CS536 Homework 4

due Tue, Apr 28th, 1:30pm

April 23, 2009

Submit your homework electronically in a text or PDF file. Email your solution to the professor by 1:30pm on Tuesday, Apr 14th. Late submission will not be accepted, nor will collaboration.

To receive credit, all submissions should contain this statement at the beginning: "By turning in this homework submission, I certify that this work was done solely by me." Questions about this homework should be directed to the TAs or the Professor, not to fellow classmates.

Problem 1 (10 pts)

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_{prop}. Will there be a collision if $d_{prop} < L/R$? Why or why not?

Problem 2 (10 pts)

Suppose a 10 Mbps adapter sends into a channel an infinite stream of 1s using a Manchester encoding. The signal merging from the adaptor has how many transitions per second?

Problem 3 (10 pts)

In CSMA/CD, after the fifth collision, what is the probability that a node chooses $K = 4$? The result $K = 4$ corresponds to a delay of how many seconds on a 10 Mbps Ethernet?

Problem 4 (10 pts)

Consider the 4-bit generator $G = 1001$, and suppose that the data D has the values given below. For each, give the value of the remainder R which serve as the CRC. Show your work.

a. 01010101

b. 10010001

c. 11011011

d. 01101011

Problem 5 (10 pts)

Suppose three active nodes—nodes A, B, and C—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 2, and so on.

a. What is the probability that node A succeeds for the first time in slot 4?

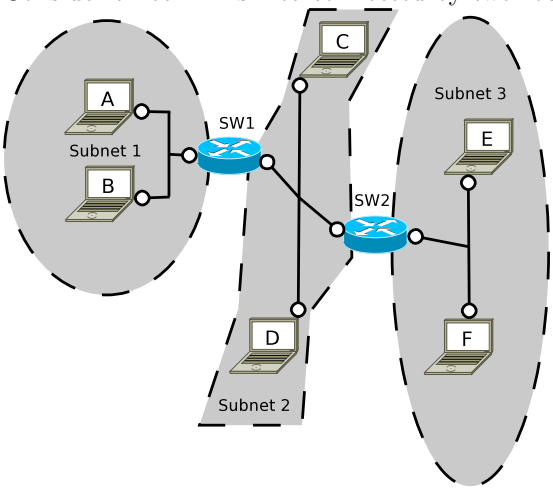
b. What is the probability that some node (either A, B, or C) succeeds in slot 2?

c. What is the probability that the first success occurs in slot 4?

d. What is the efficiency of this three-node system?

Problem 6 (20 pts)

Consider three LANs interconnected by two routers, as shown below:



a. Assign IP addresses to all of the interfaces. Let the interface for each host be Xi for a host X (i for interface), and SW#i# for switch number # interface in subnet #. So interfaces labels are Ai, Bi, Ci, Di, Ei, Fi, SW1i1, SW1i2, SW2i2, SW2i3. For Subnet 1 use addresses of the form 111.111.111.xxx; for Subnet 2 use addresses of the form 122.222.222.xxx; and for Subnet 3 use addresses of the form 133.133.133.xxx.

b. Assign MAC addresses to all of the adapters (interfaces).

c. Consider sending an IP datagram from Host A to Host F. Suppose all of the ARP tables are up-to-date. Enumerate all the steps, as done for the single-router example in class.

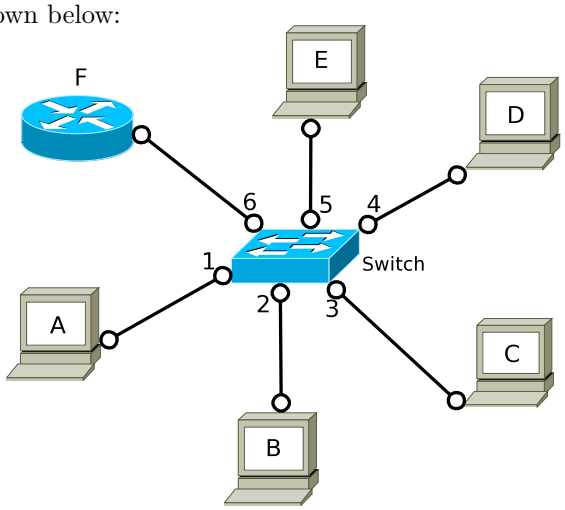
d. Repeat (c), now assuming that the ARP table in the sending host is empty (and the other tables are up to date).

Problem 7 (10 pts)

Suppose nodes A and B are on the same 10 Mbps Ethernet bus, and the propagation delay betweent he two nodes is 225 bit times. Suppose A and B send frames at the same time, the frames collide, and then A and B choose different values of K in the CSMA/CD algorithm. Assuming no other nodes are active, can the retransmissions from A and B collide? For our purposes, it suffices to work out the following example. Suppose A and B begin transmission at $t = 0$ bit times. They both detect collisions at $t = 225$ bit times. They finish transmitting a jam signal at $t = 225 + 48 = 273$ bit times. Suppose $K_A = 0$ and $K_B = 1$. At what time does B schedule its retransmission? At what time does A begin transmission? (Note: The nodes must wait for an idle channel after returning to Step 2—see protocol.) At what time does A's signal reach B? Does B refrain from transmitting at its scheduled time?

Problem 8 (20 pts)

Let's consider the operation of a learning switch in the context of the network shown below:



Suppose that (i) A sends a frame to D, (ii) D replies with a frame to A, (iii) C sends a frame to D, (iv) D replies with a frame to C. The switch

table is initially empty. Show the state of the switch table before and after each of these events. For each of these events, identify the link(s) on which the transmitted frame will be forwarded, and briefly justify your answers. (Note, for the purposes of the table, let the letter represent the interface link/MAC address).