ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)

ORGANISATION OF ISLAMIC COOPERATION (OIC)

Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION — SUMMER SEMESTER, 2022-2023

DURATION: 1 HOUR 30 MINUTES — FULL MARKS: 75

CSE 4839: Internetworking Protocols

Programmable calculators are not allowed. Do not write anything on the question paper.
Answer **all 3 (three)** questions. Figures in the right margin indicate full marks of questions with corresponding COs and POs in parentheses.

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1. a) Suppose that computer A is sending a file to computer B using a private Ethernet with no other computers using it. They are connected by a $100m$ of wire. Bits travel at the rate of $2x10^8 m/s$ in this wire. Suppose the Ethernet has a bandwidth of 10^9 bits per second (gigabit Ethernet). Now, answer the following questions. — 3 + 3 + 4 (CO1) (PO2)

   i. Based the on the provided information, what is the latency of the connection? (Assume any missing values.)

   ii. How long would it take for 10^6 bits to finish traveling from computer A to computer B? (Assume any missing values.)

   iii. Suppose you now measure the traveling time in Question 1.a)ii in real network. Furthermore, assume that the computers are fast enough that they do not limit the speed of transmission. Nevertheless, the time you measure is longer than the time you calculated above. What factors could have resulted in this?

   b) Imagine a multinational corporation with offices in major cities worldwide. Employees often travel between these offices for meetings, conferences, and client visits. Despite the implementation of Mobile IP, employees experience significant delays and disruptions in connectivity when transitioning between different network subnets. — 5 + 5 (CO1) (PO2)

   What could be the reasons for these delays and disruptions, and what strategies would you implement to address them?

   c) Explain the significance of protocols in ensuring efficient and secure communication across diverse network architectures, and support your discussion with real-world examples. — 5 (CO1) (PO1)

2. a) A system uses Reverse Path Forwarding (RPF) algorithm to build multicast trees and deliver multicast packets. There are 100 multicast sources (each generating a single stream of multicast traffic) and 5 groups currently active in the system. What is the number of RPF multicast trees existing in the system? — 5 (CO2) (PO2)

   b) A multinational company, X Corp., operates across various geographical regions and wishes to establish separate multicast groups for inter-departmental communication within each region. The company is assigned the Autonomous System (AS) number 8765. The administrator needs to allocate multicast addresses for each regional multicast group. (The multicast address ranges are shown in Table 1). — 3 + 3 + 4 (CO2) (PO1)

   Now, answer the following questions.

   i. Identify the range of valid multicast addresses for X Corp. based on its AS number.

   ii. Allocate a unique multicast address for the Marketing department within one of the regions, which is effective for communication within the department. What is its corresponding 48-bit Ethernet address for the LAN using TCP/IP?

   iii. Explain the reasoning behind the selection of multicast addresses, considering the unique communication needs of each department within the multinational company.

Table 1: Multicast Address Ranges for Question 2.b

CIDR	Range	Assignment
224.0.0.0/24	224.0.0.0 224.0.0.255	Local Network Control Block
224.0.1.0/24	224.0.1.0 224.0.1.255	Internetwork Control Block
	224.0.2.0 224.0.255.255	AD HOC Block
224.1.0.0/16	224.1.0.0 224.1.255.255	ST Multicast Group Block
224.2.0.0/16	224.2.0.0 224.2.255.255	SDP/SAP Block
	224.3.0.0 231.255.255.255	Reserved
232.0.0.0/8	232.0.0.0 224.255.255.255	Source Specific Multicast (SSM)
233.0.0.0/8	233.0.0.0 233.255.255.255	GLOP Block
	234.0.0.0 238.255.255.255	Reserved
239.0.0.0/8	239.0.0.0 239.255.255.255	Administratively Scoped Block

c) Consider the network topology and link costs in Figure 1. Assume that a source, **S**, is connected to router **R1** and routers **R5, R7, and R8** have at least one member for the multicast group **G1** connected to them. In the network topology, the MOSPF protocol is used to construct the shortest path tree and to generate the routing table. The source, **S**, sends a multicast message to the multicast group **G1**. 10 (CO2) (PO2)

Draw the multicast routing table for all the routers involved in forwarding the multicast message.

