Mobile Communications

TCS 455

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Lecture 5

Office Hours:
BKD 3601-7
Tuesday 14:00-16:00
Thursday 9:30-11:30

Announcements

- Read
  - Chapter 1
    - Don't pay too much attention to details
  - Chapter 3: 3.1 – 3.2, 3.5.1
    - Posted on the web
- Many papers posted on the SIIT online lecture note system.
- Due date for HW1: This Friday!

Activity 1

Cluster size $N = i^2 + ij + j^2$

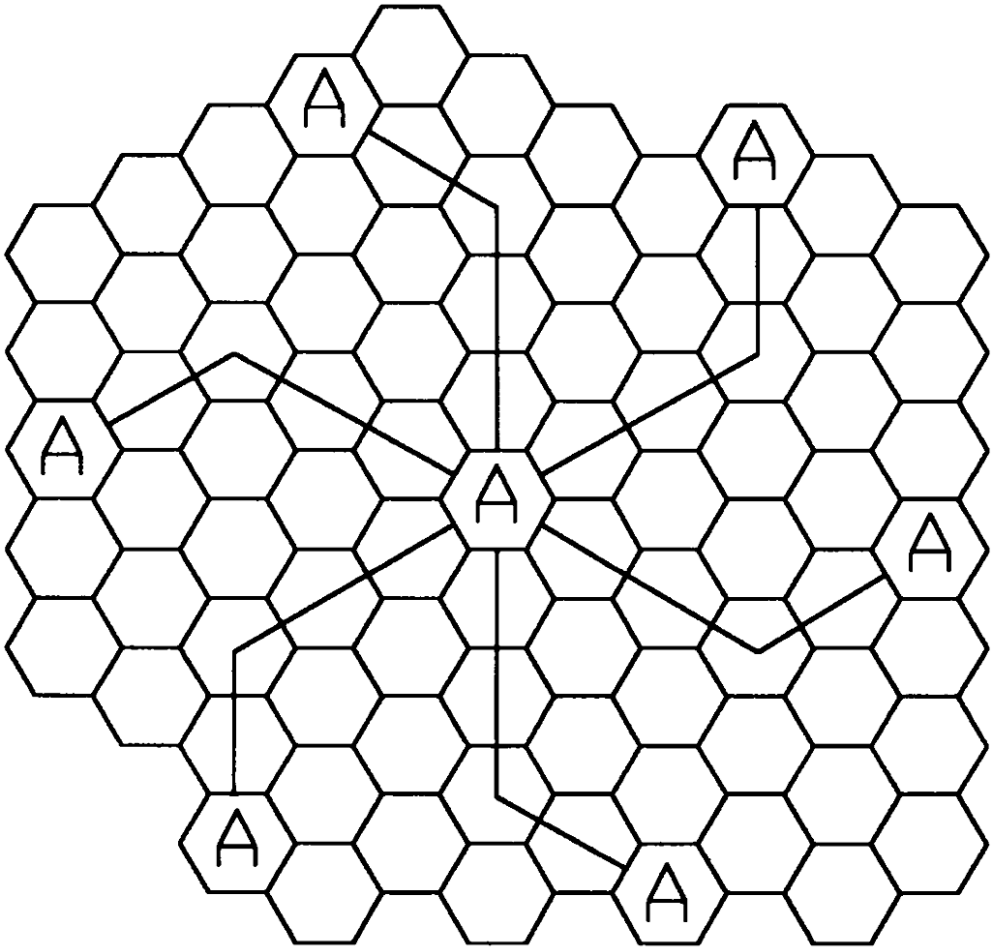
- You have seen N = 3, 4, 7, 9, 12, 13, 16, 19 ...
- Find the next five **lowest** values of N.
- In HW2, find the next fifteen **lowest** values of N.

i, j nonnegative integers.

