Date: 4th Jan, 2017 Time: 120minutes
Total Marks: 50 (30 + 20) Final (Parts 'A' and 'B')

Computer Networks

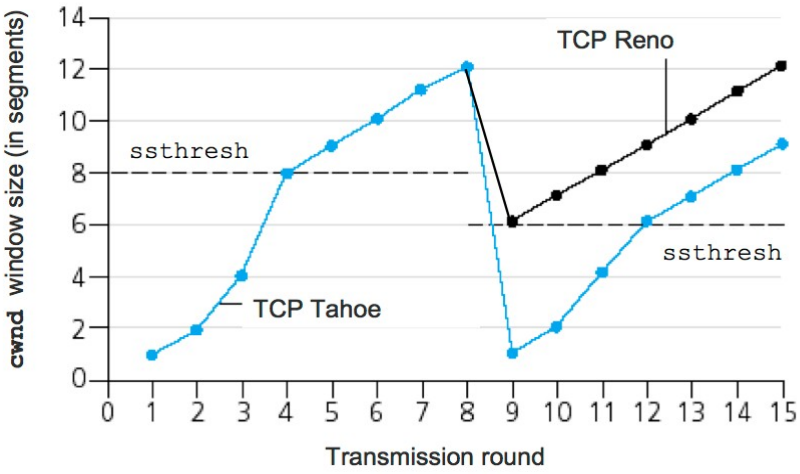
- Attempt all parts and questions.
- In case you do not find any question/phrase/word to be correctly understandable, you can ask the invigilator for assistance.
- Hint: Each MCQ takes less than a minute or two if you know it. Else skip it to come back later.

Part 'A' (30)

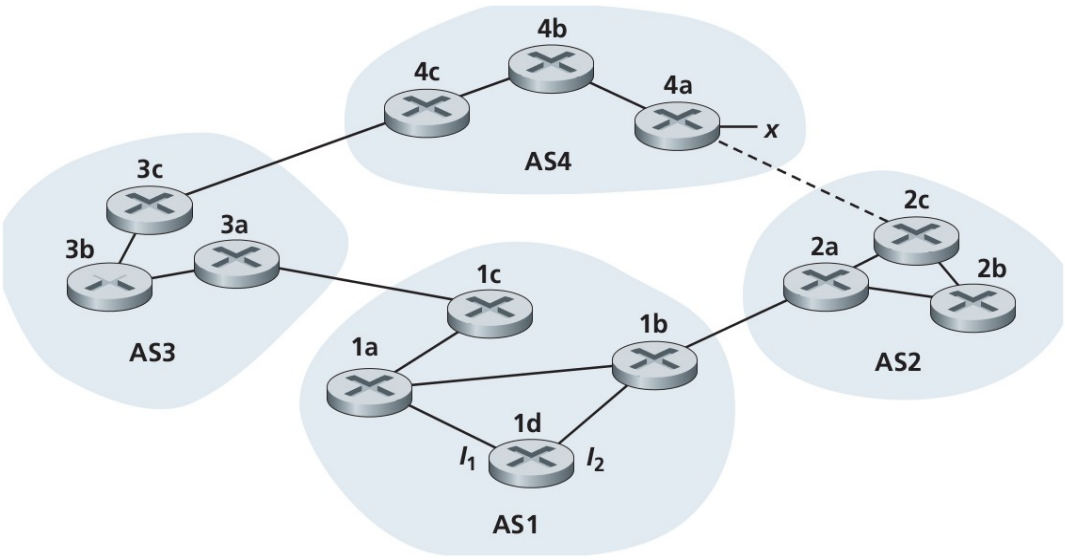
1. SR receiver dilemma (new packet or a retransmission) is attributed to
A. Too large windows B. Too small windows
2. Best window size recommendation for SR is
A. Double the range of sequence numbers B. Half the range of sequence numbers
3. The command `clientSocket.connect((serverName,serverPort))`, is sent to
A. Connect to the server B. Connect to the client
4. For a file consisting of 500,000 bytes, that the MSS is 1,000 bytes, and that the first byte of the data stream is numbered 0, determine the total number of segments.
5. For Q4 above, determine the sequence numbers of the first 3 segments.
6. Is TCP a GBN or an SR protocol?
A. GBN B. SR
7. Suppose that the acknowledgment for packet n < N gets lost, but the remaining N – 1 acknowledgments arrive at the sender before their respective timeouts. Which behaviour in TCP is different from GBN?
A. TCP would retransmit at most one segment, namely, segment n
B. TCP would not even retransmit segment n if the acknowledgment for segment n + 1 arrived before the timeout for segment n C. _____
8. For the expression, `rwnd = RcvBuffer – [LastByteRcvd – LastByteRead]`, determine the receive window status if the total buffer size is 1000, sequence number of last received byte is 100 and the sequence number of last byte read is 80?
9. Give the values of sequence number of last received byte and the sequence number of last byte read to make the current `rwnd` = 0.
10. In a typical sequence of TCP states visited by a client TCP, `Time_Wait` state is given that makes the client wait for 30 seconds. Why?
11. Draw the throughput versus offered load when each packet is assumed to be forwarded (on average) twice by the router. Since each packet is forwarded twice, the throughput will have an asymptotic value of R/4 as the offered load approaches R/ 2.

