ECS702U/P Assignment (2021-22)

Mobile and WLAN Technologies

Assignment (1)

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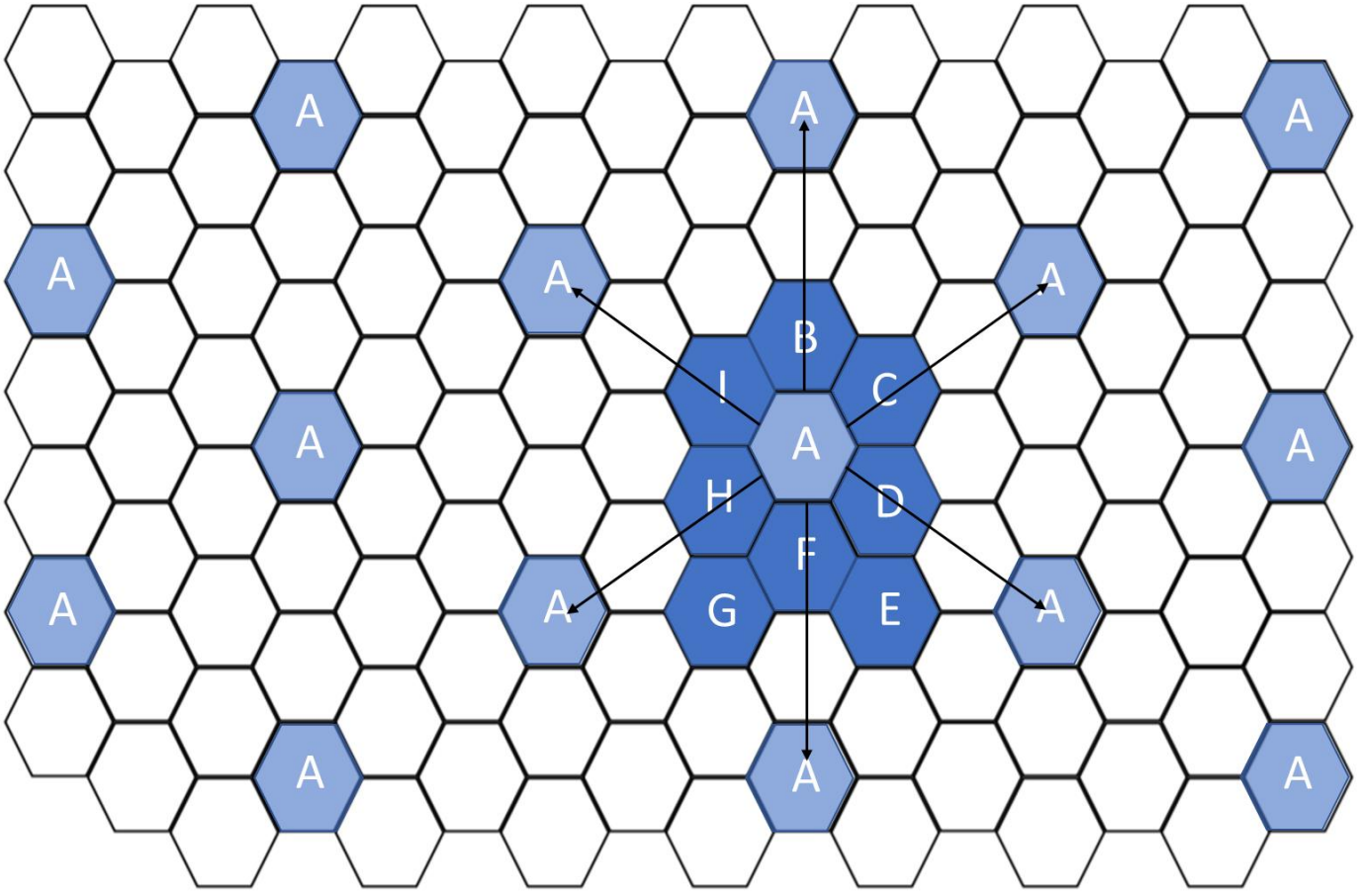
1. In a 9 cells per cluster cellular network. (3 marks)

A- Make a copy of the blank cellular network grid (last slide of Lecture 2-2: Cellular Fundamentals 2) and use capital letters (A, B, C, ...) or different colours to show in the whole network the co-channel reuse pattern and complete all network grid ?

Answer:

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

N=9 , i=0, j= 3



B - Find the carrier to interference ration C/I in dB in this cellular network using a 120 degree directional antenna ?

Answer:

$$\frac{C}{I} = \frac{R^{-4}}{(D + 0.7R)^{-4} + D^{-4}}$$

When D = 4.6 R

$$\frac{C}{I} = \frac{R^{-4}}{(D + 0.7R)^{-4} + D^{-4}} = \frac{R^{-4}}{(4.6R + 0.7R)^{-4} + (4.6)^{-4}. R^{-4}} = \frac{R^{-4}}{R^{-4}[(5.3)^{-4} + (4.6)^{-4}]}$$

$$= 285.652$$

10 log (285.652) = 24.12 dB

When D = 5.2 R

$$\frac{C}{I} = \frac{R^{-4}}{(D + 0.7R)^{-4} + D^{-4}} = \frac{1}{[(5.9)^{-4} + (5.2)^{-4}]} = 456.006$$

10 log (456.006) = 26.58 dB

2. Assume that in a cell, the number of calls per hour in the busy-hour is 1080, the average call holding time is 160 seconds and GOS is 0.03 ? (6 marks)

A- Calculate the offered traffic intensity in that cell ?

