Q1. [10 points]

Find out the nodal delay for transferring 4 data packets (DATA[1], DATA[2], DATA[3] and DATA[4]) from host A to B in a datagram network. Consider the following data:

Ignore the first letter 'K' in your roll number. The packet size, L=([Last digit of your roll number] mod 10)+1 Mbits. The transmission rate of links are R1 (link between A and X)=[2nd Last digit of your roll number] mod 10)+1 Mbps, R2(link between X and y)=([3rd Last digit of your roll number] mod 10)+1 Mbps and R3 (link between Y and B)=([4th Last digit of your roll number] mod 10)+1 Mbps. The length of the links is d1=([First digit of your roll number] mod 10)+1 Km, d2=([2nd digit of your roll number] mod 10)+1 Km and d3=([3rd digit of your roll number] mod 10)+1 Km. The processing delay is same for all packets which is the ([Last digit of your roll number] mod 10)+1 µsec. The queueing delay of packet1, packet2, packet3 and packet4 are ([1st digit of your roll number] mod 10)+1 µsec , ([2nd digit of your roll number] mod 10)+1 µsec, ([3rd digit of your roll number] mod 10)+1 µsec and ([4th digit of your roll number] mod 10)+1 µsec respectively.

For example, if a student has roll numberK171234, he has the following data:

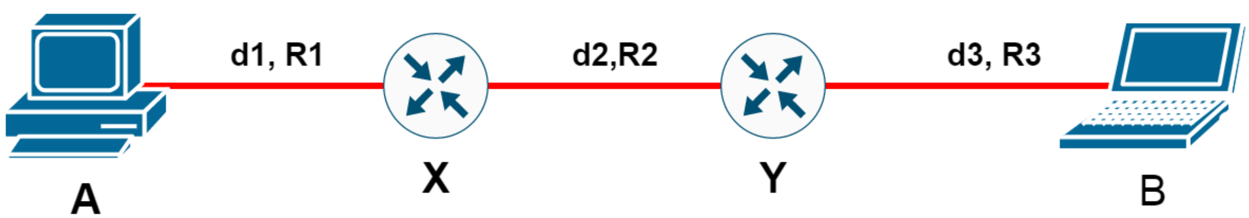
R1=(3 mod 10)+1=4Mbs, R2=(2 mod 10)+1=3Mbps and R3=(1 mod 10)+1=2Mbps

d1=(1 mod 10)+1=2Mbs, d2=(7 mod 10)+1=8Mbps and d3=(1 mod 10)+1=2Mbps

$T_{proc}= T_{proc1}= T_{proc2}= T_{proc3}= T_{proc4}$=(4 mod 10)+1=5µsec

T_{Q1}=(1 mod 10)+1=2 µsec, T_{Q2}=(2 mod 10)+1=3 µsec, T_{Q3}=(3 mod 10)+1=4 µsec and T_{Q4}=(4 mod 10)+1=5 µsec

L=(4 mod 10)+1=5Mbits



Solution

$$Delay_{nodal}=T_{prop}^{A\text{-}X}+ T_{prop}^{X\text{-}Y}+ T_{prop}^{Y\text{-}B}+(T_{proc}^{1}+ T_{Q}^{1}+ T_{trans}^{pkt,1})+ (T_{proc}^{2}+ T_{Q}^{2}+ T_{trans}^{pkt,2})+ (T_{proc}^{3}+ T_{Q}^{3}+ T_{trans}^{pkt,3})+ (T_{proc}^{4}+ T_{Q}^{4}+ T_{trans}^{pkt,4})$$

$T_{prop\text{-}total} = \frac{d_1+d_2+d_3}{s}$, $T_{trans\text{-}total}= \frac{L}{R_1} + \frac{L}{R_2}+\frac{L}{R_3}$, $T_{proc} = T_{proc}= T_{proc1}= T_{proc2}= T_{proc3}= T_{proc4}$=(4 mod 10)+1=5µsec ,

$$Delay_{nodal}= T_{prop\text{-}e2e}+4\, T_{proc}+ (T_{trans\text{-}pkt1}+ T_{trans\text{-}pkt2}+ T_{trans\text{-}pkt3}+ T_{trans\text{-}pkt4})=T_{Q1}+ T_{Q2}+ T_{Q3}+ T_{Q4}$$

Question 1: (63894)

$L = (4 \bmod 10) + 1 = 5$ M bits

$R_1 = (9 \bmod 10) + 1 = 10$ mbps

$R_2 = (8 \bmod 10) + 1 = 9$ mbps

$R_3 = (3 \bmod 10) + 1 = 4$ mbps

$T_{Q_1} = (3 \bmod 10) + 1 = 4$ μsec

$T_{Q_2} = (8 \bmod 10) + 1 = 9$ μsec

$T_{Q_3} = (9 \bmod 10) + 1 = 10$ μsec

$T_{Q_4} = (4 \bmod 10) + 1 = 5$ μsec

$d_1 = (3 \bmod 10) + 1 = 4$ km

$d_2 = (8 \bmod 10) + 1 = 9$ km

$d_3 = (9 \bmod 10) + 1 = 10$ km

Transmission delay:

$T_{T_1} = L / R_1 = 5\,\text{M bits} / 10\,\text{M bps} = 0.5$ sec

$T_{T_2} = 5/9 = 0.556$ sec

$T_{T_3} = 5/4 = 1.25$ sec.

Hence,

$T_{T_1} = 500000$ μs, $T_{T_2} = 556000$ μs, $T_{T_3} = 1250000$ μs

$\rightarrow$

Quest 1 conti:

Hence,

$T_{T_1} = 500000\,\mu s$

$T_{T_2} = 556000\,\mu s$

$T_{T_3} = 1250000\,\mu s$

For Propogation delay,

$T_{prop1} = d_1/s = \frac{4000\ m}{3\times10^8\ m/s} = 13.33\,\mu sec$

$T_{prop2} = d_2/s = \frac{9000}{3\times10^8} = 30\,\mu sec$

$T_{prop3} = d_3/s = \frac{10.000}{3\times10^8} = 33.33\,\mu sec$

New:

Total $T_{prop} = 13.33 + 30 + 33.33 = 76.66\,\mu sec$

" $T_{tran} = 500000 + 556000 + 1250000 = 2306000$ sec

" $T_q = 4 + 9 + 10 + 5 = 28\,\mu sec$

" $T_{proc} = 9 \times 4 = 36\,\mu sec$

1 conti)

Total Delay:

$76.66 + 2306000 + 28 + 36$

$= 2306140.66$ μsec.

