

## CS 5480/6480: Computer Networks – Spring 2012

### Homework 4

Due by 1:25 PM on April 11<sup>th</sup> 2012

**Important: No cheating will be tolerated.  
NO EXTENSIONS.**

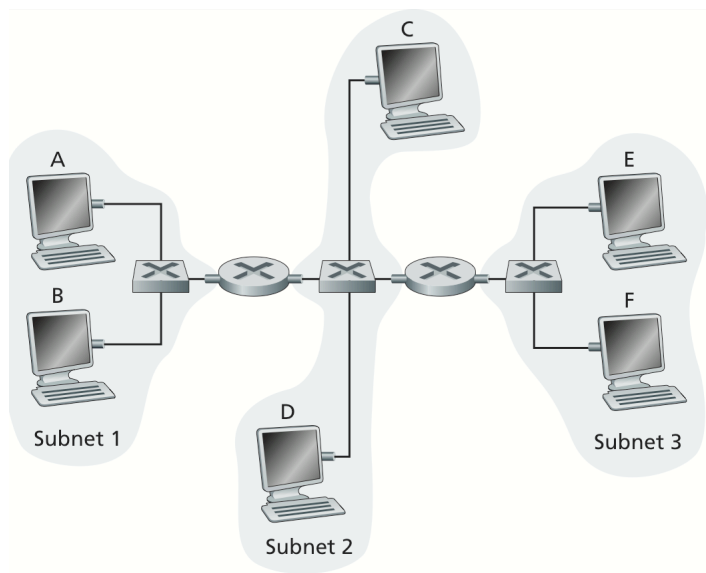
**CS5480 total points: 31**

**CS6480 total points: 40**

**Question 1** (Slotted Aloha) *5 points (1.25 points for each part)*: Suppose four active nodes—nodes A, B, C and D—are competing for access to a channel using slotted ALOHA. Assume each node has an infinite number of packets to send. Each node attempts to transmit in each slot with probability  $p$ . The first slot is numbered slot 1, the second slot is numbered slot 2, and so on.

- What is the probability that node A succeeds for the first time in slot 5?
- What is the probability that some node (either A, B, C or D) succeeds in slot 4?
- What is the probability that the first success occurs in slot 3?
- What is the efficiency of this four-node system?

**Question 2** (Ethernet) *6 points (2 points for each part)*: Consider the figure below. Now we replace the router between subnets 1 and 2 with a switch S1, and label the router between subnets 2 and 3 as R1.



a. Consider sending an IP datagram from Host E to Host F. Will Host E ask router R1 to help forward the datagram? Why? In the Ethernet frame containing the IP datagram, what are the source and destination IP and MAC addresses?

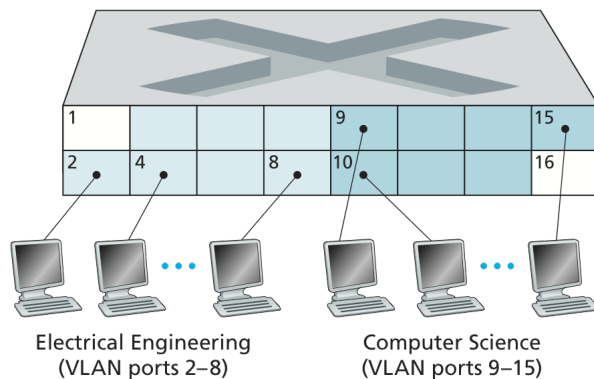
b. Suppose E would like to send an IP datagram to B, and assume that E's ARP cache

does not contain B's MAC address. Will E perform an ARP query to find B's MAC address? Why? In the Ethernet frame (containing the IP datagram destined to B) that is delivered to router R1, what are the source and destination IP and MAC addresses?

c. 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. What actions will switch S1 perform once it receives the ARP request message? Will router R1 also receive this ARP request message? If so, will R1 forward the message to Subnet 3? 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? What will switch S1 do once it receives an ARP response message from Host B?