$i = 2, j = 1 \Rightarrow N = 7$

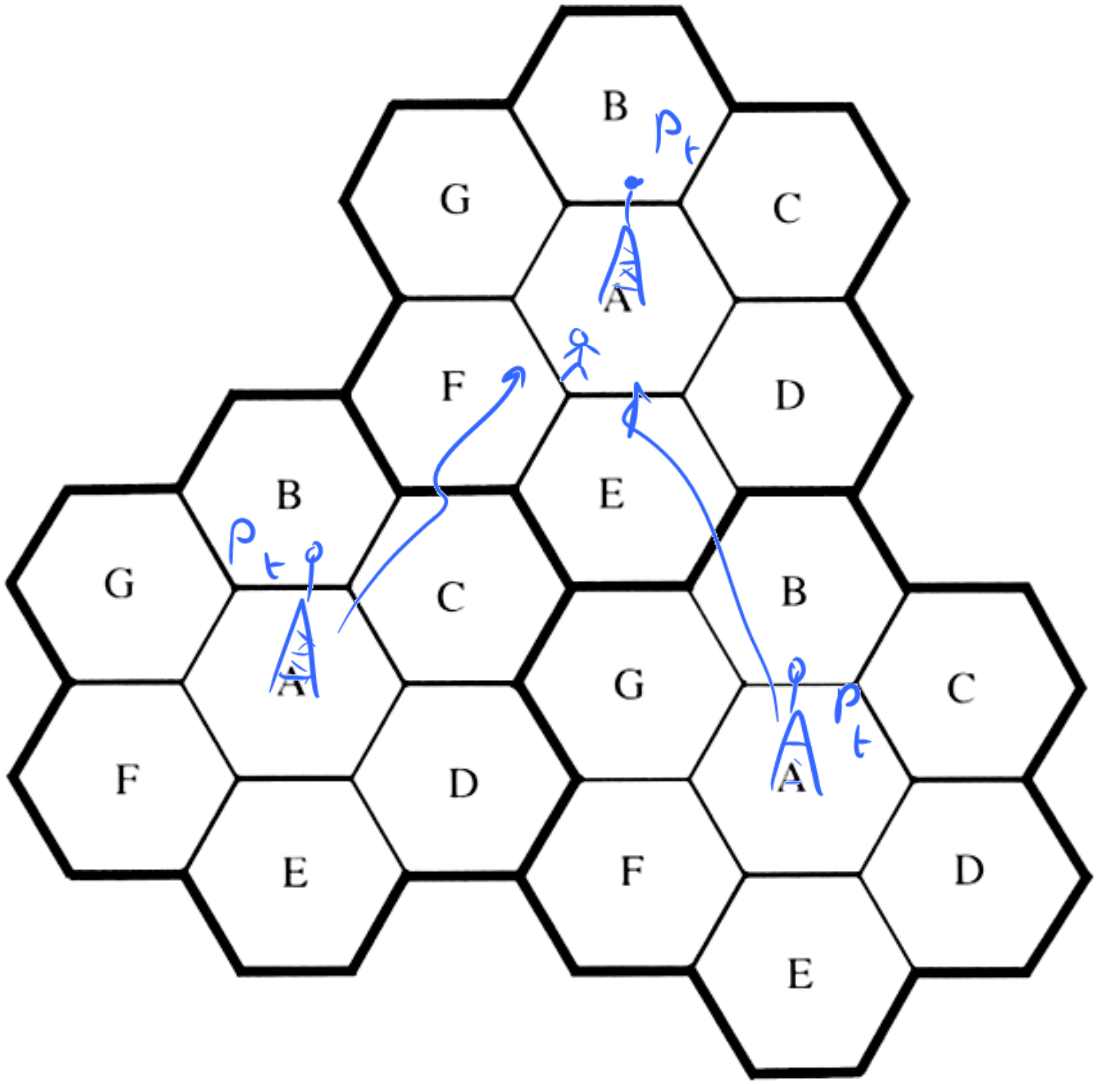
N=19

$i = 3, j = 2$



Method of locating co-channel cells in a cellular system. In this example, $N = 19$ (i.e., $I = 3$, $j = 2$). (Adapted from [Oet83] © IEEE.)

