Assignment No 1

Q1 If the operator having 10 KH. from 900 MHz, 1800 MHz is 1900 MHz mobile spectrum
Total subscriber in zone 1 = 10000, zone 2 = 15000 and zone 3 = 5000

prepare a frequency reuse strategy for all zones with respect to spectrum efficiency utilization, co-channel interference and optimum revenue generation consideration. Assume suitable data, system should dynamically allocate channels and ensure that there are minimal call drops.

Zone 1 = Total area 25 km radius
Zone 2 = Total area 30 km radius
Zone 3 = Total area 15 km radius
Use GSM standards (2G to 3G)
- Take your roll.no last two digit as a number for call services at a time in this case (14)

→

Assumptions for generation 2G
frequency band is 900 MHz, 1800 MHz, 1900 MHz
Standard: GSM
Available bandwidth for uplink: 890 MHz to 915 MHz (25 MHz)
Bandwidth for downlink: 925 to 960 MHz (25 MHz)
Bandwidth per channel: 200 KHz
Number of available channels = 124
Radius of hexagonal cell = 0.5 km

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$R = \frac{2}{\sqrt{3}} \times$ distance between adjacent cell site

$0.5 = \frac{2}{\sqrt{3}} \times$ distance between adjacent cell site.

$\frac{0.5 \times \sqrt{3}}{2} =$ distance between adjacent cell site

Distance between adjacent cell site = 0.866

For Zone 1

Area of zone $= \pi r^2 = 3.14 \times (25)^2 = 1962.5 \simeq 1963$

Area of cluster $= 5 \times \frac{3\sqrt{3}}{2} \times R^2 = 5 \times \frac{3\sqrt{3}}{2} \times 0.5 = 1.95$ km

Number of cluster $= \frac{\text{Area of zone}}{\text{Area of cluster}} = \frac{1962.5}{1.95} = 1007$

Subscriber density $= \frac{\text{Total Subscriber in zone}}{\text{Area of zone}}$

$= \frac{10000}{1962.5} = 5$ Sq. km

Channel per cluster = 10 channels at 900 MHz

Subscriber which can be served = Total channels per cluster * number of cluster

= 10070

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Zone 2:

Area of zone $= \pi r^2 = \pi \times (30)^2 = 2827.50$ sq. km

Cluster size and frequency reuse ratio $= 4$

Area of cluster $= 5 * \frac{3\sqrt{3}}{2} * R^2 = 4 \times \frac{3\sqrt{3}}{2} \times (0.5)^2$

$= 2.60$ sq. km

Number of cluster $= \frac{\text{Area of zone}}{\text{Area of cluster}}$

$= \frac{\cancel{15000}\ 2827.50}{2.60} = 1088$

Subscriber density $= \frac{\text{Total subscriber in zone}}{\text{Area of zone}}$

$= \frac{15000}{2827.50}$

$= 5$ per sq. km

Total channel per cluster $= 15$

Subscriber which can be served $=$ Total channel per cluster $\times$ Number of cluster

$= 15 \times 1088$

$= 16320$

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Zone 3

Area of Zone $= \pi r^2 = 3.14 \times (15)^2$.
$= 707.500\ km$

cluster size or frequency reuse ratio $(S) = 2$

Area of Cluster $= S \times \frac{3\sqrt{3}}{2} \times R^2 = 2 \times \frac{3\sqrt{3}}{2} \times (15)^2$

$= 130\,500\ km$

Number of cluster $= \frac{\text{Area of Zone}}{\text{Area of cluster}} = 544$

subscriber Density $= \frac{\text{Total subscriber in Zone}}{\text{Area of zone}}$

$= 7$ per sq. km

channel per cluster $= 10$

subscriber that can be served $=$ Total channel per cluster $\times$ no of cluster

$= 5440$

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Considering blocking probability:

$$P_b = \frac{\frac{A^N}{N!}}{\sum_{x=0}^{N-1} \frac{A^x}{x!} + \frac{A^N}{N!}}$$

Now ~~try~~ taking the roll no for call services.
∴ Roll no is 24.

Let us calculate the intensity of each zone & then use it to calculate the blocking

For zone 1:

Total subscriber = 10,000
Total channel per cluster = 10

$$\text{Traffic intensity} = \frac{\text{Total subscriber}}{\text{Total channel / cluster}} = \frac{10000}{10}$$

$$= 1000$$

Number of available channels = (N) = 10

$$P_b = \frac{\frac{1000^{10}}{10!}}{\sum_{x=0}^{9} \frac{1000}{x!} + \frac{1000^{10}}{10!}}$$

$$P_b = 0.00501939$$

Traffic Handling Capacity (By erlang table (B)) = ~~11.56~~ 10.23

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For Zone 2

Total subscriber = 15,000

Total Channel per cluster = 15

Traffic intensity (A) = $\frac{\text{Total subscriber}}{\text{Total channel / Cluster}}$

$= \frac{15000}{15} = 1000$

∴ Number of available channel = 15

$$P_b = \frac{\frac{1000^{15}}{15!}}{\sum_{x=5}^{14} \frac{1000^x}{x!} + \frac{1000^{15}}{15!}}$$

$P_b = 0.0051940$

∴ Traffic handling capacity (By erlang table (B) = 15.30

For Zone 3

Total subscriber = 5000

Total channel per cluster = 10

Traffic Intensity (A) = $\frac{\text{Total subscriber}}{\text{Total Channel / cluster}}$

$= 500$

$(N) = 10$

$$P_b = \frac{\frac{500^{10}}{10!}}{\sum_{x=0}^{2} \frac{500^x}{x!} + \frac{500^{10}}{10!}}$$

$P_b = 0.045599$

Traffic handling capacity (as per erlang Table) = 11.56

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Conclusion:

After calculating blocking probability we conclude that:
The zone 1 has the best natural performance due to its low value of blocking probability
Zone 2 is the second one & zone 3 is the last one