CE3005/SC2008/CZ3006: Computer Networks
Part I: Tutorial – 3

1. The CSMA/CD specification for a medium is given below:

   (a) Maximum cable length per segment is 200 meters and the propagation delay is 1 μsec per 100 meters.
   (b) Maximum number of stations per segment is 20.
   (c) Maximum number of repeaters between any two segments (or say, between any two stations) of a LAN is 4. Delay through each repeater is 2 μsec.

   Determine the minimum frame size required for correct operation of the CSMA/CD protocol if the network is run at 20 Mbps.

2. Consider an Ethernet 10BASE-T single segment LAN where three stations are connected to an Ethernet hub, and the distance between each station and the Ethernet hub is the same. Assume that each of the three stations transmits a new frame at exactly the same time resulting a collision, what is the probability that the next event on the channel is also a collision?

   (Hint: *if nothing happens on the first retrial time slot, it does not count as an event.*)

3. In a local area network using the CSMA/CD protocol, a modified Binary Exponential Backoff scheme is used if a collision is detected in the channel. Assume that two stations (A and B) are transmitting and their frames collide in one time slot. Each of them will retransmit its data frame over a window of size 2 slots. Station A retransmits in slot 0 with probability of p and station B retransmits in slot 0 with probability of q.

   (i) If $p = 1/3$ and $q = 2/3$, what is the probability that the first event in the channel will be a success?

   (ii) How would you maximize the probability that the first event in the channel will be a success, by choosing proper values for p and q?

4. You are commissioned to design an experimental Wi-Fi network for CCDS; it the multi-access reservation protocol (MARP) for data link layer. Each transmission cycle of MARP consists of two phases: a reservation phase and a transmission phase. In the reservation phase, a chosen MAC protocol is used for transmission stations to reserve the channel; and in the transmission phase, the station that successfully reserves the channel transmits one frame. The data rate in the Wi-Fi channel is 1 Mbps. The length of the data frame is 1000 bits, among which the reservation frame carries 10 information bits.

   (i) If the MAC protocol used in the reservation phase has a utilization of 0.8, what will be the throughput of your Wi-Fi network?

   (ii) What is the maximum throughput of your Wi-Fi network if the slotted Aloha is used as the MAC?