Tutorial 2 (Week 10)

Note: Some questions are from past exams. We are providing questions to prepare you for the final exam which will have mostly short questions.

Q1. Host A uses TCP Reno to transfer a file to host B. The file contains 32 MSS of data. During the first transmission round, the congestion window is equal to 1 MSS. During the fourth round when the connection is still in the slow-start mode all the transmitted packets are lost (and, therefore, host A transmits less during the fifth round). There is no packet loss during any other round. During what round does host B receive the complete file?

Q2. Consider the following forwarding table for a router R.

Destination	Interface
128.8.16.0/20	Port 1
128.8.24.0/21	Port 2
128.8.128.0/24	Port 3
128.8.128.0/28	Port 4
Default	Port 5

For each of the following destination IP addresses, indicate which port the packet is sent out on:

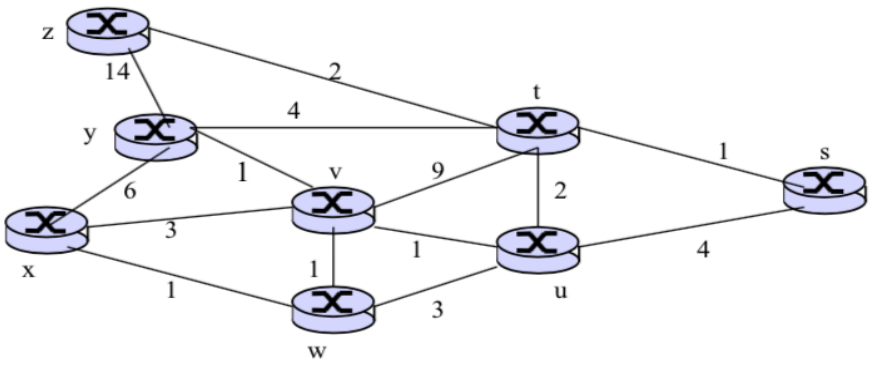
(a) 128.8.128.252

(b) 128.8.128.5

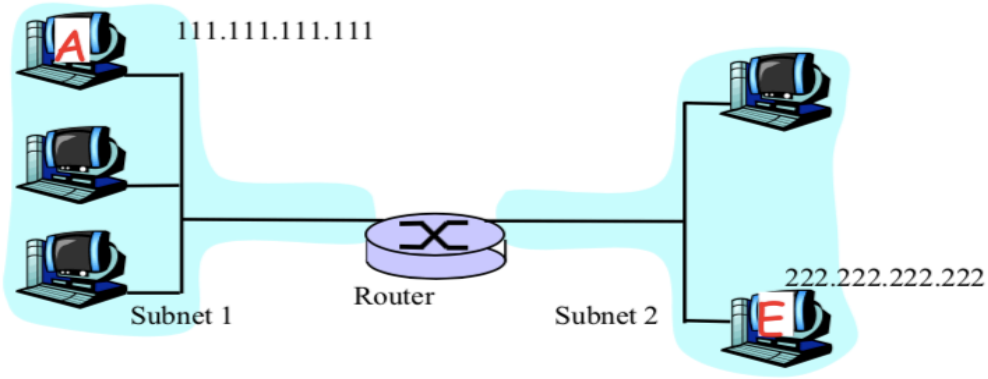
(c) 128.8.25.223

(d) 155.128.45.21

Q3. Consider the following network with the indicated link costs. Use Dijkstra's shortest path algorithm to compute the shortest path from node x to all network nodes. Show the forwarding table at node x.



Q4. Consider the network topology shown in the figure below.



(a) Write down an IP address for all interfaces at all hosts and routers in the network. The IP addresses for A and E are as given. Both Subnet1 and Subnet2 make use of 24 bit network prefixes. You should assign IP addresses so that interfaces on the same sub-network have the same network-part of their IP address.

(b) Choose physical addresses (LAN addresses) for only those interfaces on the path from A to E. Can these addresses be the same as in part (a)? Why?

(c) Now focus on the actions taken at both the network and the data link layers at Sender A, the Router and the destination E in moving an IP datagram from A to E:

1) What, specifically, are the source and destination addresses in the IP datagram that flows from A to the Router. What specifically are the source and destination addresses in the IP datagram that flows from the Router to node E?
2) Name any three other fields found in an IP datagram?
3) How do A, E and the Router determine the physical (LAN) addresses required for the data link layer frame?

