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HW 2

Ans-1

a) No receivers

MOSPF – S generates and ~~sends~~ ~~the~~ sends the data to router which is attached to it. There are no receiver in the group and hence the router discards the data it received from the server.

PIM – Sender sends the encapsulated register message to the ~~RP~~ RP. As there are no receives in group, RP sends the register stop message back to sender, but it also remembers that the source is active

b) No sender

MOSPF – Here, each router learns about all the receivers and their locations with LSA messages.
→ But since there is no sender, the routers will not compute the minimum cost path to each receiver.

PIM → When the designated routers of each receiver send the join

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message to RP, the routers along the way record receivers of the message and forwards it to the next hop towards RP.

→ The routers also maintain information about the incoming and outgoing interfaces.

c) In PIM, lets say there are only one or two group. Here only routers along the path from designated routers of the receiver to RP learns about the receivers.

→ In MOSPF, all routers in the network learns about the receivers and their location from LSA messages.

d) PIM trees are receiver driven and it has two types - shared and shortest path. PIM uses refresh messages to maintain tree edges, so first message from the source always goes through RP to the receivers, even though the receivers can join the shortest path tree. So delay is increased.

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MOSPF → Routers compute shortest path tree on getting data from sender. The path used here is best path, but it consumes time as it gets constructed every time.. Here, the cache is not timed out but are just flushed out when network changes.

An - 2

1. Router A send join (*, G) message to Router B.
2. Router B caches the location of the receiver and forwards the join message to RP.
3. RP joins receiver to Group (G).
4. Now, Router A (next hop to sender) sends the encapsulated register message to RP via B.
5. RP joins S
6. Now sender sends data to RP.
7. After sender places the data message in the LAN, the receiver sees that it is addressed to group G and picks it up.

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8. A forwards the data message to RP via B.
9. RP forwards it along the tree edges through B and A.
10. Router A sees that the data message is from sender in the LAN A and discards it.
11. A sends a prune message to RP to ~~and tell to~~ remove itself from the shared tree of that particular

Ans-3

a)

1. Routers of the receivers sends join (*, G) message
2. All routers in between caches the location of the receivers and forwards the join message to RP.
3. RP joins the receiver to group G and establishes [illegible] deliver path.
4. First hop router of the sender sends the encapsulated register message to RP.
5. RP joins S.

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6. Now the sender sends the data traffic to RP.
7. RP forwards it to the receivers via the intermediate routers.
8. Once the last hop router receivers traffic from the source, they will join the SPT of source.
9. Once the traffic arrives on the SPT, the last hop router sends prune message to RP to remove itself from shared tree.

(b)

(i) The router forwards join message to next hop ~~to~~ towards the RP.
(ii) Router ignores join message since Y is in SSM range.
(iii) Router forwards message to the next hop towards X.
(iv) Router forwards the message to the next hop towards Y.

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Ans-4

a) Suppose A is assigning VID instead of B. But B might have assigned same VID to some other flow. So VID gets duplicated at B.

→ This can't happen. So B is the one who assigns VID of data from S to D.

b) Because all router has local VIDs. For 2 byte long VID, we get 2^{16} local VIDs, which is more than enough.

→ So basically reusability ~~provides~~ makes this happen.

c) (i) Here B and C are not aware of the individual circuits, and a single virtual circuit ID is used.

→ Only A and D are aware of individual circuits. In this case, tunneling ~~[illegible]~~ ~~is used~~. can be used.

(ii) When p sends the data message with VID 5, A attaches a tunnel lable i.e. n, to reach D with VID as 10.

