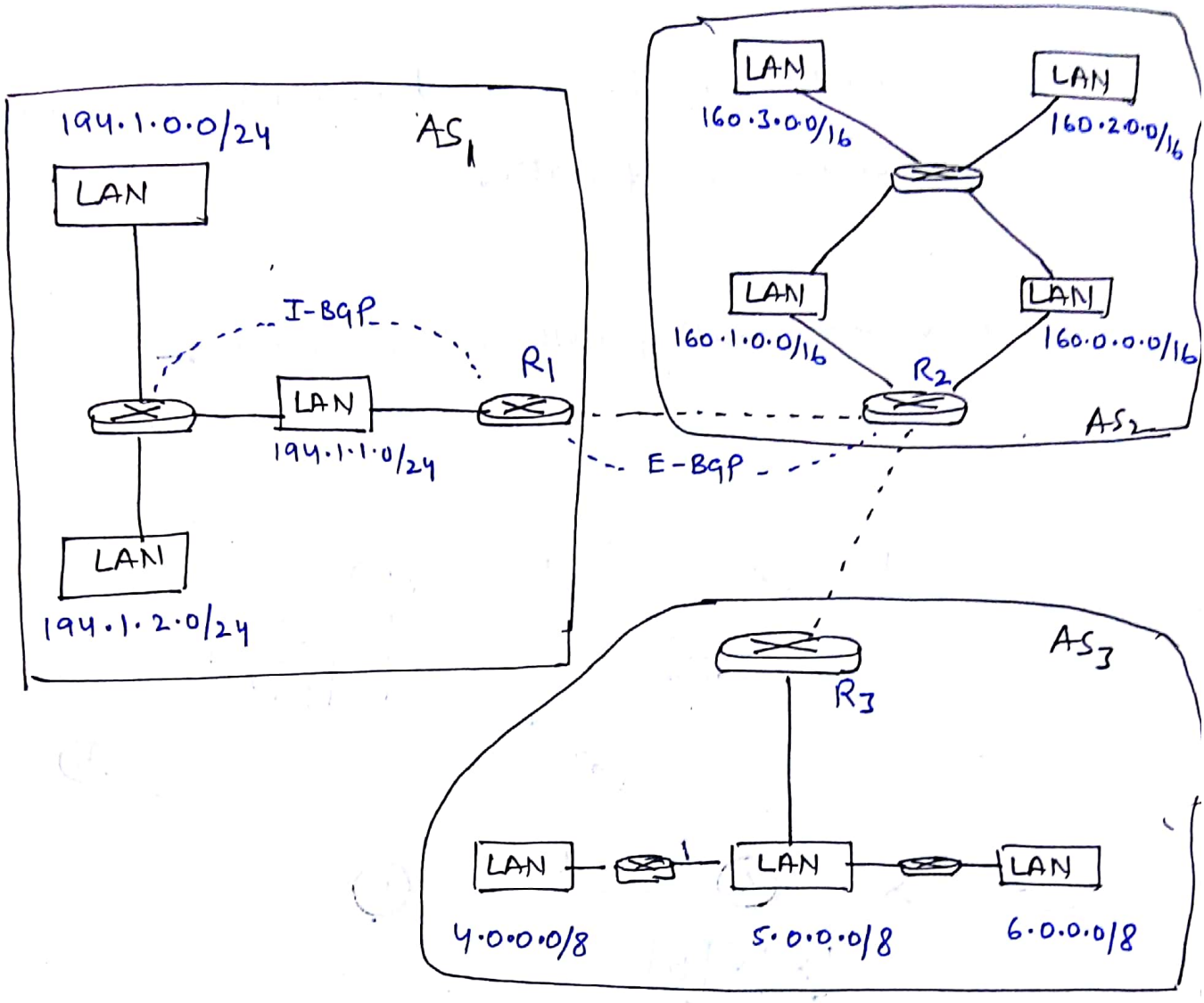
Path vector routing:-



R1

Network	path
194.1.0.0/24	AS1
194.1.1.0/24	AS1
194.1.2.0/24	AS1
160.0.0.0/16	AS1-AS2
160.1.0.0/16	AS1-AS2
160.2.0.0/16	AS1-AS2
160.3.0.0/16	AS1-AS2
4.0.0.0/8	AS1-AS2-AS3
5.0.0.0/8	"
6.0.0.0/8	"

super-netting

Network	Path
194.1.0.0/22	AS1
160.0.0.0/14	AS1-AS2
4.0.0.0/6	AS1-AS2-AS3

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- Border router R_1 will get the information about its own network (AS_1) with the help of internal routers.