**Question 3 (4 points):** Consider the MPLS network shown in slide 5.79, and suppose that routers R5 and R6 are now MPLS enabled. Suppose that we want to perform traffic engineering so that packets from R6 destined for A are switched to A via R6-R4-R3-R1, and packets from R5 destined for A are switched via R5-R4-R2-R1. Show the MPLS tables in R5 and R6, as well as the modified table in R4, that would make this possible.

**Question 4 (4 points):** Consider the single switch VLAN in the figure below, and assume an external router is connected to switch port 1. Assign IP addresses to the EE and CS hosts and router interface. Trace the steps taken at both the network layer and the link layer to transfer an IP datagram from an EE host to a CS host (*Hint*: reread the material on slides 5-45 – 5-50).



**Question 5 (WiFi) 4 points:**

(a) (2 points) Suppose there are two ISPs providing WiFi access in a particular café, with each ISP operating its own AP and having its own IP address block.

a. Further suppose that by accident, each ISP has configured its AP to operate over channel 11. Will the 802.11 protocol completely break down in this situation? Discuss what happens when two stations, each associated with a different ISP, attempt to transmit at the same time.

b. Now suppose that one AP operates over channel 1 and the other over channel 11. How

do your answers change?

(b) (2 points) In step 4 of the CSMA/CA protocol, a station that successfully transmits a frame begins the CSMA/CA protocol for a second frame at step 2, rather than at step 1. What rationale might the designers of CSMA/CA have had in mind by having such a station not transmit the second frame immediately (if the channel is sensed idle)?

**Question 6 (IP Mobility) 10 points:**

(a) (4 points) One proposed solution that allowed mobile users to maintain their IP addresses as they moved among foreign networks was to have a foreign network advertise a highly specific route to the mobile user and use the existing routing infrastructure to propagate this information throughout the network. We identified scalability as one concern. Suppose that when a mobile user moves from one network to another, the new foreign network advertises a specific route to the mobile user, and the old foreign network withdraws its route. Consider how routing information propagates in a distance-vector algorithm (particularly for the case of interdomain routing among networks that span the globe).

- a. Will other routers be able to route datagrams immediately to the new foreign network as soon as the foreign network begins advertising its route?
- b. Is it possible for different routers to believe that different foreign networks contain the mobile user?
- c. Discuss the timescale over which other routers in the network will eventually learn the path to the mobile users.

(b) (2 points) Suppose the correspondent in slide 6-43 were mobile. Sketch the additional network-layer infrastructure that would be needed to route the datagram from the original mobile user to the (now mobile) correspondent. Show the structure of the datagram(s) between the original mobile user and the (now mobile) correspondent, as in slide 6-48.

(c) (2 points) Consider two mobile nodes in a foreign network having a foreign agent. Is it possible for the two mobile nodes to use the same care-of address in mobile IP? Explain your answer.

**Question 7 (required for cs6480, extra credit for cs5480) 9 points:**

Read the following paper: “RSVP: A New Resource Reservation Protocol,” by L. Zhang *et al*, in the IEEE Communications Magazine, May 2002. This paper is available from [http://www.eng.utah.edu/~cs5480/rsvp\\_network\\_magazine.pdf](http://www.eng.utah.edu/~cs5480/rsvp_network_magazine.pdf). Answer the following questions that are based on this paper.

- (a) (2 points) Write two uses of reservation/path refresh messages.
- (b) (1 point) What is soft state? Write one advantage of using soft state?
- (c) (1 point) Does RSVP determine what routes packet will take? Explain in one sentence.
- (d) (1 point) What is the difference between the two filter types - no filter and fixed filter?
- (e) (1 point) Consider a scenario where an end-host A wishes to receive multicast from end-host B. Indicate the directions in which the path and the reservation messages will flow.

- (f) (3 points) Consider Figure 3 and the no filter example in the paper. Show the tables at S1, S2, and S3 after the path messages from all H1 – H5 hosts, and RESV messages from H1 and H2 have all been seen by these routers. Note that the table at S1 is given in the paper.