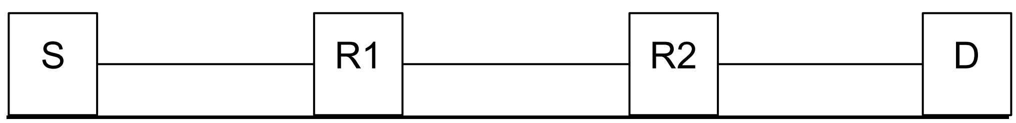
ECE 358
Tutorial Set 5

Note:
The *efficiency* of a LAN is the fraction of time spent sending successful frames. The *access time* is the maximum amount of time a station has to wait to start transmitting. An *active* station is one that has data to send. The *latency* of a ring is the time required for a bit to travel all the way around the ring. For the token ring problems below, neglect the time required to emit or absorb a token.

Problem 1*.
A source S with IP address IPS and physical address PHS sends a datagram to a destination D with IP address IPD and physical address PHD. Write the 4 address fields contained in the frame (possibly some are located in the data field of the frame, explain) being sent from router R1 with IP address IPR1 and physical address PHR1 to router R2 with IP address IPR2 and physical address PHR2, where the 2 routers are connected to the same LAN. Explain.



Problem 4*.
Consider an Ethernet LAN. Suppose A, B, and C all make their first carrier sense, as part of an attempt to transmit, while a fourth station D is transmitting. Draw a timeline showing one possible sequence of transmissions, attempts, collisions, and exponential backoff choices. Your timeline should also meet the following criteria: (i) initial transmission attempts should be in the order A, B, C but successful transmissions should be in the order C, B, A, and (ii) there should be at least four collisions.

Problem 5*.
Let A and B be two stations attempting to transmit on an Ethernet. Each has a steady queue of frames ready to send; A's frames will be numbered Al, A2, and so on, and B's similarly. Let T = 51.2 μs be the exponential backoff base unit.
Suppose A and B simultaneously attempt to send frame 1, collide, and happen to choose backoff times of 0 x T and 1 x T, respectively, meaning A wins the race and transmits Al while B waits. At the end of this transmission, B will attempt to retransmit B1 while A will attempt to transmit A2. These first attempts will collide, but now A backs off for either 0 x T or 1 x T, while B backs off for time equal to one of 0 x T, ... , 3 x T.

(a) Give the probability that A wins this second backoff race immediately after this first collision; that is, A's first choice of backoff time k x 51.2 is less than B's.
(b) Suppose A wins this second backoff race. A transmits A3, and when it is finished, A and B collide again as A tries to transmit A4 and B tries once more to transmit Bl. Give the probability that A wins this third backoff race immediately after the first collision.
(c) Give a reasonable lower bound for the probability that A wins all the remaining backoff races.
(d) What then happens to the frame Bl?

This scenario is known as the Ethernet capture effect.

Problems below were taken from Chapter 5 of an earlier version of the book.

P9*. 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 is numbered 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?