Cell splitting

- **Need of Cell Splitting:**

As no. of subscribers increase within a given area, the no. of channels allocated to a cell is no longer sufficient for supporting the subscriber demand. It becomes necessary to allocate more channels to the area that is being covered by this cell. This can be done by **CELL SPLITTING.**

MAXIMUM TRAFFIC LOAD

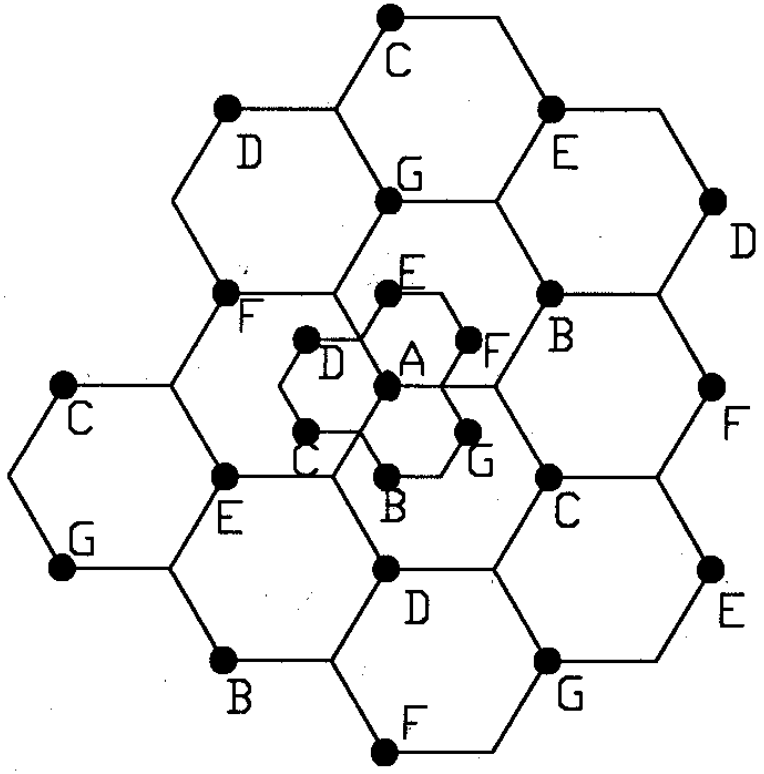
- **MAXIMUM TRAFFIC LOAD:**

  The point when a cell reaches maximum capacity occurs when the no. of subscribers wishing to place a call at any given time equals no. of channels in the cell.

CELL SPLITTING

- Cell Splitting is the process of subdividing a congested cell into smaller cells each with its own base station and corresponding reduction antenna height and transmitter power.
- It increases the capacity of the system since it increases the no. of times the channels are reused