(d) Suppose that the router in figure above is replaced by a layer 2 switch.

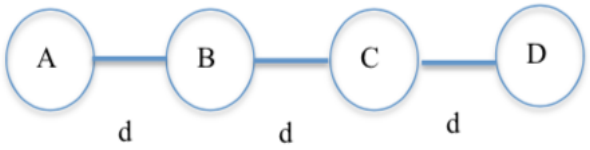
1) How would the IP addresses of the hosts change in this scenario? (simply provide an explanation without specifying the changed IP addresses).
2) How would the physical (LAN) addresses change in this case?
3) How does the switch learn the physical addresses of the attached hosts?

Q5. Suppose that nodes A and B are attached to the opposite ends of a shared 900m Ethernet cable and that they each have one 1000 bit frame (including all headers and preambles) to send to each other. Suppose that there are four repeaters between A and B, each inserting a 20-bit delay (this is the time taken to transmit 20 bits on the Ethernet cable) and that the transmission rate is 10 Mbps. Assume that CSMA/CD with back-off intervals of multiples of 512 bit time (i.e. each backoff interval is a multiple of the time taken to transmit 512 bits on the Ethernet cable) is used. Assume that both A and B transmit their packets simultaneously at time t = 0 sec resulting in a collision. After the collision, A draws K=0 whereas B draws K=1 in the exponential back-off protocol. Ignore the jam signal and the 96- bit time delay.

a. What is the one-way propagation delay (including the repeater delays) between A and B in seconds? Assume that the signal propagation speed is 2×10^8 m/sec.

b. At what time (in seconds) is A's packet completely delivered at B?

Q6. Consider a wireless network consisting of four nodes A, B, C, D where each node has a radio range of distance d. In the figure, two nodes are in each other's range, if there is an edge between them.



Consider two collision resolution schemes:

CS: This is a pure carrier sense scheme in which a node does not send when it hears someone else transmitting, but otherwise can send whenever it wants.

802.11: This uses carrier sensing as in CS. In addition, nodes wishing to communicate use an RTS-CTS-Data-ACK exchange. Nodes overhearing an RTS wait to allow the CTS to be sent. If no CTS is heard, the node can transmit. If a CTS is heard (even if no earlier RTS is heard), the node is quiet for the entire duration of the data transmission.

Assume that A and B are in the midst of a communication and C has been listening to their exchange so far (and so has heard whatever RTS or CTS packets that B may have sent if any). While A and B are in the "sending data" part of their exchange, C decides that it wants to communicate with D. Consider the following cases: (explain all answers)

(a) A is sending data to B.

(i) If scheme CS is used, would C be allowed to send a message to D?

(ii) If scheme 802.11 is used, would C be allowed to send a message to D?

(b) B is sending data to A.

(i) If scheme CS is used, would C be allowed to send a message to D?

(ii) If scheme 802.11 is used, would C be allowed to send a message to D?

Q7. Suppose Alice wants to visit the Web site activist.com using a TOR-like service. This service uses two non-colluding proxy servers, Proxy1 and Proxy2. Alice first obtains the certificates (each containing a public key) for Proxy1 and Proxy2 from some central server. Denote $K1^{+}(\ )$, $K2^{+}(\ )$, $K1^{-}(\ )$, and $K2^{-}(\ )$ for the encryption/decryption with public and private RSA keys.

a. Using a timing diagram, provide a protocol (as simple as possible) that enables Alice to establish a shared session key S_1 with Proxy1. Denote $S_1(m)$ for encryption / decryption of data m with the shared key S_1.
b. Assuming S_1 is in place, using a timing diagram, provide a protocol (as simple as possible) that allows Alice to establish a shared session key S_2 with Proxy2 *without revealing her IP address to Proxy2*.
c. Assume now that shared keys S_1 and S_2 are now established. Using a timing diagram, provide a protocol (as simple as possible and ***not using public-key cryptography***) that allows Alice to request an html page from activist.com *without revealing her IP address to Proxy2* and *without revealing to Proxy1 which site she is visiting*.