Electrical, Computer, and Systems Engineering
ECSE 4760: Computer Communication Networks

Question Set

1. Let A and B be 2 stations attempting to transmit on an Ethernet. Each has a steady stream of frames ready to send: A's frames are numbered A_1, A_2, and so on and B's are similarly numbered. Let $T = 51.2\mu s$ be the exponential backoff base unit. Suppose A and B simultaneously attempt to send frame 1, collide and happen to choose backoff times $0 \times T$ and $1 \times T$ respectively meaning A wins the race. At the end of this transmission, B will attempt to retransmit B_1 while A will attempt to transmit A_2. These first attempts will collide but now A backoffs for either $0 \times T$ or $1 \times T$ while B backoffs for time equal to one of $0 \times T, \cdots, 3 \times T$.

(a) Give the probability that A wins the second backoff race immediately after the first collision.

(b) Suppose A wins the second backoff race. A transmits A_3 and when it is finished A and B collide again while A tries to transmit A_4 and B tries once more to transmit B_1. Give the probability that A wins this third backoff race immediately after the first collision.

2. In the network topology shown in Figure 1, use Dijkstra's and the distance vector algorithms to comute the shortest path to all nodes from F.

3. State wether the following statements are true or false **and justify your answer**.

(a) Packet switching yiels lower delay than circuit switching.

(b) A data link later protocol would be necessary even if there were no bit errors or losses at the physical layer.

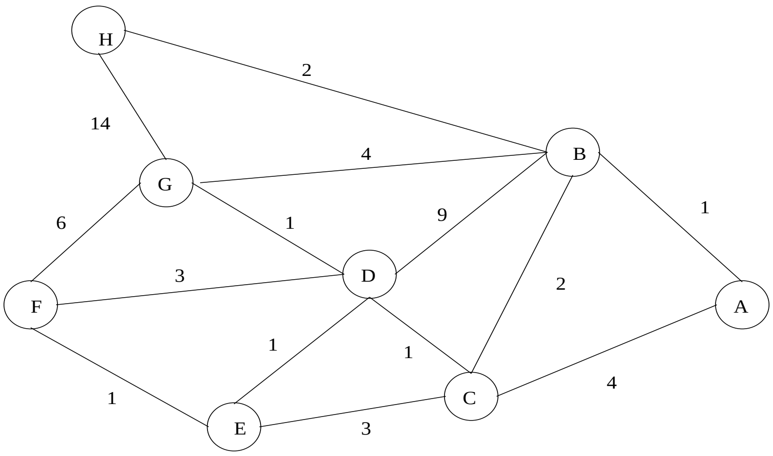

Figure 1: Topoloy for Question 2.

(c) Assuming each is correctly implemented, Selective Repeat should perform better than Go Back N on a fiber optic link between JEC and VCC here at RPI (about 0.5km).

(d) If error detecting codes are implemented in hardware, then this function is a part of the physical layer.

4. Consider a transmission link with fixed link capacity C = 1.5 Mbps, an infinite buffer, and a Poisson packet arrival process with rate $\lambda = 1000p/s$. Assume that the packet length distribution is exponential with mean L = 1000 b/p.

1. Compute the mean number of packets in the system. Compute the mean delay for a packet.

2. Now assume that the arrival rate of packets has risen to 2000 p/s, so we double the transmission capacity to 3 Mbps. What happens to the mean number of packets in the system? What happens to the mean delay for a packet? Justify your answer computationally and intuitively.

5. Suppose TCP increased its congestion window by 2 rather than by 1 for each received ACK during slow-start. Thus first window consists of one segment, second of 3 segments, third of 9 segments and so on. For this slow start procedure:

a. Express K in terms of O and S

b. Express Q in terms of RTT, S and R

c. Express latency in terms of $P = \min(K-1, Q)$, O, R and RTT.

Use the Textbook's notation.

6. Consider the scenario or $RTT = 100msec$, $O = 5Kb$ and $M = 10$. Construct a chart that compares the response time for persistent and non-persistent connections for 28 Kbps, 100 Kbps, 1 Mbps and 10 Mbps.