Experiment No. 06

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AIM:

To understand the cellular frequency reuse concept to find the cell-clusters within a certain geographical area.

THEORY:

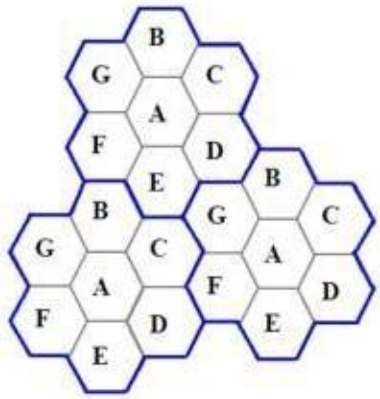
- **Hexagonal cell structure**

  Cells labeled with the same letter use the same group of channels. The hexagonal cell shape is conceptual and is the simplistic model of the radio coverage for each base station. It has been universally adopted since the hexagon permits easy and manageable analysis of a cellular system. The actual radio coverage of a system is known as the footprint and is determined from old measurements and propagation prediction models. Although the real footprint is amorphous in nature, a regular cell shape is needed for systematic system design and adaptation for future growth. If a circle is chosen to represent the coverage area of a base station, adjacent circles overlaid upon a map leave gaps or overlapping regions. A square, an equilateral triangle and a hexagon can cover the entire area without overlap and with equal area. A cell must serve the weakest mobiles typically located at the edge of the cell within the footprint. For a given distance between the center of a polygon and its farthest perimeter points, the hexagon has the largest area of the three. Thus, with hexagon, the fewest number of cell-scan cover a geographic region and close approximation of a circular radiation pattern that occurs for an Omni directional base antenna and free space propagation is possible. Base station transmitters are situated either at the center of the cell (center-excited cells) or at three of the six cell vertices (edge-excited cells). Normally, omnidirectional antennas are used in center exited cells and sectored directional antennas are used in edge-exited cells. Practical system design considerations permit a base station to be positioned up to one- fourth the cell radius away from the ideal location.

- **Cell cluster**

  Considering a cellular system that has a total of S duplex radio channels. If each cell is allocated a group of k channels and $(k<S)(k<S)$ if the S channels are divided among N cells into unique and disjoint channel groups of same number of channels, then, $S=kNS=kN$

  The N cells that collectively use the complete set of available frequencies are called a cluster. If a cluster is replicated M times within the system, the total number of duplex channels or capacity, C=MkN=MSC=MkN=MS

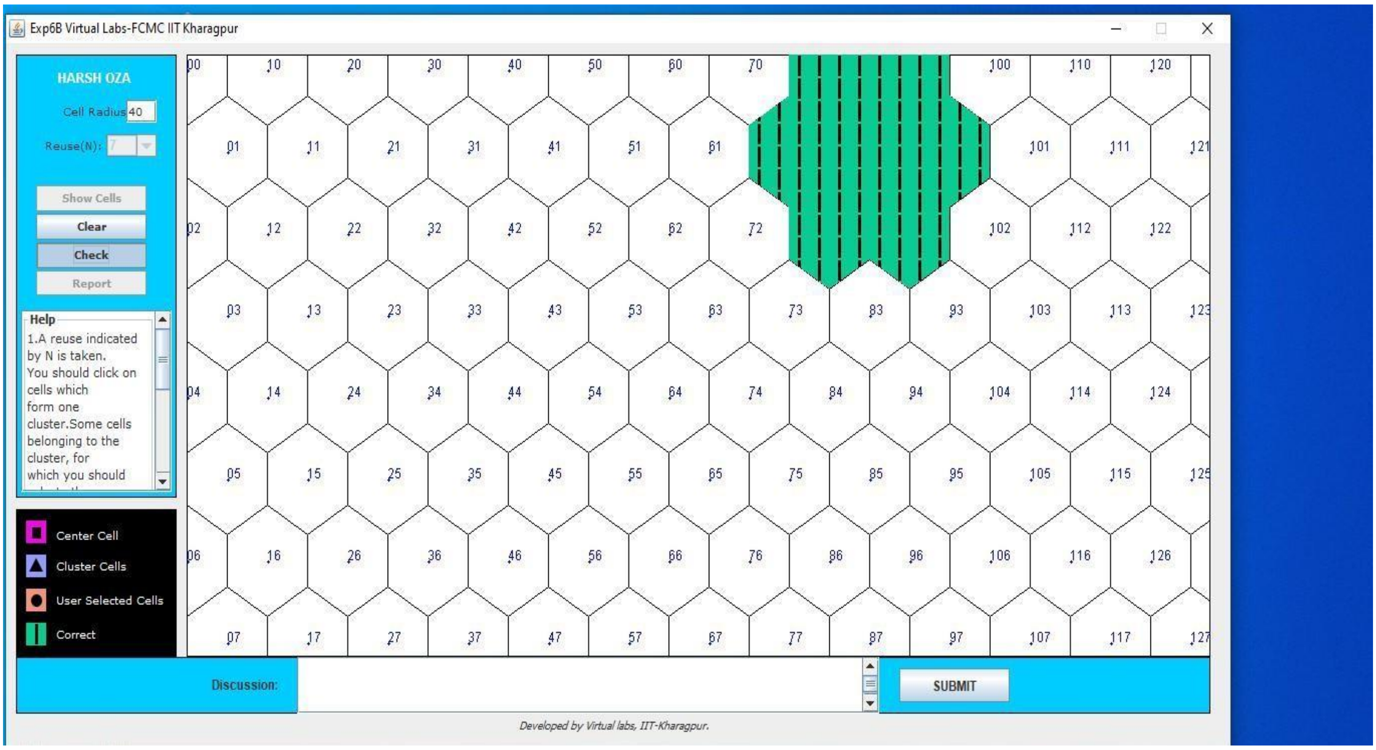


Frequency reuse concept: Cells with the same letter use the same set of frequencies. A cell cluster is outlined in blue and replicated over the coverage area.

In this example,

The cluster size N = 7 and the frequency reuse factor is 1/7 since each cell contains one-seventh of the total number of available channels. The capacity is directly proportional to M. The factor N is called the cluster size and is typically 4, 7 or 12. If the cluster size N is reduced while the cell size is kept constant, more clusters are required to cover a given area and hence more capacity is achieved from the design viewpoint, the smallest possible value of N is desirable to maximize capacity over a given coverage area. The frequency reuse factor of a cellular system is 1/N, since each cell within a cluster is assigned 1/N of the total available channels in the system.

Fading Channels & Mobile



CONCLUSION:

From this experiment we learnt about cellular frequency reuse concept. This concept is used to find the cell-clusters within a certain geographical area and the co-channel cells for a particular cell. In this experiment we the cell-clusters within a certain geographical area with using, IIT Kheradpir Virtual Labs.