ECS455 Chapter 2

Cellular Systems

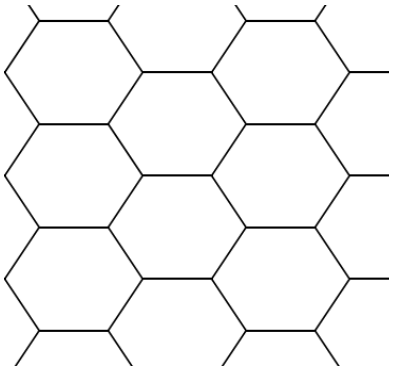
2.3 Sectoring

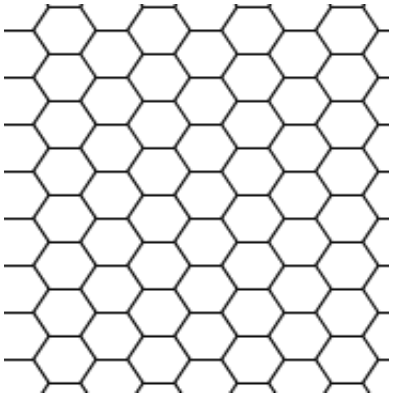
Office Hours:
BKD 3601-7
Wednesday 15:30-16:30
Friday 9:30-10:30

Improving Coverage and Capacity

- As the demand for wireless service increases, the number of channels assigned to a cell eventually becomes insufficient to support the required number of users.
- At this point, cellular design techniques are needed to provide more channels per unit coverage area.
- Easy!?

$$C = \frac{A_{\text{total}}}{A_{\text{cell}}} \times \frac{S}{N}$$

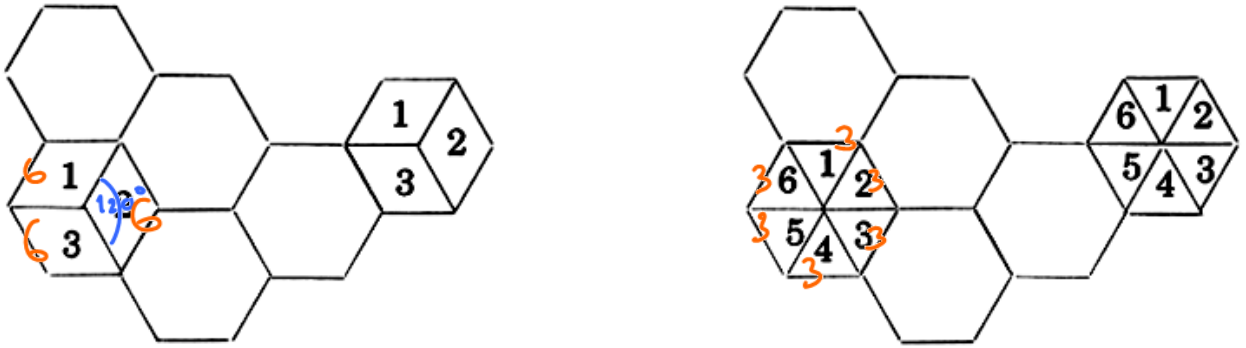




If cells can be reduced in size, more of them can be added in a given area, increasing the overall capacity.

Sectoring (N = 7)

- Ex. With no sectoring, suppose $m = 18$ channels/cell
  - With 120° sectoring, we have 6 channels/sector
  - With 60° sectoring, we have 3 channels/sector
- "Can support the same number of users" per cell
  - In the next section, we will consider different kind of capacity. For such capacity, sectoring will give less capacity.