Q No. 2 [10 points]

A) Mr. Amitabh Bachchan is using Internet Explorer as his client application to brow his website named www.bachchan.com. He wants to send a picture on a page of his website. Suppose, mistakenly he sends a wrong image (image1.jpg), now he wants to remove that image and send the right image(image2.jpg).

Keeping the above scenario in the mind please answer the following:

(i) What type of application level protocol Mr. Bachchan's client application should use?

(ii) What type of message format the Mr. Bachchan client application should use to send the data to the server?

(iii) Keeping all three actions of the above scenario in your mind; what method the message should use {keep in mind the type of message you answered in A(ii) } for each case?

(iv) Write down example messages of your proposed protocol for all three cases (showing message method for each case as well).

(v) Finally, what version of your proposed protocol is best suited for above scenarios and why?

Answer: 2A

(i) The web browser of Mr. Amitabh Bachchan should use HTTP protocol.

(ii) It should use HTTP request message to send the data to the web server.

(iii) For uploading picture both times; it should use PUT method. For deleting an image, it should use DELETE method.

(iv)

PUT /somedir/image1.jpg HTTP/1.1
Host: www.bachchan.com
Connection: Keep-Alive
User-agent: Mozilla/5.0*
Accept-language: en

DELETE /somedir/image1.jpg HTTP/1.1
Host: www.bachchan.com
Connection: Keep-Alive
User-agent: Mozilla/5.0*
Accept-language: en

PUT /somedir/image2.jpg HTTP/1.1
Host: www.bachchan.com
Connection: Keep-Alive
User-agent: Mozilla/5.0*
Accept-language: en

*Mozilla/5.0 is the general token that says the browser is Mozilla-compatible. For historical reasons, almost every browser today sends it. (this is optional, if a student put IE or Internet Explorer as User-agent in his/her answer it will be accepted as well).

(v) It should use HTTP/1.1 as the method type PUT is not available in HTTP/1.0.

B) Suppose you are running a chat application in your computer; this application requires to connect with its server on cloud to get verification of account.

(i) Explain how these applications communicate with each other.
(ii) Is it a P2P model or some other model?
(iii) What is the name of that interface which provides communication between to applications?
(iv) Many applications on computer are communicating with some other devices, how does your computer identify that, which message is received for what application and from what computer/ mobile? Define required identifications.

Answer: 2B

(i) A basic understanding of how the programs, running in multiple end systems, communicate with each other. In the jargon of operating systems, it is not actually programs but processes that communicate. A process can be thought of as a program that is running within an end system. Processes on two different end systems communicate with each other by exchanging messages across the computer network. A sending process creates and sends messages into the network; a receiving process receives these messages and possibly responds by sending messages back.

(ii) It is client-server model. In a client-server architecture, there is an always-on host, called the server, which services requests from many other hosts, called clients.

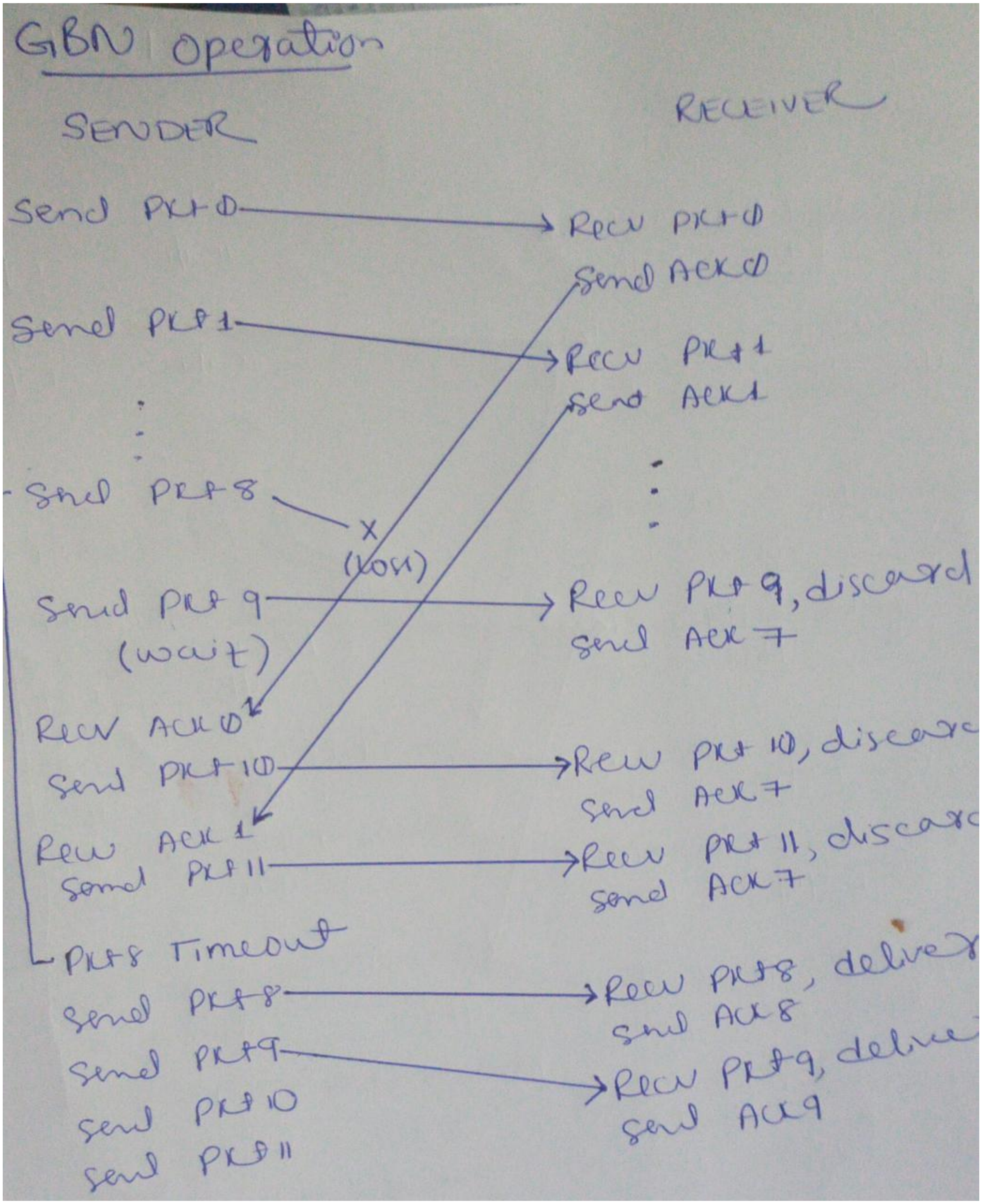
(iii) As noted above, most applications consist of pairs of communicating processes, with the two processes in each pair sending messages to each other. Any message sent from one process to another must go through the underlying network. A process sends messages into, and receives messages from, the network through a software interface called a **socket**.

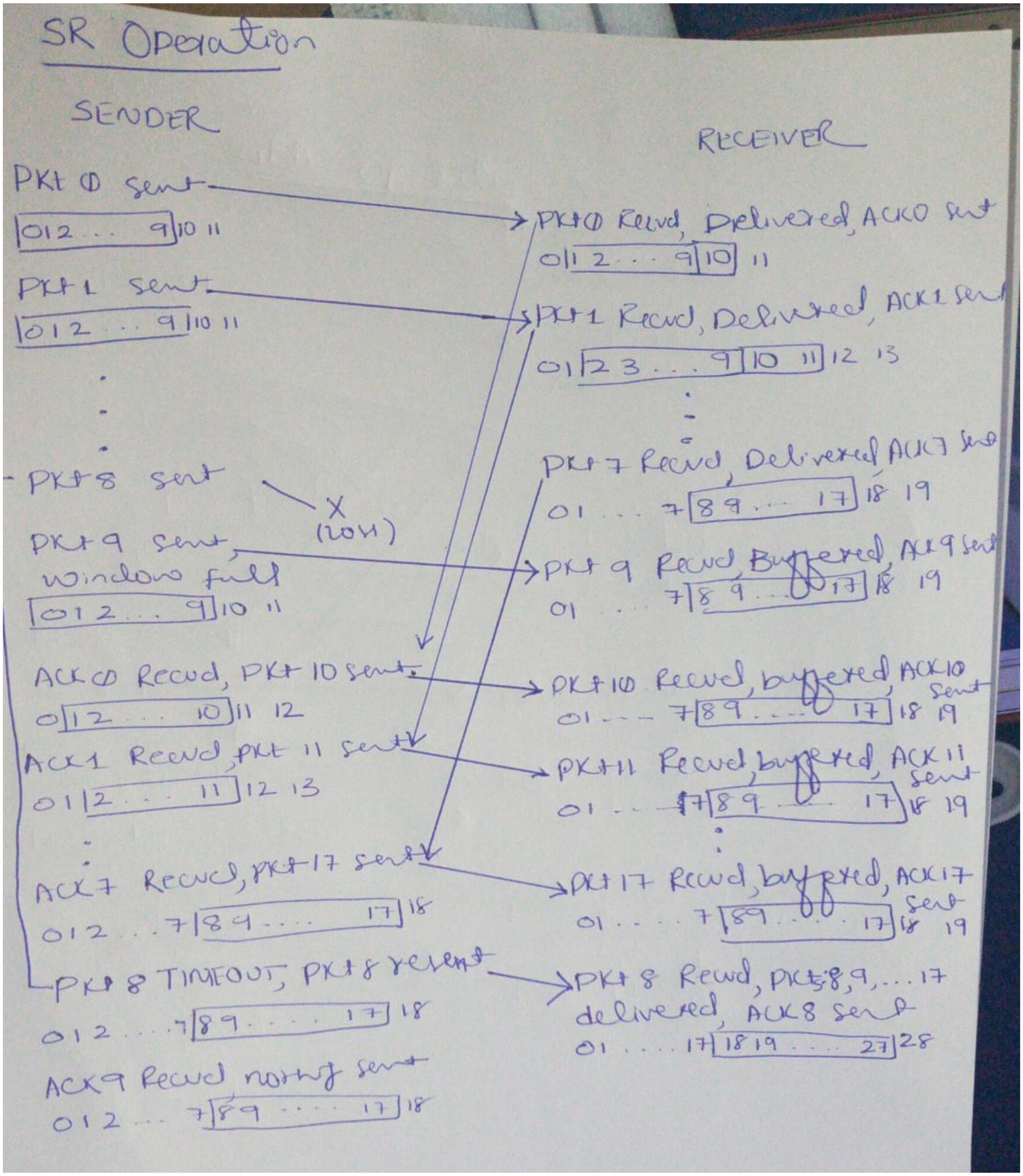
(iv) In the Internet, the host is identified by its IP address. an IP address is a 32-bit quantity that we can think of as uniquely identifying the host. In addition to knowing the address of the host to which a message is destined, the sending process must also identify the receiving process (more specifically, the receiving socket) running in the host. This information is needed because in general a host could be running many network applications. A destination port number serves this purpose. Popular applications have been assigned specific port numbers. For example, a Web server is identified by port number 80.

Q No. 3 [10 points]

Let suppose a window size of [Last two digits of your roll#] and sequence numbers range from 0 to one less than the 2*window size. Apply both the SR and GBN for sender and receiver events and actions. Compare and analyze the results. Assume that the 2nd last packet in the window is lost. Other assumptions must be clearly mentioned. Show the SR and GBN operations using diagrams in the presence of the lost packet. [For example, if your roll# is K171210, then the window size is 10 and assume that the 8th packet is lost.]

Solution:


GBN operation
SENDER
RECEIVER
Send PKt 0
Recv PKt 0
Send ACK 0
Send PKt 1
Recv PKt 1
Send ACK 1
Send PKt 8
X
(lost)
Send PKt 9
(wait)
Recv PKt 9, discard
Send ACK 7
Recv ACK 0
Send PKt 10
Recv PKt 10, discard
Send ACK 7
Recv ACK 1
Send PKt 11
Recv PKt 11, discard
Send ACK 7
PKt 8 Timeout
Send PKt 8
Recv PKt 8, deliver
Send ACK 8
Send PKt 9
Recv PKt 9, deliver
Send ACK 9
Send PKt 10
Send PKt 11



In SR, the receiver initially buffers packets 9, 10, and 11, and deliver them together with packet 8 to the upper layer when packet 8 is finally received.

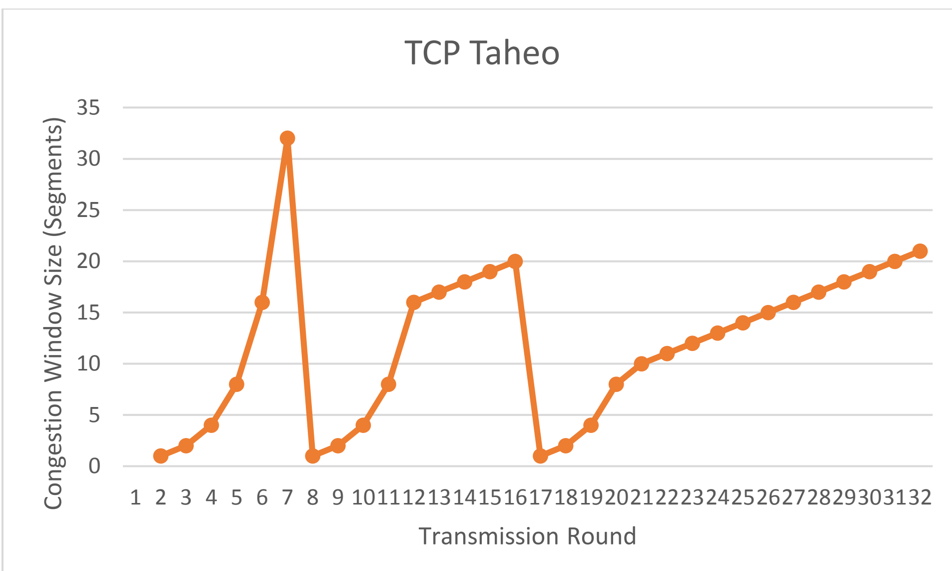
Q No. 4 [10 points]

Draw two plots with Congestion Window Size on x-axis and Transmission Round on y-axis.: one for TCP Tahoe and second for TCP Reno. Starting from CWND Size=1 segment. Consider the below two scenarios for loss event:

Scenario#1: the first loss time-out event occurs at the segment [last two digits of your roll#].

Scenario#2: the second loss event occurs at the segment [first two digits of your roll#]. Sender transmits DATA[1], DATA[2], DATA[3] and DATA[4], however, it receives ACK[1], ACK[2], ACK[2] and ACK[2]

A) State all the values of "ssthresh"
B) When Congestion avoidance is started? And when it ends?
C) When TCP performs a fast retransmit. When it ends?
D) <u>Solution</u>
E) Let suppose [last two digits of your roll#]=32 and [first two digits of your roll#]=20
F) TCP Congestion Control has four parts ▌Slow Start ▌Congestio n Avoidance ▌Fast Recovery/Fast Retransmit
G) ▌ssthresh: slow start threshold determines whether to use slow start or congestion avoidance
H) Packet losses m ay be detected by ▌Retransmission timeouts (RTO timer) ▌Duplicate Acknowledgements (at least 3)
I) FAST Recovery/ FAST Retransmission: packet loss detected by a timeout go into Slow Start (cwnd = 1) ▌packet loss detected by Dup ACKs ▌Fast Recovery/Fast Retransmission cwnd ← cwnd/2
J)

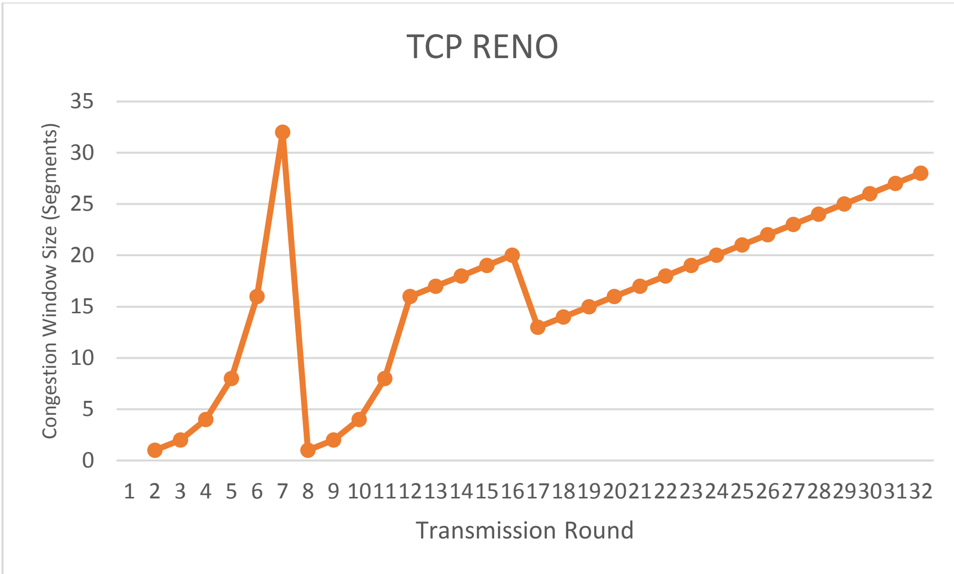


Trans. Round	Congestion Wiondow Size (cwnd)	PHASE	TCP TAHEO
0			
1	1	SS	
2	2	SS	

3	4	SS	
4	8	SS	
5	16	SS	
6	32	SS	time-out; ssthresh=16
7	1	SS	
8	2	SS	
9	4	SS	
10	8	SS	
11	16	CA	
12	17	CA	
13	18	CA	
14	19	CA	
15	20	CA	3 duplicate ACK; ssthres=10
16	1	SS	TCP Taheo went into slow start after Dup.ACKs **l** no Fast Recovery (cwnd = 1)
17	2	SS	
18	4	SS	
19	8	SS	
20	10	CA	
21	11	CA	
22	12	CA	
23	13	CA	
24	14	CA	
25	15	CA	
26	16	CA	
27	17	CA	
28	18	CA	
29	19	CA	
30	20	CA	
31	21	CA	

K)

L)



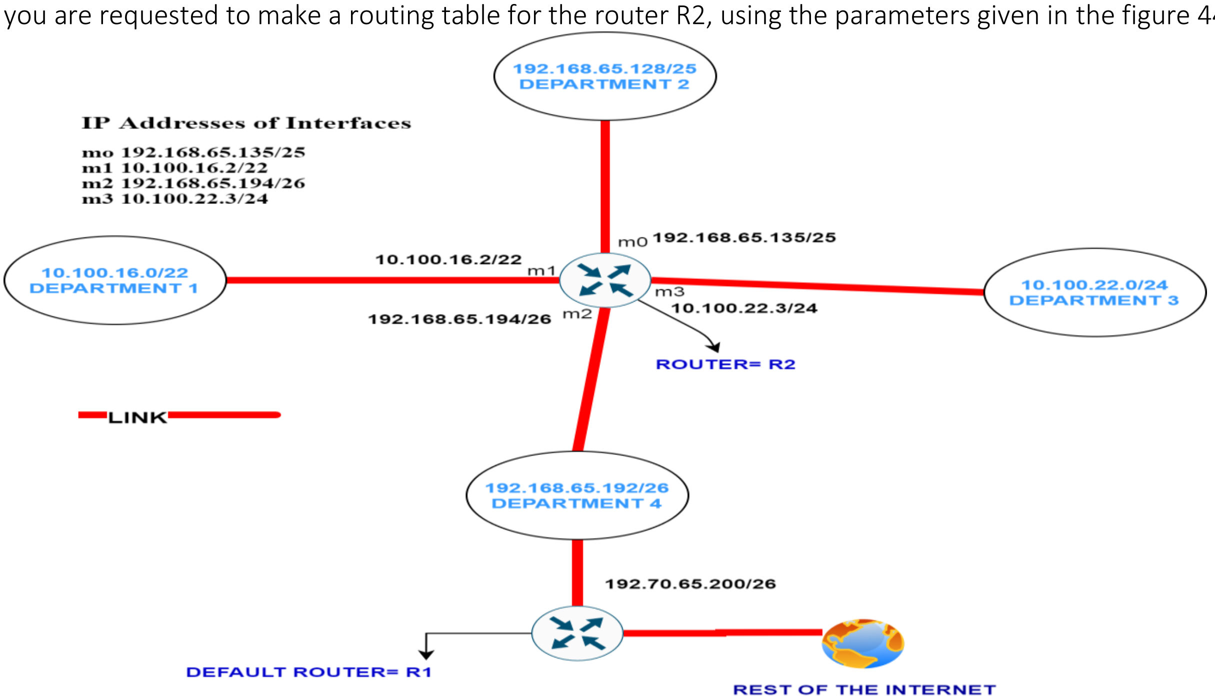
Transmission Round	Congestion Window Size	PHASE	TCP RENO
0			
1	1	SS	
2	2	SS	
3	4	SS	
4	8	SS	
5	16	SS	
6	32	SS	time-out; ssthresh=16
7	1	SS	
8	2	SS	
9	4	SS	
10	8	SS	
11	16	CA	
12	17	CA	
13	18	CA	
14	19	CA	
15	20	CA	3 duplicate ACK; ssthres=10
16	13	SS	TCP Reno, Fast Recovery
17	14	SS	
18	15	SS	
19	16	SS	
20	17	CA	
21	18	CA	
22	19	CA	

23	20	CA	
24	21	CA	
25	22	CA	
26	23	CA	
27	24	CA	
28	25	CA	
29	26	CA	
30	27	CA	
31	28	CA	

M)

Q No. 5 [10 points]

A) In the figure 444, we have a network of FAST NUCES Karachi; suppose as a network administrator you are requested to make a routing table for the router R2, using the parameters given in the figure 444:



The Routing table for router R2 in Figure 444 should look like below table with having all the entries:

Subnet Mask	Network Address	Next Hop	Interface

Solution

The Routing table for router R2 in Figure 444

Subnet Mask	Network Address	Next Hop	Interface
/26	192.168.65.192	-	m2
/25	192.168.65.128	-	m0
/24	10.100.22.0	-	m3
/22	10.100.16.0	-	m1
Any	Any	192.71.65.200	m2

B) With the help of routing table of R2 [you created in question (a)] show; how forwarding takes place if a packet arrives at R2 from any interface in the figure 444 with the destination address 192.70.65.140, identify to which interface it will be forwarded to be delivered to correct destined department.

Solution

The router performs the following steps:

1. The first subnet mask (/26) is applied to the destination address. The result is 192.168.65.128, which does not match the corresponding network address.
2. The second subnet mask (/25) is applied to the destination address. The result is 192.168.65.128, which matches the corresponding network address. The next-hop address (the destination address of the packet in this case) and the interface number mO are passed to ARP for further
processing.

C) With the help of Router = R2 routing table you have to show that how forwarding takes place if a packet arrives at R2 from any interface in Figure 444 with the destination address 168.4.22.35 so to which interface it will be forwarded so that it can be delivered to correct department.

Solution

The router performs the following steps:

I. The first subnet mask (/26) is applied to the destination address. The result is 10.100.22.0, which does not match the corresponding network address (row 1).
2. The second subnet mask (/25) is applied to the destination address. The result is 10.100.22.0, which does not match the corresponding network address (row 2).

3. The third subnet mask (/24) is applied to the destination address. The result is 10.100.22.0, which matches the corresponding network address. The destination address of the packet and the interface number m3 are passed to ARP.

D) With the help of Router = R2 routing table you have to show that how forwarding takes place if a packet arrives at R2 from any interface in Figure 444 with the destination address 192.24.32.78 so to which interface it will be forwarded so that it can be delivered to correct department.

Solution

This time all subnet masks are applied, one by one, to the destination address, but no matching network address is found. When it reaches the end of the table, the module gives the next-hop address 192.70.65.200 and interface number m2 to ARP. This is probably an outgoing package that needs to be sent, via the default router, to someplace else in the Internet.

Q No. 6 [10 points]

In the Given Scenario we have Routers of all the campuses of FAST NUCES connected for routing purposes with having different link costs (weight) and we had implemented the distance-vector protocol as per our network requirement as shown in Figure: 420. Each Router (R1, R2, R3, R4, and R5) at network has its own local clock, which is not synchronized with any other Routers clock in the network. Each Router in a network sends its distance-vector advertisement every 100 seconds. When a Router in a network receives an advertisement, it directly integrates it. The time to send a message on a link and to integrate advertisements is negligible. There is no loss in the network, so no advertisements are lost. In our Scenario there is no HELLO protocol in this network.

A) Firstly, at time "t=0", in the network all the Routers are working except R2. And "at time t=10 seconds", Router R2 suddenly starts working and immediately sends a "route advertisement" for itself to all its neighboring Routers. So, in this case what could be the minimum time at each Routers (R1, R2, R3, R4, and R5) in the network is given surety to have a correct routing table entry corresponding to a minimum-cost path to reach R2? Explain your answers.

Answer:

Router R1: 10 seconds.
Router R5: 110 seconds.
Router R4: 110 seconds.
Router R3: 210 seconds.
At time t = 10, R2 advertises to R1, R5, and R3. They integrate OR ADD this advertisement into their routing tables, so that cost(R1,R2) = 2, cost(R5,R2) = 2, cost(R3,R2) = 7. In the worst case, we wait 100s for the next round of advertisements. So at time t = 110, R1, R5, and R3 all advertise about R2, and everyone integrates. Now cost(R5, R2) = 4 (via R1), cost(R4, R2) = 4 (via R1), and cost(R3, R2) = 7 still R5 and R4 routes are correct; R3 is not. Finally, after 100 more seconds, another round of advertisements is sent. In particular, R3 hears about R4 route to R2, and updates cost(R3, R2) = 5 (via R4).

B) In given figure 420 if all the Routers sends packets to destination R2 only and not to any other destination/Router in the network, among all the links which link would carry the most traffic?

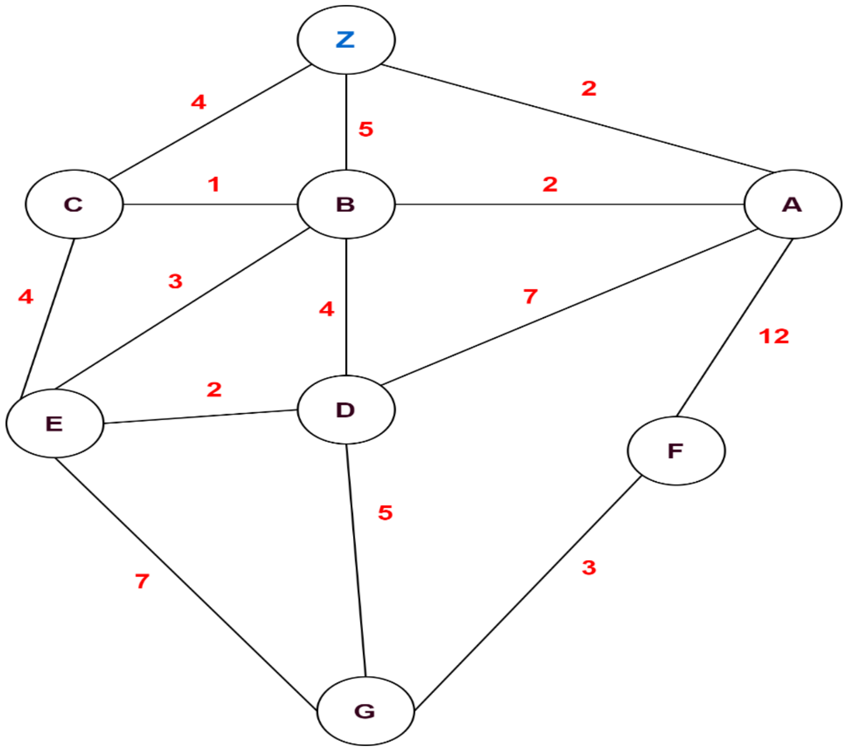
Answer : R1→R2. Every Routers best path or route to R2 is via R1

C) The IT office of all the campuses did a meeting and they were not happy and worried that one of the links in the network carries a large amount of traffic when all the Routers are sending packets to R2. The IT office decides to overcome this limitation with FAST Vector Protocol (FVP). In FVP, R1 lies, advertising a "path cost" for destination R2 that is different from the sum of the link costs along the path used to reach R2. All the other Routers implement the standard distance-vector protocol, not FVP. So, in that case we must adopt a way such that, R1 must uses the direct link with R2 for only its own traffic, not other routers traffic? And what cost R1 will be advertising for R2 along its each connected links and the paths should not be same as if two path costs are equal so in that case one (Routers) can't be sure which path will be taken to send traffic.

Answer: For the above mention problem the solution should be that the Router R1 needs to advertise a higher enough cost such that everyone's link to R2 via R1 will be no longer in used and will not be the best path for others routers as per DV. Meanwhile R4 cost to R2 without going through R1 is the highest which is 8, So in that case R1 must advertise a cost so that link cost(R4, R1) + advertised cost(R1, R2) > 8. Hence, R1 advertises a cost of 7.

Q No. 7 [10 points]

Consider the network in the figure 421 shown below.



A) Compute the least cost path from Z to all other destinations and by doing though Dijkstra's algorithm (Link State) operation.

Answer:

N	D(A), P(A)	D(B), P(B)	D(C), P(C)	D(D), P(D)	D(E), P(E)	D(F), P(F)	D(E), P(E)
Z	2,Z	5,Z	4,Z	Inf	Inf	Inf	Inf
	-	4,A	4,Z	9,A	Inf	14, A	Inf
	-	-	4,Z	8,B	7,B	14, A	Inf
	-	-	-	8,B	7,B	14, A	Inf
	-	-	-	8,B	-	14, A	14,E
	-	-	-	-	-	14, A	13,D
	-	-	-	-	-	14, A	-

B) After applying the operation of Dijkstra's algorithm from Z to all other devices in above part now briefly describe that how from Z device to A and G device you have computed the least cost path.

C) Answer: Z-A Z-B Z-C Z-D Z-E Z-F Z-G ZA ZAB ZC ZABD ZABE ZAF ZABDG

Q No. 8 [10 points]

As a Computer Scientist CS you have to design a Protocol Architecture name: “FAST SDN Based Protocol”. The Aim of your protocol “FAST SDN Based Protocol” should be like that it can provide a complete architecture for any application running on controller (Control Plane) to interact the SDN based switches (Data Plane) and to perform certain job as per the nature/requirement of the application. So below questions should be answered which at the end will give you a complete Architecture of your protocol name: “FAST SDN Based Protocol”.

A) Define what layers will be there in your Protocol architecture “SDN Controller” and define concisely working of those layers in your own words?

Answer: The communication layer is responsible for the communication between the SDN controller and those controlled network devices, via a protocol such as OpenFlow. Through this layer, an SDN controller controls the operation of a remote SDN-enabled switch, host, or other devices, and a device communicates locally-observed events (e.g., a message indicating a link failure) to the controller.

The network-wide state-management layer provides up-to-date information about state a network’s hosts, links, switches, and other SDN-controlled devices. A controller also maintains a copy of the flow tables of the various controlled devices.

The network-control application layer represents the brain of SDN control plane. The applications at this layer use the APIs provided by a SDN controller to specify and control the data plane in the network devices. For example, a routing network-control application might determine the end-end paths between sources and destinations. Another network application might perform access control.

B) Design an application at controller (SDN control plane) which will find shortest path/routes between switches in a network and at which layer you would implement that application. Must give any name you like to your application?

Answer: Our application which will be running on a controller (FAST-DIJKSTRA) will be built on Dijkstra’s algorithm in which it will be finding the shortest path between all connected switches in a network for that it will take network as a graph in which vertex or nodes will be switches and path will be links which will be having some weight. The switches will send that info to the controller about their neighbouring switches and the link weight so at controller with that information when it is complete it will compute shortest path for a network using Dijkstra’s algorithm and it will be implemented at the SDN’s network-control application layer, as this is the layer where a routing protocol determines the end-to-end paths between sources and destinations

C) After designing the application for controller "How?" your application will do interaction with the SDN based switches, and how SDN based switches will provide required info/interaction for the application running on controller? Explain it in your own words?

NOTE: If a student at least explained below part in his word with same messages as of book with showing clear working of messages then it can be assessed that he knows how his application can interact with switch.

Answer: The following is a list of types of messages flow across a SDN controller's southbound from the controller to the controlled devices. The recipient of these messages is a controlled packet switch.

- Configuration. This message allows the controller to query and set a switch's configuration parameters.
- Modify-state. This message is used by a controller to add/delete or modify entries in the switch's flow table, and to set switch port properties.
- Read-state. This message is used by a controller to collect statistics and counter values from the switch's flow table and ports.
- Send-packet. This message is used by the controller to send a specific packet out of a specified port at the controlled switch.

There are also messages that network-control applications (as senders) send to the controller across the northbound interfaces, for example, messages to read/write network state and flow tables within the state-management layer of the controller.

D) Explain the above part (c) method with an example specifically with a "Diagram" which should clearly show how application and switches do Interaction in your own words?

E) NOTE: If a student at least explained below part in his word with same example of book with showing clear working of messages then it can be assessed that he knows the complexity or working of SDN.

F)

G) Answer: In order to solidify our understanding of the interaction between SDN-controlled switches and the SDN controller, let's consider the example shown in Figure 5.16, in which Dijkstra's algorithm (which we studied in Section 5.2) is used to determine shortest path routes. The SDN scenario in Figure 5.16 has two important differences from the earlier per-router-control scenario of Sections 5.2.1 and 5.3, where Dijkstra's algorithm was implemented in each and every router and link-state updates were flooded among all network routers:

• Dijkstra's algorithm is executed as a separate application, outside of the packet switches.

• Packet switches send link updates to the SDN controller and not to each other. In this example, let's assume that the link between switch s1 and s2 goes down; that shortest path routing is implemented, and consequently and that incoming and outgoing flow forwarding rules at s1, s3, and s4 are affected, but that s2's

H)

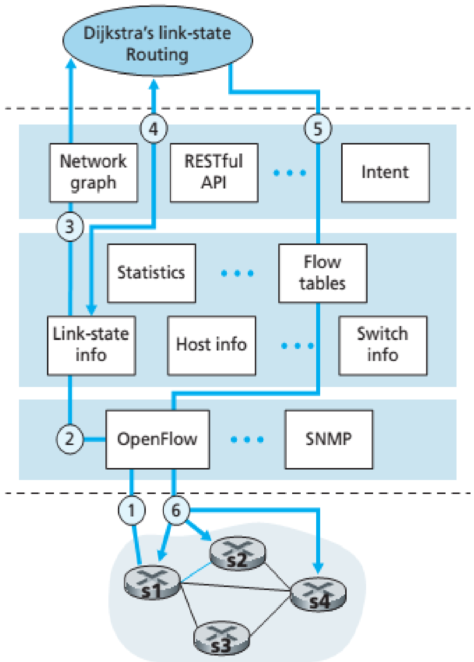


Figure 5.16 ♦ SDN controller scenario: Link-state change

I)

J) operation is unchanged. Let's also assume that OpenFlow is used as the communication layer protocol, and that the control plane performs no other function other than link-state routing.

1. Switch s1, experiencing a link failure between itself and s2, notifies the SDN controller of the link-state change using the OpenFlow port-status message.
2. The SDN controller receives the OpenFlow message indicating the link-state change, and notifies the link-state manager, which updates a link-state database.
3. The network-control application that implements Dijkstra's link-state routing has previously registered to be notified when link state changes. That application receives the notification of the link-state change.
4. The link-state routing application interacts with the link-state manager to get updated link state; it might also consult other components in the state- management layer. It then computes the new least-cost paths.
5. The link-state routing application then interacts with the flow table manager, which determines the flow tables to be updated.
6. The flow table manager then uses the OpenFlow protocol to update flow table entries at affected switches—s1 (which will now route packets destined to s2 via s4), s2 (which will now begin receiving packets from s1 via intermediate switch s4), and s4 (which must now forward packets from s1 destined to s2).

K)

Q No. 9 [10 points]

A) What different error detection and correction practices are available, briefly explain which technique is used by transport layer protocols and which is mostly used at link layer protocol, also mention the reasons for both using a specific technique. Also justify the use of these techniques by link layer protocol, whereas, transport layer protocols are already using it.

Answer: 9

A) Following error detection and correction techniques we have studied;

i) Parity Checks; single bit parity check and two-dimensional parity check.

ii) Checksumming methods

iii) Cyclic Redundancy Check (CRC)

Transport layer protocols (i.e. TCP and UDP) use Checksumming Methods or Internet checksum. The checksums in TCP and UDP use only 16 bits. However, they provide relatively weak protection against errors as compared with cyclic redundancy check. Because transport-layer error detection is implemented in software, it is important to have a simple and fast error-detection scheme such as checksumming.

Link Layer Protocol often use cyclic redundancy check (CRC). The error detection at the link layer is implemented in dedicated hardware in adapters, which can rapidly perform the more complex CRC operations.

The link-layer hardware in a receiving node can incorrectly decide that a bit in a frame is zero when it was transmitted as a one, and vice versa. Such bit errors are introduced by signal attenuation and electromagnetic noise. Because there is no need to forward a datagram that has an error, many link-layer protocols provide a mechanism to detect such bit errors. The Internet's transport layer and network layer also provide a limited form of error detection—the Internet checksum. Error detection in the link layer is usually more sophisticated and is implemented in hardware.

B) Use a generator G =x3+x2+1 and take first four digits of your date of birth (for example 18-01-1990 take 1801) convert this number into binary and take six digits from left hand side. Now perform modulo-2 arithmetic to calculate the R (CRC bits).

Answer: 9B

D= 111000 d = 6 , G= 1101, r = 3 R =?

111000 000 ÷1101

```
101001
---------
111000000
1101
----
01100000
0000
----
1100000
1101
----
001000
0000
----
01000
0000
----
1000
1101
----
101
```

R = 101

Q No. 10 [10 points]

A) In figure 10A , ee:2c:bd:8f:1b:a5 want to send frames to 23:4e:19:4b:23:cc, (i) write down the step in case if the entry for 23:4e:19:4b:23:cc is not in the switch table. (ii) Also generate a table for the switch for given scenario, which it should populate. (iii) Switch's port number 1 is connected with ee:2c:bd:8f:1b:a5, do you think port no. 1 has its own unique MAC address ? in either cases (Yes /No) Justify your answer.

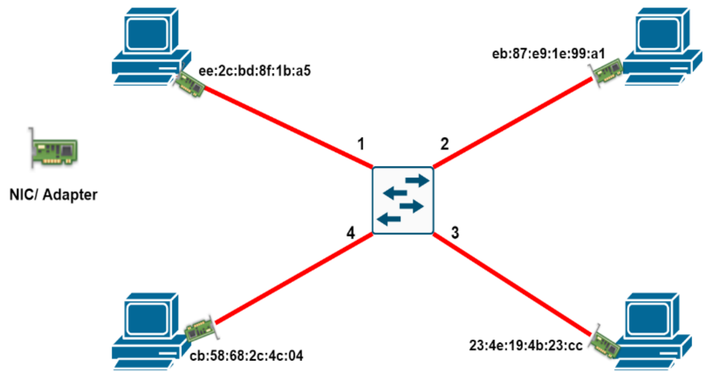


Figure 10 A

Answer:

10 A (i)

Step 1: ee:2c:bd:8f:1b:a5 sends frame to switch on port 1, switch know that it can reach ee:2c:bd:8f:1b:a5 on that port.

Step 2: Switch floods packet out all ports except 1 because it does not know to which port 23:4e:19:4b:23:cc is connected to.

Step3: 23:4e:19:4b:23:cc replies and switch learns that 23:4e:19:4b:23:cc is connected to port 3.

10 A (ii)

MAC Address	Interface	TTL
ee:2c:bd:8f:1b:a5	1	60
23:4e:19:4b:23:cc	3	60

10 A (iii)

No. Since each node is directly connected to the switch MAC addresses are not required at the switch ports (a packet sent from a host will always end up at the switch port that connects to the host). Actually, the switch is transparent for the hosts. E.g., in the case of ee:2c:bd:8f:1b:a5 sending a frame to 23:4e:19:4b:23:cc, the frame only carries ee:2c:bd:8f:1b:a5 and 23:4e:19:4b:23:cc MAC addresses and no information about the switch or its ports.

B) In figure 10B, ee:2c:bd:8f:1b:a5 want to get the MAC address of host with IP address 176.36.100.2, ee:2c:bd:8f:1b:a5 sends an ARP request, what MAC address it should get in return? Explain why?

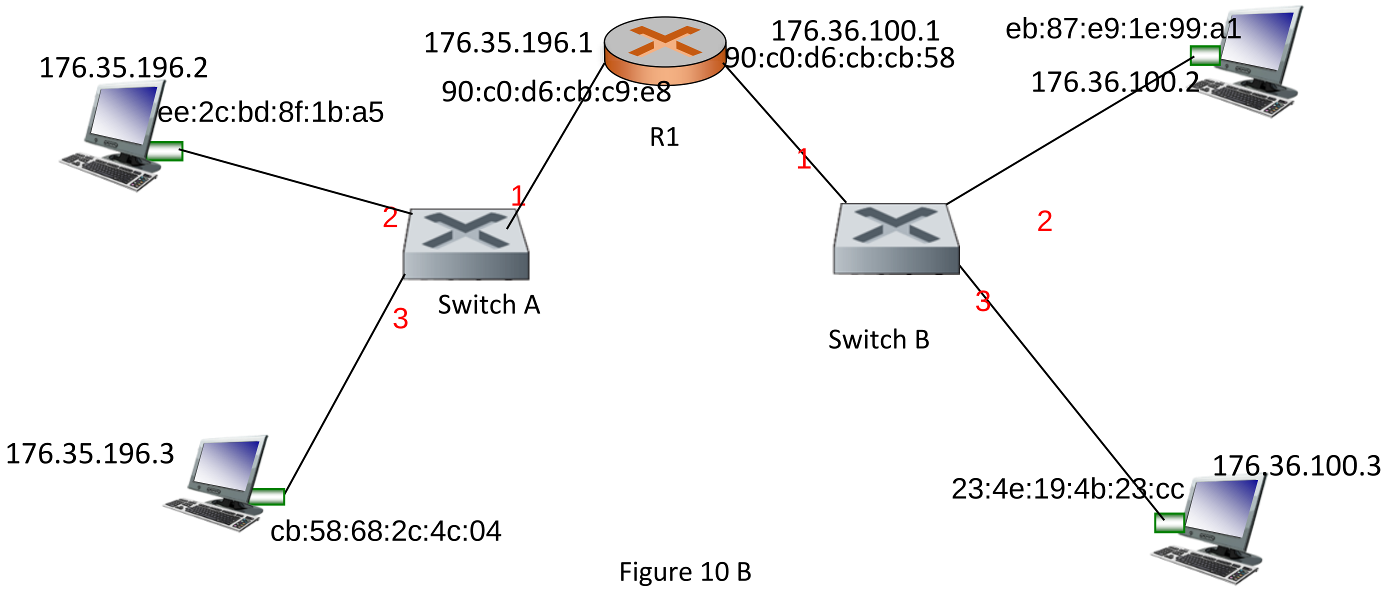


Figure 10 B

Answer

90:c0:d6:cb:c9:e8. Since eb:87:e9:1e:99:a1 is not in the same switching domain as ee:2c:bd:8f:1b:a5 frames have to be sent to the left interface of R1.

---THE END---