

ECS455 Chapter 2

Cellular Systems

2.3 Sectoring

Office Hours:

BKD 3601-7

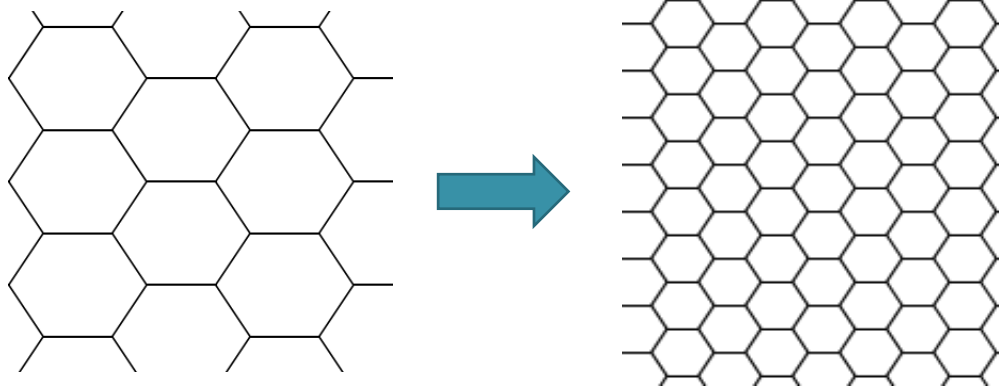
Monday 9:20-10:20

Wednesday 9:20-10:20

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!?

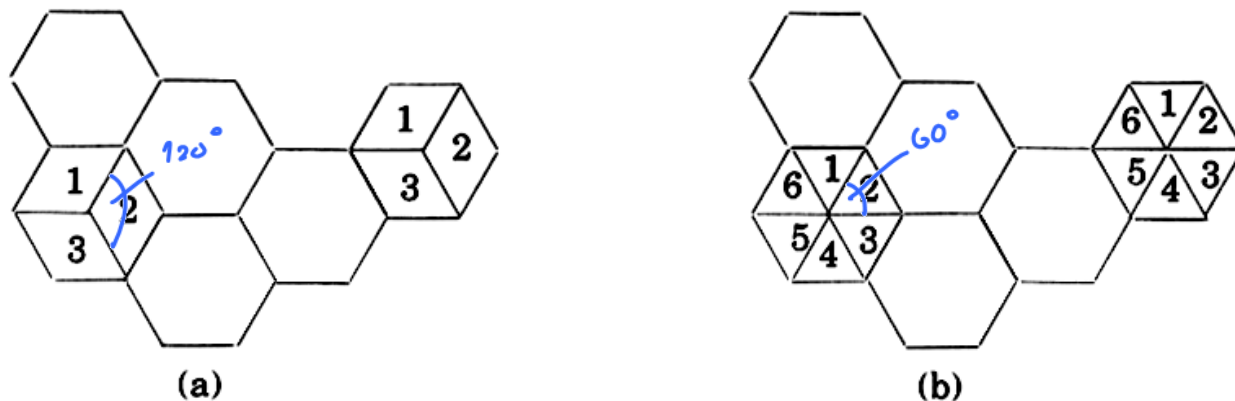
$$C = \frac{A_{\text{total}}}{A_{\text{cell}}} \times \frac{S}{N}$$



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]