[Rappaport, 2002]

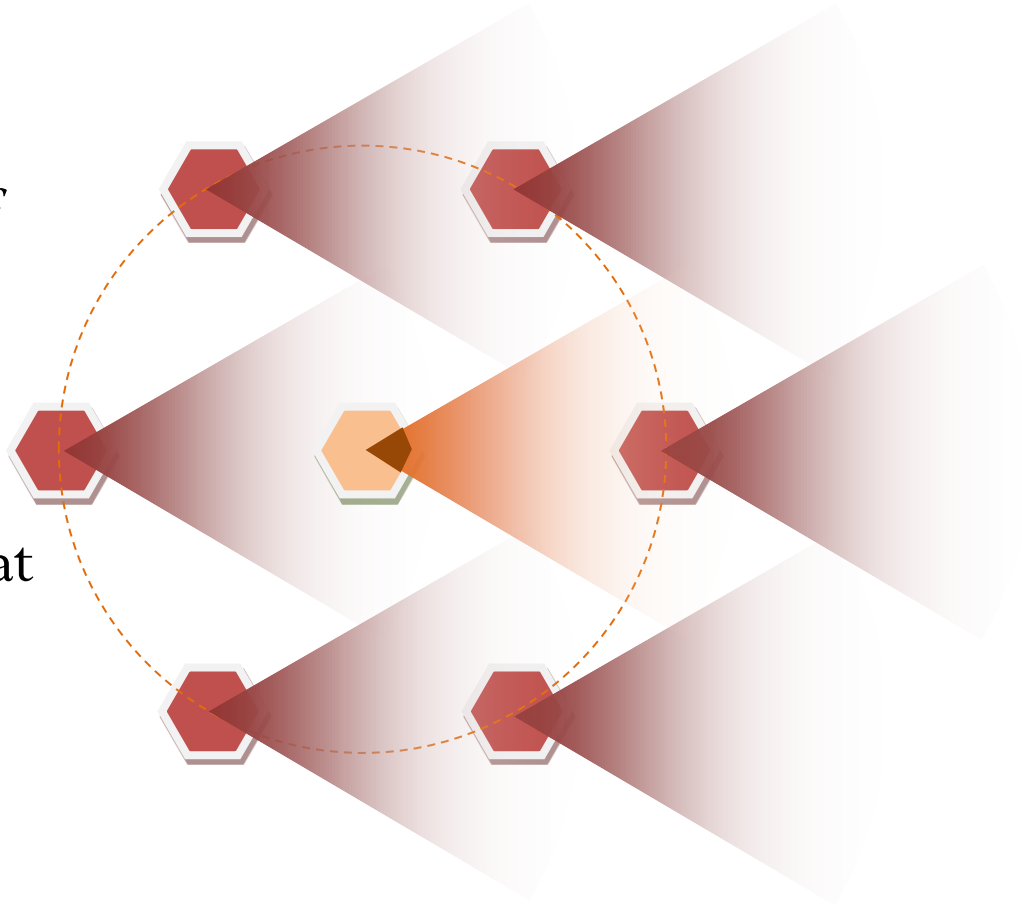
Figure 3.10 (a) 120° sectoring; (b) 60° sectoring.

- Why is this better?