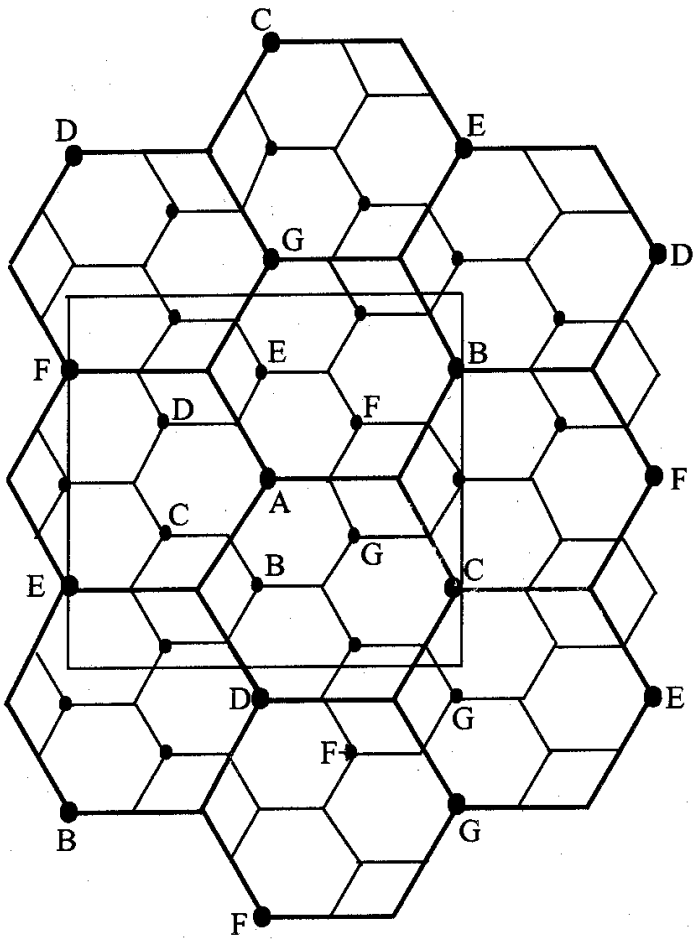
Cell splitting



Cell splitting

- Smaller cells are added in such a way to preserve the frequency reuse plan of the system for e.g Microcell base station labeled G is placed exactly half way b/w two large stations using the same channel set G

Illustration of cell splitting within a 3 km by 3 km square



Cell splitting

- New cell radius=Old cell radius/2
- New cell area=Old cell radius/4
- If each new cell carries the same maximum traffic load of the old cell then
- New Traffic Load /Unit Area=4(Old Traffic Load /Unit Area)

Problems Arising

- Let transmit power of BS of smaller cell is same as that of larger cells.
- Radius of new cell=R/2.
- Maximum distance the mobile can be from BS of this cell is R/2.
- FOR SMALLER CELL:Although the distance b/w this cell and any co-channel larger cell is reduced by half the value of Signal to Noise ratio remains the same.

Cell splitting

- FOR LARGER CELL: Signal to Noise ratio is not maintained because co-channel reuse ratio for these cells is now D/2R with respect to smaller cell.
- In order to maintain the same level of interferences the transmit power of the BS in the smaller cell should be reduced but these will increase the interference observed by the mobiles in the smaller cell.

- Transmission power reduction from P_{t1} to P_{t2}
- Examining the receiving power at the new and old cell boundary

$$P_r[\text{at old cell boundary}] \propto P_{t1} R^{-n}$$

$$P_r[\text{at new cell boundary}] \propto P_{t2} (R/2)^{-n}$$

- If we take *n = 4* and set the received power equal to each other

$$P_{t2} = \frac{P_{t1}}{16}$$

- The transmit power must be reduced by 12 dB in order to fill in the original coverage area.

- The other method is to divide the channel allocated to cells labeled A into two parts those used by ‘a’ and those not used by ‘a’.
- The channels used by ‘a’ will be used in the larger cells only within the radius of R/2 from the centre of the cell so that cochannel reuse ratio is maintained as far as these channels are concerned. This is called OVERLAID CELL CONCEPT where a larger macrocell coexists with a smaller microcell

Assignment

- Discuss in detail concept of cell splitting .

SECTORING

We know For a hexagonal geometry

- $D/R=(3N)^{1/2}$ & S/N is inversely proportional to D/R
- In Cell Splitting capacity or no. of channels per unit area is increased by decreasing the cell radius & keeping cochannel reuse ratio D/R unchanged

SECTORING

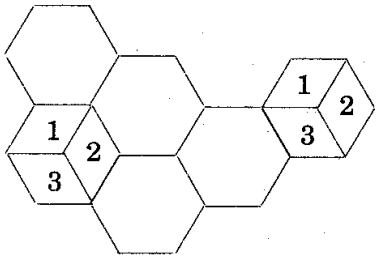
- Another way to increase the capacity is to keep cell radius unchanged and decrease D/R ratio.
- So Sectoring is the means to increase the channel capacity of a cellular telephone system by decreasing the D/R ratio while maintaining the same cell radius
- Channels allocated to a cell are further divided into three parts(120 degree sectors) each used in one sector of a cell.

SECTORING

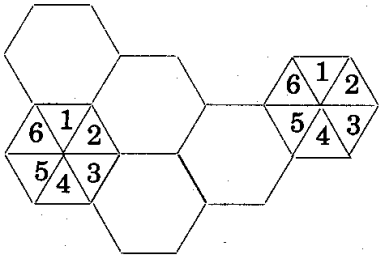
- In this approach first the S/I is improved by using directional antennas, then capacity improvement is achieved by reducing the no. of cells in a cluster.
- However Relative Interference is reduced without decreasing the transmit power.

