Example-1

If a total of 33 MHz of bandwidth is allocated to a particular FDD cellular telephone system which uses two 25 kHz simplex channels to provide full duplex voice and control channels, compute the number of channels available per cell if a system uses

(a) four-cell reuse,

(b) seven-cell reuse, and

(c) 12-cell reuse.

If 1 MHz of the allocated spectrum is dedicated to control channels, determine an equitable distribution of control channels and voice channels in each cell for each of the three systems.

Example-1 Solution

Total bandwidth = 33 MHz

Channel bandwidth = 25 kHz × 2 simplex channels = 50 kHz/duplex channel

Total available channels = 33,000/50 = 660 channels

(a) For N = 4,

total number of channels available per cell = 660/4 = 165 channels.

(b) For N = 7,

total number of channels available per cell = 660/7 = 94.29 ≈ 95 channels.

(c) For N = 12,

total number of channels available per cell = 660/12 = 55 channels.

Example-1 Solution

A 1 MHz spectrum for control channels implies that there are

Control channels = 1 MHz / 50 KHz

= 1000/50

= 20 control channels out of the 660 channels available

Voice channels = Total channels – Control channels

= 660 – 20

= 640

Example-1 Solution

(a) For N = 4,

Control channels per cell = 20/4 = 5 Channels

Voice Channels per cell = 640/4 = 160 Channels

(b) For N = 7,

Control channels per cell = 20/7 = 2.85 = 3 Channels (4 cells)

Voice Channels per cell = 640/7 = 91.43 = 92 Channels (4 cells)

2 cells with 3 control channels and 90 voice channels

1 cell with 2 control channel and 92 voice channels

(c) For N = 12,

Control channels per cell = 20/12 = 1.67 = 2 Channels (8 cells)

Voice Channels per cell = 640/12 = 53.33 = 53 Channels (8 cells)

4 cells with 1 control channels and 54 voice channels

Example-2

If a signal-to-interference ratio of 15 dB is required for satisfactory forward channel performance of a cellular system, what is the frequency reuse factor and cluster size that should be used for maximum capacity if the path loss exponent is (a) n = 4, (b) n = 3? Assume that there are six cochannel cells in the first tier, and all of them are at the same distance from the mobile. Use suitable approximations.

Example-2 Solution

(a) n = 4

First, let us consider a **seven-cell reuse pattern (N = 7).**

Using Equation $\boldsymbol{q = \frac{D}{R} = \sqrt{3N}}$,

the co-channel reuse ratio q = D/R = $\sqrt{3 * 7}$ = 4.583.

Using Equation $\frac{S}{I} = \frac{(q)^n}{6}$,

the signal-to-noise interference ratio is given by

$\frac{S}{I} = \frac{(4.583)^4}{6}$ = 73.53 = 10 log (73.53) = 10 x 1.866 dB = 18.66 dB

Since this is greater than the minimum required S/I, N = 7 can be used.

Example-2 Solution

(a) n = 3

First, let us consider a **seven-cell reuse pattern (N = 7).**

Using Equation $\boldsymbol{q = \frac{D}{R} = \sqrt{3N}}$,

the co-channel reuse ratio q = D/R = $\sqrt{3 * 7}$ = 4.583.

Using Equation $\frac{S}{I} = \frac{(q)^n}{6}$,

the signal-to-noise interference ratio is given by

$\frac{S}{I} = \frac{(4.583)^3}{6}$ = 16.04 = 10 log (16.04) = 10 x 1.205 dB = 12.05 dB

Since this is less than the minimum required S/I, we need to use a larger N.[7]

Example-2 Solution

(a) n = 3

First, let us consider a **seven-cell reuse pattern (N = 12).**

Using Equation $\boldsymbol{q = \frac{D}{R} = \sqrt{3N}}$,

the co-channel reuse ratio q = D/R = $\sqrt{3 * 12}$ = 6.

Using Equation $\frac{S}{I} = \frac{(q)^n}{6}$,

the signal-to-noise interference ratio is given by

$\frac{S}{I} = \frac{(6)^3}{6}$ = 36 = 10 log (36) = 10 x 1.556 dB = 15.56 dB

Since this is greater than the minimum required S/I, N = 12 is used.

Example-3

Cellular system has 32 cells, each cell has 1.6 Km radius and the system reuse factor of 7. The system is to support 336 traffic channels in total. Determine the total geographical area covered, the number of traffic channels per cell and total number of simultaneous cells supported by this system.

Example-3 Solution

N = 7

r = 1.6 Km

The area of hexagon cells $= \frac{3\sqrt{3}\,r^2}{2}$

$= 1.5\,r^2\sqrt{3}$

$= 1.5\,(1.6)^2\sqrt{3}$

$= 6.6510\ \text{Km}^2$

Total geographical area covered (A_T) = (Area) x (number of cells)

= 6.6510 x 32

$= 212.83\ \text{Km}^2$

Example-3 Solution

Number traffic channels = 336, N = 7

Total number of channel per cell $= \frac{Number\ of\ traffic\ channels}{7}$

$= 336 / 7$

$= 48$ channels / cell

Total capacity (C_T) = (Total Number of Channels) x (Number of cells)

= 48 Channels / cell x 32 cells

= 1536 channels