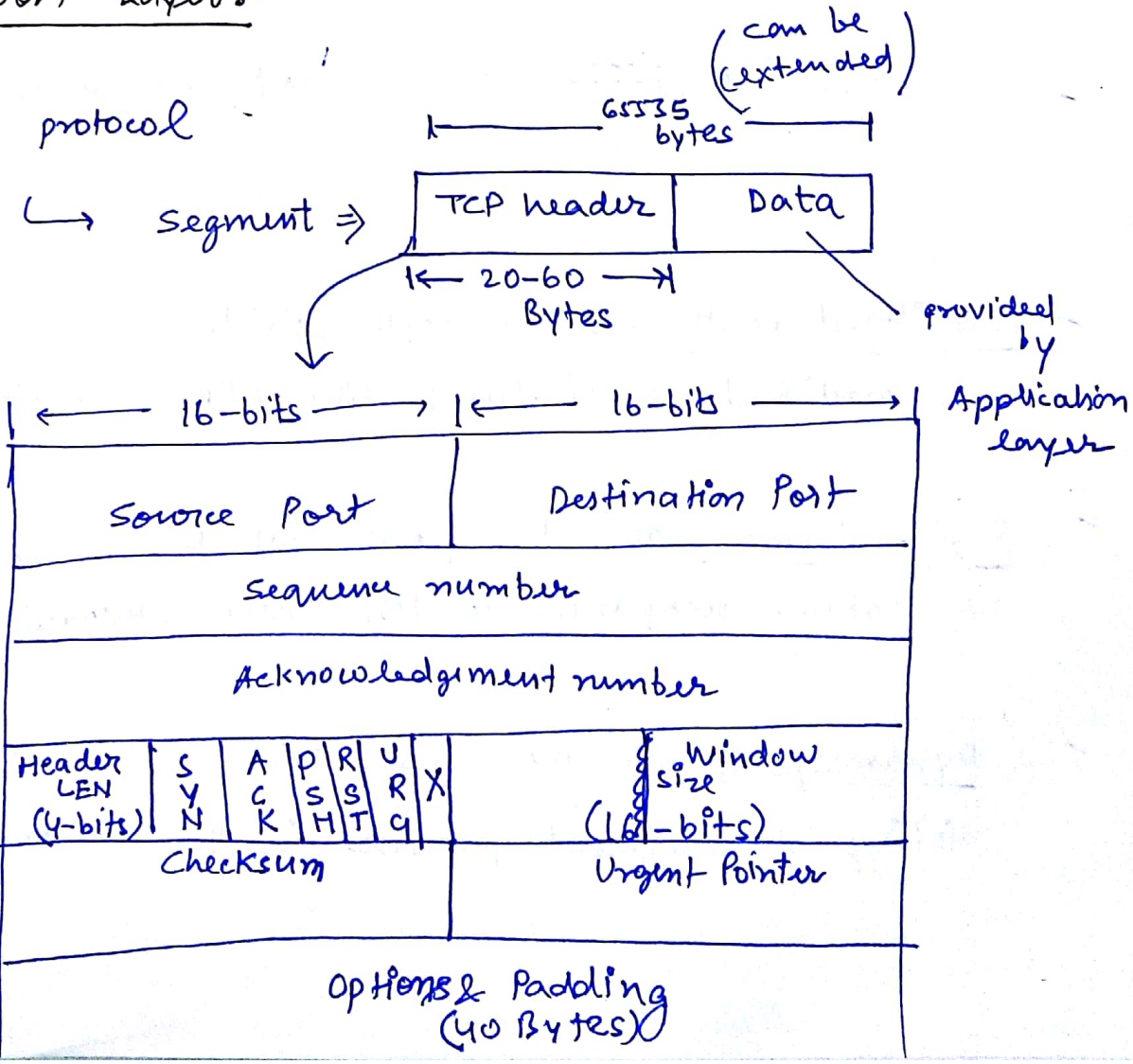
- Border router R_1 will get the information about AS_2 and AS_3 with the help of R_2 and R_3 resp.

- To reduce the number of entries or rows in routing table supernetting is done ~~and hence~~ so that size of table is reduced and hence searching time is reduced.

Transport Layer :-

TCP protocol

↳ segment ⇒



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Range of port address = 0 to $2^{16}-1$

= 0 to 65535

provided or assigned by IANA

- 0 to 1023 ⇒ fixed ports or predifined ports, or universal ports

  eg - ftp = 21, 20
  SMTP = 25
  http = 80

  } these are fixed they can't be changed

- 1024 to 49151 ⇒ Registered ports

- 49152 to 65535 ⇒ Dynamic ports or ephemeral ports.

- Predifined ports are the ports which are used for some predifined applications like http, ftp, smtp, etc.

- Registered ports are the ports which are used by networking companies to test there networking softwares

- Dynamic ports are the ports which are used to distinguish different processes in the network.

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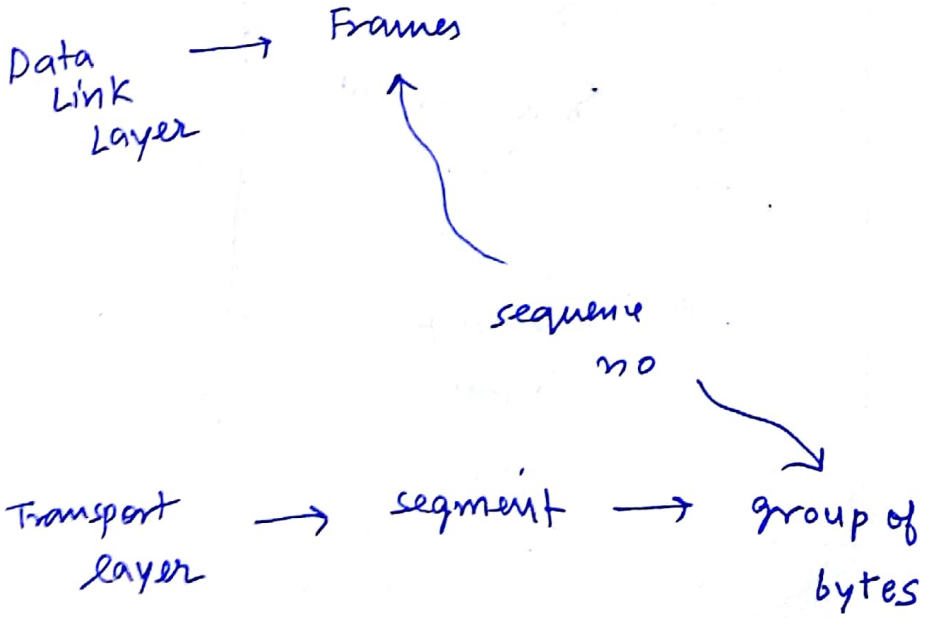
- Each process in a network can be uniquely identified by port address.

Source port	Destination port	Route of segment
Dynamic	fixed	client → Server
Fixed	Dynamic	server → client

- No. of sequence numbers = (0 to $2^{32}-1$)

- In data link layer we provide sequence number to every frame, whereas in transport layer a sequence number is assigned to each & every byte in a segment.



