F.DD = Frequency division duplex

TDD = Time division duplex

MSC = Mobile switching center

PSTN = public switched telephone network.

MTSO = mobile telephone switching office

FCC = Forward control channel

RCC = Reverse " "

FVC = Forward voice "

RVC = Reverse " "

GPRS = General packet Radio service

GSM = Global system mobile

PANs = Personal Area Network

PCS = Personal communication system

Base station: A fixed station in a mobile radio system used for radio communication

Control channel :

Frequency reuse, hand off → D, A, DB, Type

P → 78

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

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

Propagation mechanism → Reflection, diffraction, scattering

Hata model, Okumura model

Doppler shift : where transmitter and receiver move ~~relative~~ relative to each other.: the signal frequency is shifted depending on the velocity. → This so called doppler effect. → passing car, moving stars.

Cell: ~~একটি cellular base station~~ Cell হলো একটি geographic area যেটি single base station দ্বারা covered.

Base station: Mobile radio system এর মধ্যে একটি fixed station যেটি radio communication এর জন্য ব্যবহৃত হয়।

Control Channel: একটি Radio channel যেটি call setup, call request, transmission এর জন্য ব্যবহৃত হয়।

Reverse " → বিপরীত

Forward channel: একটি Radio channel যেটি base station থেকে mobile station এ information transmission করে. এর জন্য ব্যবহৃত হয়।

Full duplex: Two way communication, simultaneously

Half Duplex: " " " Not simultaneously

Handoff: Base station to Base station or mobile station to one channel এ transferring process.

Mobile station: may be portable or installed in vehicle (mobile)

MSC: Also called MTSO, MSC connects mobile and base station to the PSTN

Simplex System: Only one way communication.

Subscriber: A user who pays subscription charges

FDD: provides simultaneous radio transmission channels for the subscriber and the base station.

Frequency Reuse: The design process of selecting and allocating channel groups for all of the cellular base stations within a system. is called FR.

Holding Time: Average duration of a typical call. (H)

Traffic Intensity, A: $\dfrac{\text{Period for which a server is occupied}}{\text{Total period of observation}}$

Grade of Service, GOS = $\dfrac{\text{lost traffic}}{\text{offered traffic}} = \dfrac{A - A_0}{A}$

Okumura model:

1. Signal prediction model in urban areas
2. Applicable 150 MHz to 1920 MHz
3. Distance 1 km to 100km
4. Antenna height, 30m to 1000 m

Hata Model:

1. ~~Radio propagation model~~ for path loss radio propagation mod
2. Applicable 150 MHz to 1500 MHz
3. Based on Okumura model
4. Also known as Okumura-Hata model

P-61

MIH

$BW = 33 \times 10^6$

No of channel

$CBW = 2 \times 25$

=

Total available channel $= \frac{33000}{50}$

$= 660$ channel

a) For N = 4

Total number of channels

$= \frac{660}{4}$

$= 16$

$CCBW = 1000$ KH

Total available channel $= \frac{\text{Total Bandwidth}}{\text{Channel Bandwidth}}$

The number of available channel, $= \frac{CCBW}{\text{Total } CBW}$

Voice channel $= \frac{TAC - NOAC}{N}$

Q.1 P-61

Control n $= \frac{NOAC}{N}$

1. $\boxed{\text{Total available channels} = \frac{\text{Total Bandwidth}}{\text{channel Bandwidth}}} = \frac{33000}{50} = 660$

2. Channel Bandwidth = (25 KHz × 2 simplex Channels) $= 25 \times 2 = 50$

↳ KHz / duplex Channel

3. Total number of channel available per cell = $\frac{\text{Total available channel}}{\text{Number of cell reuse (N)}}$

$N=4$, $= \frac{660}{4} = 165$, $N=7$, $\frac{660}{7} = 94$, $N=12$ $= 660/12 = 55$ [Ans round করতে হবে]

a. ~~Total~~ number of available Control Channel $= \dfrac{\text{Frequency}}{\text{Channel BW}}$

∴ Equitable distribution of,

(i) Voice channel $= \dfrac{\text{Total available channel} -}{\text{No. of cell reuse } (N)}$

(ii) Control Channel = Total number of channels available per cell − voice channel.

