Mobile Communication Laboratory

ECED,SVNIT , Surat.

Experiment 3 :

AIM :

Understand the Pathloss prediction formula.

Experiment 3 :

Objectives :

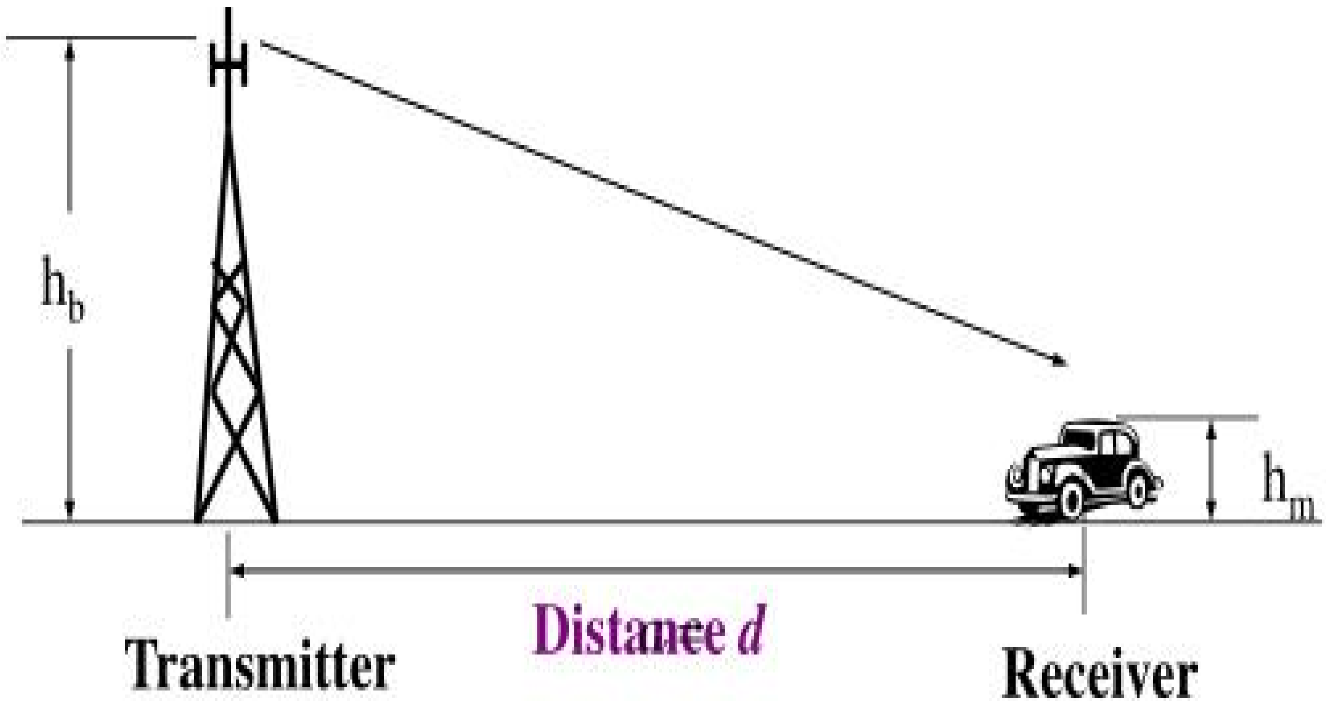
- Calculation of received signal strength as a function of distance separation between transmitter and receiver.
- Impact of parameters on received signal strength
  - Transmitter Power
  - Path Loss Exponent
  - Carrier Frequency
  - Receiver Antenna height
  - Transmitter Antenna height

Experiment 3 :

- The design of a communication system involves selection of values of several parameters.
- Most important parameter is Transmit power.
- In terrestrial mobile communication system , electromagnetic waves propagation is affected by reflection , diffraction and scattering.
- These leads to dynamic variation of signal strength as a function of frequency , distance of separation , antenna height etc.