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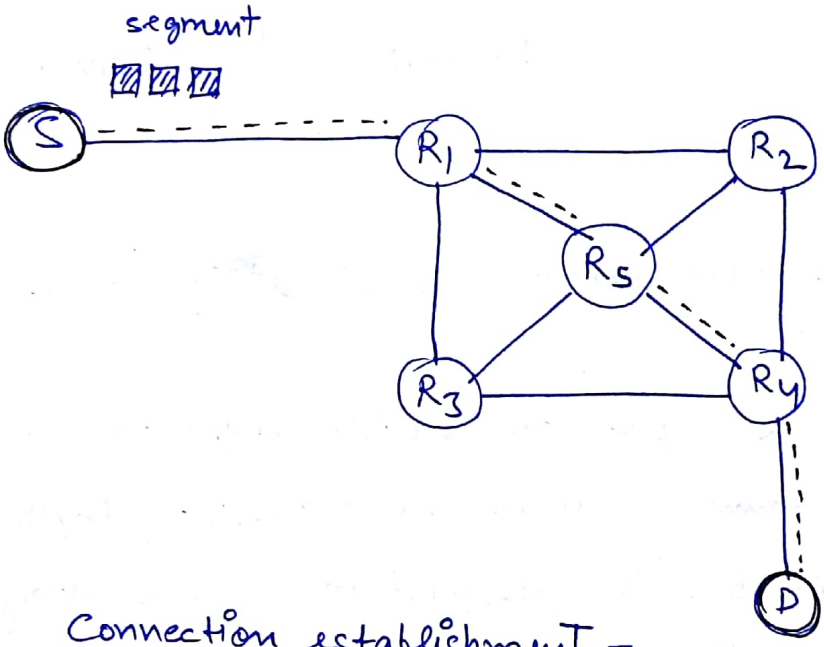
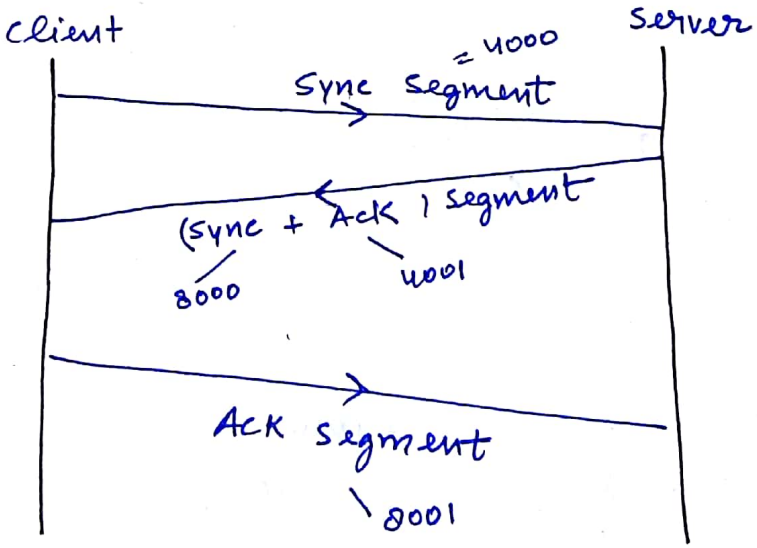
The Initial sequence number in case of TCP will be a random number r where

$$(0 \leq r < 2^{32} - 1)$$

Circuit switching in TCP (Transport Layer) :-



(i) Connection establishment -



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- For a complete connection establishment 3-way handshaking is requirement.

- SYNC segment doesn't carry any data but it consumes one sequence number.

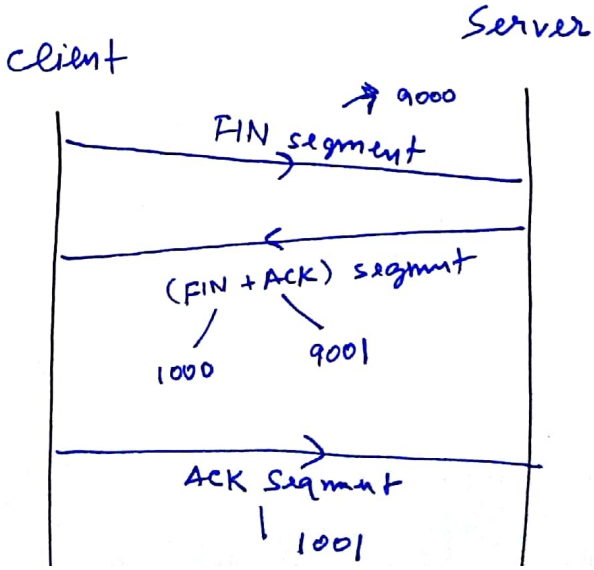
[client] sync segment → (sequence number = 4000)

[server] ACK segment → (ACK number = 4001)
+
SYC segment → (seq. number = 9000)

[client] ACK segment → (ACK number = 9001)

(ii) Data Transfer - In this data (segment) is transfer in fully duplex manner.

(iii) Connection Release -



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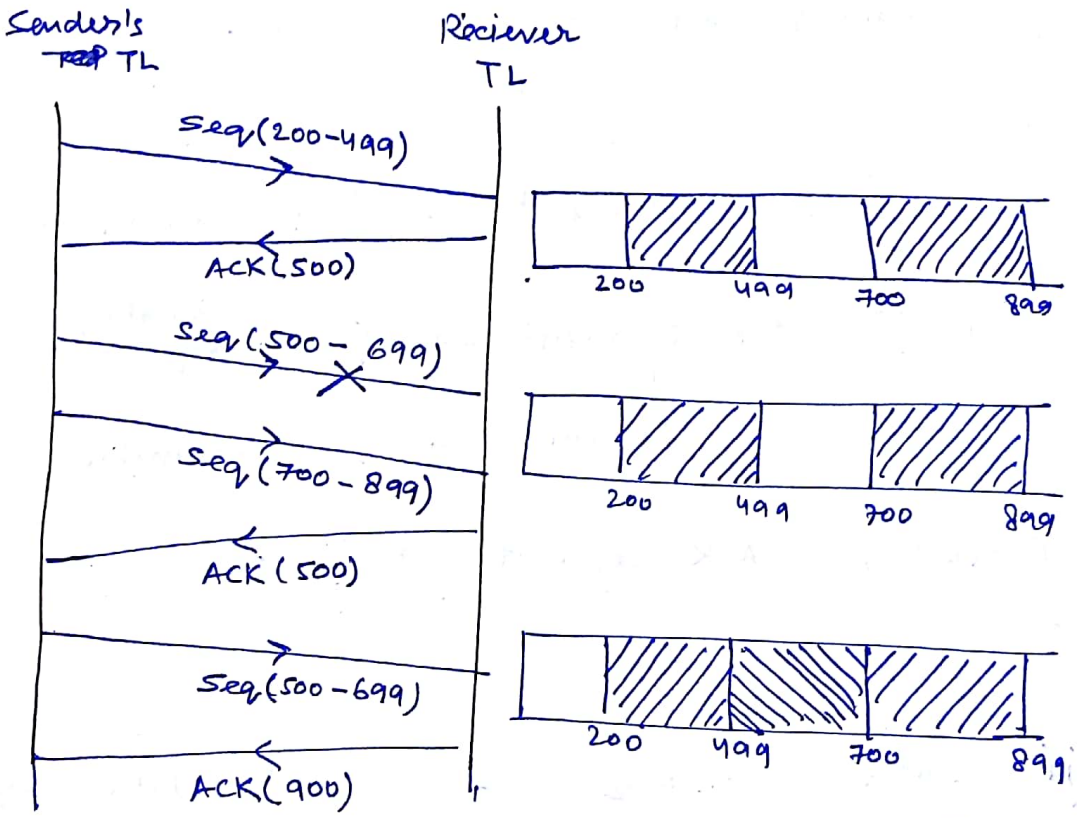
- TCP can accept out-of-order segments, but always sents in order acknowledgment.

