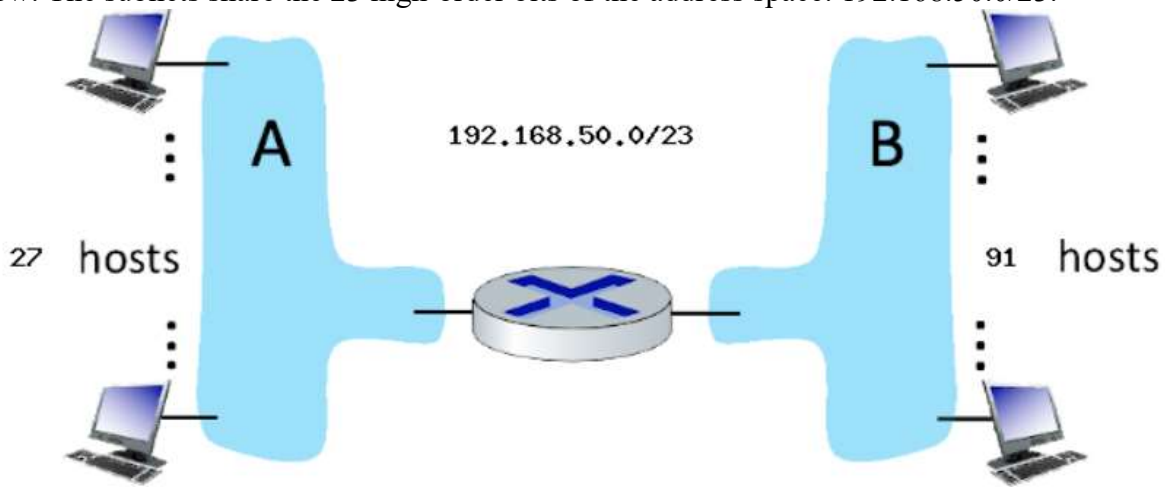
Final Exam Part – B: Solution

EITHER THIS

Question 1: [10 Marks; 1 Mark each]

Consider the router and the two attached subnets below (A and B). The number of hosts is also shown below. The subnets share the 23 high-order bits of the address space: 192.168.50.0/23.



Assign subnet addresses to each of the subnets (A and B) so that the amount of address space assigned is minimal, and at the same time leaving the largest possible contiguous address space available for assignment if a new subnet were to be added. Then answer the questions below.

1. Is the address space public or private?

private.

2. How many hosts can there be in this address space?

Maximum number of hosts = 2^x - 2 = 2^9 - 2 = 510.

3. What is the subnet address of subnet A? (CIDR notation)

192.168.50.128/27

4. What is the broadcast address of subnet A?

The broadcast address of subnet A is 192.168.50.159, because it is the last address in the IP range.

5. What is the starting address of subnet A?

The first IP address of subnet A is 192.168.50.129, found by adding 1 to the subnet address.

6. What is the ending address of subnet A?

The last IP address of subnet A is 192.168.50.158

7. What is the subnet address of subnet B? (CIDR notation)

192.168.50.0/25

8. What is the broadcast address of subnet B?

192.168.50.127, because it is the last address in the IP range.

9. What is the starting address of subnet B?

192.168.50.1, found by adding 1 to the subnet address.

10. What is the ending address of subnet B?

192.168.50.126

OR: **Question 1: [10 Marks]**

Consider a datagram network using 32-bit host addresses. Suppose a router has six links, numbered 0 through 5, and packets are to be forwarded to the link interfaces as follows:

Destination Address Range	**Link Interface**
11100000 00000000 00000000 00000000 through 11100000 00111111 11111111 11111111	0
11100000 01000000 00000000 00000000 through 11100000 01000000 11111111 11111111	1
11100000 01000001 00000000 00000000 through 11100001 01111111 11111111 11111111	2
11100000 00000000 00000000 00000000 through 11100000 00001111 11111111 11111111	3
11100000 01000001 00000000 00000000 through 11100000 11111111 11111111 11111111	4
otherwise	5

a. Complete the forwarding table given below that has six entries, uses longest prefix matching, and forwards packets to the correct link interfaces.

