KFUPM - COMPUTER ENGINEERING DEPARTMENT

COE-543 – Mobile Computing and Wireless Networking

Assignment 2 – Due April 26th, 2010.

Problem 1: (20 points) The figure below shows the traffic in Erlangs for a seven-cell cellular system located in a busy metropolitan area. The total available channels in the system are 395. Assuming each subscriber in the system generates 0.03 Erlangs of traffic with an average call holding time of 120 seconds and the system covers an area of 1,200 square kilometers with cells designed for Grade-of-Service (GOS) of 2% blocking. Compute the following quantities:

a) The number of channels required in each cell

b) The number of subscribers served by the system

c) The average number of subscribers per channel

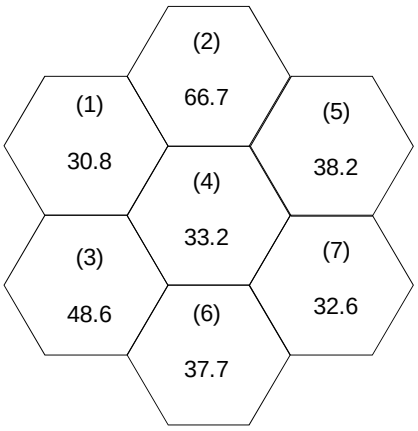
d) The number of calls supported by the system

e) The subscriber density per square kilometer

f) The call density per square kilometer

g) The cell radius in kilometers

h) The channel reuse factor



Problem 2: (20 points) Consider the example "Example 4" in course notes slide 32. Given the problem statement in the notes:

(a) Complete the table shown below. Show all your calculations at least for the case of $N = 7$ and $S = 1$, 3, and 6.

(b) Plot spectral efficiency versus cell radius for each of value of S (number of sectors).

(c) Examine the relation between spectral efficiency, S, and reuse factor. State your observations.

System	Reuse Factor (N)	Channels per Sector	Offered Load per Cell	Carried Load per Cell	Call/Cell per Hour	Cell Radius (km)	Mean SIR (dB)	Spectral Efficiency (Erlangs/ km2/MHz)
Omni (S = 1)	4							
	7							
	12							
120 degrees Sector (S = 3)	4							
	7							
	12							
60 degrees Sector (S = 6)	4							
	7							
	12							

Problem 3: (20 points) Explain *briefly* how can Lee's Microcell Zone technique provides capacity enhancement for cellular deployments. In your explanation draw the corresponding configuration showing the reuse pattern for the cluster (three zonal sectors). In your diagram identify the reuse distance for the cluster and also the reuse distance of the zonal sector. Show that this configuration produces a capacity increase of 233%.

Also List the cost involved with this method.

Hint: refer to textbook section 5.6.1.3 and original Lee's 1991 paper cited in the course notes.

Problem 4: A service provider is deploying a cellular system using 100 cell sites with a frequency reuse pattern equal to 12. Let there be a total of 500 channels.

a) Give number of channels per cell, total number of channels available to the service provider, and the minimum carrier-to-interference ratio of the system in dB.

b) To expand the system, the provider decided to create an underlay-overlay system where the new system uses a frequency reuse factor of K = 3. Give the number of channels assigned to inner and outer cells to keep a uniform traffic density over the entire system area.

c) What is the capacity increase obtained by the service provider.

Assume a path loss exponent equal to 4.

Problem 5: Consider the multiple access techniques discussed in chapter 4 of textbook. Neglect the frequency spectrum and resources used for control channels.

a) What is the maximum number of two-way channels that can fit inside the frequencies allocated to the AMPS system?

b) What is the number of channels in each cell? Note that a reuse pattern of 7 is required for AMPS operation.

c) Repeat (b) for IS-136 assuming the reuse pattern is equal to 4 and the number of slots per TDMA channel is three.

d) Repeat (b) for IS-95 CDMA, assuming the minimum required Eb/N0 is 6 dB. Account for the effects of antenna sectorization, voice activity, and extra CDMA interference (refer to section 4.2.3.2).

e) Repeat (b) for UMTS (W-CDMA) where 5 MHz bands are used in each direction. Assume that the performance improvement factor (i.e. *K* as defined in textbook) for UMTS is double that for IS-95.

Problem 6: A local 3-hour tour boat with 50 passengers has on AMPS radio phone to connect to the shore. On the average, each user places one call per tour and the average holding time for the calls is 3 minutes.

a) What is the probability that a person attempts to use the phone and he/she finds it occupied?

b) Repeat (a) is the AMPS phone is replaced by three IS-136 phones using the three slots of the existing IS-136 TDMA over the same band.

c) If the phone system allows calls to wait till the line is free, compute the average waiting time for a call before it gets service in part (b). What would be probability that the waiting time exceeds 10 seconds?