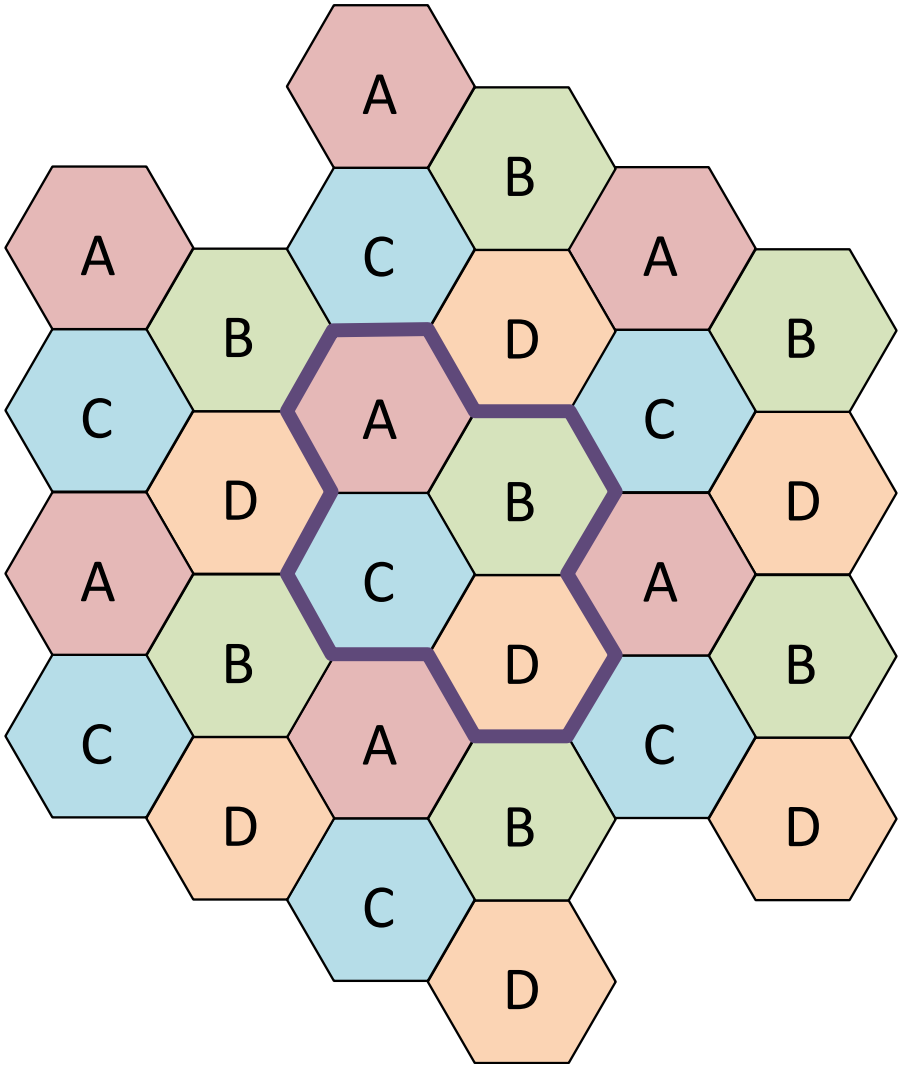
N = 7



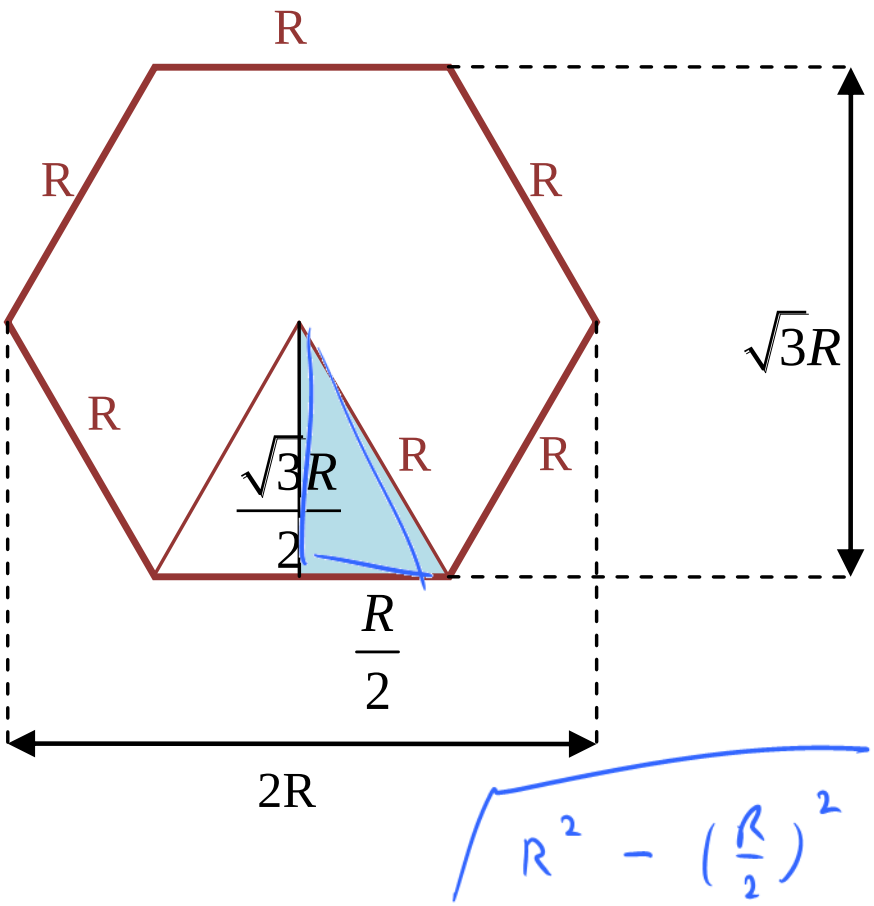
Activity 2

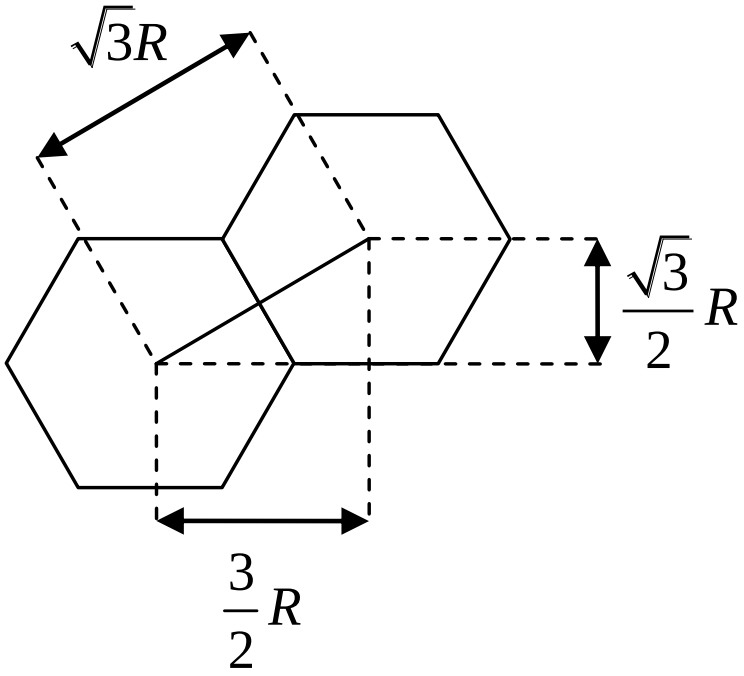
- Separate into groups of 3-4 persons.
- Draw a picture similar to the one shown on the previous slide. Use N = the number of persons in your groups.
  - If you have 3 persons, then use N = 3.
  - If you have 4 persons, then use N = 4.
- ~~Draw at least 25 cells.~~