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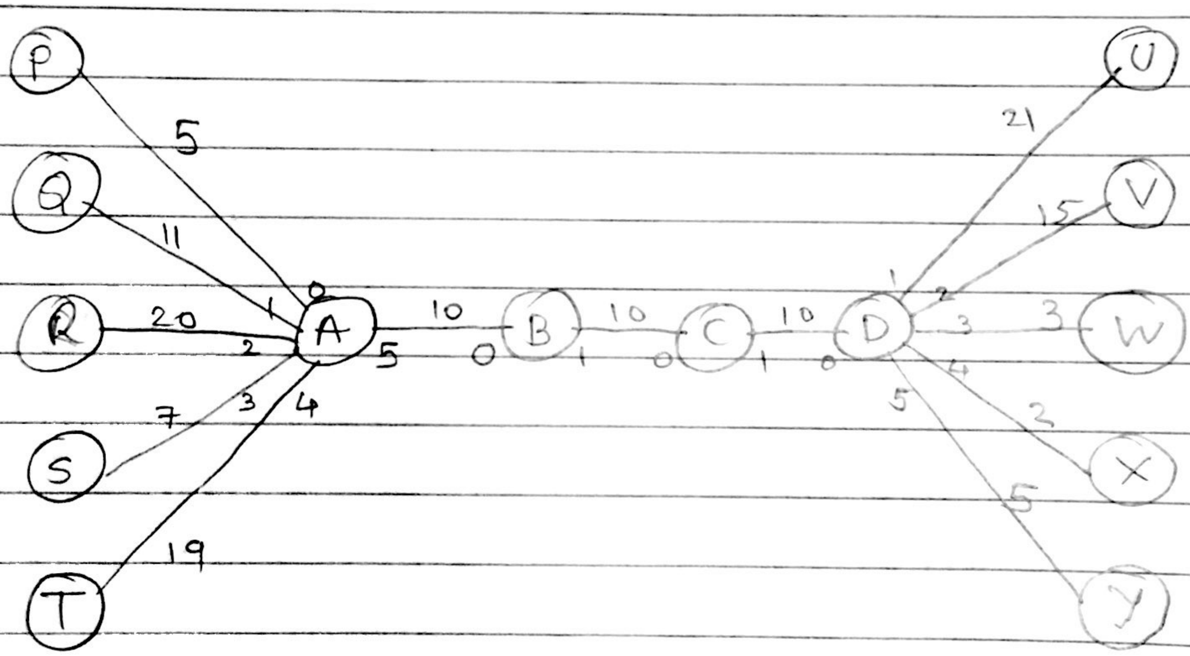
(ii) B and C forwards the message as normal way.

(iii) D removes the tunnel label and modifies the VID to 21 and sends it to ~~u~~.

* Same happens ~~in~~ with q & v, r & w, x & s and t & y.

~~(b)~~ (ii)



Switch A

Input Port	Input VID	Output Port	Output VCI
0	5	5	n1
1	11	5	n2
2	20	5	n3
3	7	5	n4
4	19	5	n5

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Switch D

Input Port	Input VCI	Output Port	Output VCI
0	n1	1	21
0	n2	2	15
0	n3	3	3
0	n4	4	2
0	n5	5	5

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Ans-6 X will forward message to neighbour only if X is MPR of Y otherwise it will not.

→ Now X is aware of all neighbours of Y. Therefore X will send message to node Z, if Z is not neighbour of Y.

* What if Z is neighbour of both X and Y?

Case 1: If Z is not an MPR of X, then X don't send message to Z because Y will send message to Z anyway.

Case 2: If Z is an MPR of X and MPR of Y, there is no need to send the message to Z because Z will forward it and Y will send message to Z.

Case 3: If Z is MPR of X but not an MPR of Y, then to be on the safe side, do send message to Z, because Z might be able to reach a node that is 2 hops away from X but more than 2 hops away from Y.

