Computer Networks (CS 453), Spring 2011
Homework 4
Instructor: V. Arun

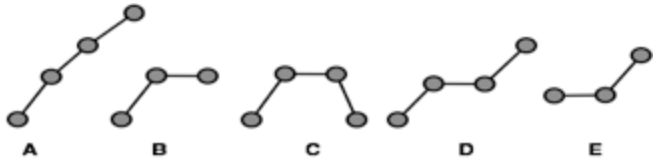
Assigned: 04/20/11, Due: 04/27/11

Note: Please show as much of your work as you can. Whenever possible, use variable names before plugging in numerical values. Even if you get the answer wrong, you can get partial credit if you show your approach clearly. It will help us tell you where you made a mistake. If you plug in numbers right upfront and your answer is wrong, you will not get partial credit.

Problem 1 (MAC quickies, 21 points):

A. Suppose two nodes start to transmit at the same time a packet of length L over a broadcast channel of rate R. Denote the propagation delay between the two nodes as D. Will there be a collision if D < L/R? Explain.
B. Will there be a collision if D > L/R? Explain.
C. We listed four desirable properties of a broadcast channel in slide 5-16 (as also listed in Section 5.3 in the text). Which of these properties does ALOHA have?
D. Which of the four properties above does token ring passing have?
E. How big are the (1) MAC, (2) IPv4, and (3) IPv6 address spaces?
F. ARP translates a/an _____ address to a/an _____ address.
G. In Figure 5.26 of the text, how many subnets are there in the addressing sense of Section 4.4?
H. A switch executes the CSMA protocol, but a hub does not. True or false?

Problem 2 (Routing), 15 points: Which of the following interdomain routes are possible with commonly used valley-free routing policies and which ones are not?



Problem 3 (CRC, 15 points): Suppose you need to send data D = 110110010 in a frame using a CRC so as to detect up to 3 corrupted bits.

A. Compute the CRC using the generator 1001.
B. Give an example of a 4 bit corruption that can *not* be detected by the CRC. Describe how you found this example.

Problem 4 (ALOHA, 24 points): Suppose three active nodes A, B, and C are competing for access to a channel using slotted ALOHA. Assume that 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 1, the second slot is numbered 2, and so on.

A. What is the probability that node A succeeds for the first time in slot 4?
B. What is the probability that some node (either A, B, or C) succeeds in slot 2?
C. What is the probability that the first success occurs in slot 4?

D. What is the efficiency of this three-node system (in terms of p)? For what value of p is the efficiency maximized?

Problem 5 (Ethernet, 25 points):

A. Consider a C=100Mbps Ethernet of length L=100m. Assuming that nodes send packets of length S=1000B, calculate the efficiency of the Ethernet.
B. Problem 25 from Chapter 5 in the textbook (5th ed.).