N = 4

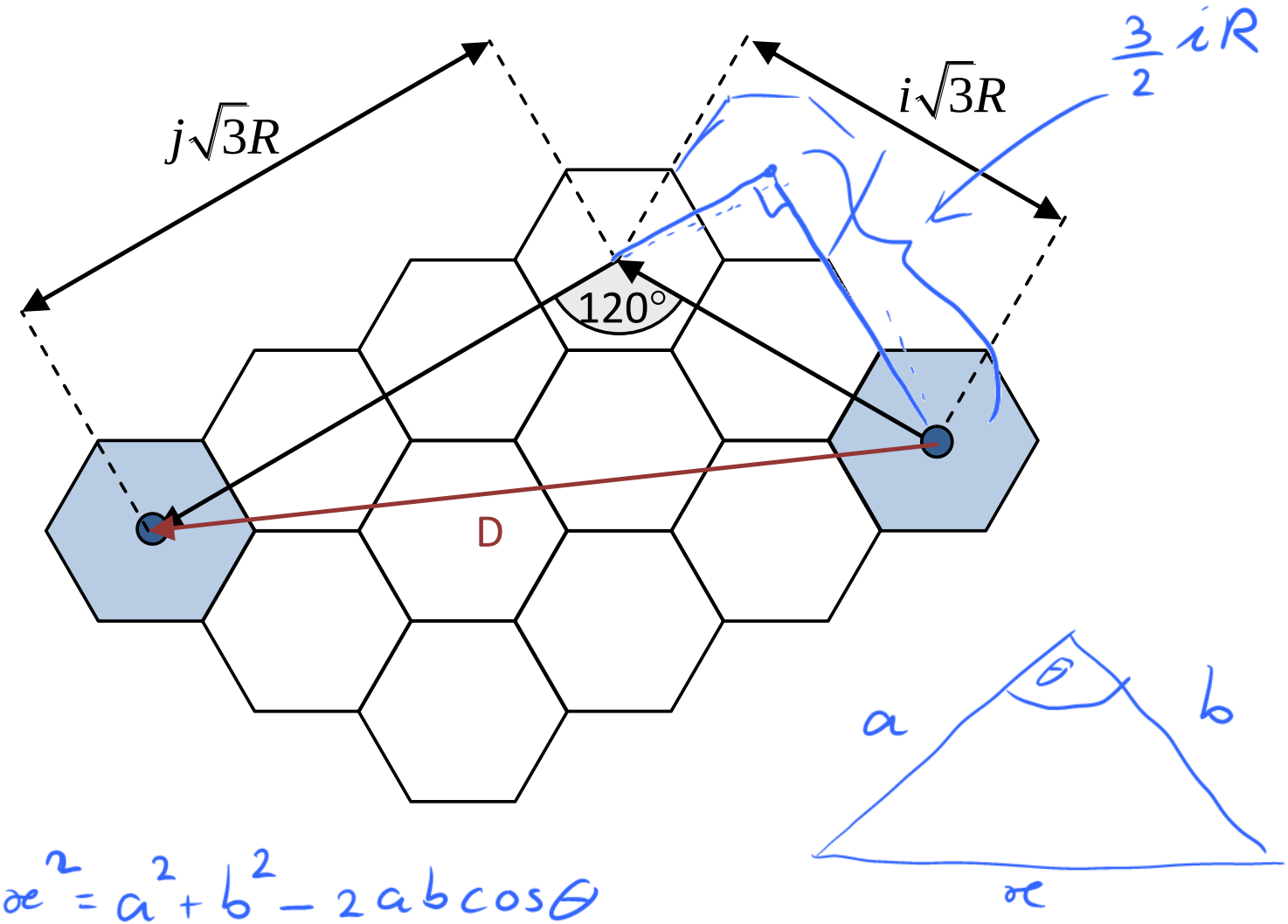


Hexagon

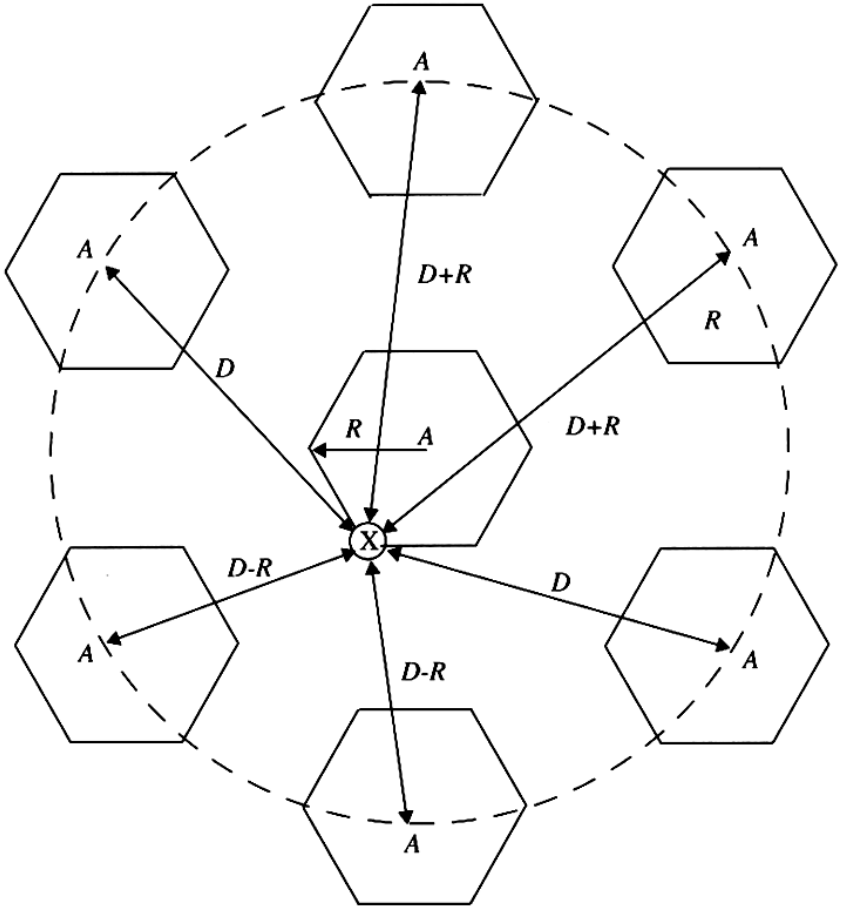

R
R
R
R
R
R
$\sqrt{3}R$
$\frac{\sqrt{3}R}{2}$
$\frac{R}{2}$
2R
$R^2 - \left(\frac{R}{2}\right)^2$