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(b) Let say path is S ...... X Y Z ...... D.
So Y is some intermidiate node in path S to D and X and Z are previous and next node to Y, respectively

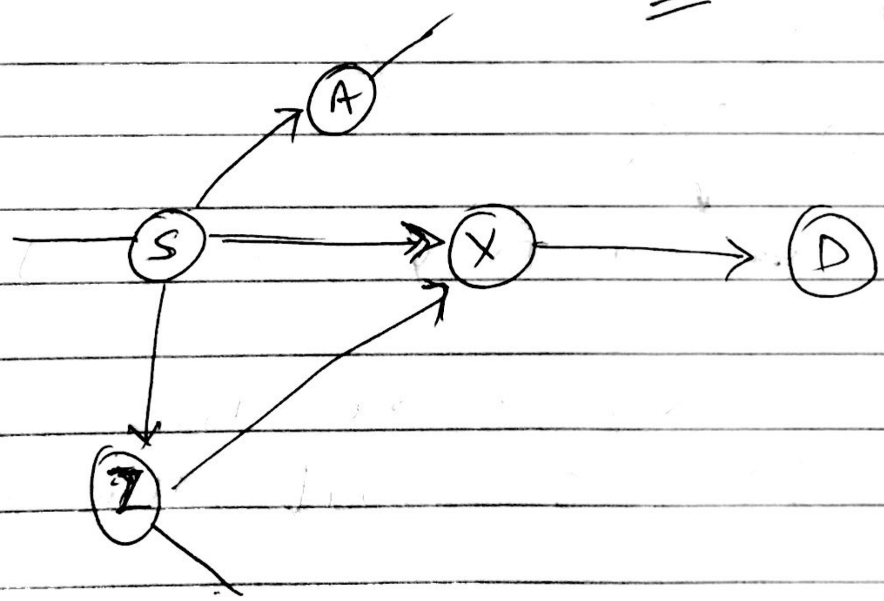
→ If this is smallest ~~path~~ route than X can be S and Z can be D.

→ For S to learn the edge Y-Z, Z send out TC meesage saying that Y is one of its MPRs.

→ But also, to learn (X-Y) edge for S, Y must send TC meesage saying that X is one of its MPRs.

→ Hence Y is an MPR

Ans-5



Here, S is source and D is destination.

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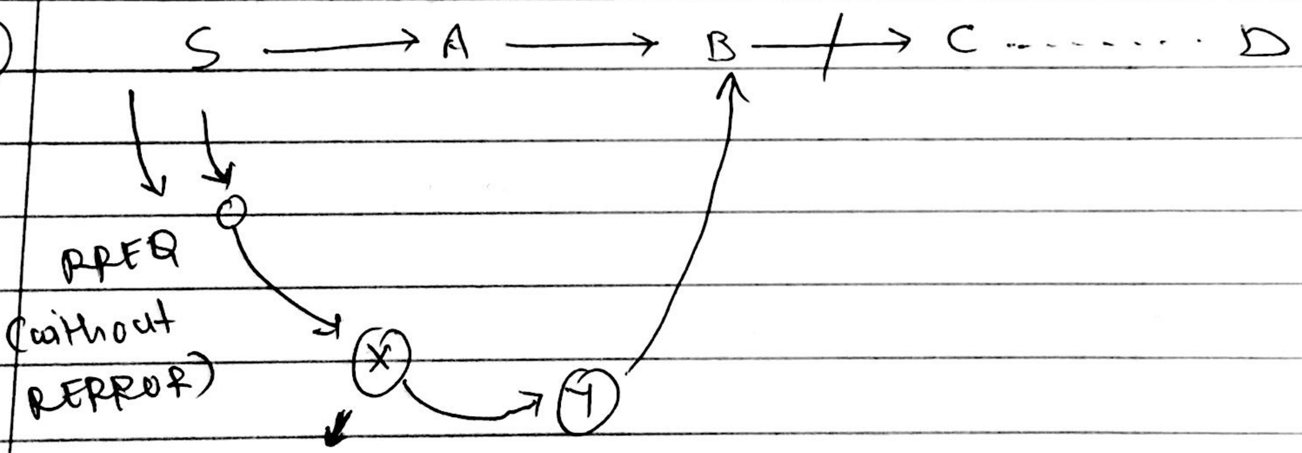
→ Let say S sends RREQ message here to its neighbours.

