Roll. No.: _______________ Name: _________________________________ Section: ____

Endsem
CSE232 Computer Networks
Duration-2 hours, Full marks-42
December 8, 2024

Q.1. Match the columns **[3.5]**

(1) filter traffic sent from the host process	(a) DNS
(2) modify packets arriving at the network	(b) performs caching
(3) MAC (Medium access control) layer	(c) iptables: INPUT chain
(4) Application layer	(d) iptables: OUTPUT chain
(5) Load balancer	(e) stickiness property
(6) Proxy server	(f) maps private IP to public IP and vice-versa
(7) Network address translation	(g) iptables: PREROUTING chain
	(h) CSMA

(1) ________ (2) __________ (3) _________

Ans. (1) d ; (2) g ; (3) h ; (4) a ; (5) e or g ; (6) b; (7) f

Q.2. The routing table of a router is shown below: **[1+1+1+1=4]**

entry#	**Destination**	**Subnet mask**	**Interface**
I	10.1.1.0	255.255.255.0	1
II	10.1.1.128	255.255.255.128	2
III	10.1.1.64	255.255.255.192	3
IV	10.1.1.192	255.255.255.192	4
V	Default		0

On which interface will the router forward packets addressed to the following destinations? Explain how you obtain the answer. **Note that you will NOT be awarded partial points for correct answers without explanation.**

(a) 10.1.1.16
(b) 10.1.1.72
(c) 10.1.1.132
(d) 10.1.10.191

Roll. No.: _______________ Name: _________________________________ Section: ____

Ans:

(a) 1
Matches with the entry I only; choose the interface for entry I

(b) 3
Matches with the entries I, and III; use longest prefix match (LPM); choose the interface for entry III

(c) 2
Matches with the entries I and II; use longest prefix match (LPM); choose the interface for entry II

(d) 0
Does not match with any entry, choose the default interface

Q.3. A network has a subnet mask 255.255.240.0. What is the maximum number of hosts on this network? Justify your answer. **[1+1]**

Ans.

The subnet mask represents the number of leading 1's as network identification bits and the number of trailing 0's as host identification bits. The number of host identification bits, n = 12. **[1]**
Therefore, the maximum number of hosts on this network is (2^n -2) = **4094** hosts. **[1]**

Q.4. Suppose the **TCP congestion control** algorithm starts with the **Slow Start phase with a window size of 1MSS** and the slow start threshold (ssthresh) is 64000 bytes. If the receiver window size is 16000 bytes and the maximum segment size is 1000 bytes, then **after how many RTT sender will send full window (i.e., 16000 bytes)?** Assume no timeouts, no packet losses, and no errors. Justify. **[3]**

Ans.

After 5 RTT

1 segment size, MSS=1000 bytes; Window size = 16000 bytes = 16 MSS (i.e., 16 segments)

Slow start: After each RTT double the congestion window **[1]**

First RTT: Send 1 segment
Second RTT: Send 2 segments (total = 3 segments)
Third RTT: Send 4 segments (total = 7 segments)
Fourth RTT: Send 8 segments (total = 15 segments)
Fifth RTT: Send 1 more segment (to make the total 16 segments) **[2]** → Even if you write 16 segments instead of 1 segment here, it is fine

Q.5. Suppose you receive an IP packet. **[1+1+1+2=5]**

a. The value at the "HLEN" field (Header length) in the IP packet header is **5 (in decimal),** and the "Total length" field has a value **1500 (in decimal)**. What is the **payload/data size (in bytes)** carried by the IP packet?
b. What can you comment about IP options size if you were told that the "HLEN" field value was **10 (in decimal)?**
c. The "fragment offset" field is **100 (in decimal)**, the "MF" flag is **0,** and the "total length" is **500 (in decimal).**

i. Is this packet fragmented? Justify your answer
ii. What is the offset of the first and last payload bytes in this fragment?

Ans.

(a) Data len = Total length - HLEN*4 = 1500 - 5*4 = 1480 bytes.

(b) HLEN = 10 => IP header length = 10*4 = 40 bytes.

IP header's fixed size is 20 bytes. This implies that the IP options are present and have a size of 20 bytes.

(c)

(i) Yes

Even if "MF" is 0 indicates this is the last fragment, "fragment offset" is non-zero. This indicates that there was a fragment prior to this.

(ii) First payload byte =100*8=800**; Header length=40**

Payload length = total length - header length = 500 - 40 = 460

Last byte=800+460-1=1259 — minus 1 since the count is inclusive of the first byte "800"

OR

(ii) First payload byte =100*8=800**; Header length=20**

Payload length = total length - header length = 500 - 20 = 480

Last byte=800+480-1=1279 — minus 1 since the count is inclusive of the first byte "800"

{For TAs:

Alternative solution allowed (though incorrect): Last byte=800+500-1=1299 without including header size → DEDUCT 1 mark}

Q.6. An ISP has the following chunk of CIDR-based IP addresses available with it: 194.100.128.0/20. The ISP wants to give 2000 addresses to Org "A", 1000 addresses to Org "B", and retain the rest with itself. Assume that the addresses are assigned in the order: Org A, Org B, and ISP. What is the valid allocation of address range for all three organizations, given that the wastage of addresses is minimal? **[2+2+2=6]**

