## 19EC601 – Wireless Communication

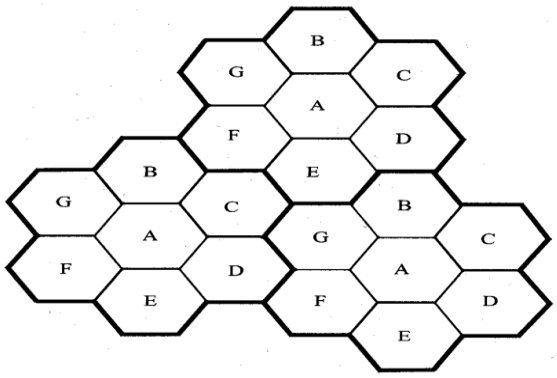
# Unit -1
# Cellular Concepts

# Overview

- Introduction.
- Frequency reuse concept.
- Channel assignment strategies.

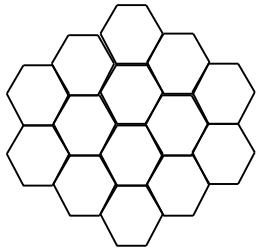
# Introduction to Cellular Systems

- Solves the problem of spectral congestion and user capacity.
- Offer very high capacity in a limited spectrum without major technological changes.
- Reuse of radio channel in different cells.
- Enable a fix number of channels to serve an arbitrarily large number of users by reusing the channel throughout the coverage region.



# What is Cell?

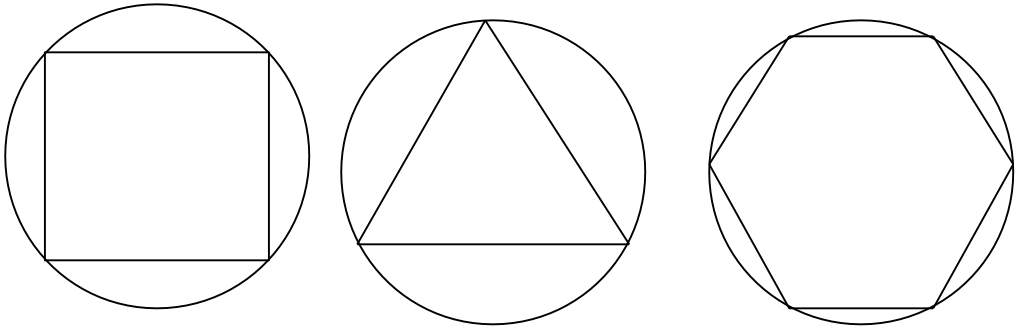
Each cellular base station is allocated a group of radio channels within a small geographic area called a *cell*.



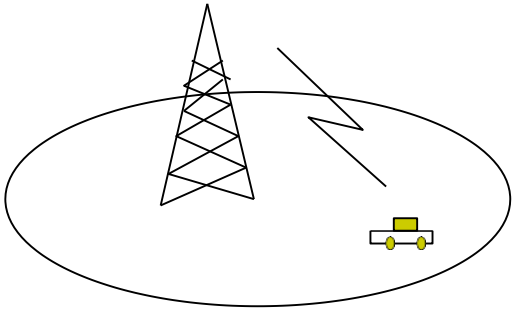
**Cell Shapes**

- Geometric shapes covering an entire region without overlap and with equal area.
- By using the hexagon, the fewest number of cells can cover a geographic region, and the hexagon closely approximates a circular radiation pattern which would occur for an omni-directional antenna.

# Cell shapes



square equilateral triangle hexagon



# Frequency Reuse

- Neighboring cells are assigned different channel groups.
- By limiting the coverage area to within the boundary of the cell, the channel groups may be reused to cover different cells.
- Keep interference levels within tolerable limits.
- Frequency reuse or frequency planning.
- seven groups of channel from A to G
- footprint of a cell - actual radio coverage
- omni-directional antenna v.s. directional antenna

Consider a cellular system which has a total of $S$ duplex channels. Each cell is allocated a group of $k$ channels, $k \in S$ .

