考試時間	月 日上午 下午第 節 （星期 ）晚間	份數		任課教師	

國立臺灣科技大學 109學年度第 2 學期 考試命題用紙

考試科目：Computer Networks ☑研究所 ☐大學部 ☐工程在職進修 系班別：博七班資格考

1, (12%) Figure 1 shows the process to send an e-mail. Alice wants to send an e-mail to Bob, and their e-mails are managed by different e-mail servers. There are three e-mail transmissions ((A), (B), and (C)) in the whole process as the red arrows in the figure. Please answer the following questions:

(1) What are the protocols used in the three transmissions?

(2) In Figure 3, [1][3] are message queues, and [2][4] are mailboxes. Which two of [1][2][3][4] the email from Alice to Bob will go through?

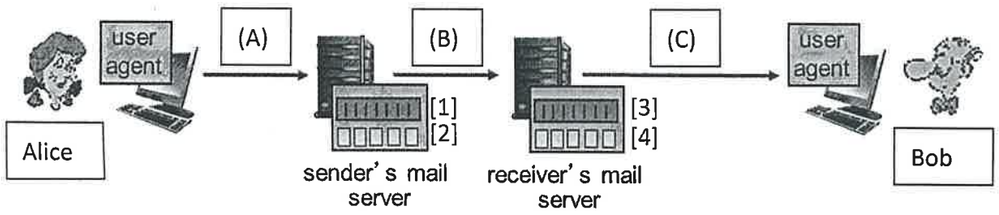


Figure 1

2, (12%) As shown in Figure 2, Host 1 sends a packet to Host 2. Assume the propagation speed in the links is 2 km/s. Moreover, the length of Link 1 is 2km, the length of Link 2 is 4km, and the length of Link 3 is 2km. The packet length is 2k bytes and the link bandwidth is 1k byte/s. When the packet sent from Host 1 to Host 2 reaches Switch 1, there are two packets in the queue. When the packet reaches Switch 2, there are three packets in the queue. If we consider only propagation delay, queuing delay, and transmission delay. What is the total delay for the packet from Host 1 to Host 2?

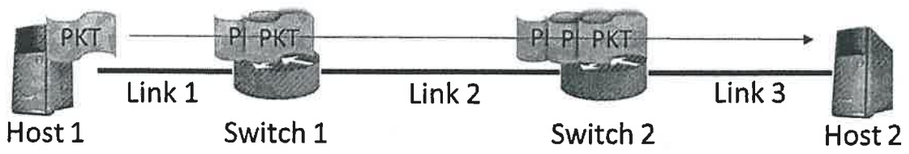
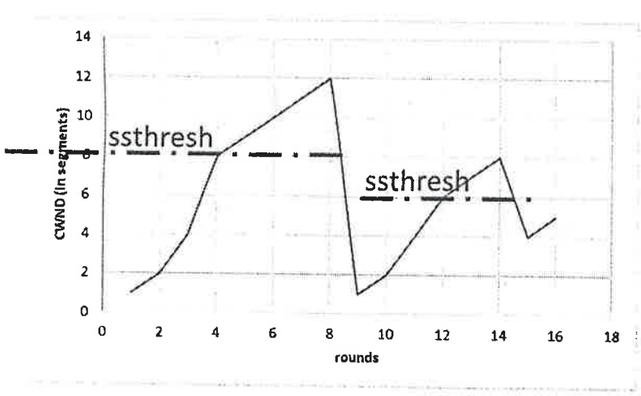


Figure 2

3, (14%) The following figure shows current TCP CWND at a sender side. Assume the sender receives 3 duplicate ACKs, (a) draw the CWND after the 3 duplicate ACKs (shows the location and the length of CWND). (b) then, the sender receives an ACK with ack number = 3. Please draw the CWND.