$\sqrt{3}R$
$\frac{\sqrt{3}}{2}R$
$\frac{3}{2}R$

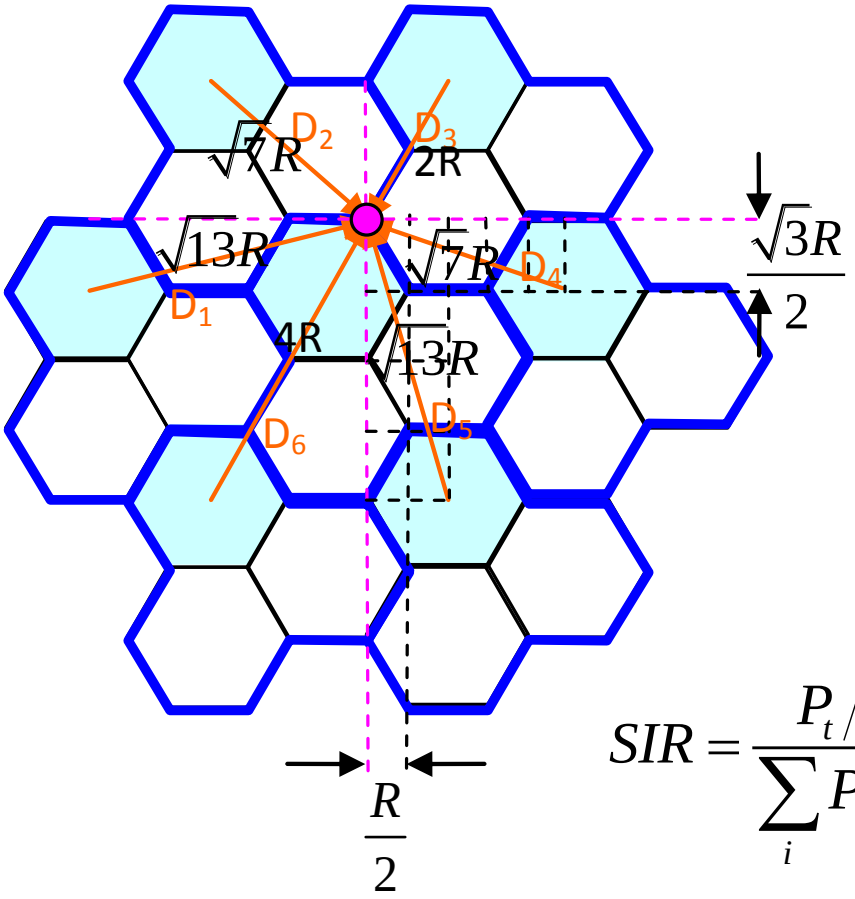
D and R



Co-channel cells for 7-cell reuse



SIR: N = 3



$$D_1 = D_5 = R\sqrt{(1)^2 + \left(4\frac{\sqrt{3}}{2}\right)^2} = R\sqrt{13}$$

$$D_2 = D_4 = R\sqrt{\left(\frac{5}{2}\right)^2 + \left(\frac{\sqrt{3}}{2}\right)^2} = R\sqrt{4}$$

$$D_3 = 2R$$

$$D_6 = 4R$$

$$SIR = \frac{P_t / R^{-\gamma}}{\sum_i P_t / D_i^{-\gamma}} = \frac{1}{2\left(\sqrt{7}\right)^{-\gamma} + 2\left(\sqrt{13}\right)^{-\gamma} + 2^{-\gamma} + 4^{-\gamma}}$$

Sectoring (N = 7)

