National University of Singapore
School of Computing

CS2105 **Problem Set 7** Semester 2 05/06

1. **(KR, Chapter 5, Review Question 13)** 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?

2. **(KR, Chapter 5, Problem 11)** Suppose nodes A and B are on the same 10 Mbps Ethernet segment, and the propagation delay between two nodes is 225 bit times. Suppose node A begins transmitting a frame and, before it finishes, node B begins transmitting a frame.
   (a) What is the minimum possible time taken by A to finish transmission?
   (b) When is the latest time, by which B can begin its transmission?
   (c) Can A finish transmitting before it detects that B has transmitted?

3. **(KR, Chapter 5, Problem 12)** Suppose nodes A and B are on the same 10 Mbps Ethernet segment, and the propagation delay between 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 retransmission from A and B collide?

   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 $t = 225+48$ 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 that a node 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?

4. **(KR, Chapter 5, Problem 15)** Suppose two nodes, A and B, are attached to opposite ends of a 900 m cable, and that they each have one frame of 1,000 bits (including all headers and preambles) to send to each other. Both nodes attempt to transmit at time t = 0. Suppose there are four repeaters between A and B, each inserting a 20-bit delay. Assume the transmission rate is 10 Mbps, and CSMA/CD with back-off intervals of multiples of 512 bits is used. After the first collision, A draws K = 0 and B draws K = 1 in the exponential back-off protocol. Ignore the jam signal and the 96-bit time delay.
   (a) What is the one-way propagation delay (including repeater delays) between A and B in seconds? Assume that the signal propagation speed is 2×10^8 m/sec.
   (b) At what time (in seconds) is A's packet completely delivered at B?
   (c) Now suppose that only A has a packet to send and that the repeaters and replaced with switches. Suppose that each switch has a 20-bit processing delay in addition to a store-and-forward delay. At what time, in seconds, is A's packet delivered at B?