Answer:

$$T(\text{Erlang}) = \frac{(\text{No. of calls / hour}) * (\text{Average call holding time / sec})}{3600}$$

$$T(\text{Erlang}) = \frac{1080 * 160}{3600} = \underline{48 \text{ Erlang}}$$

B- How many channels are needed (use Erlang B table provided), if an omni-directional antenna is used ?

Answer:

GOS = 0.03 = 3%

From the Erlang table we need = 57 Channels *(48.7 in Erlang Table)*

C- How many channels are needed If 60 degree directional antennas are used ?

Answer:

Each sector can receive traffic of 48/6 = 8 Erlang

The required channels in the sector is 14 Channels *(8.80 in Erlang Table)*

D- Compare and comment on the trunking efficiencies in (B) and (C) ?

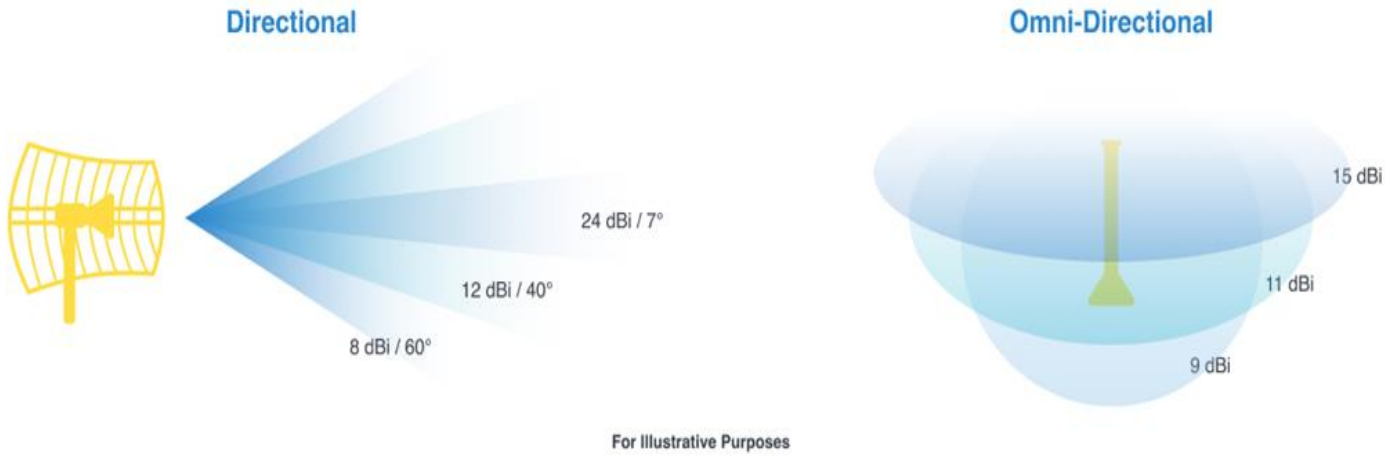
For B:

Trunking efficiency: TE(%) = T/C * 100 = 48/57 * 100 = 84.2 %

For C:

Trunking efficiency: TE(%) = T/C * 100 = 48/(14*6) * 100 = 57.1 %

- When a cell is divided in sectors there is a degradation of channel utilization efficiency
- When 60° sectorization is used, one cell that usually covers 360° is divided into six 60° regions.
- Out of the 6 co-channel cells in the first tier, only one of them interfere with the center cell.



3. Assume a system with seven cells, the maximum number calls per hour in each cell is 1600, 1800, 800, 500, 1200, 900, 800. Assuming that 65% of the subscribers will be using their mobile terminals during the busy hour traffic and one call is made per mobile. Calculate the estimated number of subscribers in the system ? (1 mark)

Answer:

$$M = \frac{\Sigma \text{ Maximum number of calls per cell}}{\eta_c}$$

$$= \frac{7600}{0.65} = \underline{11{,}692 \text{ Subscribers}}$$

4. In GSM-900 network. (5 marks)

A. Find how many users can be supported in a cell (cell capacity) and compare it with that being supported in an AMPS cell (Hints: The mobile operator can use entire GSM900 band, but either A or B band(including ES) in AMPS) ?

Answer:

In GSM 900:

Number of channels = 124 Channel / Cluster

Slots/channel = 8

Cells/Cluster = 4

Users = 124*8 / 4 = 248

In AMPS :

Number of channels for Single band = 312 channel

Cells/Cluster = 7

= 312 + 83 (ES) = 395

Users = 395 / 7 = 56.42

B. If GOS is required to 0.02, find the traffic intensity can be supported in a cell ?

Answer:

GOS = 0.02 = 2%

N = 124 / 4 = 31

TI = 22.8 Erlang

C. Find the carrier to interference ration C/I in dB ?

Answer:

D/R = √3N = √3*4 =√12

D = 3.46 R

$$\frac{C}{I} = \frac{R^{-4}}{(D + 0.7R)^{-4} + D^{-4}} = \frac{R^{-4}}{(3.46R + 0.7R)^{-4} + (4.16R)^{-4}} = \frac{1}{[(3.46)^{-4} + (4.16)^{-4}]}$$

$$\frac{C}{I} = \underline{96.931}$$

= 10 log (285.652) = **19.86 dB**