For questions [12-14], refer to the figure below.

12. Label the diagram for the `Slow Start` Phase(s)
13. Label the diagram for the `Congestion Avoidance` Phase(s)
14. Label the diagram for the `Fast Retransmit` Phase(s)



For questions [15-21], refer to the figure.

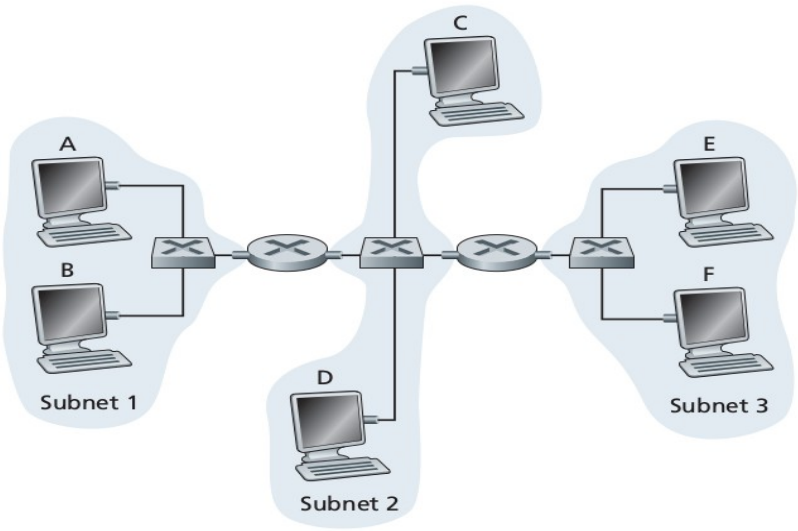


Consider the network shown below. Suppose AS3 and AS2 are running OSPF for their intra-AS routing protocol. Suppose AS1 and AS4 are running RIP for their intra-AS routing protocol. Suppose eBGP and iBGP are used for the inter-AS routing protocol. Initially suppose there is no physical link between AS2 and AS4.

15. Router 3c learns about prefix x from which routing protocol: OSPF, RIP, eBGP, or iBGP?
16. Router 3a learns about x from which routing protocol?
17. Router 1c learns about x from which routing protocol?
18. Router 1d learns about x from which routing protocol?

Once router 1d learns about x it will put an entry (x, I) in its forwarding table.

19. a. Will I be equal to I1 or I2 for this entry? Explain why in one sentence.
20. Now suppose that there is a physical link between AS2 and AS4, shown by the dotted line. Suppose router 1d learns that x is accessible via AS2 as well as via AS3. Will I be set to I1 or I2? Explain why in one sentence.
21. Now suppose there is another AS, called AS5, which lies on the path between AS2 and AS4 (not shown in diagram). Suppose router 1d learns that x is accessible via AS2 AS5 AS4 as well as via AS3 AS4. Will I be set to I1 or I2? Explain why in one sentence.
22. Suppose the information content of a packet is the bit pattern 1110 0110 1001 1101 and an even parity scheme is being used. What would the value of the
field containing the parity bits be for the case of a two-dimensional parity
scheme?
23. Consider the 7-bit generator, G=10011, and suppose that D has the value 1010101010. What is the value of R?
For questions [24-30], refer to the figure below
24. 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 contains entries for Host B and router R1 only. Thus, A will broadcast an ARP request message.
25. What actions will switch S1 perform once it receives the ARP request message?
26. Will router R1 also receive this ARP request message?
27. If so, will R1 forward the message to Subnet 3?
28. 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?
29. What will switch S1 do once it receives an ARP response message from Host B?
30. How many collision domains are there?



