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UT-1

Q.1)

Parameter	Cell Splitting	Sectoring	Microcell Zone concept
1) Process	Each cell divided smaller radius cells.	Each cell divided into sector of equal area having centered at mid of main cell.	Each cell is formed using many zones.
2) Base Station	Each smaller cell require new base station.	No more BS's are required.	Each cell has only one BS.
3) Interference	Gets increased due to nearer cochannel cells.	Cochannel interference is reduced.	Interference is reduced.
4) System capacity	Increase due to increase in number of clusters.	Increase by Increasing S/I ratio.	Capacity increase without any degradation in trunking efficiency.
5) Radius of cell	Radius of cell decreases	Radius remains unchanged.	Radius of cell increases.
6) Cost	It increases due to new BS's	cost increases due to more antennas.	Cost decreases due to less base stations.

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UT-1

Q.3) a) $n=4$

consider a seven cell reuse pattern,

$$\frac{D}{R} = \sqrt{3N} = \sqrt{3\times7} = 4.582$$

$$\frac{S}{I} = \frac{(\sqrt{3N})^n}{i_0} = \frac{(D/R)^n}{i_0} = \frac{1}{6}\times(4.582)^4$$

$$= 73.64$$

$$\frac{S}{I} = 73.46$$

$$\frac{S}{I} = 10\log(73.46) = 10\times1.8660$$

$$= 18.66\text{ dB.}$$

As $\left(\frac{S}{I}\right) > 18$ dB, $N=7$ can be used.

b) $n=3$ consider a seven cell reuse pattern

$$\frac{S}{I} = \frac{(D/R)^n}{i_0} = \frac{(4.582)^n}{6} = 16.03$$

$$\frac{S}{I} = 10\log(10.03) = 12.05\text{ dB}$$

As $\left(\frac{S}{I}\right)$ is <18 dB, i.e. minimum required

$\left(\frac{S}{I}\right)$ we need to user large N.

Consider $N=12$

$$\frac{D}{R} = \sqrt{3N} = \sqrt{3\times12} = 6$$

Name: Nishant Sanjay Chavan
Class: BE/B Sub: MCS Roll no: 18

UT-1

$$\frac{S}{I} = \frac{(D/R)^n}{i_0} = \frac{(6)^3}{6} = 36$$

$$\frac{S}{I} = 10\log(36) = 15.56\text{ dB.}$$

For N=12 $$\left(\frac{S}{I}\right)_{min} = \frac{1}{2(Q-1)^{-3} + 2(Q+1)^{-3} + 2Q^{-3}}$$

$$= \frac{1}{2(6-1)^{-3} + (2(6+1)^{-3} + 2(6)^{-3}}$$

$$\left(\frac{S}{I}\right) = \frac{1}{0.016 + 5.83\times10^{-3} + 9.25\times10^{-3}}$$

$$\left(\frac{S}{I}\right)_{min} = 32.165 = 10\log(32.165)$$

$$= 15.07\text{ dB.}$$

c) Now consider the interference from first and second layer.

$$\frac{S}{I} = \frac{1}{6(Q_1^{-4} + Q_2^{-4})}$$

$$Q_1 = \frac{D_1}{R_1} = 4.587 \text{ (for N=7)}$$

$$Q_2 = \frac{2D_1}{R} = 9.165$$

$$\frac{S}{I} = \frac{1}{6(4.587^{-4} + 9.165^{-4})}$$

$$= 69.452$$

$$\frac{S}{I} = 10\log(69.452) = 18.4\text{ dB}$$

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VT-1

But the $\left(\frac{S}{I}\right)$ value considering first layer interference only is 18.66 dB. The drop in $\left(\frac{S}{I}\right)$ is 18.66 − 18.4 = 0.26 dB. when the second layer interference is included. Hence the second layer and higher layer interferences can be neglected as compared with interference from first layer.

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UT-1

Q.2) The free space propagation model is used to predict received signal strength when the transmitter signal and receiver have a clear, unobstructed line of sight path between them. Satellite communication system and microwave line of sight radio links typically undergo free space propagation.

As with most large scale radio wave propagation models, the free space model predicts that received power decays as function of the T-R seperation distance raised to some power (i.e. powe law function). The free space power received by receiver antenna which is seperated from radiating transmitter antenna by distance d, is given by the friss free space equation.

$$P_r(d) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 d^2 L}$$

where, P_t is the transmitted power. ($P_r(d)$ is the received power which is function of T-R seperation. G_t is the antenna gain.

$$G = \frac{4\pi A_e}{\lambda^2}$$

A_e is related to physical size of antenna.

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