

# Electrical, Computer, and Systems Engineering

## ECSE 4760: Computer Communication Networks

### Question Set

- 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  $0 \times T, \dots, 3 \times T$ .
  - Give the probability that A wins the second backoff race immediately after the first collision.
  - 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.
- In the network topology shown in Figure 1, use Dijkstra's and the distance vector algorithms to compute the shortest path to all nodes from  $F$ .
- State whether the following statements are true or false **and justify your answer**.
  - Packet switching yields lower delay than circuit switching.
  - A data link layer protocol would be necessary even if there were no bit errors or losses at the physical layer.

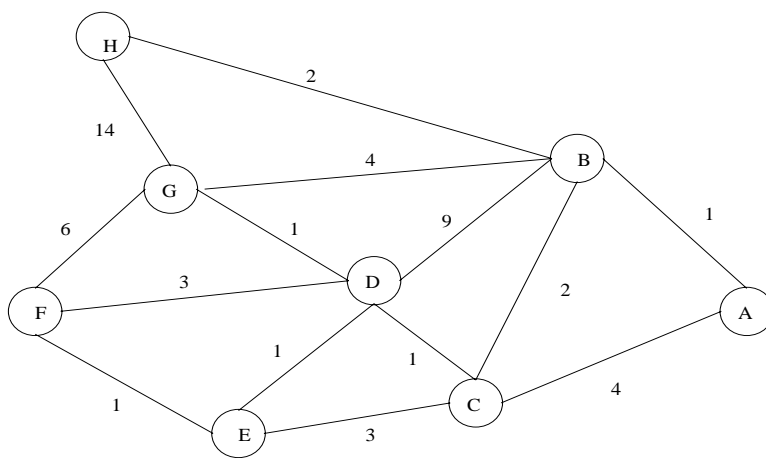


Figure 1: Topology for Question 2.

(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.