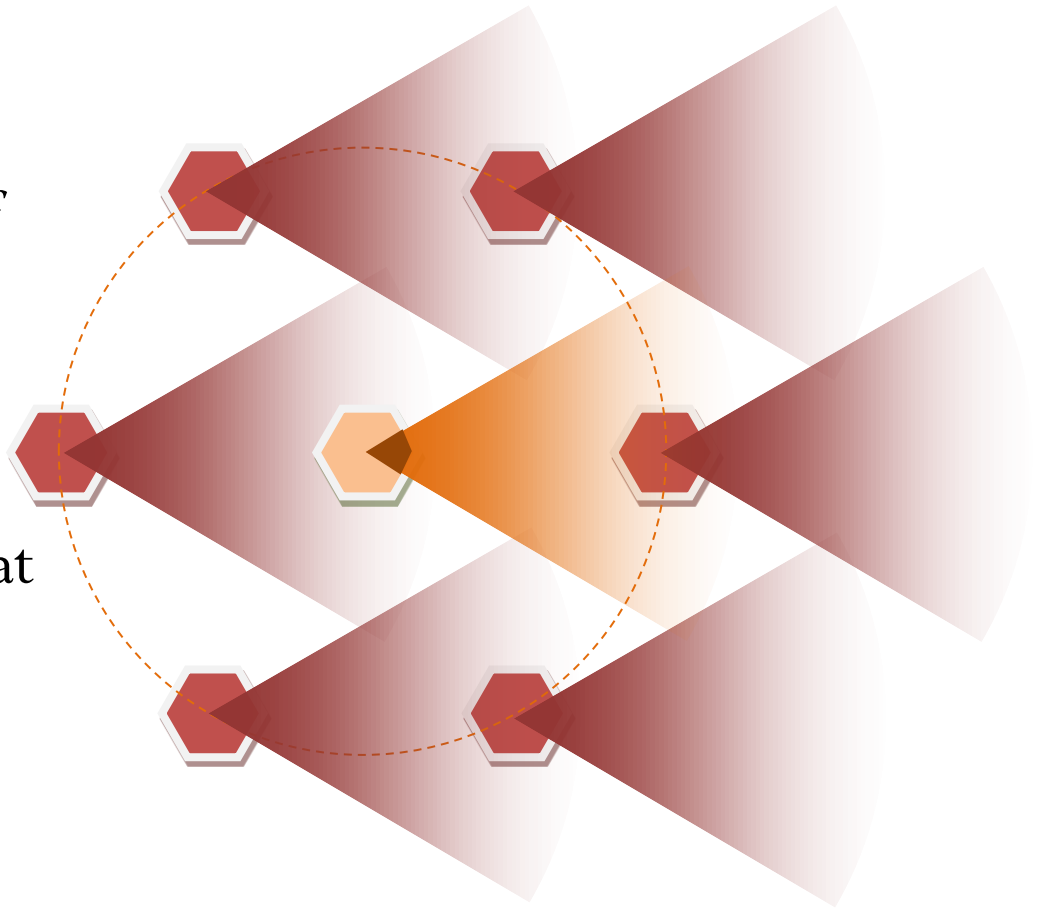
Figure 3.10 (a) 120° sectoring; (b) 60° sectoring.

- Why is this better?

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

60 Degree Sectoring

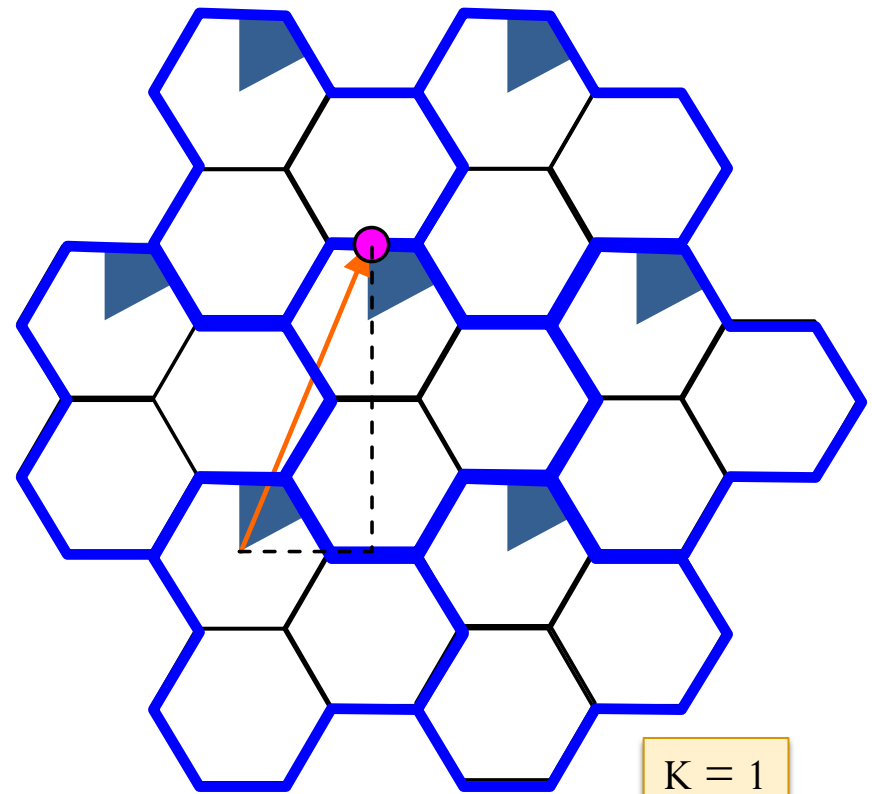
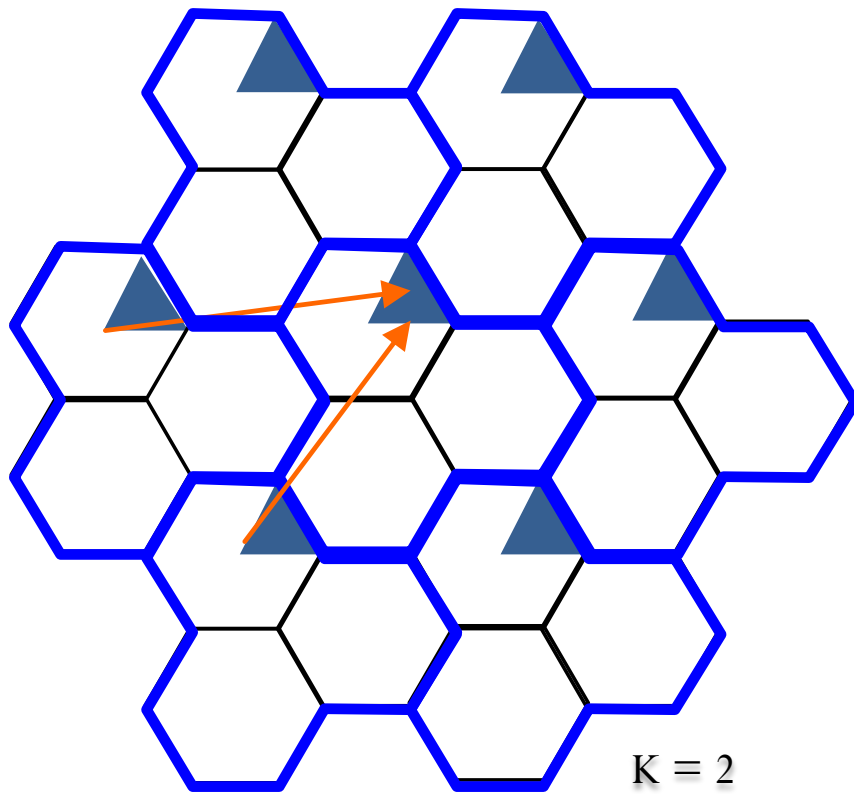
- Out of the 6 co-channel cells in the first tier, only one of them interfere with the center cell.
- If omnidirectional antennas were used at each base station, all 6 co-channel cells would interfere the the center cell.