(Note: First row is filled in the table below is just for the hints, complete the remaining rows accordingly)

Destination Address Range	**Link Interface**
11100000 00****** ******** ********	0
11100000 01000000 ******** ********	1
1110000* ******** ******** ********	2
11100000 0000**** ******** ********	3
11100000 ******** ******** ********	4
otherwise	5

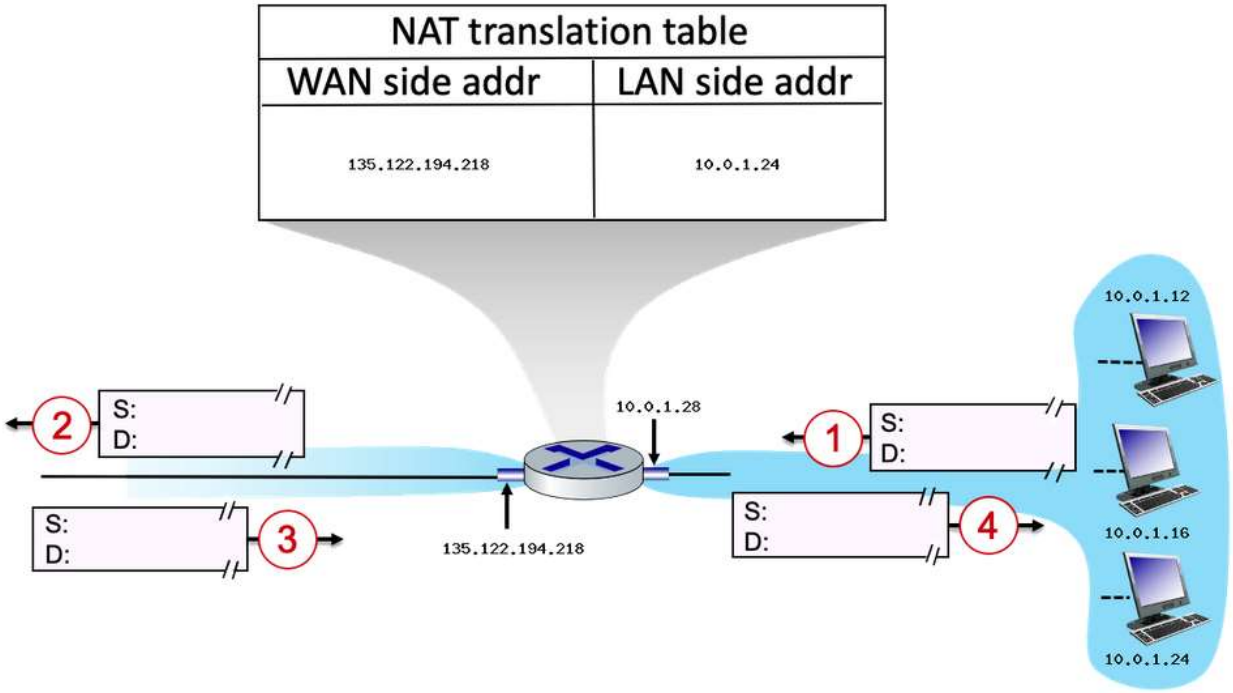
b. Describe how your forwarding table determines the appropriate link interface for datagrams with destination addresses:

IP address	**Appropriate link Interface?**
11001000 10010001 01010001 01010101	5
1110000**1** 01000000 11000011 00111100	2

11100000 00010000 11000011 00111100	3
11100001 10000000 00010001 01110111	2
11100000 00001111 11110000 01010101	3
11100000 11110000 00001111 00000111	4
10100000 11110000 00001111 00000111	5
11100000 00110000 00001111 00000111	0
11100000 00010000 00001111 00000111	3
10100000 00000000 11001111 00000111	5

Question 2: [10 Marks]

Consider the scenario below in which three hosts, with private IP addresses 10.0.1.12, 10.0.1.16, 10.0.1.24 are in a local network behind a NAT-enabled router that sits between these three hosts and the larger Internet. IP datagrams being sent from, or destined to, these three hosts must pass through this NAT router. The router's interface on the LAN side has IP address 10.0.1.28, while the router's address on the Internet side has IP address 135.122.194.218



Suppose that the host with IP address 10.0.1.24 sends an IP datagram destined to host 128.119.176.190. The source port is 3391, and the destination port is 80.