60 Degree Sectoring

$$\mathrm{SIR} \approx \frac{1}{K}\left(\sqrt{3N}\right)^{\gamma}$$

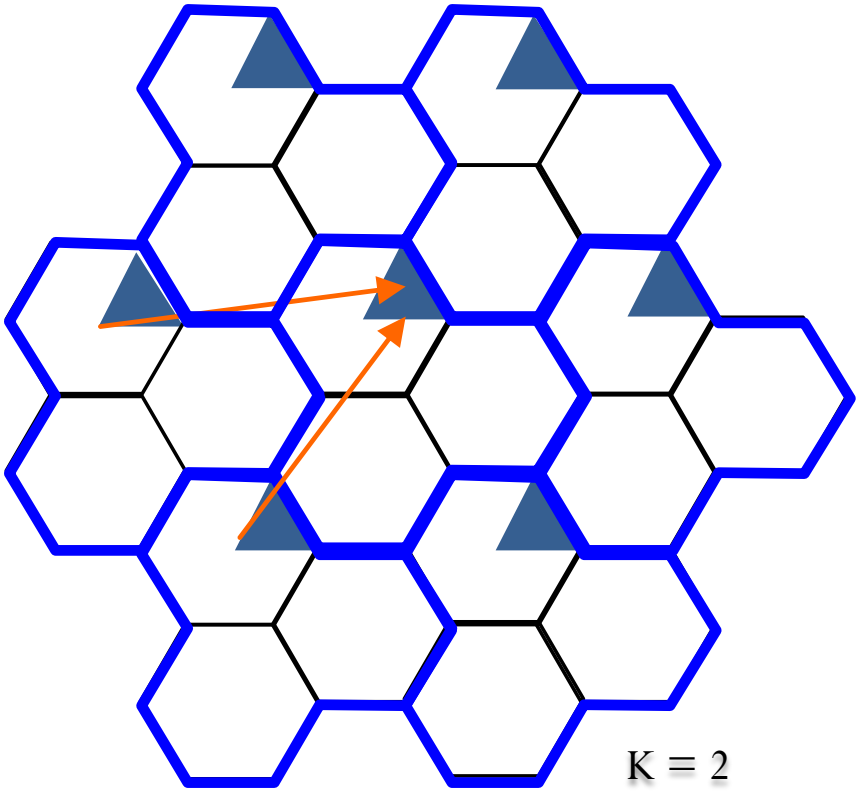
- Out of the 6 co-channel cells in the first tier, only one of them interfere with the center cell.
- If omnidirectional antennas were used at each base station, all 6 co-channel cells would interfere the the center cell.

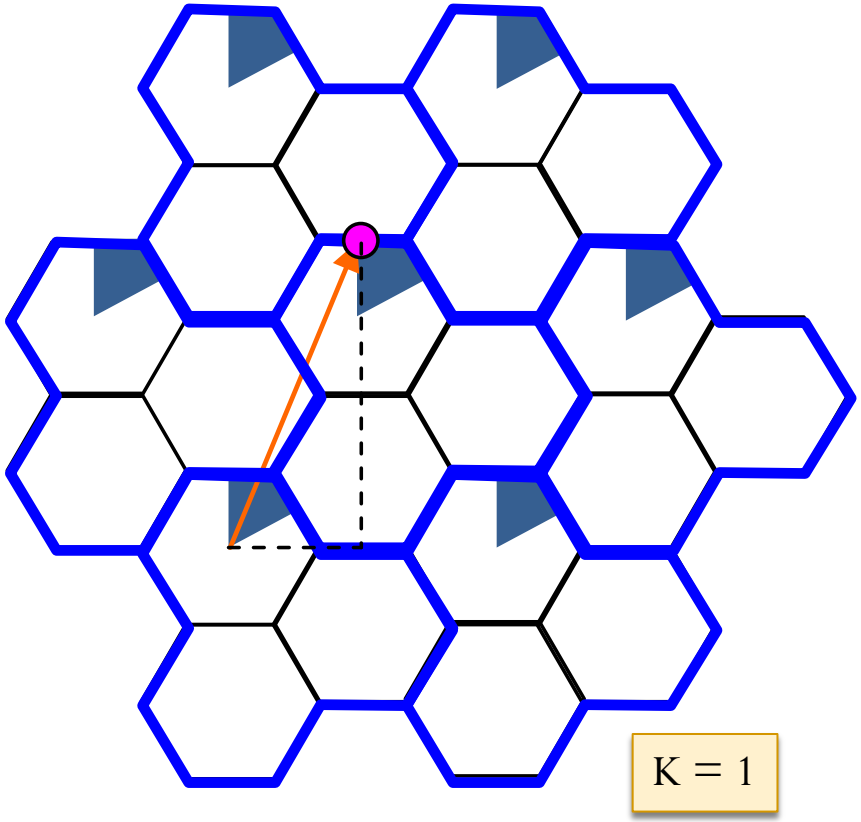


The value of K changes from 6 to 1!