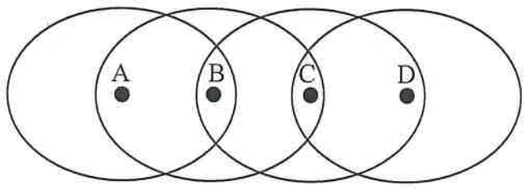
4, (12%) The congestion window size for TCP Reno varies as the following figure. Please answer the following questions:

a. The first TCP slow start phase in the figure start from Round ____ to Round ____.
b. When does the TCP sender detect 3 duplicate ACKs and cut down CWND size? In Round ____
c. When does the TCP sender detect timeout and cut down CWND size? In Round ____



5. (10%) If two CDMA senders have codes (1, 1, 1, -1, 1, -1, -1, -1) and (1, -1, 1, 1, 1, 1, 1, 1), would the corresponding receivers be able to decode the data correctly? Justify.

6. Consider the scenario shown in the following figure:



There are four wireless nodes, A, B, C, and D. The radio coverage of the four nodes is shown via the ovals. All nodes share the same frequency. When A transmits, it can only be heard/received by B; when B transmits, both A and C can hear/receive from B; when C transmits, both B and D can hear/receive from C; when D transmits, only C can hear/receive from D.
Suppose now that each node has an infinite supply of messages that it wants to send to each of the other nodes. If a message's destination is not an immediate neighbor, then the message must be relayed. For example, if A wants to send to D, a message from A must first be sent to B, which then sends the message to C, which then sends the message to D. Time is slotted, with a message transmission time taking exactly one time slot, e.g., as in slotted Aloha. During a slot, a node can do one of the following: (i) send a message, (ii) receive a message (if exactly one message is being sent to it), (iii) remain silent. As always, if a node hears two or more simultaneous transmissions, a collision occurs and none of the transmitted messages are received successfully. You can assume here that there are no bit-level errors, and thus if exactly one message is sent, it will be received correctly by those within the transmission radius of the sender.

(a) (3%) Suppose now that an omniscient controller (i.e., a controller that knows the state of every node in the network) can command each node to do whatever it (the omniscient controller) wishes, i.e., to send a message, to receive a message, or to remain silent. Given this omniscient controller, what is the maximum rate (in terms of messages/slot) at which a data message can be transferred from C to A, given that there are no other messages between any other source/destination pairs?

(b) (3%) Suppose now that A sends messages to B, and D sends messages to C. What is the **combined** maximum rate (in terms of messages/slot) at which data messages can flow from A to B and from D to C?

(c) (3%) Suppose now that A sends messages to B, and C sends messages to D. What is the **combined** maximum rate (in terms of messages/slot) at which data messages can flow from A to B and from C to D?

(d) (9%) Suppose now that the wireless links are replaced by wired links. Repeat questions (a) through (c) again in this wired scenario.

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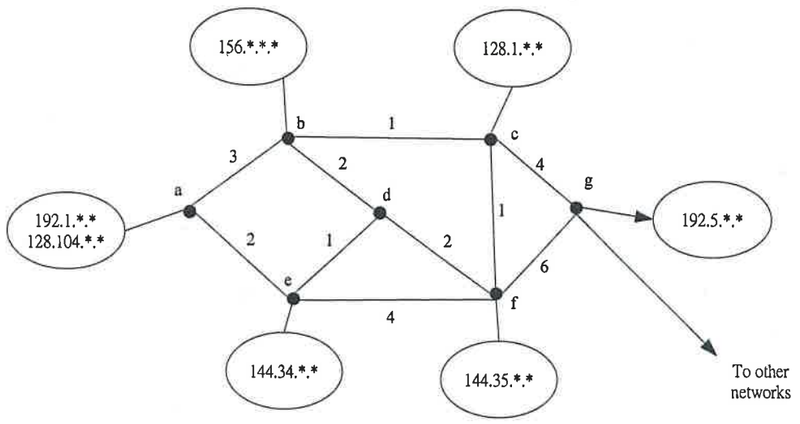
7. The figure below shows a network. The prefixes describing the hosts in a sub-network are also shown in the figure. Assume that node g is the BGP router and packets destined for hosts with addresses not shown in the figure are to be forwarded to node g.



(a) (10%) Show the steps involved in executing the Dijkstra's algorithm at node a.

(b) (12%) Show the most efficient routing table (i.e., the one with the fewest entries) at node e. Note that you will have to mentally run the shortest path algorithm from node e, but you need not show the calculations here. The routing table contains only two columns as follows.

Destination Address	Next hop/ Interface
..*.*	d

命題請勿超出線外