Flow control policies of TCP :-



- It is not necessary to response for missing or lost segment instantly, we can first send some other segment and after that we can resend lost segment.

Examples :-

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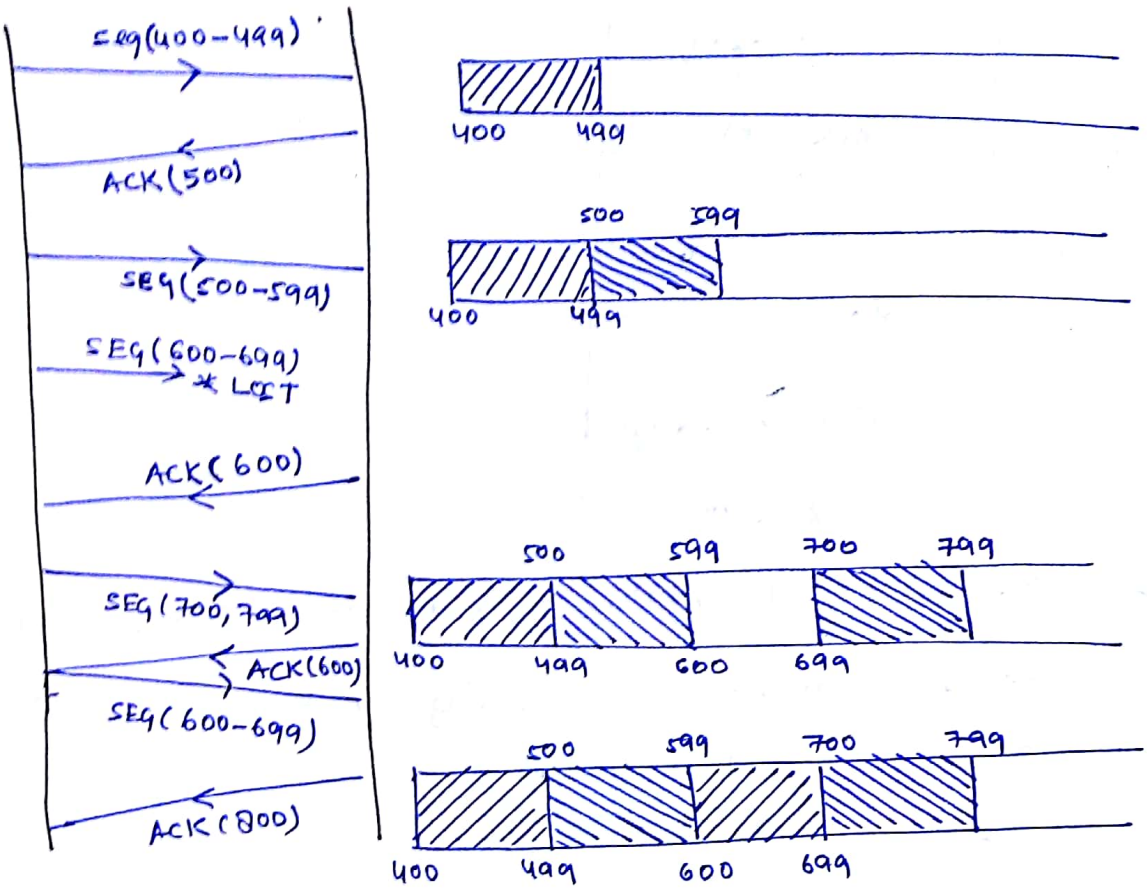
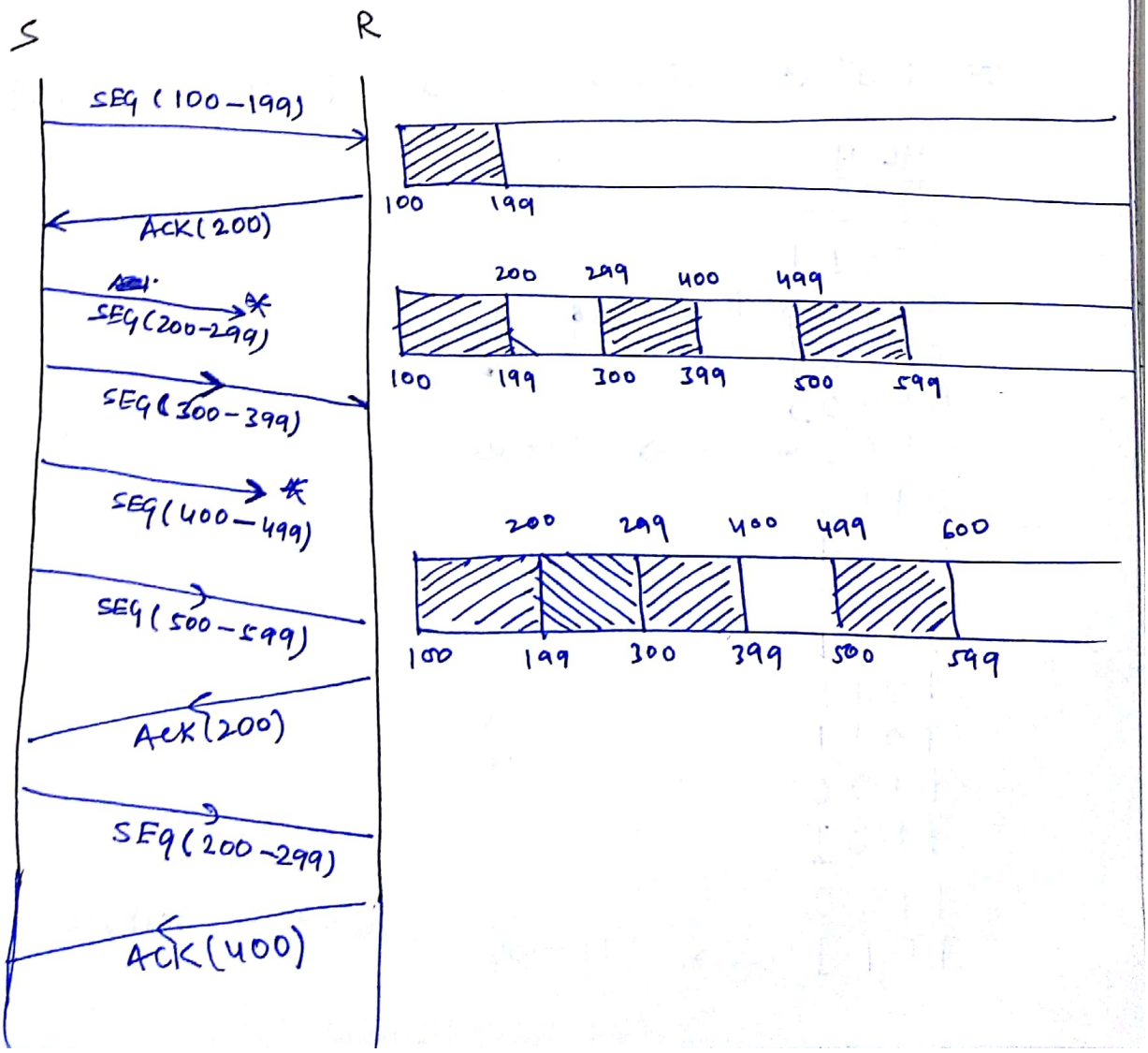
Ex