Sectoring (N = 3 , 60°)

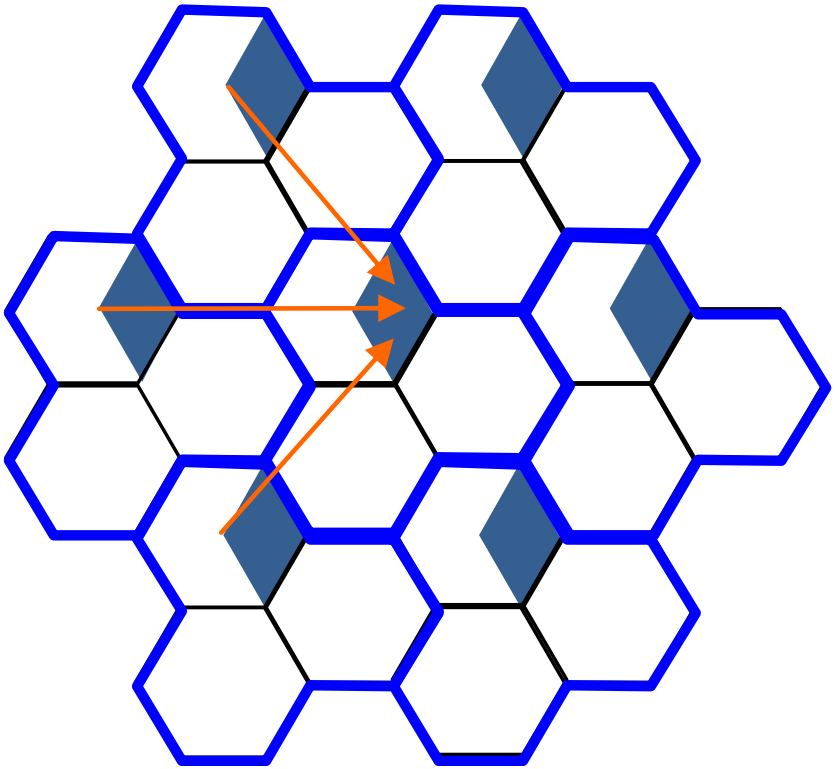
$$\mathrm{SIR} \approx \frac{1}{K}\left(\sqrt{3N}\right)^{\gamma}$$



