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Endsem
CSE232 Computer Networks
Duration-2 hours, Full marks-48.5

December 13, 2022

Q.1. An Internet Service Provider (ISP) has the following chunk of CIDR-based IP addresses available with it: 200.100.64.0/20. The ISP wants to give 1000 addresses to Organization A, and 500 addresses to Organization B, 200 to organization C while retaining the remaining with itself.

(a) What is a valid allocation of address range for Org A? Show calculation as well **[2]**

(b) What is a valid allocation of address range for Org B? Show calculation as well **[2]**

(c) What is a valid allocation of address range for Org C? Show calculation as well **[2]**

(d) What is the address range remaining with the ISP? Show calculation as well **[2]**

Note:

(1) Ensure packed allocation to minimize wastage of IP addresses

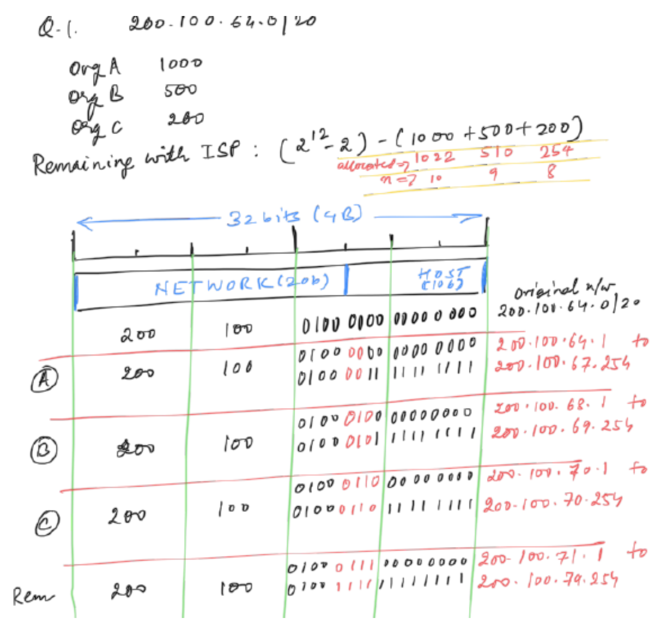
(2) Assign the IP address range in the following order: start with Org A, then Org B, then Org C, and the last chunk remains with the ISP

Ans:

- **(a) Org A:** 200.100.64.1 to 200.100.67.254 **OR** 100.100.64.0/22 **OR** 200.100.64.0 to 200.100.67.255
- **(b) Org B:** 200.100.68.1 to 200.100.69.254 **OR** 200.100.68.0/23 **OR** 200.100.68.0 to 200.100.69.255
- **(c) Org C:** 200.100.70.1 to 200.100.70.254 **OR** 200.100.70.0/24 **OR** 200.100.70.0 to 200.100.70.255
- **(d) Remaining with the ISP:** 200.100.71.1 to 200.100.79.254 **OR** 200.100.71.0/20 **OR** 200.100.71.0 to 200.100.79.255

If there is no justification deduct 50% marks

Calculation:



OR:

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Calculation

200.100.64.0/20

OrgA: 1000=>closest 2 power=>1024=>10bits

Representing the 3rd byte and 4th byte

01000000 00000000 01000011 11111111

Hence, address assigned=100.100.64.0/22

Org B: 500=>512=>9 bits

01000100 0000000 01000101 11111111

Hence, address assigned 200.100.68.0/23

Org C: 200=> 256=>8 bits

01000110 0000000 01000110 11111111

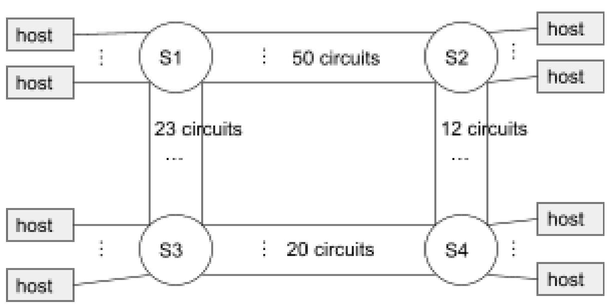
Hence, address assigned 200.100.70.0/24

Address remaining with the organization

01000111 11111111 01001111 11111111

Hence, address assigned 200.100.71.0/20

Q.2.