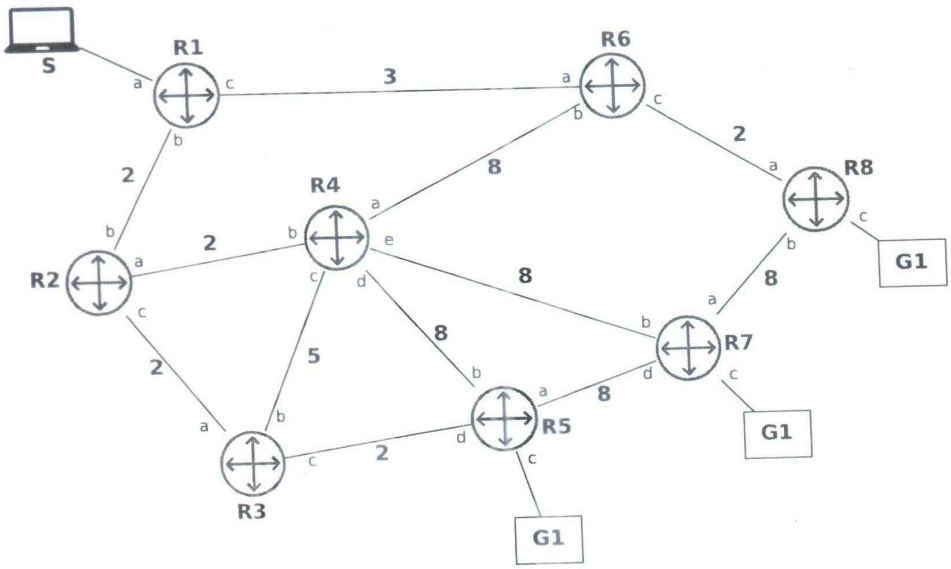

Figure 1: A sample network topology for Question 2.c

3. a) Which algorithm is closer to the path-vector routing algorithm: distance-vector routing or link-state routing? Justify your answer. (CO2) (PO1)

b) Consider the network topology with 11 different Autonomous Systems (ASes) in Figure 2. AS 15, AS 17, and AS 18 are Tier-1 ISPs without any provider, whereas all other ASes have at least one provider. Some BGP sessions between ASes are already shown in the figure, but not all of them. 6 (CO2) (PO2)

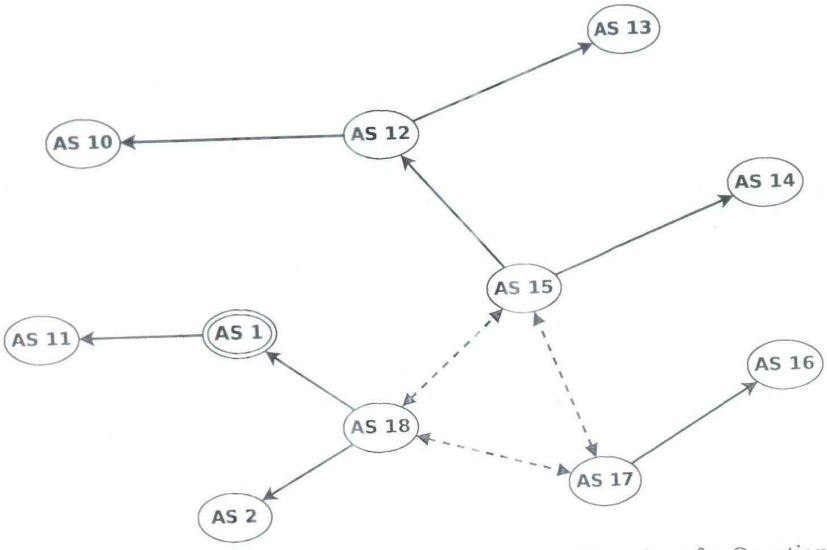

Figure 2: Network topology with a subset of existing BGP sessions for Question 3.b