1. Consider the datagram at step 1, after it has been sent by the host but before it has reached the router. What is the source IP address for this datagram?

2. At step 1, what is the destination IP address?

3. Now consider the datagram at step 2, after it has been transmitted by the router. What is the source IP address for this datagram?

4. At step 2, what is the destination IP address for this datagram?

5. Will the source port have changed? Yes or No.

6. Now consider the datagram at step 3, just before it is received by the router. What is the source IP

address for this datagram?

7. At step 3, what is the destination IP address for this datagram?

8. Last, consider the datagram at step 4, after it has been transmitted by the router but before it has been received by the host. What is the source IP address for this datagram?

9. At step 4, what is the destination IP address for this datagram

Solution:

1. The source address will be the local host's IP, which is 10.0.1.24

2. The destination address will be the remote machine's IP, which is 128.119.176.190

3. The source address will be the router's public IP, which is 135.122.194.218

4. The destination address will be the remote machine's IP, which is 128.119.176.190

5. Yes, the NAT will change the source port.

6. The source address will be the remote machine's IP, which is 128.119.176.190

7. The destination address will be the router's public IP, which is 135.122.194.218

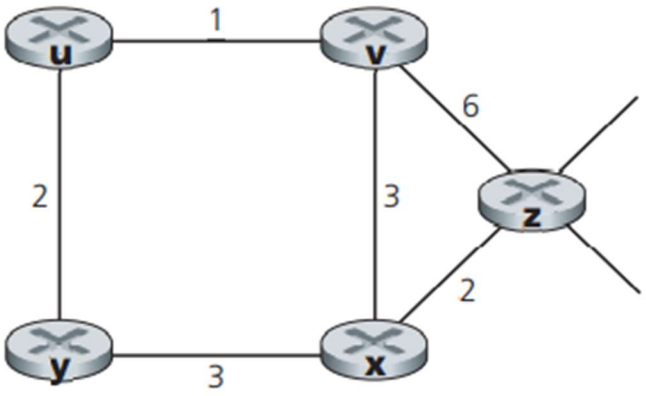
8. The source address will be the remote machine's IP, which is 128.119.176.190

9. The destination address will be the local host's IP, which is 10.0.1.24

10. No, an entry is made when there's an outbound request, which only happens between step 1 and step 2.

Question 3: [10 + 10 = 20 Marks]

Consider the network shown below, and assume that each node initially knows the costs to each of its neighbors.



a) Consider the Dijkstra's shortest-path algorithm to compute the shortest path from z to all network nodes. (Encircle the next node in each row)

option 1

Step	N'	D(v), P(v)	D(x), P(x)	D(u), P(u)	D(y), P(y)
1	Z	6, Z	(2, Z)	∞	∞
2	Z, x	5, x		∞	(5, x)
3	Z, x, y	(5, x)		7, y	
4	Z, x, y, v			(6, v)	—
5	Z, x, y, v, u	-	-	-	-

option 2

Step	N'	D(v), P(v)	D(x), P(x)	D(u), P(u)	D(y), P(y)
1	Z	6, Z	(2, Z)	∞	∞
2	Z, x	(5, x)		∞	5, x
3	Z, x, v		—	6, v	(5, x)
4	Z, x, v, y	—	—	(6, v)	
5	Z, x, v, y, u	—	—	—	-
6					

Consider the distance-vector algorithm and show the distance table entries at node z. (Show all

		Cost to u	v	x	y	z
	v	∞	∞	∞	∞	∞
From	x	∞	∞	∞	∞	∞
	z	∞	6	2	∞	0

		Cost to u	v	x	y	z
	v	1	0	3	∞	6
From	x	∞	3	0	3	2
	z	7	5	2	5	0

		Cost to u	v	x	y	z
	v	1	0	3	3	5
From	x	4	3	0	3	2
	z	6	5	2	5	0

		Cost to u	v	x	y	z
	v	1	0	3	3	5
From	x	4	3	0	3	2
	z	6	5	2	5	0

Question 4: [4 + 6 + 5 Marks]

