Homework 2
CS386W: Wireless Networks (Fall 2020)
Assigned: Sept. 29, 2020
Due: Oct. 5, 2020

1) A pair of nodes A and B close to each other is sending packets to node C using IEEE 802.11 DCF. Both nodes A and B have many packets pending for node C. Show on a timing diagram the sequence of events that occurs until each of nodes A and B has received ACK for their 1st packet sent to C or we exhaust the backoff sequence (whichever earlier). Assume that they pick their successive backoff intervals as follows:
   Node A: 4, 3, 10, 6, 2
   Node B: 4, 6, 12, 3, 9
Assume that the propagation delay is negligible, and that the two nodes choose their initial backoff exactly at time t0, and that at time t0 channel changes status from busy to idle, because node D completes a transmission. In your timing diagram, show one timeline each for hosts A, B and C. In the timeline, show the various packets sent by the hosts, and backoff slots counted by the hosts. Also, if a packet transmission results in a collision, indicate that as well. Assume that RTS/CTS are sent prior to Data and ACK, and that in the absence of a collision, all transmissions are received reliably. (2 points)

2) Repeat the question (1) when A and B are hidden terminals and RTS/CTS is not used. 54 Mbps data rate, RTS length = 20 bytes, CTS length = 14 bytes, data frame size = 1000 bytes, ACK Frame Size = 14 bytes, Propagation Delay = 0μs, Slot Time = 9 μs. (2 points)

3) Repeat the question (1) when A and B are hidden terminals but RTS/CTS is used. (2 points)

4) RTS frames are subject to collision. Why do we send RTS/CTS under hidden terminals instead of sending the original data frames? For what types of data frames does it make sense to send RTS/CTS? (2 points)

5) Suppose an 802.11a station is configured to always reserve the channel with the RTS/CTS sequence. Suppose this station wants to transmit data, and all other stations are idle at this time. As a function of SIFS and DIFS, and ignoring propagation delay and assuming no bit errors, calculate the time required to transmit the frame and receive the acknowledgment. Further calculate the effective throughput (i.e., the data rate received by the MAC layer data payload). FYI, 802.11 physical layer transmission rate = 36Mbps, MAC layer data payload = 1000 bytes, MAC header = 28 bytes, ACK Frame Size = 14 bytes, RTS length = 20 bytes, CTS length = 14 bytes, Propagation Delay = 1μs, Slot Time = 9 μs, SIFS Time = 16μs, DIFS Time = 34μs, Physical layer overhead = 20μs (every frame has the same PHY overhead). (2 points)