Exp 1: Signal Strength: Signal strength refers to the power level of a received signal, indicating how well a device can receive and interpret (বোঝা) information from a transmitter.

unusable	Not good	Okay	very good	Excellent
> -90 dBm	> -80 dB	> -70 dB	> -67 dBm	> -30 dBm

mail

online stream

1. P_t = Transmitted Power (dBm)
2. f = frequency (MHz)
3. d = distance (Km)
4. FSPL PL = (dB)
5. RSS (Received Signal Strength)

$$P_r\,(\text{dBm}) = P_t\,(\text{dBm}) - PL\,(\text{dB})$$

FSPL eq:

$$\text{FSPL (dB)} = 20\log_{10}(d_{Km}) + 20\log_{10}(f_{MHz}) + 32.44$$

it accounts for the speed of light, unit conversion & environment under standard conditions

* FSPL = free space path loss

FSPL assumes there is a line of sight between the transmitter and receiver, and no obstructions.

It is commonly used for satellite, microwave and early-stage wireless system planning.

* $32.44 \Rightarrow 20\log_{10}\left(\frac{4\pi}{c}\right)$.

* RSS decreases as path loss or distance increases.

Pt, d, f

30 dB 500m 900MHz

$$\boxed{\begin{aligned} FSPL &= 20\log_{10}(d_{km}) + 20\log_{10}(f_{MHz}) + 32.44 \\ P_r &= P_t - FSPL \end{aligned}}$$

High quality, low noise $\rightarrow$ $\beta \uparrow$ $(\beta > 1)$

Bandwidth efficiency $\rightarrow$ $\beta \downarrow$ $(\beta < 1)$

$\cancel{s(t) \; A_c}$

$$s(t) = A_c \cos\left(2\pi f_c t + \beta \sin 2\pi f_m t\right)$$

Exp # 3 : Grade of Service (GOS)

To calculate GOS, which represents the probability that a call is blocked or lost during peak (busy) hours in a telecommunication system.

$$GOS = \frac{\text{Number of lost calls}}{\text{total offered calls}} = \frac{LC}{LC + CC}$$

GOS 0.01 means 1 in 100 calls gets blocked.

$$\boxed{GOS = \frac{LC}{LC + CC}}$$

Exp 4 : Okumura model for calculating Median Path loss and Propagation Analysis.

The Okumura model is an empirical radio propagation model for estimating path loss in urban, suburban, and rural environments.

freq. range 150 MHz to 1920 MHz

total Median Path Loss, $L = L_{fs} + A_{mu} - G(h_m) - G(h_b) - G_{Area}$

1000 20 1.5

L_{fs} = free space path loss

A_{mu} = Median attenuation relative to free space

$G(h_m)$ = Mobile antenna height gain factor (dB)

$G(h_b)$ = Base station " " " " (dB)

G_{Area} = Area Gain factor (correction factor) (dB)

Median Path loss : Typical signal loss over a given path (dB)

→ To ensure wireless signals can reach the receiver effectively & To predict how much the radio signal will weaken.

Propagation: It refers to the movement or transmission of radio waves through space from a transmitter to receiver.

It is how a wireless signal travels from one point to another.

* environmentcorrection factor বাস্তব পরিবেশে signal কতটা দুর্বল হয় তার হিসাব করার জন্য একটি সমীকরণ।

$\underline{L} = 100 - 20 = \underline{80}$

$\underline{L} = 100 - 5 = \underline{95}$

$$L = L_s + A_{mu} - G(h_m) - G(h_b) - G_{Area}$$

Exp 5: Calculate Number of mobile subscribers supported

Channels: The information from sender to receiver is carrier over a well defined frequency band. This is called a channel.

Blocking Probability: The chance a call is rejected due to all channels being busy.

Erlang: It is a unit of traffic load. 1 earlang means one channel is occupied for an entire hour.

$$\text{Traffic} = \frac{\text{BHCA} \times \text{Holding time (sec)}}{3600}$$

Carried traffic: The portion of offered traffic that is successfully handled by the system.

$$\text{No\_of\_users} = \frac{\text{Carried traffic}}{\text{average traffic per user}}$$

Carried traffic = A * (1 - blocking)

Average traffic per user =

BHCA = Busy hour call Attempts

$$\boxed{A = \frac{BHCA \times HT}{3600}}$$

Exp 6: Hata Model for predicting radio wave propagation in urban and suburban environments.

The Hata model is an empirical formula for estimating path loss in mobile wireless communication systems. It was developed from Okumara's measurement data and is suitable for frequencies from 150MHz to 1500MHz.

It is commonly used to predict signal strength or signal loss in urban or suburban areas.

$$L_{urban}(dB) = 69.55 + 26.16 \log_{10}(f) - 13.82 \log_{10}(h_b) + (44.9 - 6.55 \log_{10}(h_b)) \log_{10}(d) - a(h_m)$$

f = freq. (150 MHz - 1500 MHz)

h_b = height of base station antenna in meters (30 - 200m)

h_m = height " mobile " " (1m - 10m)

d = distance between transmit and reception

$a(h_m)$ = correction factor for mobile antenna height.

* $a(h_m)$ is used to adjust the path loss based on the mobile stations's antenna height.

$$L_{suburban} = L_{urban} - 2\left[\log_{10}(f/28)\right]^2 - 5.4$$

$$L_{urban} = 69.55 + 26.16\log_{10}(f) - 13.82\log_{10}(h_b) + \left(44.9 - 6.55\log_{10}(h_b)\right)\log_{10}(d) - a(h_m)$$

Exp 7: ~~Write~~ to calculate the average busy hour call attempts.

Busy hour call attempts (BHCA) refers to the average number of call attempts made during the busiest hour of the day.

$$\text{Average BHCA} = \frac{\text{Total call attempts in a Day}}{\text{Number of busy hours}}$$

$$BHCA = \frac{T}{H}$$

Exp 8: log distance path loss model.

It is a theoretical and measurement-based propagation models indicate that average received signal power decrease logarithmically with distance, whether in outdoor or indoor radio channels.

$$PL(d) = \underline{PL(d_0)} + 10\,n.\log_{10}\left(\frac{d}{d_0}\right)$$

$$PL(d_0) = 20 * \log_{10}(4 * pi * d_0 / lamda)$$

PL(d) = Path loss at distance d

PL(do) = ~~[illegible]~~ " " at reference distance

n = path loss exponent

d = distance from tx.

do = reference distance (usually 1m)

$$\lambda = \frac{3\times10^8}{f_c}.$$

Received power, $P_r = P_t - P_L(d)$.

Exp 9: AM

Message signal, $m(t) = A_m \sin(2\pi f_m t)$

Carrier signal, $c(t) = A_c \sin(2\pi f_c t)$

AM signal, $s(t) = A_c \cdot [1 + \mu \cdot m(t)] \cdot \sin(2\pi f_c t)$

Amplitude modulation is a technique used in analog communication in which the amplitude of a high frequency carrier wave is varied in proportion to the ~~#~~ instantenous amplitude of the message (information) signal.