→ Here S-Z-X message reaches before S-X message due to some reasons (may be congetion on S-X link etc).

→ So X will send [S Z X] path to D and S will get [S Z X D] path as source routing.

* So S gets longer hop route, even though sorter one exists.

(b)



cache [X Y B C .... D]

* Here, let say B → C link breaks and B informs S about this break

⇒ Therefore S looks for another route in cache and does not find anything

⇒ So it will send new RREQ msg. Here assume it doesn't add RERROR msg

⇒ So, when RREQ will ~~send to~~ come to X, X will add cached path [X Y B C ... D] to RREQ and send back to source S.

→ This is because piggyback is not done

→ And result is S gets invalid path to destination D.

* So new RREQ is not meaningful. But if piggyback RERROR msg was added, then this situation could have been avoided.

→ So piggybacking is necessary.

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Ans-7 $L_A = 100{,}000$ bits

$L_B = L_C = 10{,}000$ bits

→ Capacity $C = 1{,}000{,}000$ bits / s

$\therefore \underline{C = 1000}$ bits / ms $(\because 1s = 10^3 \text{ ms})$

* $A_A = t+1$ ms = arrival of A

— $A_B = A_C = t+10$ ms

(a) * Lets say fake time = 0 for real time = t+1

$\therefore V(t+1) = 0.$ ~~and V(t+10)~~

$F(A,1) = \max(F(A,0), V(A(A,1))) + L_A$

$= \max(0, V(t+1)) + 10{,}000$

$= \max(0, 0) + 100{,}000$

$[\because V(t+1) = 0]$

$F(A,1) = 100{,}000$

$F(B,1) = \max(F(B,0), V(A(B,1))) + L_B$

$= \max(0, V(t+10)) + 10{,}000$

$= \max(0, 9000) + 10{,}000$

$[\because V(t+10)$ gives rounds in 9 ms

$\Rightarrow$ 9ms transfers 9000 bits

$\therefore$ round $= \frac{9000}{1} = 9000]$

$= 9000 + 10000 = \underline{\underline{19{,}000}}$

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$F(C,1) = \max[F(C,0), V(A(C,1))) + L_C$

$= \max[0, V(t+10)) + 10,000$

$= \cancel{\max}\ 9000 + 10,000$

$\boxed{F(C,1) = 19,000}$

(b) (A,1) ~~(B)~~ arrives first at $(t+1)$ ms and is sent first

→ (A,1) finishes at $\frac{100,000}{1000} + (t+1)$

$= 100 + (t+1) = \underline{(t+101)\text{ ms}}$

* B and C both have arrived by $(t+101)$ ms. Also F(B,1) and F(C,1) are same

∴ either one can be sent next.

→ lets assume (B,1) got send first.

time to transmit $(B,1) = \frac{10,000}{1000} = 10$ ms

∴ ~~finish~~ exit time for $(B,1) = (t+101) + 10$

$= t+111$ ms

→ At time $(t+111)$ ms (C,1) gets transmited.

Transmit time for $(C,1) = \frac{10000}{1000} = 10$ ms

∴ Exit time for $(C,1) = 10 + (t+111)$

$= \underline{t+121\text{ ms}}$

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Ans-8

(a) The finishing time of ~~packate~~ packet depends on its starting time and the length of the packet. The starting time of the packet is either its arrival time or the finishing time of the previous packet.

→ Here, new flow arrival or termination do not affect finishing time.

→ So this makes fair queuing possible.

(b) Total no. of rounds = $\frac{(t_2 - t_1) * C}{B}$ in ~~t1 t2~~ $t_2 - t_1$ time.

→ X is virtual time of t_1. $\therefore \boxed{V(t_1) = X}$

Virtual time of $t_2 = X +$ no of round in $t_2 - t_1$

$\therefore \boxed{V(t_2) = X + [(t_2 - t_1) * C / B]}$ Ans