Single-headed plain arrows point from providers to their customers, while double-headed dashed arrows connect peers. Each AS applies the default selection and exportation BGP policies based on their customers, peers and providers. ASes break ties by preferring the neighbor with the **lowest AS number.**

Each AS XX advertises its prefix XX.0.0.0/24 to all of its neighbors. For instance, AS 12 advertises 12.0.0.0/24. The Tier-1 ISPs (AS 15, 17, and 18) do not advertise any prefix. You are given a complete and sorted list of all incoming BGP messages of AS 1 in Table 2. "**U**" abbreviates a BGP Update message, and "**W**" abbreviates a BGP Withdraw message.

Consider the BGP messages of AS 1 in the table. What might have caused message number 4? Explain the possible causes of receiving the message numbered 4.

Table 2: Stream of BGP messages received by AS 1 for Question 3.b.

AS 1			
#	**type**	**prefix**	**AS path**
1	U	2.0.0.0/24	1 18 2
2	U	10.0.0.0/24	1 11 10
3	U	10.0.0.0/24	1 12 10
4	W	10.0.0.0/24	1 11 10
5	U	11.0.0.0/24	1 11
6	U	12.0.0.0/24	1 12
7	U	13.0.0.0/24	1 12 13
8	U	13.0.0.0/24	1 18 15 12 13
9	U	14.0.0.0/24	1 18 15 14
10	U	16.0.0.0/24	1 18 17 16

c) You are an operator of an AS and you have decided to peer with two new networks, namely AS 195 and AS 466, at router IUTR1. Before establishing the eBGP sessions, you receive the BGP routes that both of them would advertise to you. IUTR1 performs regular BGP path selection process. Further, assume that IUTR1 does not know any additional routing information. For each subtask, you are given a table with three routes, one from each AS (195 and 466), and the currently known route. 3+3+4+4 (CO2) (PO2)

i. Consider the route information in Table 3 for the network prefix 5.21.2.0/24. Find the best route for the destination 5.21.2.35.

Table 3: Route information for the network prefix 5.21.2.0/24

from	prefix	next hop	local pref.	MED	AS Path	IGP cost
current	5.21.2.0/24	12.16.9.1	50	200	260 590	4600
AS 195	5.21.2.0/24	20.79.3.2	100	50	195 439 590	0
AS 466	5.21.2.0/24	13.8.47.25	100	120	466 338 10 590	0

ii. Consider the route information in Table 4 for the network prefix 2.7.8.0/24. Find the best route for the destination 2.7.8.22.

Table 4: Route information for the network prefix 2.7.8.0/24

from	prefix	next hop	local pref.	MED	AS Path	IGP cost
current	2.7.8.0/24	56.22.219.29	150	50	30 89 59 20	0
AS 195	2.7.8.0/24	20.79.3.2	100	100	195 338 89 59 20	0
AS 466	2.7.8.0/24	13.8.47.25	100	80	466 439 20	0

iii. Consider the route information for the network prefix 9.19.2.0/20 in Table 5. There exists no single, most preferred route for 9.19.2.0/20.
Compare the three routes for 9.19.2.0/20 individually with each other. Assume that only two routes are present at the same time. For each pair (i.e. Current vs. AS 195, Current vs. AS 466, and AS 195 vs. AS 466), indicate which route is preferred, and write down the deciding attribute.

Table 5: Route information for the network prefix 9.19.2.0/20

from	prefix	next hop	local pref.	MED	AS Path	IGP cost
current	2.7.8.0/23	56.22.219.29	150	50	30 89 59 20	0
AS 195	2.7.8.0/24	20.79.3.2	100	100	195 338 89 59 20	0
AS 466	2.7.8.0/23	13.8.47.25	100	80	466 439 20	0

iv. Why is a single and preferred route not available for 9.19.2.0/24, and what can you do as a network operator to resolve this issue?