Ex



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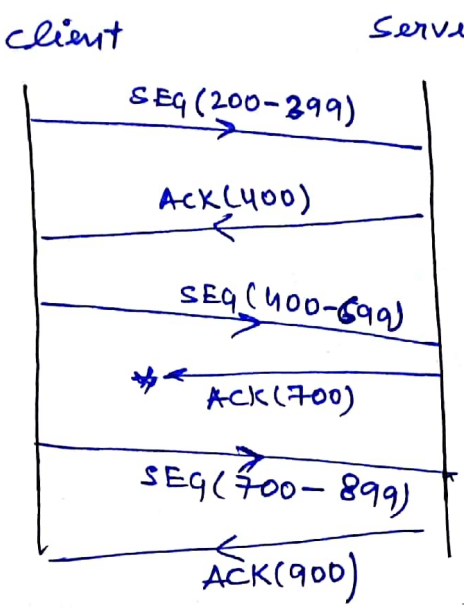

- TCP will not bother about the ACK's which are lost, because next upcoming ACK will nullify the previously lost ACK.

Header length – (4-bits)

It indicate size of Header in the segment as,

HLEN	
0000	Don't used
0001	
0010	
0011	
0100	
0101	→ 5 rows
0110	
0111	
1000	
1001	
1010	
1011	
1100	
1101	
1110	
1111	→ 15 rows

5 × 4 = 20 Bytes

15 × 4 = 60 Bytes

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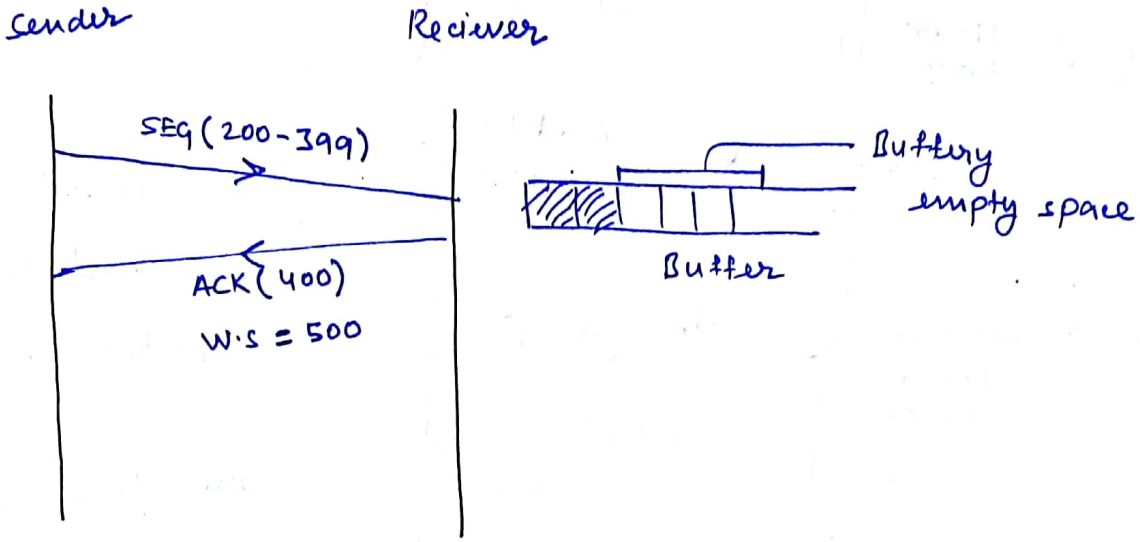
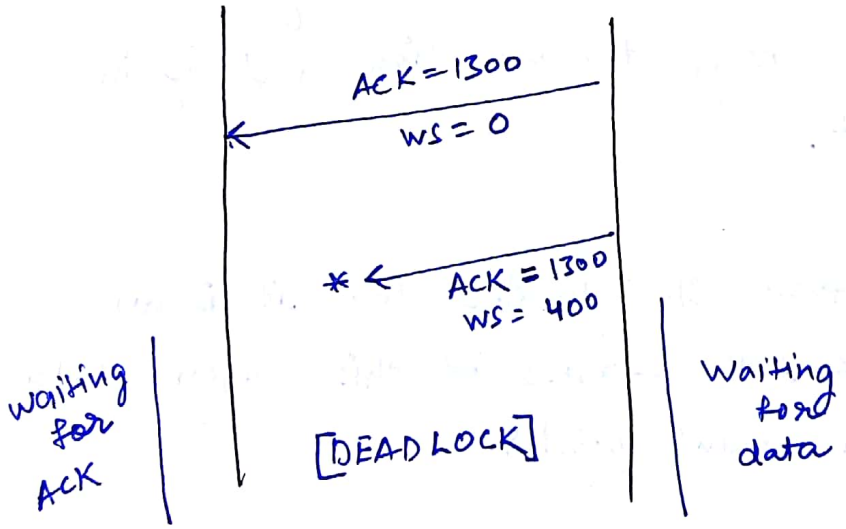
Window size :-



so, W.S = space left in Buffer

- It is used for syncronization b/w sender & reciever.

