KFUPM - COMPUTER ENGINEERING DEPARTMENT

COE-543 – Mobile Computing and Wireless Networking

Assignment 2 – Due Nov 12th, 2011.

Problem	Total Points	Points
1	10	
2	10	
3	10	
4	20	
5	10	
6	20	
7	20	
Total	100	

Problem 1 (10 points):

The IEEE802.11 standard specifies the infra-red (IR) option for the physical layer that may support 1 or 2 Mb/s. Explain briefly how does the system implement pulse position modulation (PPM) to obtain the prescribed rates.

Problem 2 (10 points):

Frequency shift keying (FSK) is a popular modulation scheme for wireless systems.

a) Explain briefly the basic operation and properties (bandwidth requirement, signal properties, etc.) of the basic M-ary FSK.

b) Explain the basic operations and properties of the derivative minimum shift keying (MSK) scheme emphasizing on the advantages of MSK versus FSK.

c) The mobile system GSM implements Gaussian MSK or GMSK. Explain, again, the basic operation and the properties of this scheme relative to MSK.

Problem 3 (10 points):

Pulse shaping filter (PSF) can be placed as a low-pass filter before mixing the signal with the carrier or as a band-pass filter after the mixer. For both of these cases, the sides lobes of the transmission bandwidth can be controlled by this filter. In practice a pair of identical filters where one at the transmitter and the other at the receiver are used.

a) Compare and contrast the use of an ideal low-pass filter versus a raised cosine filter for pulse shaping.

b) What are the typical values for the roll-off factor for the raised-cosine filter that is used in practical systems and what would be the corresponding transmission bandwith? Why?

Problem 4 (20 points):

Consider a system that is using a 64-QAM modem and requires a bit error rate equal or less than 10^{-5}.

a) Compute the required SNR to achieve the desired bit error rate. Use the results in Table 3A.1.

b) Give the average SNR at which the average error rate over a flat Rayleigh fading radio channel is 10^{-5}.

c) Give the outage probability from the threshold error rate of 10-5 if the system operates in a Rayleigh fading radio channel and the receiver uses a single antenna (i.e. no diversity) Assume that the average received SNR per symbol is 14 dB.

Problem 5 (10 points):

Consider the capacity expansion technique outlined by Lee in:
W. C. Lee, "*Smaller Cells for Greater Performance*," IEEE Communications Magazine, November 1991, pp. 19-23.

Assuming AMPS is to be deployed using this technique with a total of 395 traffic channels, explain how does this technique provide a capacity increase of 2.33 folds? What is the cost for this capacity increase?

Problem 6 (20 points):

Consider an installed cellular system with 100 sites, a frequency reuse factor of N = 7, and 500 overall two-way channels:

a) Give the number of channels per cell, total number of channels available to the service provider, and the minimum carrier-to-interference ratio (C/I) of the system in dB. Assumes a pathloss exponent of 4.

b) To expand the network, we decide to create an underlay-overlay system where the new system uses a frequency reuse factor of N = 3.

b.1) If R_0, D_0 are the cell radius and reuse distance for the underlay system, respectively, while R_1 and D_1 are the cell radius and reuse distance of the overlay system, respectively. Draw the frequency plan on the figure below? (i.e. put down the channel set number for both underlay and overlay systems). Indicate on the figure the quantities R0, D0, R1, and D1.

b.2) Using the figure of b.1 - show that $D_1 = 3\ R_0$?

b.3) What is the quantity D_1/R_1 equal to? Why?

b.4) Give the number of channels assigned to inner and outer cells to keep a uniform density over the entire coverage area.

Problem 7 (20 points):

Assume that STC is providing wireless public telephone for airplanes using 6 telephone channels per airplane. Let there be 100 passengers in an airplane where, on the average, each passenger makes a 3-min telephone call every 2 hours. Assume the installed system allows call requests to be queued and does not block them when all channels are occupied.

a) What is the probability of a passenger will attempt to do a call and not find an empty channel?

b) What is the average delay for a passenger to get access to the telephone?

c) What is the probability of a passenger waiting for more than 3 minutes for access to the telephone?

d) What would be the average delay if the number of passengers is increased to 200.