P-72

Q2 ~~Consider~~, Number of cell reuse, $N = i^2 + ij + j^2$

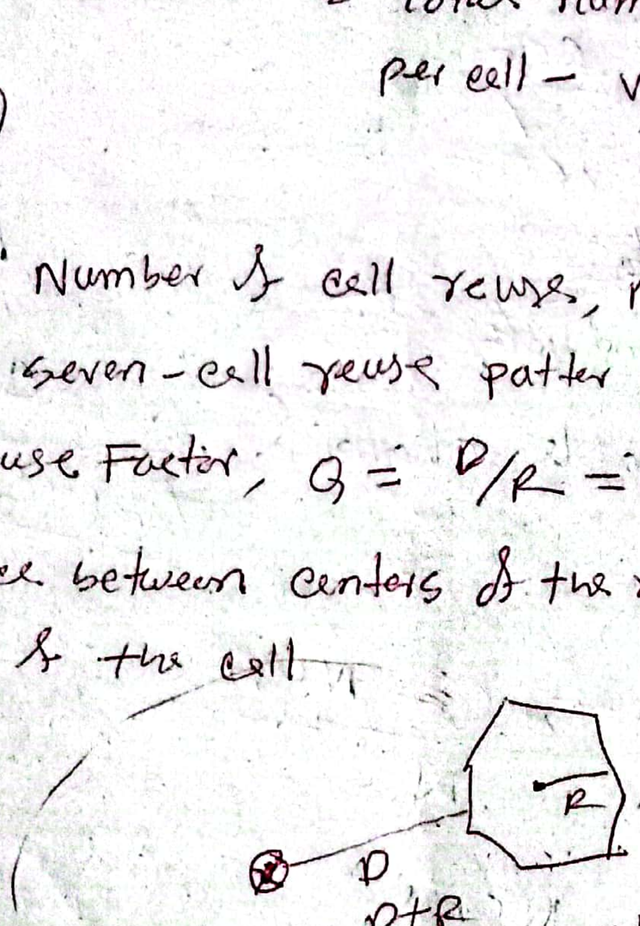
Consider a seven-cell reuse patter, $N = 7$ $(i = 1, j = 2)$

Frequency Reuse Factor, $Q = D/R = \sqrt{3N}$

D = Distance between centers of the nearest co-channel cells

R = Radius of the cell

$10 \log (SIR) = dB$



show-(P-71)

The Signal-to-noise interference ratio, S/I or $SIR = \dfrac{(\sqrt{3N})^n}{i_0}$

i_0 = The number of Co-Channel interfering cells, = 6

$i = 6$ ~~because~~

assume that ~~$i_0 = 6$~~ The six closets cells $(i_0 = 6)$ ~~are close~~ enough to ~~create~~ significant interference.

$$\therefore SIR = \frac{(\sqrt{3N})^n}{i_0} = \frac{Q}{6}$$

*- R.W ... ST ... Corporatth

Scattering ... the ... where ... obstacle obstacles or scatter

In a fast ... Scattering: Scattering

In a fast fading, ... coherence time of the channel smaller than the symbol period of transmission

Signal $P \to 80$

$$\nearrow GOS = \frac{A - A_c}{A} = \frac{\text{lost traffic}}{\text{Offered Tr...}}$$

Q.3 For Erlangs, GOS = Blocking probability (P_B)

Total number of users, $U = A/A_u$; A = offered traffic intensity; A_u = Traffic intensity

Trunked channel, $C = 1, 5, 10, 20, 100$

For GOS $= 0.5\% = 0.005$

Offered traffic intensity, A = 0.005, 1.13, 3.96, 11.1, 80.9

$$GOS = 0.5\% = \frac{0.5}{100} = 0.005$$

P-63

Q.4 For Erlangs, $GOS = P_B = 2\% = 0.02$

Traffic intensity per user, $A_u = \lambda H$

λ = The average number of call requests per unit time

H = The average duration of a call =

A_u = Two calls per hour at average duration of 3 m...