The value of K changes from 6 to 1!

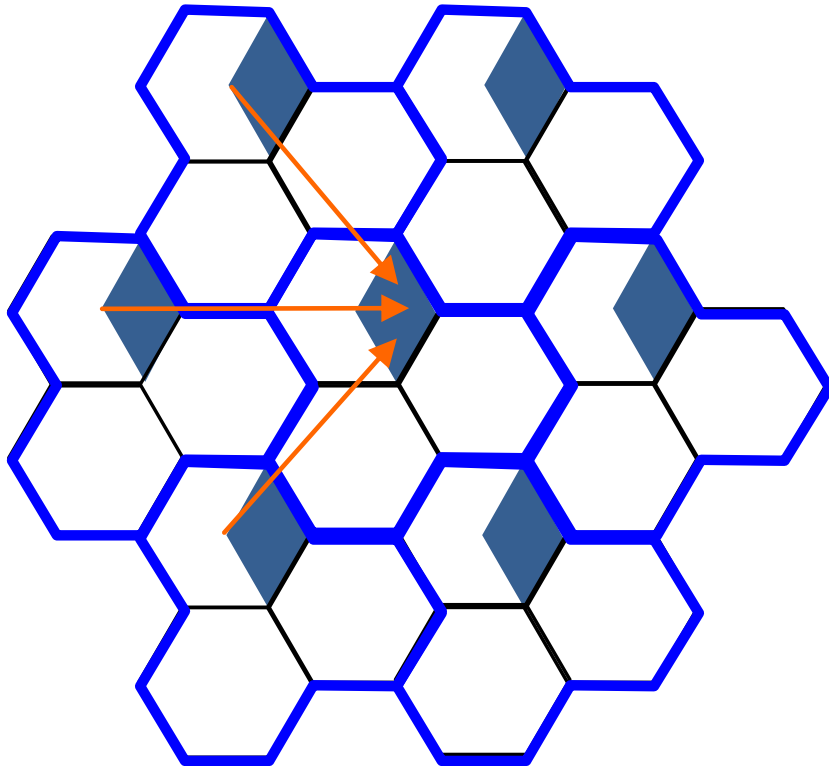
Sectoring ($N = 3, 60^\circ$)

