Experiment No. –

AIM: **To evaluate propagation path-loss using Hata model based on distance travelled by Mobile user and frequency of operation.**

Theory: The propagation path loss models predicts the average received signal power at a given distance from the transmitter. The significant variation in received signal level depends on the operating terrain conditions, frequency of mechanism, sources of interference, speed of mobile vehicle and many other dynamic factors. The signal propagation through wireless media is location specific. The received signal power decreases logarithmically with distance irrespective of whether the radio channel is indoor or outdoor. The radio propagation models are developed using a combination of analytical and the empirical methods. The propagation pathloss models are used for link budget design.

Classification of propagation pathloss model:

1. Free space propagation model
2. Mobile point to point propagation model
    a. Two ray point to point propagation model
    b. Near-Distance propagation
    c. Propagation over Flat open area
3. Outdoor propagation path-loss model
    a. Okumara propagation model
    b. Hata propagation model
    c. COST-231 Hata propagation model
    d. Longley-Rice propagation model
    e. Durkin's propagation model
4. Indoor propagation path-loss model
    a. Partition and Building penetration losses
    b. Log distance propagation model
    c. Attenuation factor model

The **Hata propagation model** is an empirical model based on Okumara model. It is used in microcellular wireless communication system for large cells exceeding 1km radio coverage and frequency range of 150MHz to 1000MHz. The BS antenna is generally installed on towers or roof-top of high-rise building of height of 30m to 200m and MS height 2m.

The propagation path loss model proposed by **Hata (Urban area)**

$$L_{ph}(dB) = 68.75 + 26.16logf_c(MHz) - 13.82logh_t(m) + (44.9 - 6.55logh_t) \times logr$$

L_{ph} = Median value of path loss in dB

If the height of Mobile antenna is other than 2m, the mobile antenna correction factor needs to be applied (Urban area)

$$L_{ph}(dB) = 68.75 + 26.16logf_c - 13.82logh_t - \alpha_r + (44.9 - 6.55logh_t) \times logr$$

α_r is the correction factor

For large city:

$$\alpha_r(dB) = 8.29(log1.54h_r)^2 - 1.1 \qquad for\ f_c \leq 300MHz$$

$$\alpha_r(dB) = 3.2(log11.75h_r)^2 - 4.97 \qquad for\ f_c > 300MHz$$

For small city:

$$\alpha_r(dB) = (1.1logf_c - 0.7)h_r - (1.56logf_c - 0.8)$$

The median path loss in Suburban area

$$L_{pH}(dB) = L_{pH}(Urban)(dB) - 2\left[log\left(\frac{f_c}{28}\right)\right]^2 - 5.4$$

The median path loss in Open Rural area

$$L_{pH}(dB) = L_{pH}(Urban)(dB) - 4.78(logf_c)^2 + 18.33logf_c - 40.94$$

Hata model is not suitable for Personal Communication Systems.

Problem: Determine the propagation path loss of a 700MHz and 900MHz cellular system operating in a large city from a BS with antenna height of 100m and mobile unit installed in a vehicle with an antenna height of 4m, when the mobile user is travelling distance of 2km to 25km from the BS.

Answer the following questions:

1. Why is propagation path-loss is one of the key parameters used in the analysis of radio wave propagation for mobile communication.
2. Explain Rayleigh and Rician fading.

Result analysis and Conclusion: