

29th June 2020, 9:00 am – 12:00 pm

Course Code: CS 307	Course Name: Computer Networks	
Instructors: Dr. Ghufran Ahmed, Dr. Hassan Jamil Syed, Mr. Abdullah Zarshaid		
Student Roll No:	Section No:	DoB:

**Instructions:**

- Read each question completely before answering it. There are 10 questions on 8 pages. Each question has 10 Points.
- The Exam will start at 9:00 am and will end at 12:00 pm, you have 30 minutes as the submission time, you must submit your PDF answer sheet **before 12.30 pm** (submission procedure is given below).
- This is an open book /notes exam. But copying still not allowed, answer in your own words.
- Answers must be given in your **own handwriting**, must write your **roll number, page number** and put your **signature on each page**. The **orientation** should be **portrait** for each page.
- All the answers must be solved according to the **SEQUENCE** given in the question paper. **Out of order questions will not be checked**.
- You are required to use **cam-scanner, MS lens** or an equivalent application to scan and convert your hand-written answer sheets into **a single PDF file**, which you have to **submit at Google Classroom**, and also email it to your respective teacher's **email address** ([ghufran.ahmed@nu.edu.pk](mailto:ghufran.ahmed@nu.edu.pk) / [hassan.jamil@nu.edu.pk](mailto:hassan.jamil@nu.edu.pk) / [abdullah.zarshaid@nu.edu.pk](mailto:abdullah.zarshaid@nu.edu.pk)). You are given 30 minutes for this purpose.
- You **must use file name as your roll numbers** (i.e. for example 20K-1234.pdf).
- You have **180 minutes** to answer the questions and **30 minutes** to scan and upload.
- Write neat and clean also draw diagrams clearly visible and under stable.
- After Deadline of submission **4 Points will be deducted** for every **5-minute late submission**.

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Time allowed: 180 minutes

Maximum Points 100

Q1. [10- 15 minutes] [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,  $L = ([\text{Last digit of your roll number}] \bmod 10) + 1$  Mbits. The transmission rate of links are  $R_1$  (link between A and X)= $([\text{2nd Last digit of your roll number}] \bmod 10) + 1$  Mbps,  $R_2$ (link between X and Y)= $([\text{3rd Last digit of your roll number}] \bmod 10) + 1$  Mbps and  $R_3$  (link between Y and B)= $([\text{4th Last digit of your roll number}] \bmod 10) + 1$  Mbps. The length of the links is  $d_1 = ([\text{First digit of your roll number}] \bmod 10) + 1$  Km,  $d_2 = ([\text{2nd digit of your roll number}] \bmod 10) + 1$  Km and  $d_3 = ([\text{3rd digit of your roll number}] \bmod 10) + 1$  Km. The processing delay is same for all packets which is the  $([\text{Last digit of your roll number}] \bmod 10) + 1$   $\mu$ sec. The queueing delay of packet1, packet2, packet3 and packet4 are  $([\text{1st digit of your roll number}] \bmod 10) + 1$   $\mu$ sec ,  $([\text{2nd digit of your roll number}] \bmod 10) + 1$   $\mu$ sec ,  $([\text{3rd digit of your roll number}] \bmod 10) + 1$   $\mu$ sec and  $([\text{4th digit of your roll number}] \bmod 10) + 1$   $\mu$ sec respectively.

For example, if a student has roll number K171234, he has the following data:

$R_1 = (3 \bmod 10) + 1 = 4$  Mbps,  $R_2 = (2 \bmod 10) + 1 = 3$  Mbps and  $R_3 = (1 \bmod 10) + 1 = 2$  Mbps

$d_1 = (1 \bmod 10) + 1 = 2$  Mbps,  $d_2 = (7 \bmod 10) + 1 = 8$  Mbps and  $d_3 = (1 \bmod 10) + 1 = 2$  Mbps

$T_{\text{proc}} = T_{\text{proc1}} = T_{\text{proc2}} = T_{\text{proc3}} = T_{\text{proc4}} = (4 \bmod 10) + 1 = 5$   $\mu$ sec

$T_{Q1} = (1 \bmod 10) + 1 = 2$   $\mu$ sec,  $T_{Q2} = (2 \bmod 10) + 1 = 3$   $\mu$ sec,  $T_{Q3} = (3 \bmod 10) + 1 = 4$   $\mu$ sec and  $T_{Q4} = (4 \bmod 10) + 1 = 5$   $\mu$ sec

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

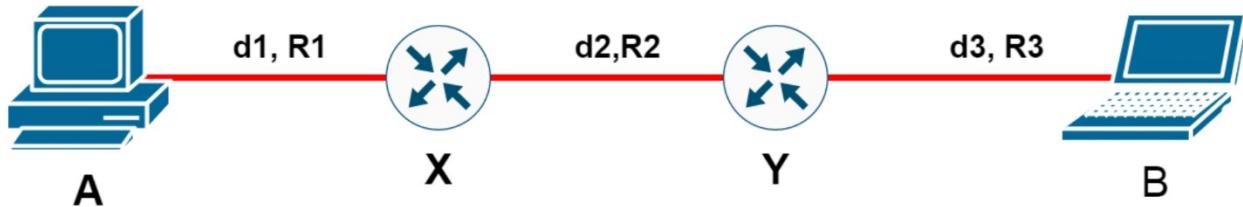


Figure: 1

Q No. 2

[10- 15 minutes] [10 points]

A) Mr. Amitabh Bachchan is using Internet Explorer as his client application to browse his website named [www.bachchan.com](http://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).

[5 points, each subsection carries equal points]

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?

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. [5 points, each subsection carries equal points]

- (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 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.

Q No. 3	[15-20 min]	[10 points]
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Let suppose a window size of ([Last two digits of your roll number] mod 10)+1 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 2<sup>nd</sup> 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 number is K171209, then the window size is (09 mod 10)+1=10 and assume that the 8th packet is lost.]

Q No. 4	[15-20 min]	[10 points, each part carries equal points]
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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:

- o Scenario number1: the first loss time-out event occurs at the segment ([last two digits of your roll number] mod 10)+1.
  - o Scenario number2: the second loss event occurs at the segment ([first two digits of your roll number] mod 10)+1. 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 does Congestion avoidance is started? And when it ends?
- C) When TCP performs a fast retransmit. When it ends?

Q No. 5

[10-15 min]

[10 points, each part carries equal points]

- A) In the figure: 5 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 5:

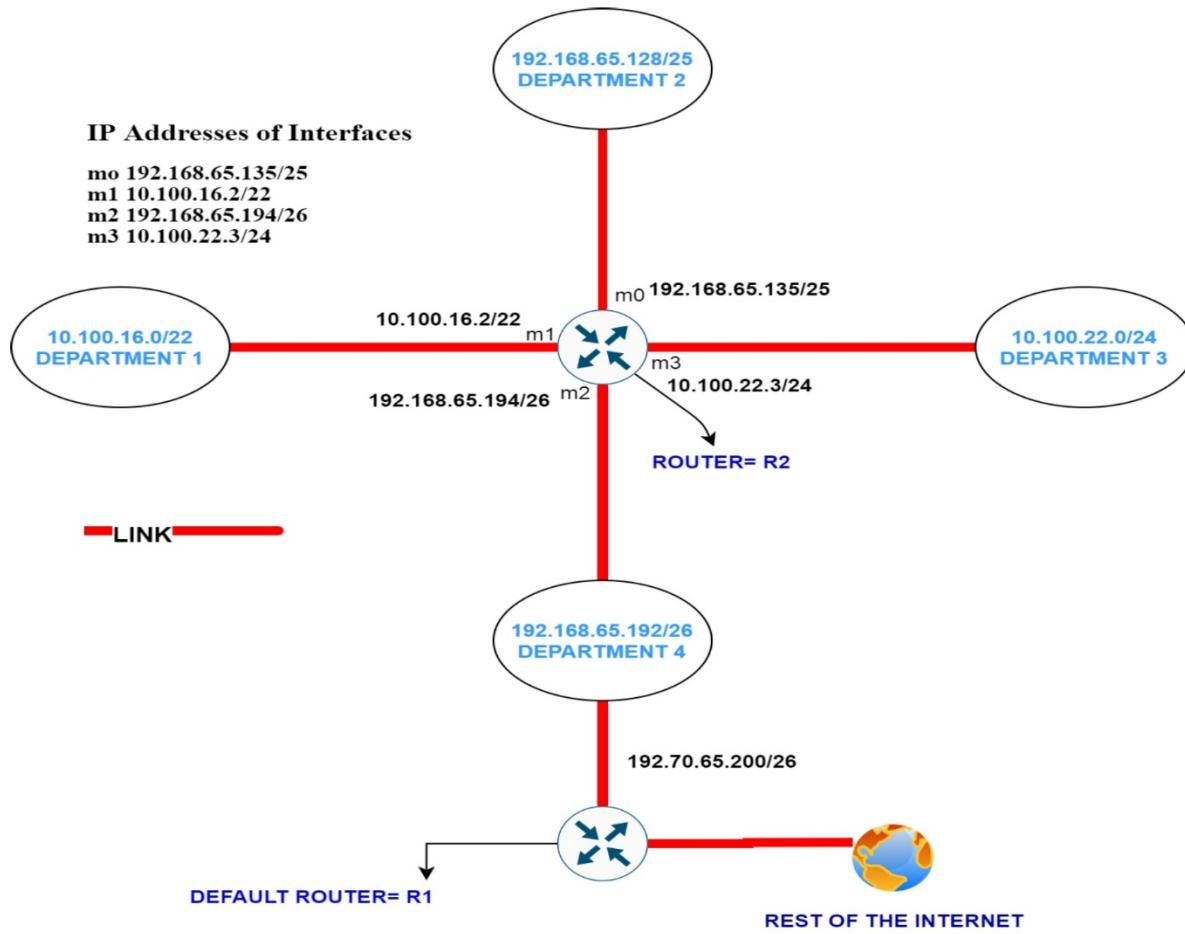


Figure: 5

The Routing table for router R2 in Figure 5 should look like below table with having all the entries:

Subnet Mask	Network Address	Next Hop	Interface

- B) With the help of routing table of R2 [you created in question 5 (A)] show; how forwarding takes place if a packet arrives at R2 from any interface in the figure 5 with the destination address 192.70.65.140, identify to which interface it will be forwarded to be delivered to correct destined department.
- 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 5 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.
- 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 5 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.

Q No. 6 [10-15 min] [10 points, each part carries equal 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:6. 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.

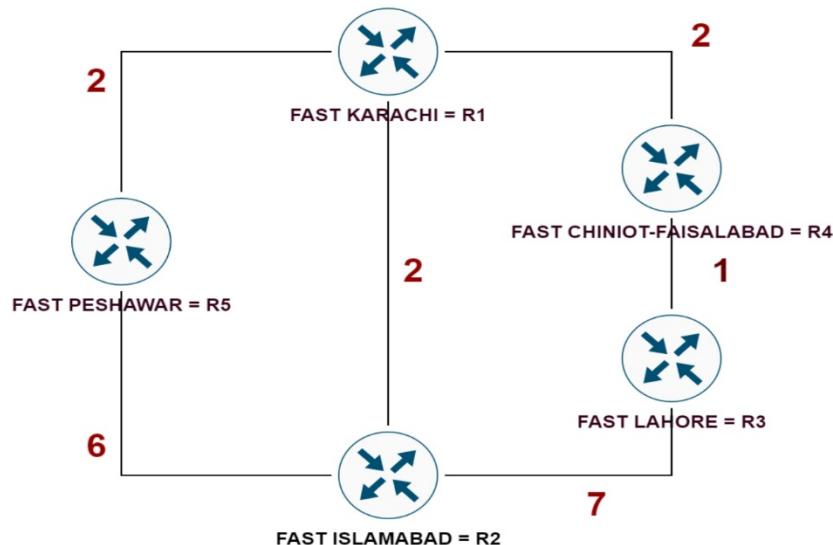


Figure: 6

- 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 surely to have a correct routing table entry corresponding to a minimum-cost path to reach R2? Explain your answers.
- B) In given figure 6 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?

- 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.

Q No. 7

[10-15 min]

[10 points]

Consider the network in the figure 7 shown below.

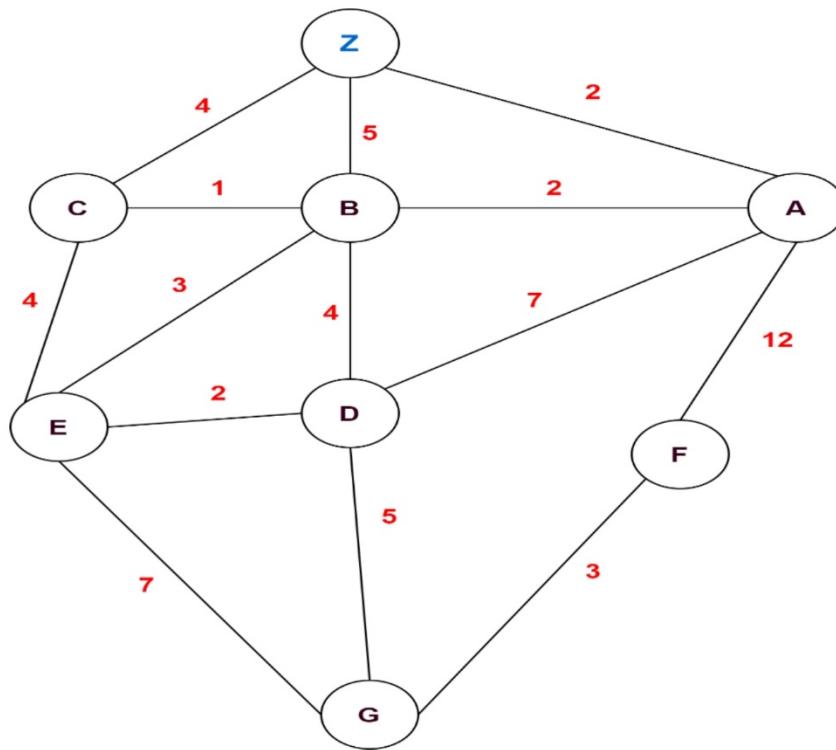


Figure: 7

- A) Compute the least cost path from Z to all other destinations and by doing though Dijkstra's algorithm (Link State) operation. [7 points]
- 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. [3 points]

Q No. 8 [15-20 min] [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?
- 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?
- 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?
- 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?

Q No. 9 [10-15 min] [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. [ 5 points]
- B) Use a generator  $G(x) = x^3 + x^2 + 1$  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). [ 5 points]

Q No. 10 [10- 15 min] [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. [5 points]

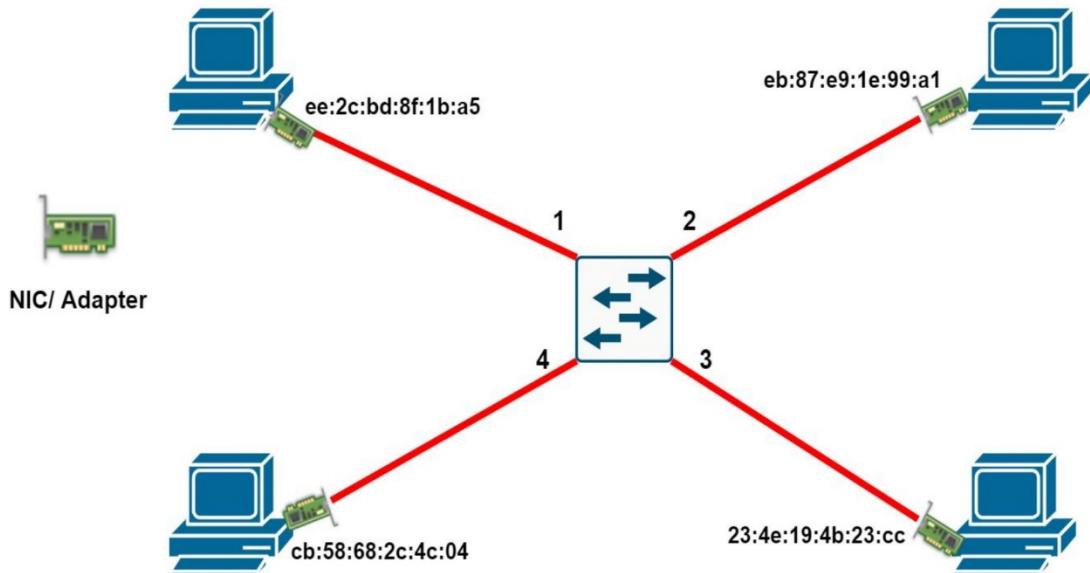


Figure 10 A

- 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? [5 points]

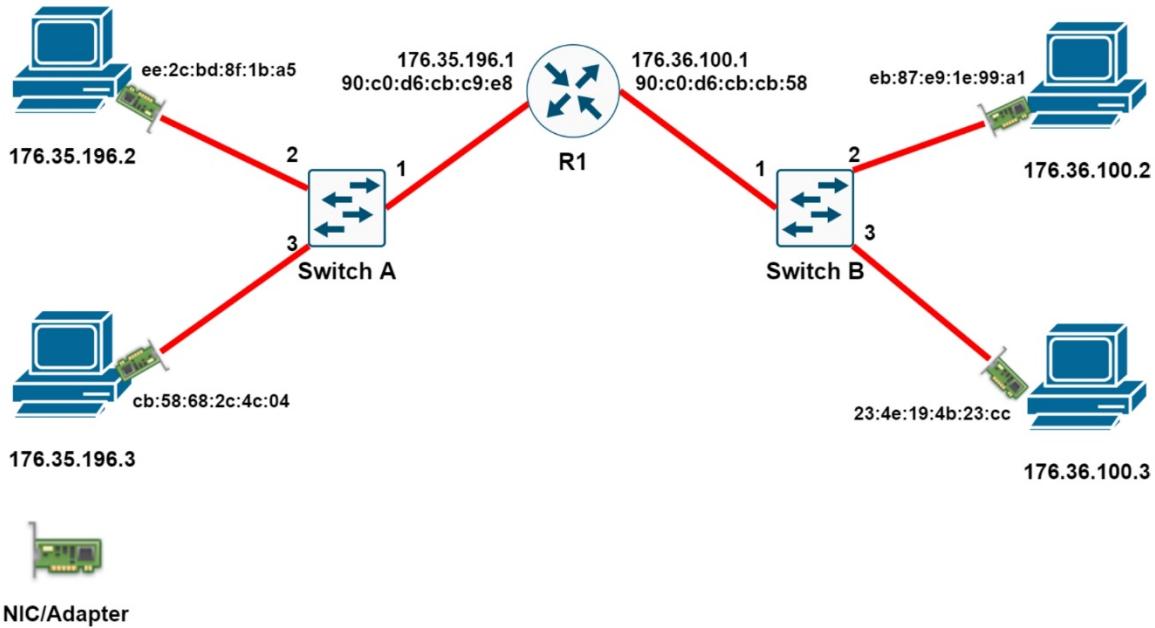


Figure 10 B

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