Consider the circuit-switched network shown in the figure, with circuit switches S1 to S4. Suppose there are 50 circuits between S1 and S2, 12 circuits between S2 and S4, 20 circuits between S3 and S4, and 23 circuits between S1 and S3.

(a) What is the maximum number of connections that can be ongoing in the network at any one time? **[1]**

Ans: 105

[Max number of circuits=50+12+20+23=105]

(b) When the number of connections mentioned in (a) are ongoing, what happens if a new connection request arrives at switch S1? **[1]**

(i) Discard the connection request (ii) Wait for availability of resource

Ans: (i)

[Discard the connection request]

Q.3. Suppose that a network has a subnet mask **255.255.255.224**

(a) What is the maximum number of hosts (assignable IP addresses) on this network? **[2]**

Ans: 30
Justification:

Subnet mask: 255.255.255.224 can be written in binary as

11111111 11111111 11111111 11100000

The leading 1's indicate the network bits & the trailing zeros indicate the host bits.

Number of host bits (n) = 5; the maximum number of hosts = 2^n - 2 = 30

(b) This network originally belongs to which network class? Check all that apply. **[1]**

- ☐ Class-A
- ☐ Class-B
- ☐ Class-C
- ☐ Can't say!

Ans: "Can't say" OR Check all
The subnet mask does not define the class; the range of the first byte of the network address does. The given mask could belong to a subnetted network from class A/B/C.

Q.4. Suppose that an IPV4 fragment has the "fragment offset" field value as 660. What is the offset of the first byte of the fragment in the original packet? **[1]**
Ans: 660 * 8 = 5280
Justification:

Since "total length" in the IP header is 16 bits and "fragment offset" is 13 bits, the fragment offset value is calculated as **(offset of the first byte of the packet)/8**. This ensures that we can index the offset of the maximum-sized packet.

Q.5. Mark the one(s) that is(are) TRUE. **[1]**

(a) CRC technique is used at the Internet's link layer for error detection only
(b) CRC technique is used at the Internet's link layer for error detection and correction
(c) The size of the CRC checksum is equal to the length of the generator bits
(d) The size of the CRC checksum is not equal to the length of the generator bits

Ans: (a) and (d) — [0.5+0.5 points]

Q.6. As you know, IIITD has a 1Gbps LAN. Suppose IIITD's access link (i.e., link connecting IIITD and NKN) is of bandwidth 500Mbps. Suppose, RTT to a web server outside from IIITD's gateway is 3sec. The web object size is 600KB. Also, assume the users from IIITD generate 100 requests/sec. Also, assume there is no other traffic generated from IIITD except those generated for the webserver.

(a) Compute the utilization of the access link, show individual steps and final answer **[2]**

Steps:

Total request size= 100*600 KB/sec=60000*8Kb/sec=480Mbps
Hence, utilization of the access link =480/500=0.96

Ans: 0.96

(b) How much will be end-end-delay (ignore LAN delay), no need to give exact delay value tell if it is in the orders of ms/sec/minutes **[1]**
Ans: minutes
Since the utilization of the access link is close to 1, there will be huge queueing at the gateway router. Hence, the end-to-end delay will be in minutes.

(c) Now suppose, IIITD buys a webcache and installs at the gateway router. Suppose, the cache hit rate is 60%. Now compute the access link utilization and end-to-end delay (ignore LAN delay). Show individual steps and final answer **[2]**
Steps:
Since the cache hit rate =60%
Now, the total traffic going to access link /sec= 600KB*100*40/100=192Mbps
Hence, the access link utilization = 192/500=0.384
Since the access link utilization is less, there won't be queueing at the gateway router.
Now, end-to-end delay =
0.6*LAN_delay + 0.4*(RTT/2) =0.6*(neigligible)+0.4*(3/2)=0.6 sec

Ans: 0.6 sec (can be written as 600 msec, etc.)

OR
Since the cache hit rate =60%
Now, the total traffic going to access link /sec= 600KB*100*40/100=192Mbps
Hence, the access link utilization = 192/500=0.384
Since the access link utilization is less, there won't be queueing at the gateway router.
Now, end-to-end delay =
0.6*LAN_delay + 0.4*RTT =0.6*(neigligible)+0.4*3=1.2 sec

Ans: 1.2 sec (can be written as 1200 msec, etc.)