The $S$ channels are divided among $N$ cells. The total number of available radio channels

$$S = kN$$

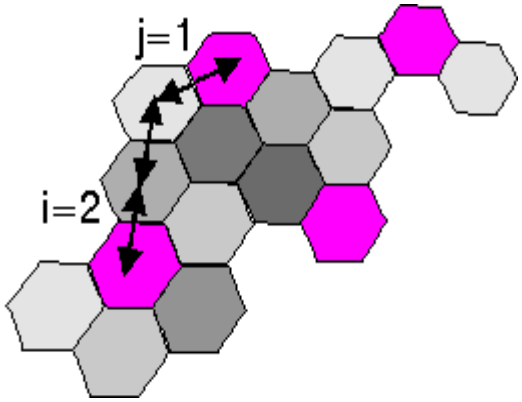
The $N$ cells which use the complete set of channels is called *cluster*.

The cluster can be repeated $M$ times within the system. The total number of channels, $C$, is used as a measure of capacity

$$C = MkN = MS$$

The capacity is directly proportional to the number of replication $M$. The cluster size, $N$, is typically equal to 4, 7, or 12.

Small $N$ is desirable to maximize capacity. The frequency reuse factor is given by $1/N$



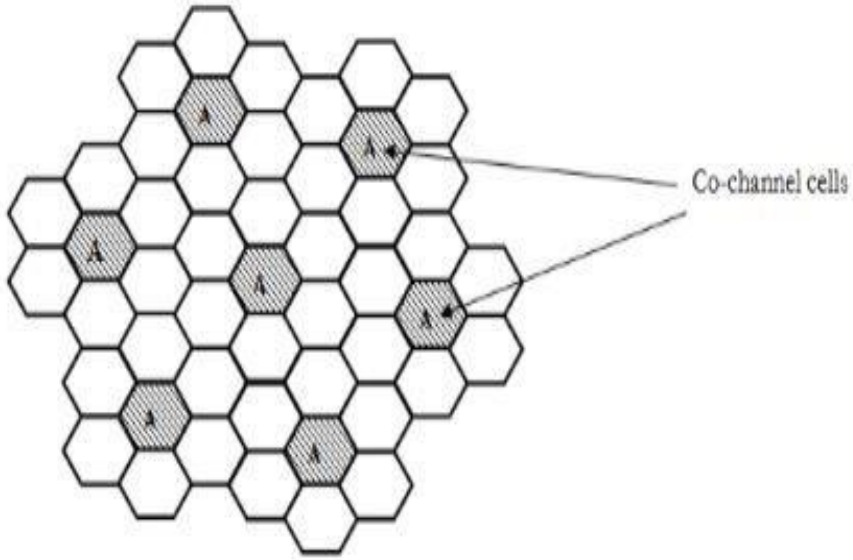



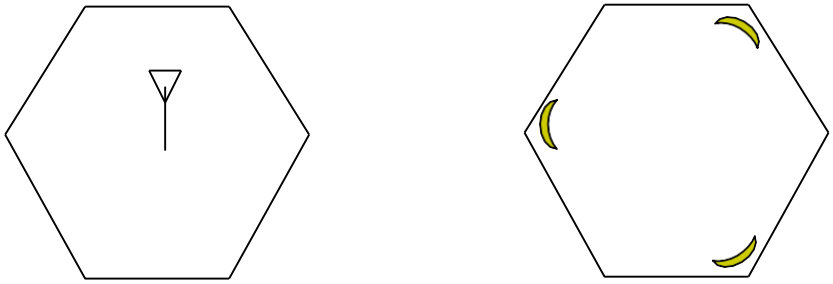

Fig: Frequency reuse

Frequency reuse scheme

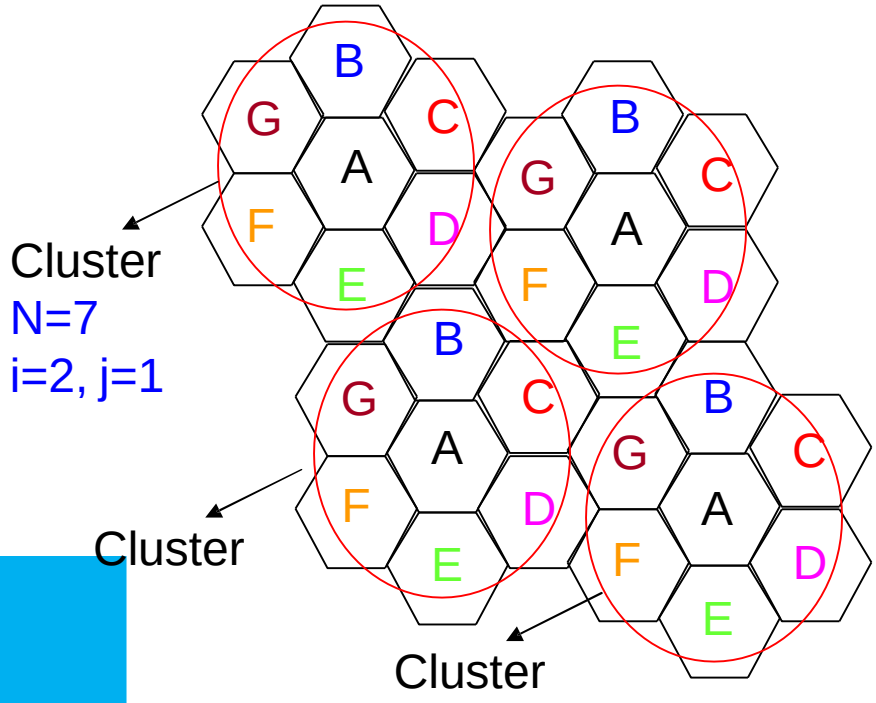
- ❑ increases capacity
- ❑ minimize interference

# Frequency Reuse: Excitation modes

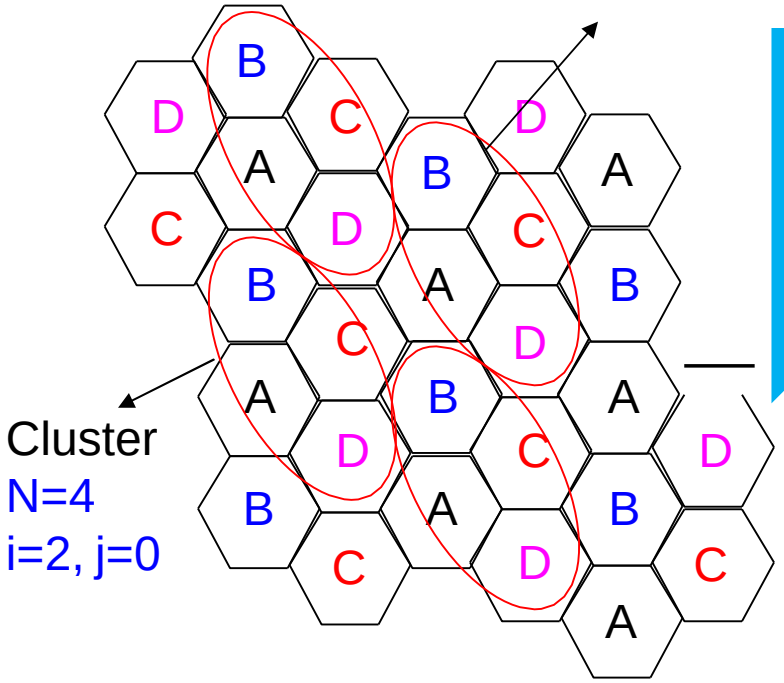
- Center-excited cell
  - Base station transmitter is in the center of the cell.
  - Omni-directional antennas are used.
- Edge-excited cell
  - Base station transmitters are on three of the six cell vertices.
  - Sectored directional antennas are used.



# Reuse Planning Example




7-cell reuse




4-cell reuse

- $N = i^2 + ij + j^2$

# Channel Assignment Strategies

- Objectives:
  - Increasing capacity
  - Minimizing interference

- Classification:
  - Fixed channel assignment strategies
  - Dynamic channel assignment strategies

# Fixed channel assignment

- Each cell is allocated a predetermined set of voice channel
- Any new call attempt can only be served by the unused channels
- The call will be *blocked* if all channels in that cell are occupied

# Dynamic channel assignment

- Channels are not allocated to cells permanently.
- Allocate channels based on request.
- Reduce the likelihood of blocking, increase capacity.


Thank
you