Part A

What are the different BGP message types?
BGP messages:

1) OPEN: opens TCP connection to remote BGP peer and authenticates sending BGP peer
2) UPDATE: advertises new path (or withdraws old)
3) KEEPALIVE: keeps connection alive in absence of UPDATES; also ACKs OPEN request
4) NOTIFICATION: reports errors in previous msg; also used to close Connection

Part B

Consider the network shown below. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol.

a. Router 3c learns about prefix x from which routing protocol: OSPF, RIP, eBGP, or iBGP?

   iBGP

b. Router 3a learns about x from which routing protocol?

   eBGP

c. Router 1c learns about x from which routing protocol?

   eBGP

d. Router 1b learns about x from which routing protocol?

   iBGP

e. Router 1e learns about x from which routing protocol?

   RIP

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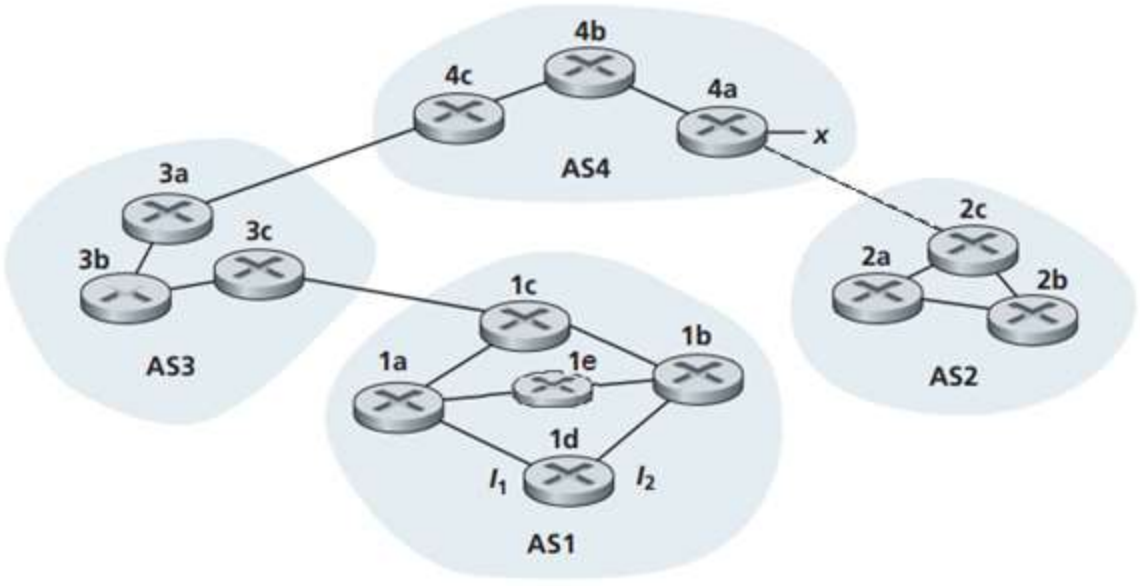
f. Suppose there is a physical connection between 1b and 2a (connecting AS1 and AS2), once router 1d learns about x it will put an entry (x, I) in its forwarding table. Will I be equal to I1 or I2 for this entry?