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

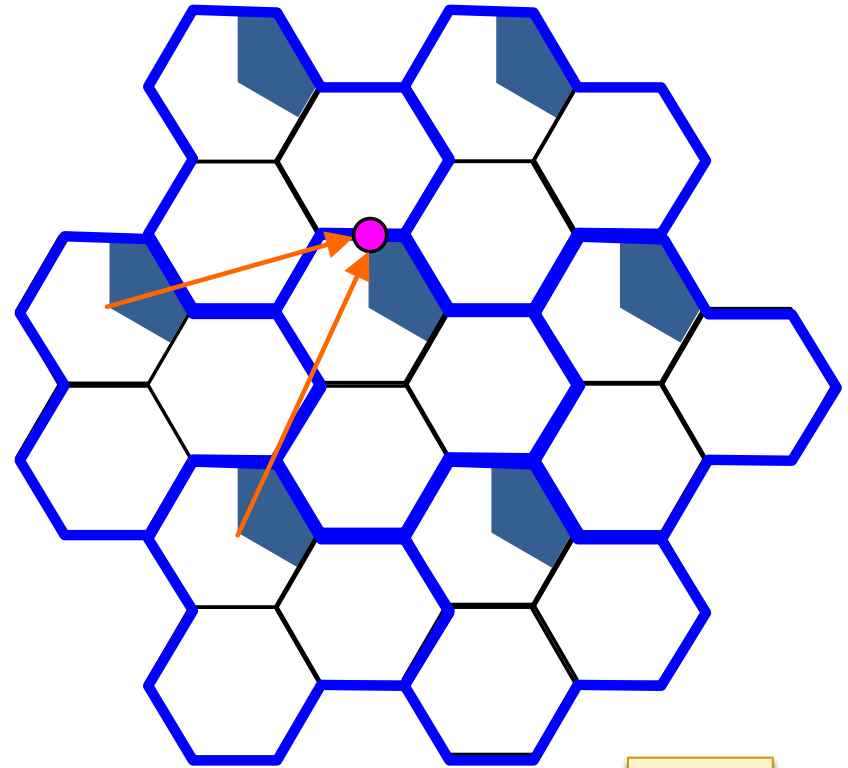


Sectoring ($N = 3, 120^\circ$)

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



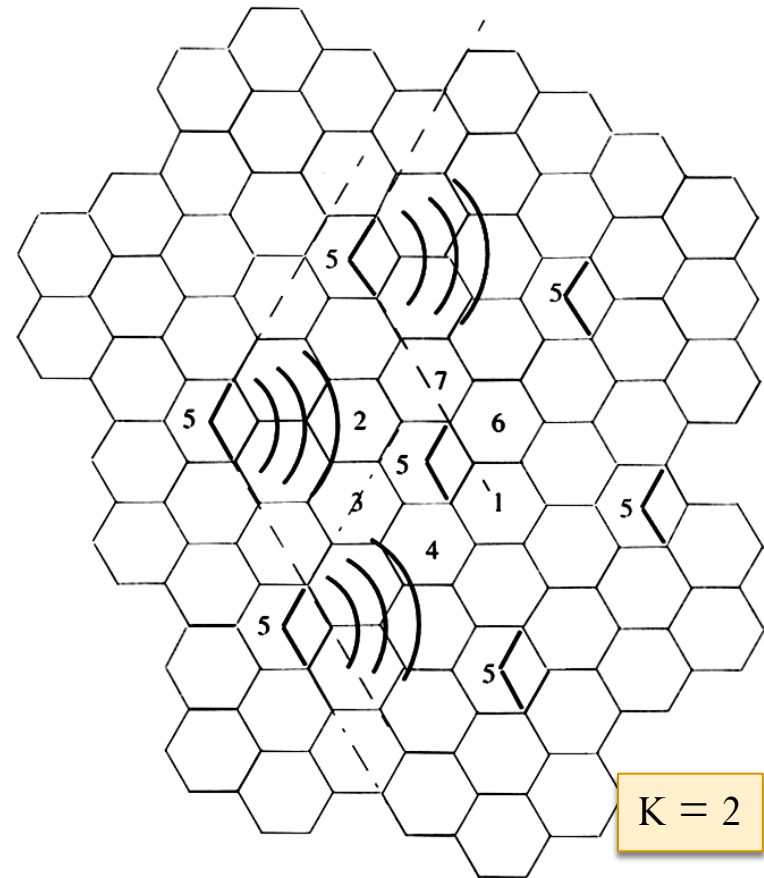
$K = 3$



$K = 2$

Sectoring ($N = 7, 120^\circ$)

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]

Sectoring

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

6 omnidirectional
2 120° sectoring
1 60° "

- 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.