Sectoring

- Decrease the *co-channel interference* and keep the cell radius *R* unchanged
  - Replacing single omni-directional antenna by several directional antennas
  - Radiating within a specified sector

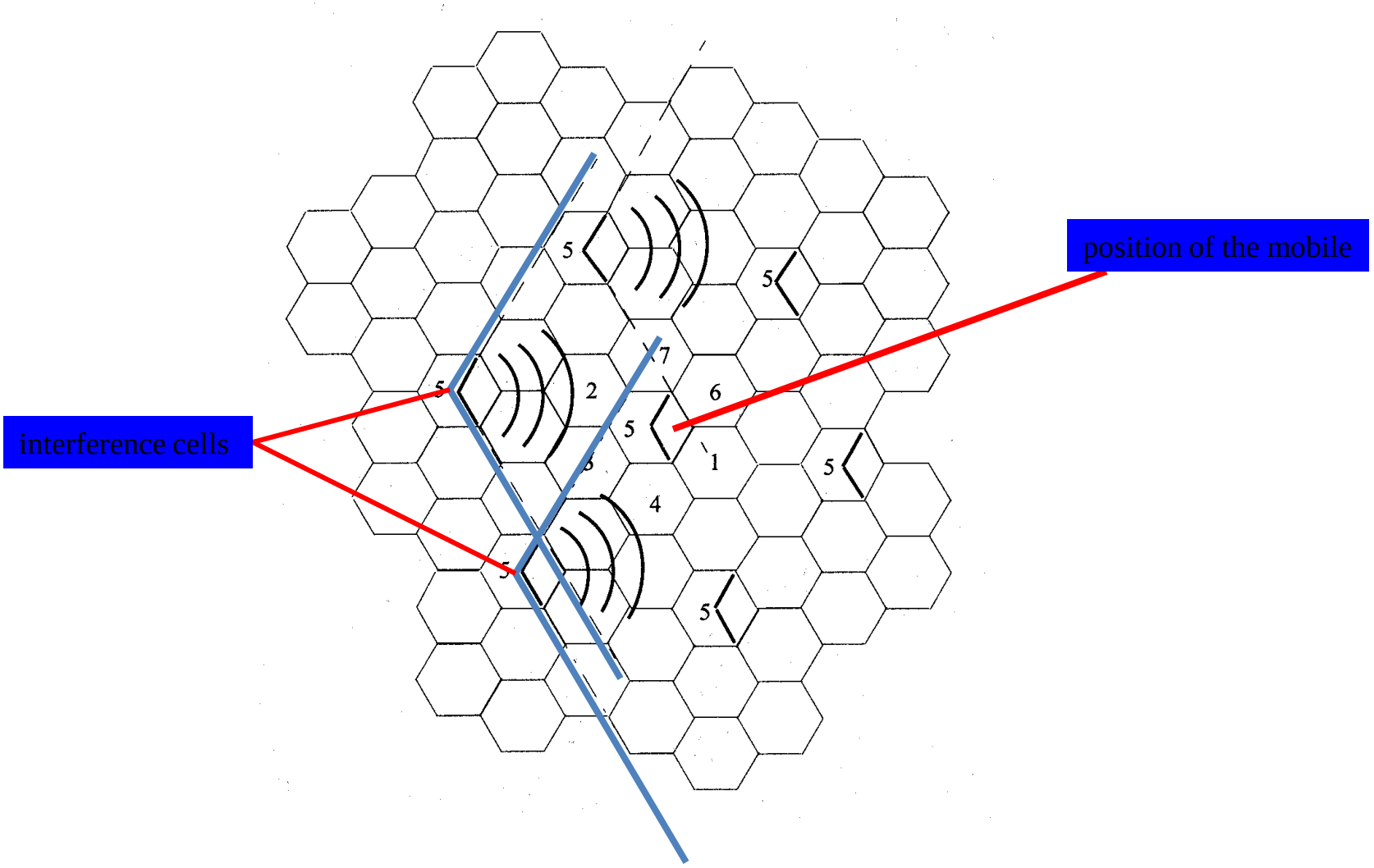


(a)



(b)