Deadlock Condition -



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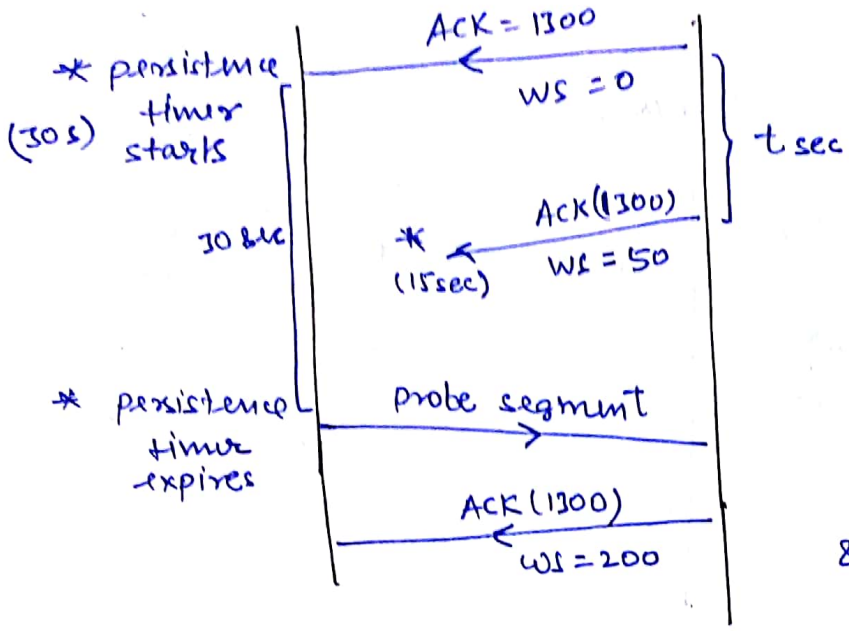

<0, persistence timer is used for resolving problem of deadlock.

& this timer is setted when WS = 0.

- If PSH bit = 1, then it indicates that it is an interactive data so response is immediate. This data will not be buffered.

- If RST bit = 1 (used for reseting the connection) i.e temporarily closing the connection and again restablishing it.

- If URG = 1 then it indicates that it is an urgent data. And the address of this urgent data is available in urgent pointer.

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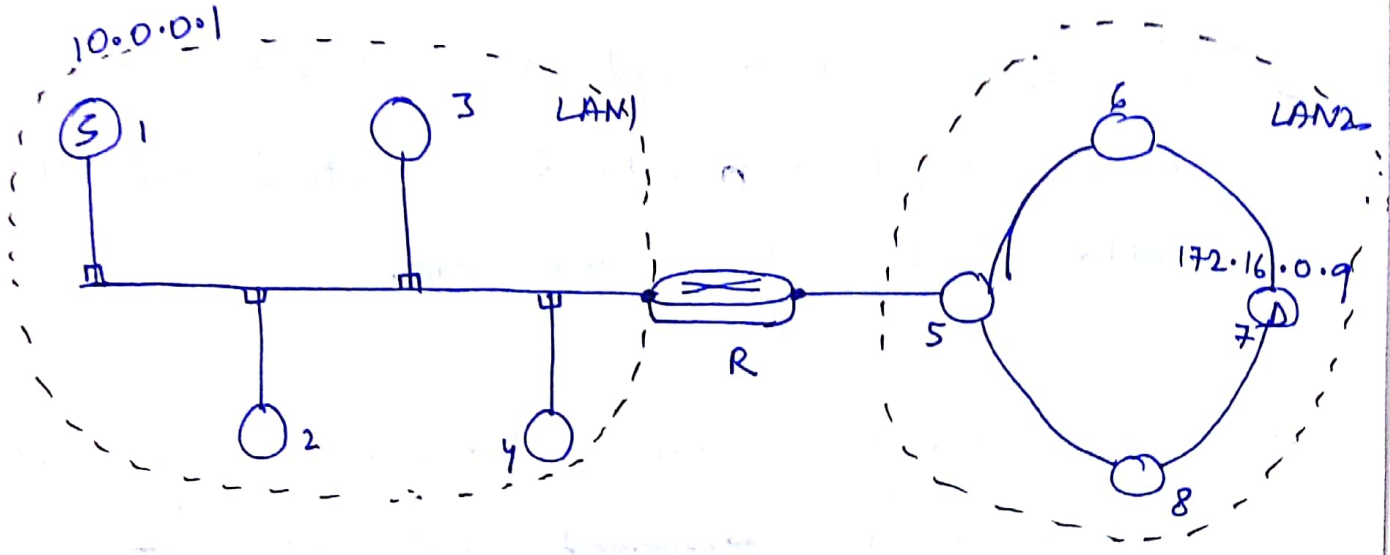
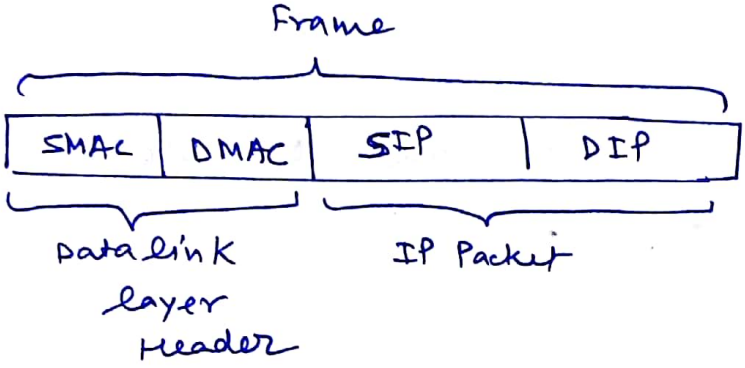


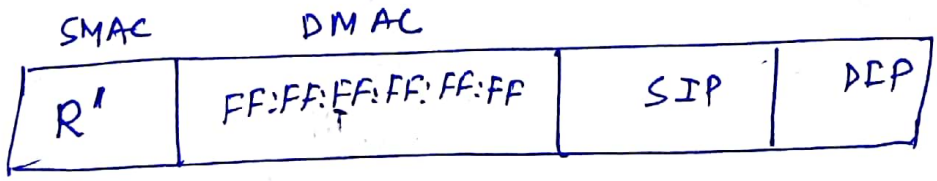


ARP frame

DMAC = FF:FF:FF:FF:FF:FF

So ~~in~~ during travelling ~~in~~ ~~LAN1~~ b/w routers, frame is travelling through BUS cable. At ~~o~~ entry of router Data link layer header is taken out only packet is saved inside Router.