Q.7. Suppose you are trying to access ***google.in*** from your laptop while you are in IIITD. As you might know IIITD provides NAT support. Suppose, you send a HTTP GET request and the server replies back with HTTP OK. Assume that there is no caching.

(a) Write down the source IP, src port, destination IP and dest port number of the response packet. **[2]**

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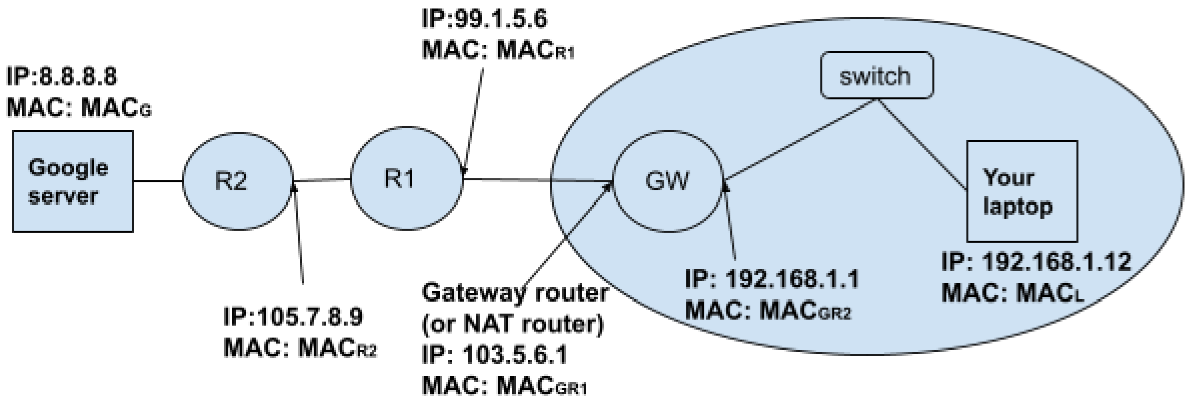
(b) Now when the response reaches the Gateway router. The router forwards the packet to your laptop. Write down the source IP, src port, destination IP and port number of the response packet. **[2]**



Assuming when the first packet i..e, TCP SYN packet is sent from the client, the NAT creates a mapping between <192.168.1.12, 5000>=><103.5.6.1.5001>. The private port of the client is 5000, and the public port is 5001

Note: The numbers 5000 and 5001 will be assumed by the students. The only condition is that these numbers should be greater than 1024

	Src IP	Src port	Dst IP	Dst port
a	8.8.8.8	80	103.5.6.1	5001
b	8.8.8.8	80	192.168.1.12	5000

Q.8. Consider the picture in ***Q.7.***, assume you have not yet been allocated an IP address. IP addresses are assigned using DHCP protocol. The DHCP server is running on the gateway router. Assume that your laptop does not have any prior knowledge of the IIITD network.

(a) What is the very first packet sent from your laptop? **[1+1]**

Ans: ____________DHCP discovery_______

Tell the src IP, src MAC, Dst IP, Dst MAC (in case any of these addresses are not applicable, you can write N/A). *Answer in the table below*.

(b) Suppose the DHCP server responds back, tell the src IP, src MAC, Dst IP, Dst MAC **[1]**

(c) When you are trying to send a HTTP GET request, what is the srcIP, src MAC, Dst IP, Dst MAC for the packet sent from gateway router to R1. **[1]**

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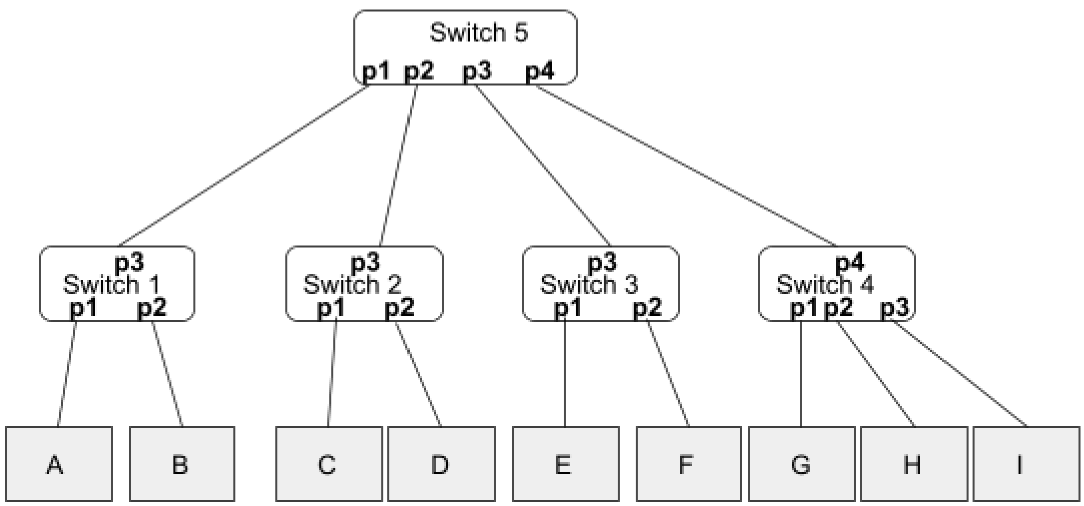
0.25 marks for each correct entry