   I2



Part C

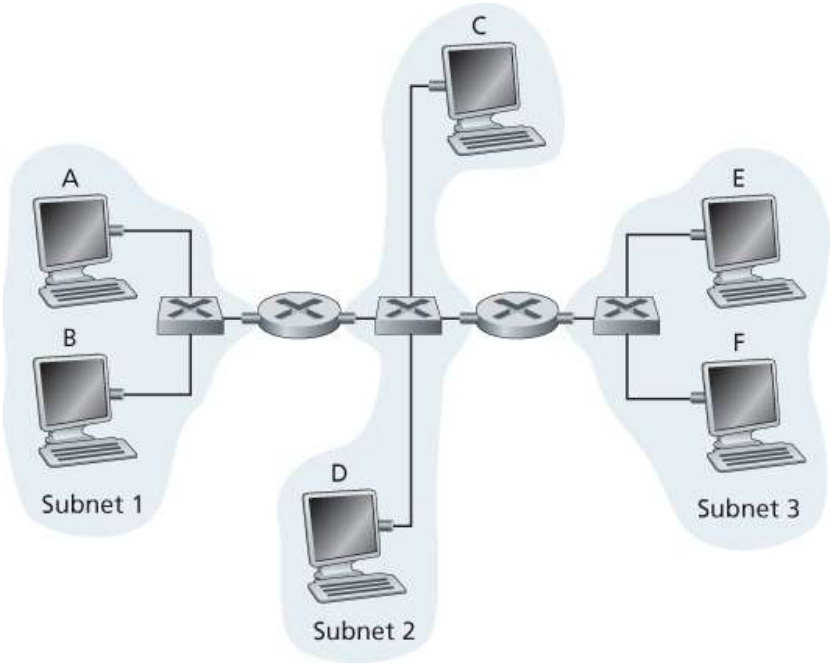
Identify the scenario and select appropriate control plane, either "traditional per router" or "SDN".

Scenario	Control plane
Network administrator wants to implement OSPF and BGP for intra-	**per router**

AS and inter-AS respectively	
Network administrator wants to implement some load balancing techniques	**SDN**
Network administrator wants to block "Z" type of traffic from Department D of school.	**per router**
Network administrator wants to allow "Z" type of traffic a specific path	**SDN**
Network administrator wants to implement some network control applications	**SDN**

Question 5: [5+13 = 18 Marks]

Consider we have three subnets interconnected by routers. Answer the following questions based on the scenario given below.



a) Consider sending an IP datagram from Host E to Host F. Will Host E ask router R1 to help forward the datagram? Why? In the Ethernet frame containing the IP datagram, what are the source and destination IP and MAC addresses? [**3+ 2**]

No. E can check the subnet prefix of Host F's IP address, and then learn that F is on the same LAN. Thus, E will not send the packet to the default router R1. (3 Marks)

Ethernet frame from E to F:

Source IP = E's IP address
Destination IP = F's IP address
Source MAC = E's MAC address
Destination MAC = F's MAC address

(0.5 * 4 = 2 Marks)

b) Suppose Host A would like to send an IP datagram to Host B, and neither A's ARP cache contains B's MAC address nor does B's ARP cache contain A's MAC address. Further, suppose that the switch S1's forwarding table (switch table) contains entries for Host B and router R1 only. Thus, A will broadcast an ARP request message. **[4+3+3+3]**

i. Which actions will switch S1 perform once it receives the ARP request message?

Switch S1 will broadcast the Ethernet frame via both its interfaces as the received ARP frame's destination address is a broadcast address. And it learns that A resides on Subnet 1 which is connected to S1 at the interface connecting to Subnet 1. And, S1 will update its forwarding table to include an entry for Host A.

(Broadcast: 2 Marks)
(Update ARP Table: 2 Marks)

ii. Will router R1 also receive this ARP request message? If so, will R1 forward the message to Subnet 3?

Yes, router R1 also receives this ARP request message, (1.5 Marks)
but R1 won't forward the message to Subnet 3. (1.5 Marks)

iii. Once Host B receives this ARP request message, it will send back to Host A, an ARP response message. But will it send an ARP query message to ask for A's MAC address? Why?

B won't send ARP query message asking for A's MAC address, as this address can be obtained from A's query message.

iv. What will switch S1 do once it receives an ARP response message from Host B?

Once switch S1 receives B's response message, it will add an entry for host B in its forwarding table, and then drop the received frame as destination host A is on the same interface as host B (i.e., A and B are on the same LAN segment).

(Add Entry: 2 Marks)
(Drop Frame: 1 Mark)

Question 6: [6+2 = 8 Marks]

a) Write pros (advantages) and cons (disadvantages) of the following multiple access protocols. **[2+2+2]**

Please refer to Chapter 6 of the textbook.

b) Consider the 5-bit generator, G=10011, Given that D=1001010101, What is the value of R?

We get 1000110000, with a remainder of R=0000.