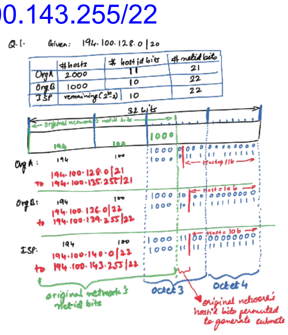
Ans

a. Org A: 194.100.128.1/21 to 194.100.135.254/21
b. Org B: 194.100.136.1/22 to 194.100.139.254/22
c. ISP: 194.100.140.1/22 to 194.100.143.254/22

OR

@TAs: Allow this too, even though not completely accurate

a. Org A: 194.100.128.0/21 to 194.100.135.255/21
b. Org B: 194.100.136.0/22 to 194.100.139.255/22
c. ISP: 194.100.140.0/22 to 194.100.143.255/22



Roll. No.: _______________ Name: _________________________________ Section: ____

Q.7. Suppose “A” initiates a TCP connection with “B”. **[1+3=4]**

(a) Will it use a stream or datagram socket?

(b) Suppose the initial sequence number at “A” is “501” and at “B” is “701”. Provide details about the messages exchanged for TCP connection handshake along with the associated sequence numbers and flag values.

Ans.

(a) Stream socket

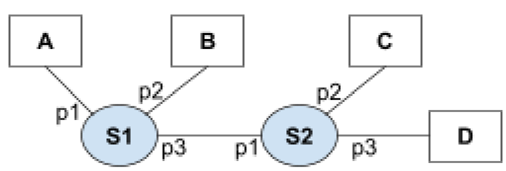
(b)

- A to B: SYN packet <SEQ# = 501, SYN=1, ACK=0>
- B to A: SYN+ACK packet <SEQ# = 701, SYN=1, ACK=1, ACK#=502>
- A to B: ACK packet <SEQ# = 502, SYN=0, ACK=1, ACK#=702>

Q.8. Suppose the Stop & wait protocol is implemented between nodes A and B. Frames of 1000 bits are sent over a 1Gbps (Gigabits per second, i.e., 10^9 bps) channel with propagation delay of 20 microseconds. What is the throughput for Stop & wait protocol? **[2.5]**

Ans. L=1000 bits; DR=10^9 bps;
d_trans=L/DR=1 usec; → **[1]**
Throughput= L/(d_trans+2*d_prop) = (1000/41) Mbps = **24.4Mbps** → **[1] + [0.5 for calculation]**

Q.9. Suppose the switches in the figure below, S1 and S2, use **switch learning algorithm** to update their forwarding table. “p_i” represents the switch interface name. Assume that the switch forwarding tables are currently empty.



For each example frame in the table below, specify the switch table entry made **(if any)** in the format <MAC, interface_name>, and action taken by the switch for forwarding this frame. Fill out the table for both S1 and S2. Explain your answer in short. **[6]**

Ans. [Except for (c), 0.5 mark for correct <MAC,interface>, 0.5 mark for action]

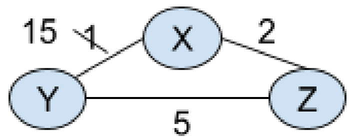
	<src_MAC→dst_MAC>	**Switch table, S1 <MAC, interface>, action**	**Switch table, S2 <MAC, interface>, action**
(a)	A→D	<A, p1>, flood	<A, p1>, flood
(b)	C→B	<C, p3>, flood	<C, p2>, flood
(c)	D→C	No entry made, the frame does not reach S1	<D, p3>, forward

Roll. No.: _______________ Name: _________________________________ Section: ____

Q.10. Suppose the routers use DVR (Distance Vector Routing) protocol. For the topology shown in the figure, the cost from "X" to "Y" changes from "1" to "15". The distance vectors for nodes "x", "y", and "z" show the entries with this link update. Given DVR, these updates will be shared. **[6+1=7]**

(a) Show the changes in the distance vectors for all the nodes for the next 2 iterations. Update the given tables on this sheet. Submit this sheet along with the main supplement.

(b) After two iterations, does every router have correct routing table entries as per the changed cost? If not, which routers have the wrong entries? Do not get confused with "convergence".



Solution

(a) [1 mark per table]

X's DV table: Cost to

	Cost from	x	y	z
	x	0	15	2
	y	1	0	3
	z	2	3	0

X's DV table: Cost to

	Cost from	x	y	z
	x	0	5	2
15	y	15	0	3
5	z	2	3	0

X's DV table: Cost to

	Cost from	x	y	z
	x	0	7	2
15	y	7	0	5
5	z	2	5	0

Y's DV table: Cost to

	Cost from	x	y	z
	x	0	1	2
	y	15	0	3
	z	2	3	0

Y's DV table: Cost to

	Cost from	x	y	z
15	x	0	15	2
	y	7	0	5
2	z	2	3	0

Y's DV table: Cost to

	Cost from	x	y	z
15	x	0	5	2
	y	7	0	5
2	z	2	5	0

Z's DV table: Cost to

	Cost from	x	y	z
	x	0	1	2
	y	1	0	3
	z	2	3	0

Z's DV table: Cost to

	Cost from	x	y	z
5	x	0	15	2
2	y	15	0	3
	z	2	5	0

Z's DV table: Cost to

	Cost from	x	y	z
5	x	0	5	2
2	y	7	0	5
	z	2	5	0

(b) Yes

-----------------*THE END*---------------