- Interference Reduction



Sectoring

- By using directional antennas a given cell will receive and transmit with only a fraction of available co-channel cells.
- In the example shown Consider the interference experienced by a mobile located in the rightmost sector in the center cell labeled ‘5’

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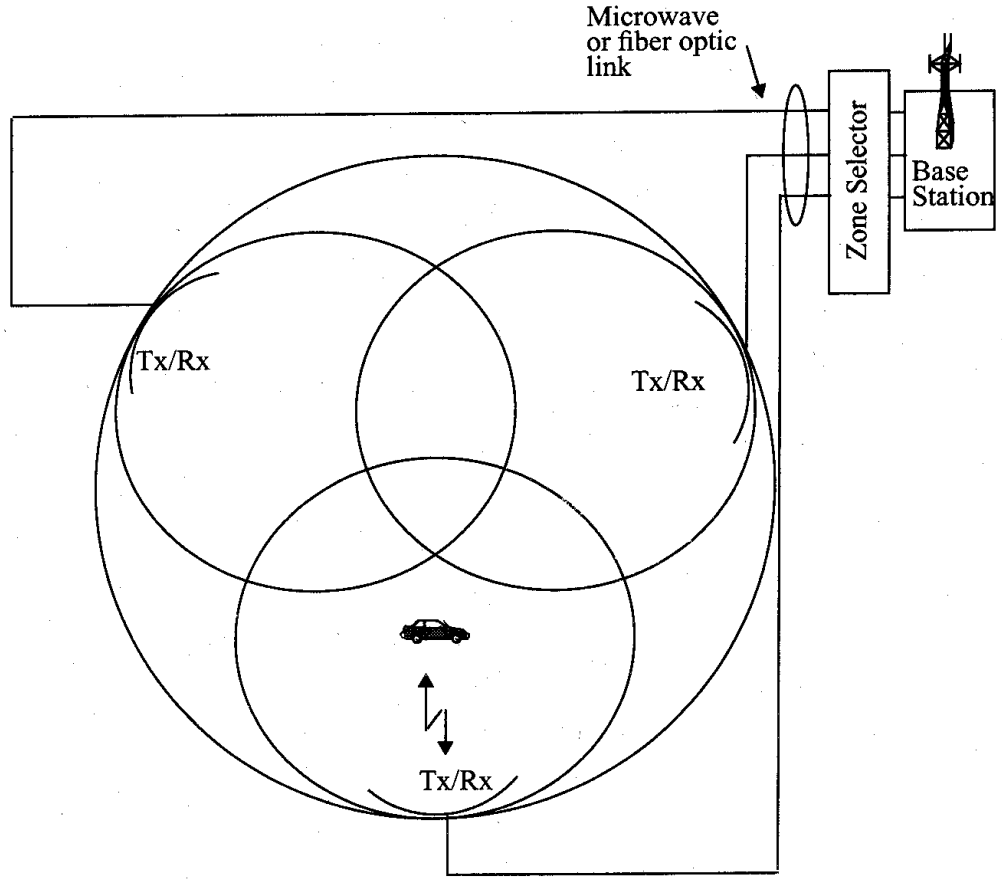
Sectoring

- There are six co-channel cell sectors labeled ‘5’ three to its right & three to its left. Out of these six only two cells have sectors with antenna patterns which radiate into the centre cell.Hence a mobile will experience interference on the forward link from these two sectors only.
- Hence Signal to Interference ratio is improved.
- By using 60 degree directional antennas no. of interfering cochannel cells reduces to one

LEE's MICROCELL ZONE CONCEPT

- In sectoring concept, Handoff is increased which increases the load on the switching &control link elements of the mobile system.
- In this concept there is only one BS per cell but there are three zone-sites located at the corners of a cell.
- All the three zone sites act as receivers for signal transmitted by mobile terminal and connected to a single BS and share the same radio equipment.

LEE's MICROCELL ZONE CONCEPT



LEE's MICROCELL ZONE CONCEPT

- The BS determines which of the zone-sites has the best reception from the mobile and uses that zone-site to transmit the signal on the downlink.
- As the mobile user travels within the cell it is served by the zone with the strongest signal retaining the same channel.
- Thus like in sectoring, a handoff is not required at MSC when mobile travels b/w zones within the cell. The BS simply switches the channel to a different zone site.