	Src IP	Src MAC	Dst IP	Dst MAC
a	0.0.0.0	MAC_L	255.255.255.255 **OR** 192.168.1.255 (not correct though)	FF:FF:FF:FF:FF
b	192.168.1.1	MAC_{GR2}	255.255.255.255 **OR** 192.168.1.255 (not correct though)	MAC_L
c	103.5.6.1	MAC_{GR1}	8.8.8.8	MAC_{R1}

Q.9. Consider the network topology shown in the figure. The network has 5 network switches and the hosts (Host A to Host I) connected to the shown ports. Assuming that the forwarding tables at all the switches are empty initially, and each switch implements self learning algorithm, answer the new entries made at each switch as ***"MAC, interface"*** and the action taken. Use the name of the host, e.g., ***A*** for MAC address of host A, and the interface as the port, e.g., p1. If any entry is not applicable, write N/A. **[2.5+ 2.5+ 2.5]**



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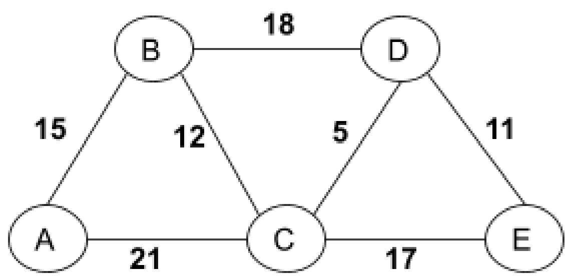
Ans: **0.25 marks for each correct entry, action could be flood or broadcast**

Frame src->Dst	New entry at S1 MAC, interface	S1's action	New entry at S2 MAC, interface	S2's action	New entry at S3 MAC, interface	S3's action	New entry at S4 MAC, interface	S4's action	New entry at S5 MAC, interface	S5's action
B->H	B, p2	Flood	B, p3	Flood	B, p3	Flood	B, p4	Flood	B, p1	Flood
F->I	F, p3	Flood	F, p3	Flood	F, p2	Flood	F, p4	Flood	F, p3	Flood
G->I	G, p3	Flood	G, p3	Flood	G, p3	Flood	G, p1	Flood	G, p4	Flood

Q.10. Consider the network topology shown in the figure below. We have 5 routers, A to E, and the edge weights represent the same cost in both directions.



(a) Assuming that all the routers implement LSR (Link State Routing) and they have just booted (or started) up, show the contents of the initial routing tables. **[2.5]**
0.5 marks for correct routing table (No partial marking within the table)

Routing table: A			Routing table: B			Routing table: C			Routing table: D			Routing table: E		
Dest	Cost	Next hop	Dest	Cost	Next hop	Dest	Cost	Next hop	Dest	Cost	Next hop	Dest	Cost	Next hop
A	0	NA	A	15	A	A	21	A	A	inf	NA	A	inf	NA
B	15	B	B	0	NA	B	12	B	B	18	B	B	inf	NA
C	21	C	C	12	C	C	0	NA	C	5	C	C	17	C
D	inf	NA	D	18	D	D	5	D	D	0	NA	D	11	D
E	inf	NA	E	inf	NA	E	17	E	E	11	E	E	0	NA

(b) If the routers implemented DVR (Distance Vector Routing), will the initial routing tables be exactly same as the answer in (a)? YES or NO? **[1]**
Ans: __Yes___________
(c) What is the converged routing table for router C? **[2.5]**