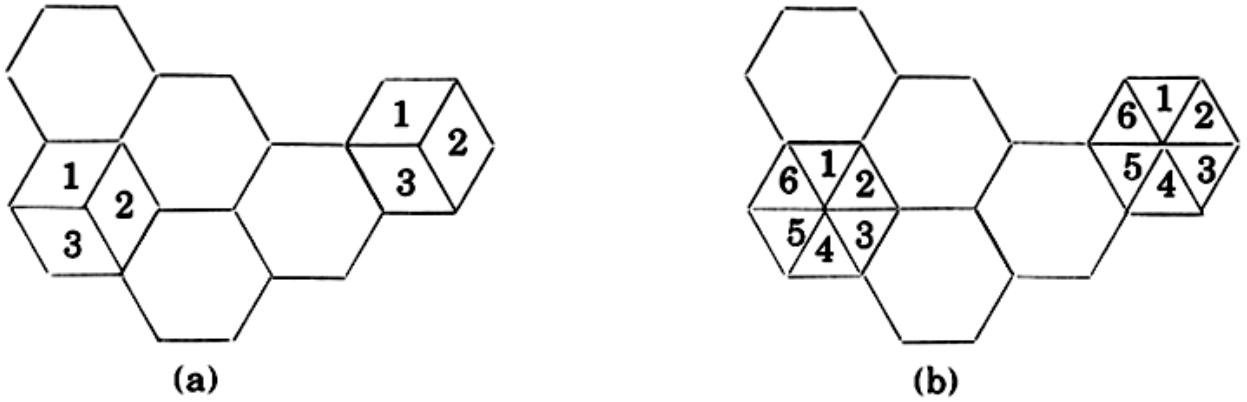


Figure 3.10 (a) 120° sectoring; (b) 60° sectoring.

Sectoring (N = 7)

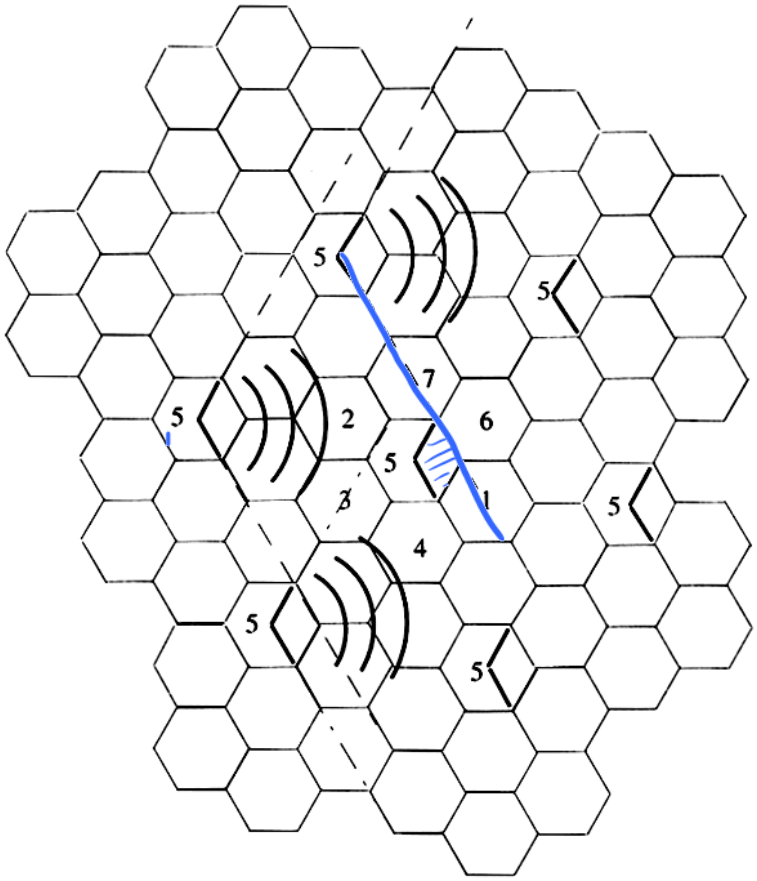
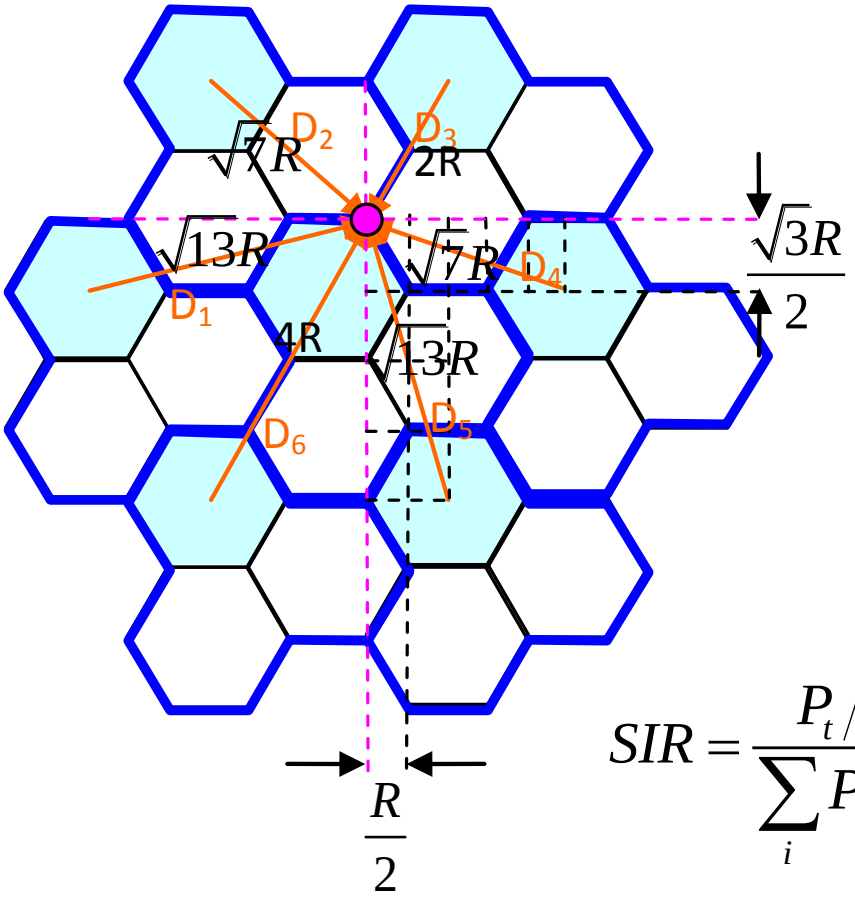


Figure 3.11 Illustration of how 120° sectoring reduces interference from co-channel cells. Out of the 6 co-channel cells in the first tier, only two of them interfere with the center cell. If omnidirectional antennas were used at each base station, all six co-channel cells would interfere with the center cell.

SIR: N = 3



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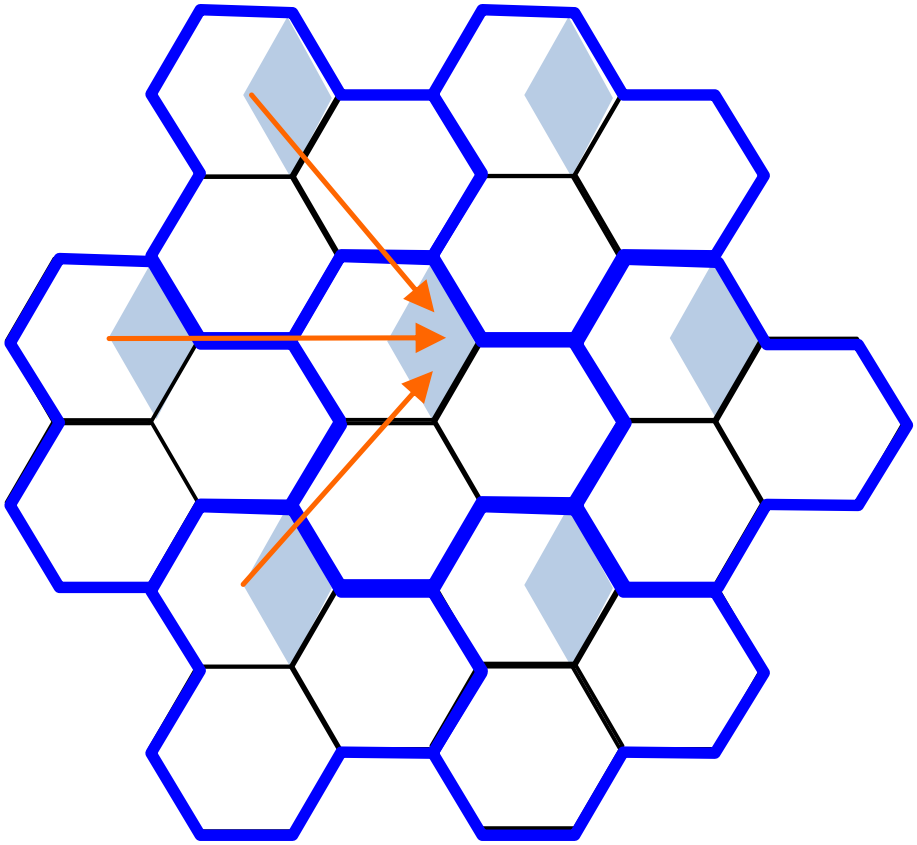
$$SIR = \frac{P_t / R^{-\gamma}}{\sum_i P_t / D_i^{-\gamma}} = \frac{1}{2\left(\sqrt{7}\right)^{-\gamma} + 2\left(\sqrt{13}\right)^{-\gamma} + 2^{-\gamma} + 4^{-\gamma}}$$

Sectoring (N = 3, 120°)



Bad!

Sectoring (N = 3 , 120°)