CS 653 Mobile Computing *Spring 2014*

Problem Set 1 **Due: Jan 30, 2014 (in class)**

Instructions

1. Submit hand-written answers. No soft copies. No printouts.
2. Clearly mention your name and roll number on the answer sheet.
3. Write down all the steps in your solution. Providing the final answer alone is not enough.
4. You may discuss the problems with your classmates, but you must write up the final solution yourself, without looking at the answers of anyone else. Also, please list the names of your collaborators on the first page of your answer sheet.

Problem 1

Consider a convolutional code with k = 1, n = 3, and constraint length l = 3. It's generators are (111), (110), and (101). A four bit message string is encoded into a 12-bit coded string with this code and transmitted. The decoder at the receiver has obtained the coded string 011001001010. What is the most likely transmitted 4-bit message string?

Problem 2

The highest bit rate in the WiFi standards of 802.11a/g uses the QAM64 modulation and a convolutional code of rate ¾. Derive the physical layer data rate (in Mbps) obtained by this modulation and coding scheme.

Problem 3

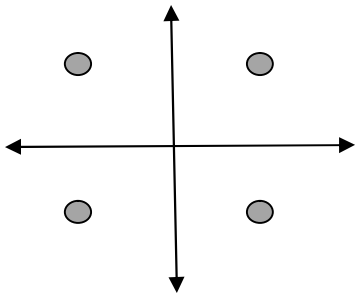
Consider a sender and receiver communicating over a 20 MHz wireless channel.

a. The transmit power of the sender is 100 mW. Convert this value into units of dBm.
b. The thermal noise on this channel is measured to be -100 dBm. Convert this value into units of watts.
c. What is the SNR at the receiver if the transmitted signal suffers a path loss of 90 dB due to channel propagation effects? (Use the transmit power and noise values from (a) and (b) above.)
d. What is the maximum rate at which information can be transmitted between this sender and receiver as per Shannon's capacity formula?
e. What are the answers to (c) and (d) above if the sender doubles his transmit power?

Problem 4

Consider a sender and receiver communicating using the QPSK modulation scheme. The constellation diagram used has valid symbols at the four corners of a unit square as shown below. That is, the valid constellation symbols are (1,1), (1, -1), (-1, 1) and (-1,-1).

a. How many data bits can be modulated using each constellation symbol in this modulation scheme?
b. Provide a Gray coding that maps from bits to constellation symbols.
c. Assume that the receiver demodulates a received symbol to obtain a point (x,y) on the constellation diagram. The receiver must map this point to the closest constellation symbol to extract the most likely transmitted bits. Provide a formula / decision rule that maps (x,y) to the set of likely transmitted bits.



Problem 5

Please refer to the paper on wireless link measurements from the Roofnet project ("Link-level Measurements from an 802.11b Mesh Nework") that is posted on the class website. Refer to Figures 12 and 14, which provide packet delivery rates as a function of SNR, for various transmit bit rates. Figure 12 is derived by connecting the WiFi cards via a channel emulator (i.e., a wire that mimics a wireless channel), which Figure 14 is from real experiments. We will use these curves as a guide to pick the best transmit bit rate between a sender and receiver. Note that the best transmit bit rate is defined for now as the bit rate that maximizes the throughput (which is roughly the packet delivery rate times the bit rate).

a. Use Figure 12 as your guide and suggest what the best transmit bit rate would be for a sender and receiver that have SNR values of 2,4,6,8, and 10 dB respectively.
b. Will your choices change if you use Figure 14 instead? What will your new answer be? And why?