PART 'B' (20)

Q1. Consider a datagram network using 8-bit host addresses. Suppose a router uses longest prefix matching and has the following forwarding table:

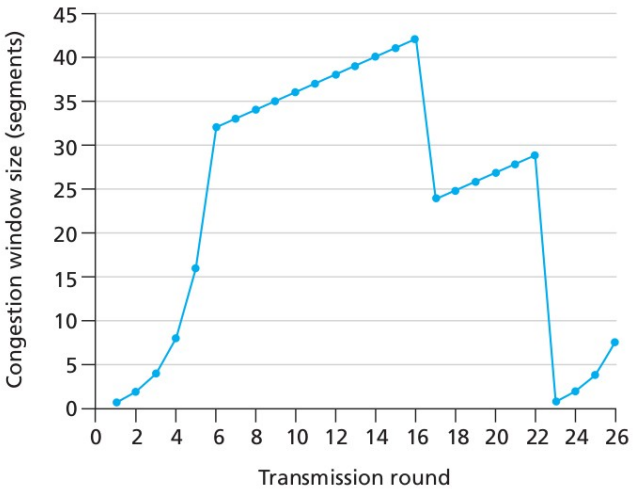
Prefix Match	Interface
1	0
10	1
111	2
otherwise	3

Q2. Consider a subnet with prefix 128.119.40.128/26. Give an example of one IP address (of form xxx.xxx.xxx.xxx) that can be assigned to this network. Suppose an ISP owns the block of addresses of the form 128.119.40.64/26. Suppose it wants to create four subnets from this block, with each block having the same number of IP addresses. What are the prefixes (of form a.b.c.d/x) for the four subnets?

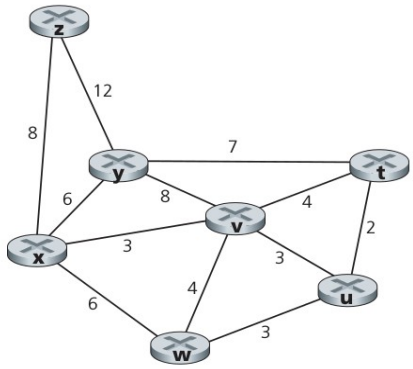
Q3. Consider the figure below. Assuming TCP Reno is the protocol experiencing the behavior shown above, answer the following questions. In all cases, you should provide a short discussion justifying your answer.

a. Identify the intervals of time when TCP slow start is operating.
b. Identify the intervals of time when TCP congestion avoidance is operating.
c. After the 16th transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
d. After the 22nd transmission round, is segment loss detected by a triple duplicate ACK or by a timeout?
e. What is the initial value of ssthresh at the first transmission round?
f. What is the value of ssthresh at the 18th transmission round?
g. What is the value of ssthresh at the 24th transmission round?
h. During what transmission round is the 70th segment sent?
i. Assuming a packet loss is detected after the 26th round by the receipt of a triple duplicate ACK, what will be the values of the congestion window size and of ssthresh?
j. Suppose TCP Tahoe is used (instead of TCP Reno), and assume that triple duplicate ACKs are received at the 16th round. What are the ssthresh and the congestion window size at the 19th round?

k. Again suppose TCP Tahoe is used, and there is a timeout event at 22nd round. How many packets have been sent out from 17th round till 22nd round, inclusive?



Q4. Consider the following network. With the indicated link costs, use Dijkstra's shortest-path algorithm to compute the shortest path from x to all network nodes. Show how the algorithm works by computing a table.



_____End of Exam_____