Once IP packet comes out of Router, it adds its own Header and it sends on LAN2



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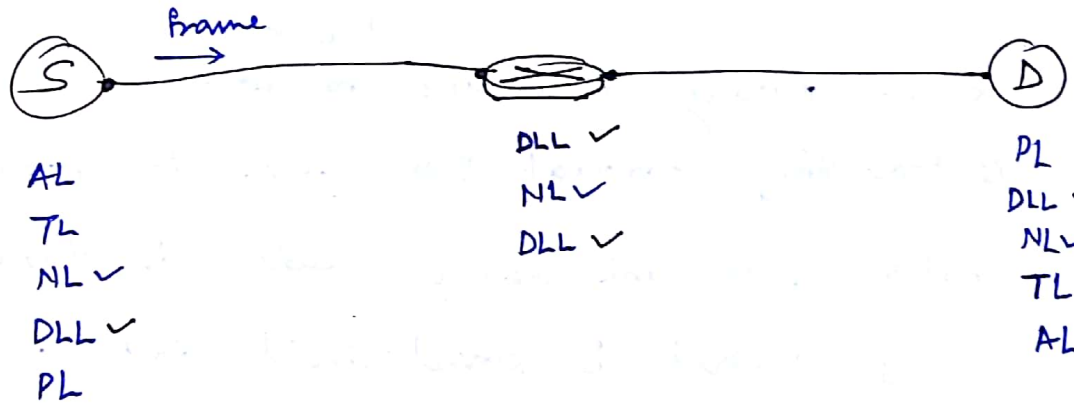
- So, from end-to-end SIP and DIP address is not changed when data is transmitted but MAC address is changed at every hop.

- So actually frame is travelling on channel, packet is only ~~converted~~ used inside router.

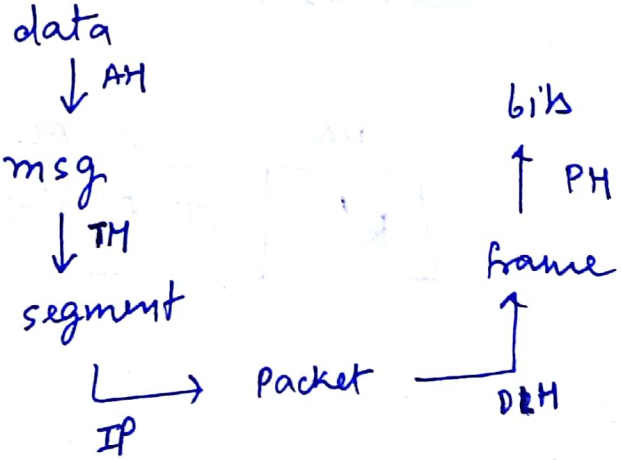
Q. Calculate no. of times DLL, NLE are visited from S to D.



so, NL = 3

DLL = 4

at source :- and dest



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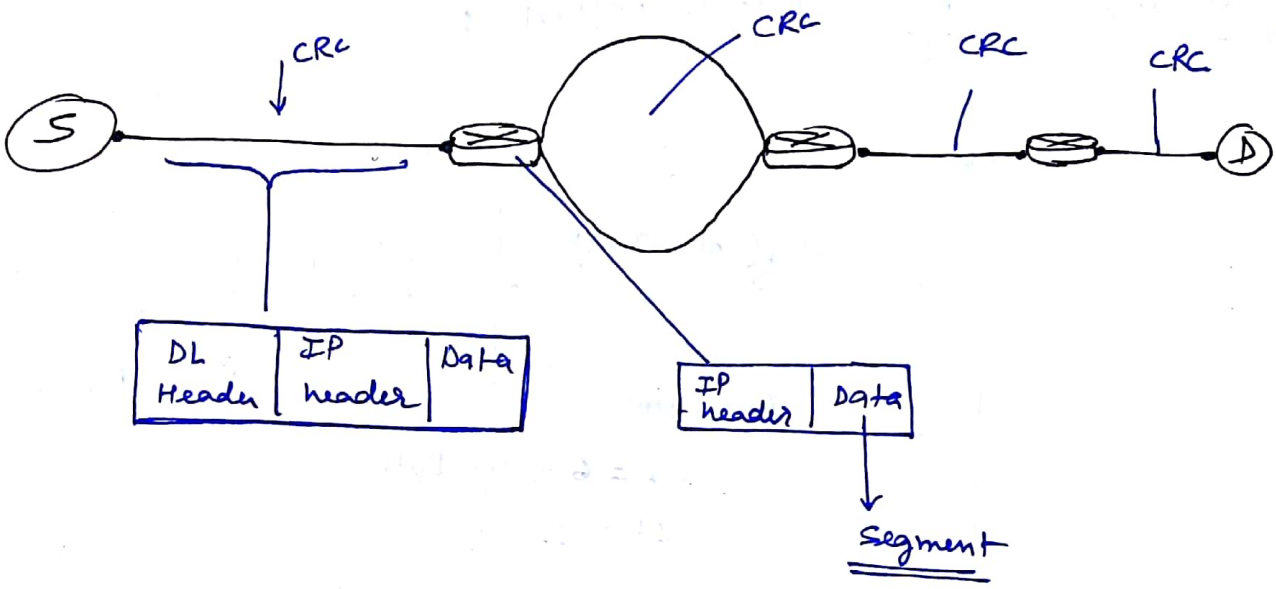
at router – removal of DLL header

bits
↳ frame → IP packet



- As DL Header provide checksum to whole frame so, CRC will provide error control during transmission in channel.

- But inside router DL Header is deattached and IP header is providing error control only for IP header, so if noise changes segment part no checksum is there.

- So TCP checksum is provided at source & destination (end-to-end) to provide error control inside routers.

