The Cellular Concept

Unit 3

3.5 Interference and System Capacity

- Sources of interference
  - another mobile in the same cell
  - a call in progress in the neighboring cell
  - other base stations operating in the same frequency band
  - noncellular system leaks energy into the cellular frequency band
- Two major cellular interference
  - co-channel interference
  - adjacent channel interference

3.5.1 Co-channel Interference and System Capacity

- Frequency reuse - there are several cells that use the same set of frequencies
  - co-channel cells
  - co-channel interference

- To reduce co-channel interference, co-channel cell must be separated by a minimum distance.

- When the size of the cell is approximately the same
  – co-channel interference is independent of the transmitted power
  – co-channel interference is a function of
    • R: Radius of the cell
    • D: distance to the center of the nearest co-channel cell
- Increasing the ratio $Q=D/R$, the interference is reduced.
- Q is called the co-channel reuse ratio

- For a hexagonal geometry

$$Q = \frac{D}{R} = \sqrt{3N}$$

- A small value of Q provides large capacity
- A large value of Q improves the transmission quality - smaller level of co-channel interference

Table 2.1 Co-channel Reuse Ratio for Some Values of N

	Cluster Size (N)	Co-channel Reuse Ratio(Q)
$i = 1, j = 1$	3	3
$i = 1, j = 2$	7	4.58
$i = 2, j = 2$	12	6
$i = 1, j = 3$	13	6.24

Trunking and Grade of Service

- Erlangs: One Erlangs represents the amount of traffic density carried by a channel that is completely occupied.
    - Ex: A radio channel that is occupied for 30 minutes during an hour carries 0.5 Erlangs of traffic.
- Grade of Service (GOS): The likelihood that a call is blocked.

Trunking and Grade of Service

- Each user generates a traffic intensity of A_u Erlangs given by

$$A_u = \mu H$$

  H: average duration of a call.

  μ: average number of call requests per unit time

- For a system containing U users and an unspecified number of channels, the total offered traffic intensity A, is given by

$$A = UA_u$$

- For C channel trunking system, the traffic intensity A_c, is given as

$$A_c = UA_u / C$$

3.7 Improving Capacity in Cellular Systems

- Methods for improving capacity in cellular systems
  - Cell Splitting: subdividing a congested cell into smaller cells.
  - Sectoring: directional antennas to control the interference and frequency reuse.
  - Zone microcell concept : Distributing the coverage of a cell and extends the cell boundary to hard-to-reach place.