# ECT402-Wireless Communication

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Tutorial 1: Cell Capacity, Reuse Distance, Signal to Interference Ratio

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1. Consider a city of 10 square kilometers. A macrocellular system design divides the city into square cells of 1 square kilometer, where each cell can accommodate 100 users.

   (a) Find the total number of users that can be accommodated in the system.

   (b) Find the length of time it takes a mobile user to traverse a cell (approximate time needed for a handoff) when moving at 30 km per hour.

   (c) If the cell size is reduced to 100 square meters and everything in the system scales so that 100 users can be accommodated in these smaller cells, find the total number of users the system can accommodate and the length of time it takes to traverse a cell.

2. A cellular system with hexagonal cells of radius $R = 1$km. Suppose the minimum distance between cell centers using the same frequency must be $D = 6$ km to maintain the required SIR.

   (a) Find the required reuse factor N and the number of cells per cluster.

   (b) If the total number of channels for the system is 1200, find the number of channels that can be assigned to each cell.

   (c) Sketch two adjacent cell clusters and show a channel assignment for the two clusters with the required reuse distance.

3. Compute the SIR for a TDMA cellular system with diamond-shaped cells, where the cell radius $R = 10$ m and the reuse distance $D = 60$ m. Assume that the path-loss exponent within the cell is $n_I = 2$ but that the intercell interference has path-loss exponent $n_0 = 4$. Compare the SIR for $n = n_I = n_0 = 4$ and $n = n_I = n_0 = 2$. Explain the relative orderings of SIR in each case.

4. Find the minimum reuse distance and user capacity for a TDMA cellular system with hexagonally shaped cells, path-loss exponent $n = 2$ for all signal propagation in the system, and BPSK modulation. Assume an AWGN channel model with required $P_b = 10^{-6}$, a total system bandwidth of $B = 50$ MHz, and a required signal bandwidth of 100kHz for each user.

5. A receiver in an urban cellular radio system detects a 1mW signal at $d = d_0 = 1$ meter from the transmitter. In order to mitigate co-channel interference effects it is required that the signal received at any BS receiver from another BS transmitter which operates with the same channel must be below $-100$dBm. A measurement team has determined that the average path loss exponent in the system is $n = 3$.

   (a) Determine the radius of each cell if a $7-$cell reuse pattern is used.

   (b) What is the radius if a 4-cell reuse pattern is used.