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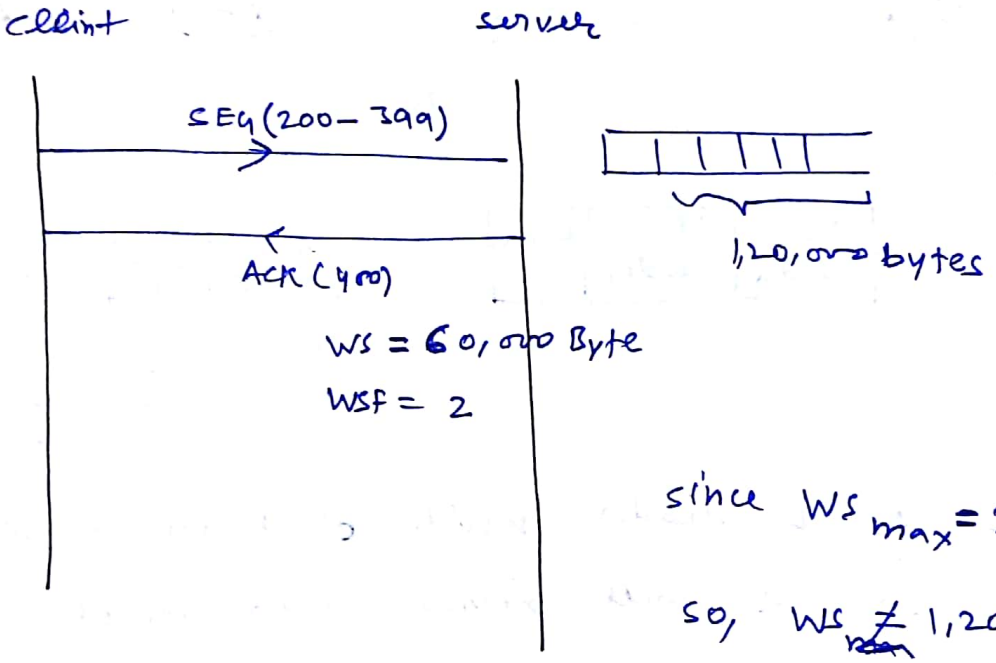
- When the datasize is large not possibility of modulation of vertically placed bits in a checksum is less so, we can use checksum in transport layer.

Option & padding

(i) Window scaling factor option :-



since $WS_{max} = 2^{16} - 1$

so, WS ≠ 1,20,000

So, according to RFC (Request for comment) standard:

$$WS \times WSF$$

$$(2^{16} \times 2^{14})$$

- Segmentation is done when the Transport Layer has given the data to network layer is greater than 65535 bytes.

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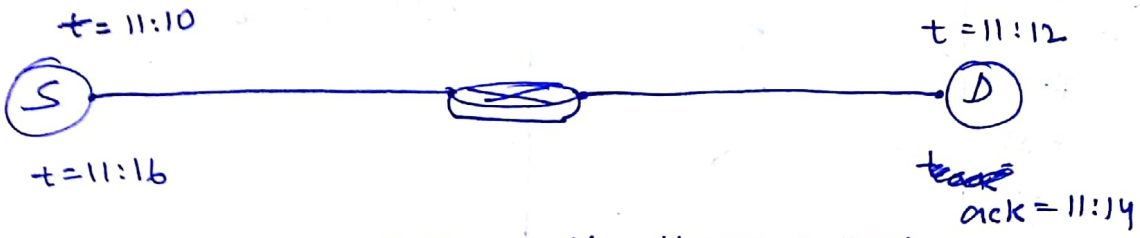
- When the network layer given the data to data-link layer fragmentation is done.

(ii) Timestamp option :-



RTT = 11:16 − 11:00 = 0.06 sec

It is used to calculating round-trip time b/w two end process.

(iii) NOP option :- (1-Byte)

used to fill the gaps b/w options.

(iv) EOP option :- (1-Byte)

used as separator b/w header and data.

RTO timer :- (Retransmission after time-out)

$$(RTO = 2\ IRTT\ (\text{Initial RTT}))$$

where $(ERTT = \alpha \cdot IRTT + (1-\alpha) \cdot NRTT)$

ERTT → estimation

NRTT → new or actual

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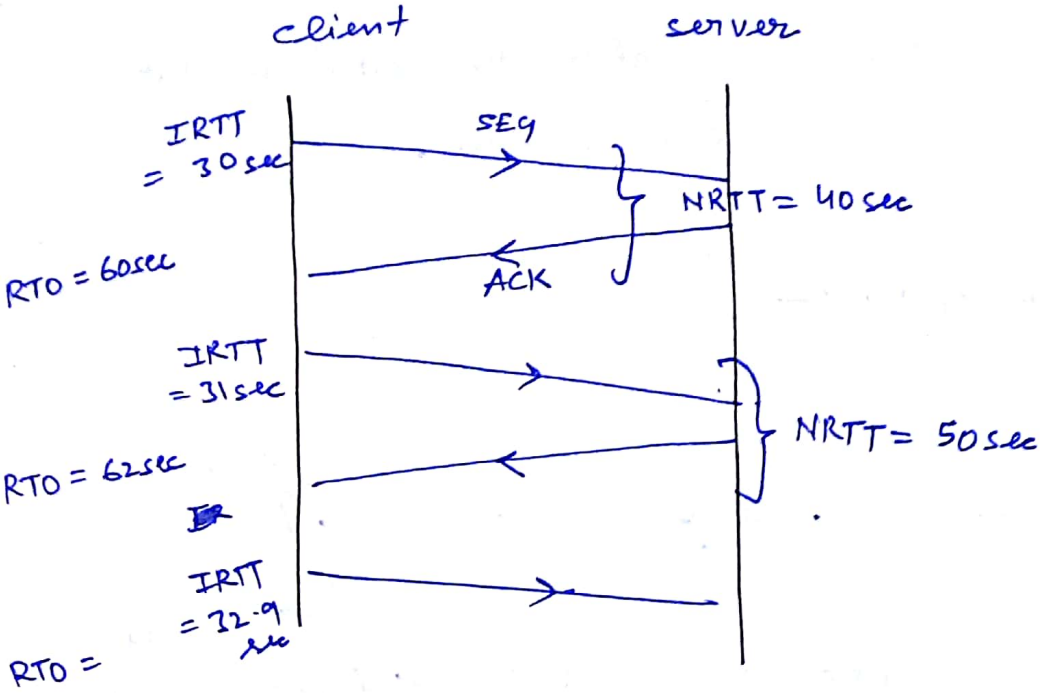

$\alpha = 0.9$
(scaling factor)

So, $ERTT_1 = \alpha\, IRTT + (1-\alpha)\, NRTT$

$= (0.9)(30) + (0.1)(40)$

$= 31$ sec

$ERTT_2 = (0.9)(31) + (0.1)(50)$

$= 32.9$

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