$\therefore \lambda = 2$, $H = 3/60$; $A_u = 2 \times \frac{3}{60} = 0.1$ Erlangs

Total number of user, $U = A/A_u$

Total no of users that supported by system, A/B/C $= U \times$ cell

Percentage market penetration $= \frac{A_t}{\text{population}}$

Q.5 (P-85)

Number of channels $= \dfrac{\text{allocated spectrum}}{\text{channel width}} = \dfrac{40000}{60}$

$= 666$

Q.6 → P (109)

Q.9 → (P-125) presentation,

C=95
Addressing
2005

$\lambda = \dfrac{c}{f} = \dfrac{3\times10^{8}}{900\times10^{6}} = 0.333$

length of the antenna $L = \lambda/4$

$= \dfrac{0.333}{4}$

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

$= \dfrac{(0.33)^2}{4\pi} \times 1.8$

$= 0.016\ m^2$

$G = 2.55\ dB = 10\log$

$X = \text{Antilog}\left(\dfrac{2.55}{10}\right)$

$= 1.8$

$E_R(d) = \dfrac{2E_0 d_0\, 2\pi h_t h_r}{\lambda\, d^2} \leftarrow \dfrac{k}{d^2}$

$P_r(d) = \dfrac{|E_R(d)|^2}{377} \times A_e$

$= ?$

From e chart 27 C=15

$P(A|B) = \dfrac{P(A\cap B)}{P(B)}$

Q.10 (P- 85)

The conditional probability that the delay is greater than t seconds.

P_r [delay > t | delay > 0] $= \exp\left(-(C-A)\, t/H\right)$

P_r [delay > 0] = 5% = The probability of delayed call.

Q.7 From Hata model,

We know, The path loss in urban areas is given by

$$L_{50}(\text{urban})\,dB = 69.55 + 26.16 \log f_c - 13.82 \log h_{te} - a(h_{re}) + (44.9 - 6.55 \log h_{te}) \log d \quad \text{--- (1)}$$

Where, f_c = The frequency (in MHz) = 900 MHz

The effective transmitter (base station) antenna height, h_{te} = 100m

The effective receiver (mobile) antenna height, h_{re} = 2 m

T-R separation distance, d = 4 km

Now, the correction factor for effective mobile antenna height, $a(h_{re}) = 3.2(\log 11.75 h_{re})^2 - 4.97$ dB for $f_c \geq 300$ MHz

$$= 3.2(\log(11.75 \times 2))^2 - 4.97 \text{ dB}$$

$$= 1.045 \text{ dB}$$

From equation (1), we have Path loss,

$$L_{50}(\text{urban})\,dB = 69.55 + 26.16 \times 2.954 - 13.82 \times 2 - 1.045 + (44.9 - 13.1) \times 0.6$$

$$= 69.55 + 77.283 - 27.64 - 1.045 + 19.145$$

$$= 137.3 \text{ dB}$$

Q.8 We know the path loss in a high-rise urban area is given with perpendicular street to the location of the BS is given by (slide → 17)

$$L_p(\text{high-rise}) = 135.41 + 12.49 \log f_c - 4.99 \log h_{te} + [46.84 - 2.34 \log h_{te}] \log d \quad \text{--- (1)}$$

Where, for ~~0.9 GHz~~ $f_c < 2$ GHz

T-R separation distance, $d = \sqrt{20^2 + 30^2}$

$= 36.05$ m

$= 0.036$ Km

$h_{te} = 20$ m

$f_c = 1.8$ GHz → (0.9 ~~to~~ 2 GHz)

From equation (1)

$$= 135.41 + 12.49 \log(1.8) - 4.99 \log 20 + [46.84 - 2.34 \log 20] \log 0.036$$

$$= 68.89 \text{ dB}$$