1. (**10 points**) What MAC protocol does Ethernet use? What MAC protocol does 802.11b wireless LAN use? Why Ethernet has a much higher transmission efficiency than slotted ALOHA? What are the basic differences between Ethernet switch and hub?

2. (**10 points**)Two-dimensional parity scheme: Consider the data bit stream: 10101 01000 01110 10001 00001. Use the 2-dimensional parity code that has 5 rows and 5 columns (use even parity scheme)

a). Write out the parity code in the matrix format as shown in lecture slides Chapter5-part1.ppt
b). Suppose the received data bit stream is 10101 01100 01110 10001 00001, which has one bit error. Explain how you use the parity code to detect this bit error.

3. (**15 points**)For the CRC checksum example shown in Chapter5-part1.ppt, Suppose the G is 1001, the D data has value of 10010001, 10100011, and 01010101, respectively in three scenarios. What is the value of R for each D?

4. (**15 points**) We provided the outline of derivation of the efficiency of sloted ALOHA in our lecture notes. In this problem, you will complete the derivation.

 a). Recall that when there are N active nodes, the efficiency of slotted ALOHA is $Np(1-p)^{N-1}$. Find the value of p that maximizes this expression. Show how you derive this optimal value.

 b). Using the value of p found in (a), find the efficiency of slotted ALOHA by letting N goes to infinity. Hint: $(1-1/N)^N$ approaches $1/e$ as N approaches infinity.

5. (**15 points**) Suppose two nodes share a single Ethernet. At exactly the same time, each of them transmits a packet so these two packets collide with each other. Each of them will try to retransmit again according to Ethernet CSMA/CD protocol. What is the probability that they will collide again for their second attempt? What is the probability that they will collide three times? Assuming that each of these two nodes only have a single packet to transmit.

6. **(10 points)** What is the working radio frequency and bandwidth of 802.11b, 802.11g, and 802.11a ? Why wireless MAC protocol does not use "collision detection"?

7. **(10 points)** Compared with Ethernet MAC protocol, wireless MAC protocol has added DIFS, SIFS, RTS, CTS. Explain their full names, where are they used? Why wireless MAC protocol uses RTS/CTS?

8. **(15 points)** Suppose an 802.11b station is configured to always reserve channel with RTS/CTS sequence. Suppose this station wants to transmit 1,000 bytes of data, and all other stations are idle at this time period. As a function of SIFS and DIFS, and ignoring propagation delay and assuming no bit errors, calculating the time required to transmit the frame and receive the acknowledgement. Suppose each frame header is 32 bytes, which is the length of RTS, CTS, and ACK frames. The 1,000 bytes data is able to be put into one data frame.