EXPERIMENT 3 :

Free Space Propagation Model



EXPERIMENT 3 :

- Received Power at distance **d** is given by :

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

- **Path Loss :**

The reduction in power density of an electromagnetic wave as it propagates through space.

$$PL(\mathrm{dB}) = 10\log\frac{P_t}{P_r} = -10\log\left[\frac{G_t G_r \lambda^2}{(4\pi)^2 d^2}\right]$$

EXPERIMENT 3 :

- Received Power at distance **d** is given by :

$$P_r(d) = P_r(d_0)\left(\frac{d_0}{d}\right)^2 \qquad d \geq d_0 \geq d_f$$

- Important Formula :

$$P_r(d) = P_r(d_0) + 10n_p \log_{10}\left(\frac{d_0}{d}\right)$$

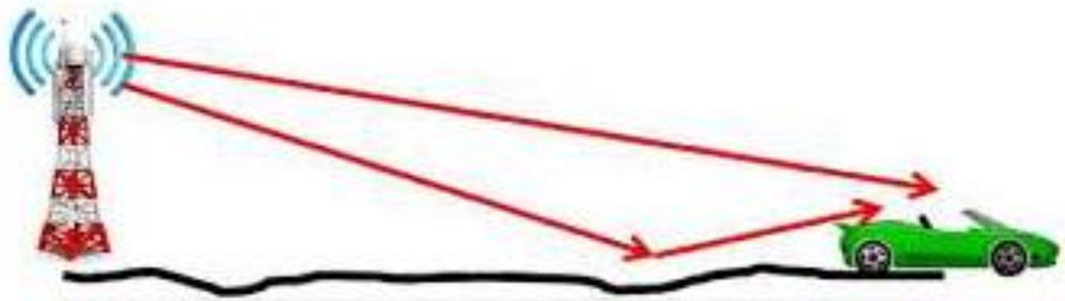
$$PL(dB) = PL(d_0) + 10n_p \log_{10}\left(\frac{d}{d_0}\right)$$

Experiment 3 :

- Two Ray Propagation Model :

  A free space propagation model is inaccurate.

- A useful propagation model (Two Ray Propagation Model) considers both direct path and ground reflected path between transmitter and receiver.



Experiment 3 :

$$PL = 10n_p \log_{10}(d) + 7.8 - 18\log_{10}(h_{BS}) - 18\log_{10}(h_{UT}) + 20\log_{10}(f_c)$$

where,

- d= $T_x - R_x, i.e., T_x and R_x$ separation distance in meters.
- h_{BS}= the base station antenna height in meters.
- h_{UT}= the user terminal i.e. receiver antenna height in meters.
- f_c is the carrier frequency in GHz.

Experiment 3 :

Environment	Path Loss Exponent
Free space	2
Urban area cellular radio	2.7 to 3.5
Shadowed urban cellular radio	3 to 5
In building line-of-site	1.6 to 1.8
Obstructed in building	4 to 6
Obstructed in factories	2 to 3

EXPERIMENT 3 : 1 A

Distance (m)	Pr (d)	Avg. Pr(d)
100		

$$P_r(d) = P_r(d_0) + 10 n_p \log_{10}\left(\frac{d_0}{d}\right)$$

D = 500 m , 800 m , 1000 m , 1500 m

Path loss Exponent (n) = 2

EXPERIMENT 3 : 1 B

Distance (m)	Pr (d)	Path Loss Exponent (n)	Path Loss (PL)
100			

$$PL(dB) = PL(d_0) + 10n_p \log_{10}\left(\frac{d}{d_0}\right)$$

D = 500 m , 800 m , 1000 m , 1500 m

Tx Power = 50 dBm

EXPERIMENT 3 : 1 C

$$PL = 10n_p \log_{10}(d) + 7.8 - 18\log_{10}(h_{BS}) - 18\log_{10}(h_{UT}) + 20\log_{10}(f_c)$$

Tx Power = 50 dBm

hTx = 30 m

hRx = 1 m

n = set it to fix value (any)

Distance (m)	Pr (d)	Carrier Frequency (Fc)	Path Loss (PL)
1000			

Experiment 3 : 1 D

$$PL = 10n_p \log_{10}(d) + 7.8 - 18\log_{10}(h_{BS}) - 18\log_{10}(h_{UT}) + 20\log_{10}(f_c)$$

Tx Power = 50 dBm

hTx = 30 m

Fc = 2.1 GHz , 2,3 GHz , 2.5 GHz

n = set it to fix value (any)

Distance (m)	Pr (d)	Receiver Antenna Height (hRx)(m)	Path Loss (PL)
1000			

Experiment 3 : 1 E

$$PL = 10n_p \log_{10}(d) + 7.8 - 18\log_{10}(h_{BS}) - 18\log_{10}(h_{UT}) + 20\log_{10}(f_c)$$

Tx Power = 50 dBm

hRx = 1 m

Fc = 2.1 GHz , 2,3 GHz , 2.5 GHz

n = set it to fix value (any)

Distance (m)	Pr (d)	Transmitter Antenna Height (hTx)(m)	Path Loss (PL)
1000			