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0.5 marks for each entry

Routing table: C		
Dest	Cost	Next hop
A	21	A
B	12	B
C	0	C
D	5	D
E	16	D

(c) Suppose DVR algorithm with poisoned-reverse is implemented. The routes have already converged and router C advertises the periodic update. **[1+2]**
(i) Fill in the blanks (Specify the router name to which the distance vector is sent)
(ii) What are the distance vectors advertised by router C?
0.25 marks for each router name
0.5 marks for correct routing table (No partial marking within the table)

To Router ___A_	
Dest	Cost
A	inf
B	12
C	0
D	5
E	16

To Router __B__	
Dest	Cost
A	21
B	inf
C	0
D	5
E	16

To Router __D__	
Dest	Cost
A	21
B	12
C	0
D	inf
E	inf

To Router _E_	
Dest	Cost
A	21
B	12
C	0
D	5
E	16

Q.11. Consider TCP congestion control algorithm with the slow-start threshold (*ssthresh*) value at the start of the transmission as **4 MSS**. Assume that the sender has established the TCP connection and starts sending data.
(a) Plot the congestion window values (with corresponding ssthresh value) in the graph below. ***Plot upto the 15th transmission (a.ka., transmission round) considering the following conditions. [3]***

(i) Assume that a timeout occurs during the 9th transmission
(ii) A timeout occurs again during the 12th transmission after which there are no errors upto the 15th transmission.

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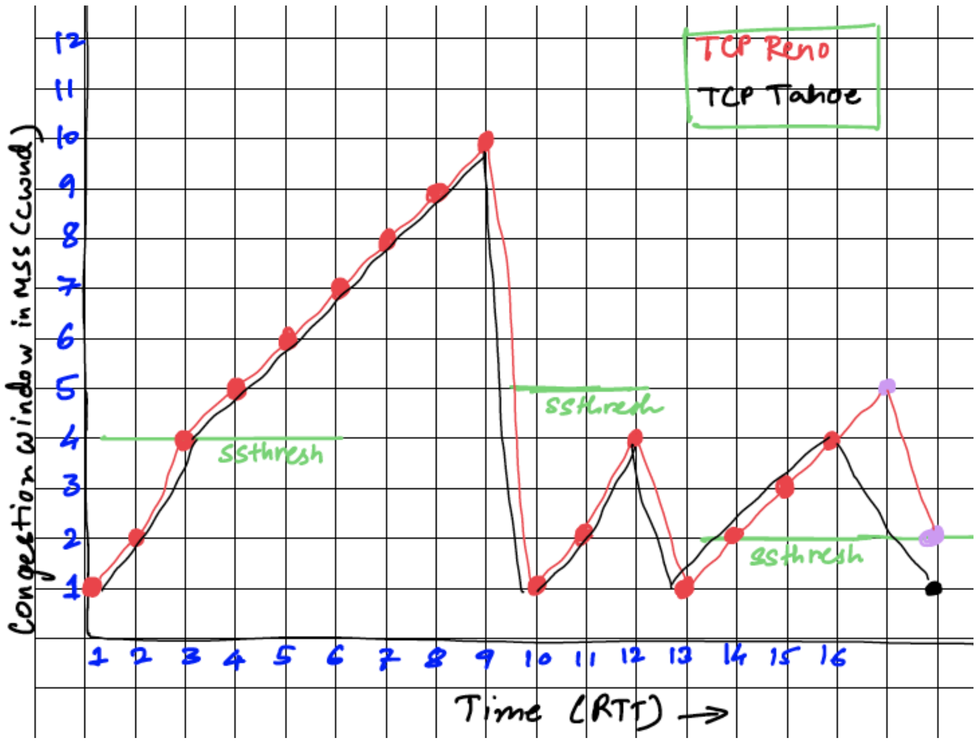
Ans: Please check the plot value upto RTT value = 15 (i.e., X-axis value is 15)



Plot is not required for (b) and (c) [2+1]

(b) Assume TCP Reno, if the sender receives 3 duplicate ACKs during the 16th transmission:

(b-i) The congestion window size immediately after detecting 3 dup ACKs is ____**5**_____

(b-ii) The congestion window size immediately after fast recovery is _____**2**____

(b-i) 5

(b-ii) 2

(c) Assume TCP Tahoe, if the sender receives 3 duplicate ACKs during the 16th transmission:
The congestion window size immediately after detecting 3 dup ACKs is ____**1**_____

(c) 1

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