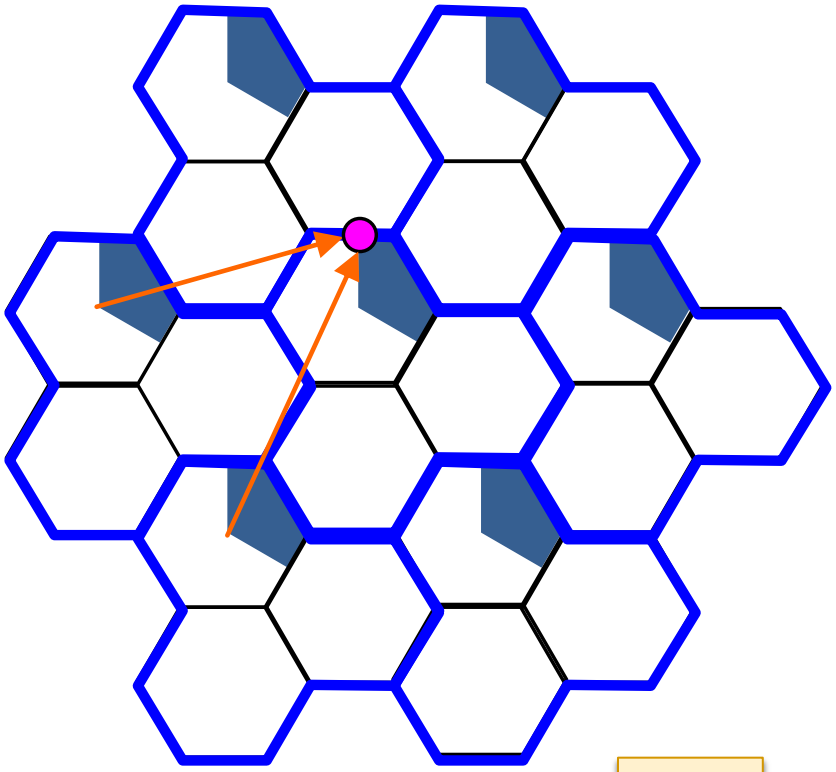


Sectoring (N = 3, 120°)

$$\mathrm{SIR} \approx \frac{1}{K}\left(\sqrt{3N}\right)^{\gamma}$$



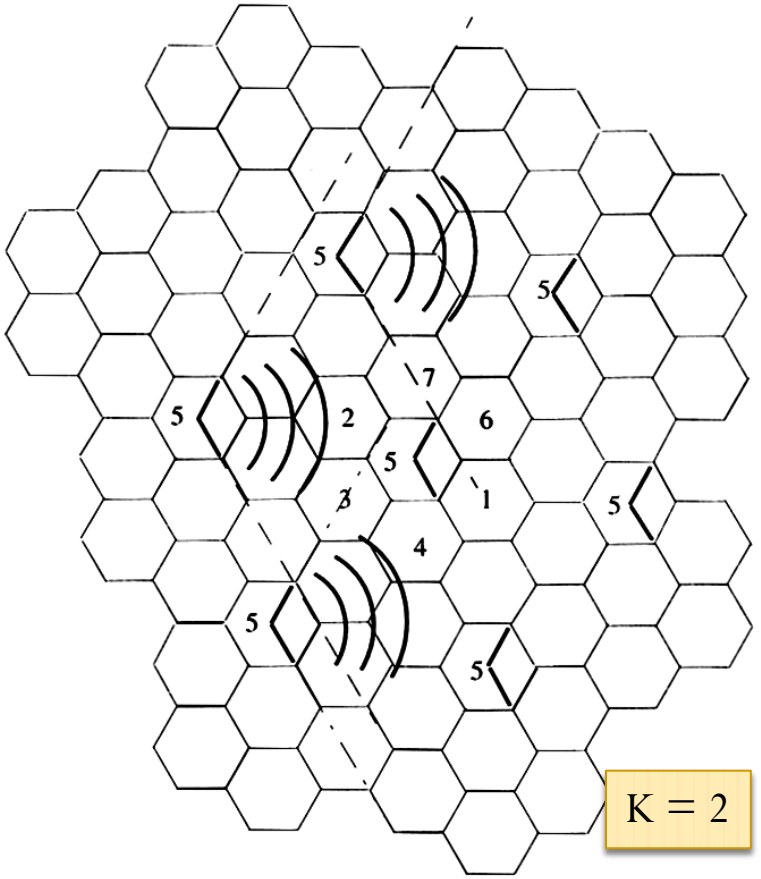
K = 3



K = 2

Sectoring (N = 7, 120°)

Assuming seven-cell reuse, for the case of 120° sectors, the number of interferers in the first tier is reduced from six to two.



[Rappaport, 2002, Fig 3.11]

$$\text{SIR} \approx \frac{1}{K}\left(\sqrt{3N}\right)^{\gamma} \qquad C = \frac{A_{\text{total}}}{A_{\text{cell}}} \times \frac{S}{N}$$

Sectoring

K = 6 omni

K = 1 60°

K = 2 120°

- Advantages
  - Reduce interference by reducing K
    - Increase SIR (better call quality).
    - The increase in SIR can be **traded** with reducing the cluster size (N) which increase the capacity.
- Disadvantages
  - Increase number of antennas at each base station.
  - Next section: Decrease **trunking efficiency** due to channel sectoring at the base station.
    - The available channels in the cell must be subdivided and dedicated to a specific antenna.