Tugberk Göç
115200084

Question 1)

Co-channel interference and adjacent interference are the two types of system-generated cellular interference.

Interference that occurs between cells that use same set of frequencies is called co-channel interference.

$$q = \frac{D}{R} = \sqrt{3N} \quad \text{(co-channel reuse ratio)}$$

Adjacent interference may occur when N is small. If we want to minimize this interference, we can do filtering or channel assigning.

They can affect to voice and control channels. Voice channels are related to crosstalk and controll channels are related to missed and blocked calls due to errors.

Question 2)

Whilst we are talking someone on our mobiile phone, we use a specific channel. When we move away from our placement by using car, we have left the cell that we were in. Cells cover specific places. In that moment, the MSC transfers the call to a new channel that belongs to another station in order to keep conversation going on mobile phone. This is called Handoff.

Definition of Handoff:

Δ is called margin.

$$\Delta = P_{r\,handoff} - P_{r\,minumum\ usable}$$

If Δ is too large, we create unnecessary handoffs.

If Δ is too small, we couldn't create handoff properly. because we don't have enough time to complete a handoff before a call is lost.

Question 3)

(the load per user)

$C = 3$, $\lambda = 0.2$ calls/hour , $GOS = 5\% = 0.05$, $A_u = 0.01$ Erlangs

from Erlang C graph: $A = 0.8$ (where $\underline{GOS = 0.05}$ and $C = 3$)

$$U = \frac{A}{A_u} = \frac{0.8}{0.01} = 80 \text{ users}$$

$$Pr[\text{delay} > t \mid \text{delay} > 0] = \exp\left[\frac{-(C-A)t}{H}\right]$$

$$Pr[\text{delay} > 1 \mid \text{delay} > 0] = \exp\left[\frac{-(3-0.8)\cdot 1}{180}\right]$$

$$H = A_u / \lambda = 0.01 / 0.2 = 0.05 \text{ hours}$$

$$= 180 \text{ sn.}$$

$$Pr[\text{delay} > 1 \mid \text{delay} > 0] = 0.987 = 98.7\%$$

$$Pr[\text{delay} > 1] = Pr[\text{delay} > 0] \cdot Pr[\text{delay} > 1 \mid \text{delay} > 0]$$

$$= 0.05 \cdot 0.987$$

$$= 0.04935$$

$$= \%4.935$$

Question 4)

$f_c = 900\,MHz$, $P_t = 30W$, $G_t = G_r = L = 1$

$n = 4$, $d = 2km$, $\sigma = 20dB$, $d_0 = 50m$, Power Turestold $= -120dB$

Friis Free Space Model $= P_r(d) = \dfrac{P_t\, G_r\, G_d . \lambda^2}{(4\pi)^2 . d^2 . L}$

$$P_r(50m) = \frac{30 . 1 . 1 . \lambda^2}{(4\pi)^2 . (50)^2 . 1} = \frac{30 . 1 . 1 . (0.33)^2}{(4\pi)^2 . (50)^2 . 1} = -50.82dB$$

$(-20.82dBm)$

$$\lambda = \frac{c}{f} = \frac{3.10^8 m/s}{900.10^6 /s} = 1/3 = 0.33\,m$$

$n.10 = 4.10$

$$P_r(2km) = P_r(50m) + 40\log\left(\frac{50m}{2km}\right)$$

$$= -50.82dB - 64.08dB$$

$$= -114.90\,dB$$

$$= -84.90\,dBm$$

power turestold

$$P_r[\,P_r(2km) > -120dB\,] = Q\left(\frac{-120 + 114.90}{20}\right) \cong Q(-0.255)$$

$$= 1 - Q(0.255)$$

$$= 1 - \frac{1}{2}\left[1 - erf\left(\frac{0.255}{\sqrt{2}}\right)\right]$$

$$= \frac{1}{2}\left[1 + erf(0.180)\right]$$

erf (0.180)
$\sim$
z

if $z = 0.2$
then, $erf(z) = 0.22270$

$$= \frac{1}{2}\left[1 + 0.22270\right]$$

$$= 0.61135$$

$\cong 0.6$ (This is the probability that received power exceeds $-120dB$ at a distance of 2 km from the transmitter.)

Question 5)

a) voice , control

b) space

c) adaptive, training

d) Channel coding

e) co-channel

f) Equalization

g) TDD

h) training , tracking

i) decreased , decreased , increased

j) orthogonal

k) duplexing

l) multiple access

m) Co-channel, adjacent channel

n) Diversity