Advanced Communication Systems
ELE 42ACS

Laboratory Exercise No. 1

Okumura - Hata Path Loss Model

07 August 2006

1 INTRODUCTION

The objective of this laboratory exercise is to compare path loss estimates obtained with Okumura's method with that obtained by Hata's model. Every student is required to perform a minimum of four radio path cases (scenarios).

Okumura's method of estimating radio path loss is based on extensive measurements in and around the city of Tokyo at frequencies up to 1,920 MHz. In simple terms, Okumura calculates the free-space path loss between the points of interest and then adds other factors obtained from graphs resulting from his measurements. The basic median path loss relative to free-space loss in urban areas in dB is obtained from Figure 1.1 and the correction factors for base station and mobile antenna heights obtained from Figures 1.2 and 1.3 respectively.

The median path loss is calculated from the equation:

$$L_{50}(dB) = L_F + A_{mu} - H_{tu} - H_{ru}$$

Where the free-space loss (L_F) is calculated, as usual, from the equation:

$$L_F(dB) = 32.44 + 20\log(d_{km}) + 20\log(f_{MHz})$$

The remaining values are obtained from the graphs in Figures 1.1, 1.2, and 1.3

As an example, the separation distance between BS and MS in a 900 MHz system is 10 km in a medium size city. The antenna heights of BS and MS are 50m and 3m respectively. Calculate the median path loss using Okumura's method.

Solution:

Free-space loss:

$$L_F(dB) = 32.44 + 20\log(10) + 20\log(900) = 111.53 \quad dB$$

From the graphs:

$$A_{mu} = 29.5 \quad dB$$
$$H_{tu} = -12 \quad dB$$
$$H_{ru} = 0 \quad dB$$

The median path loss:

$$L_{50}(dB) = 111.53 + 29.5 + 12 - 0 = 153.03 \quad dB$$

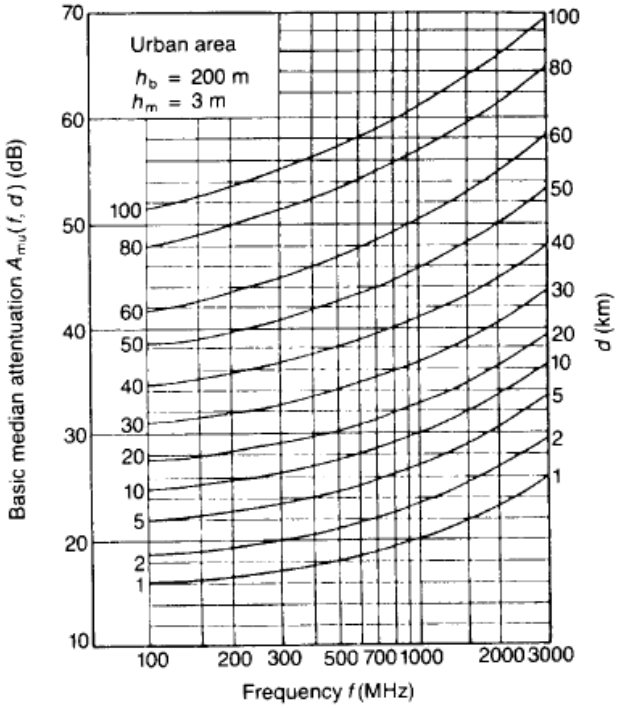

Figure 1.1 - Basic median path loss relative to free-space in urban areas over quasi-smooth terrain (after Okumura)

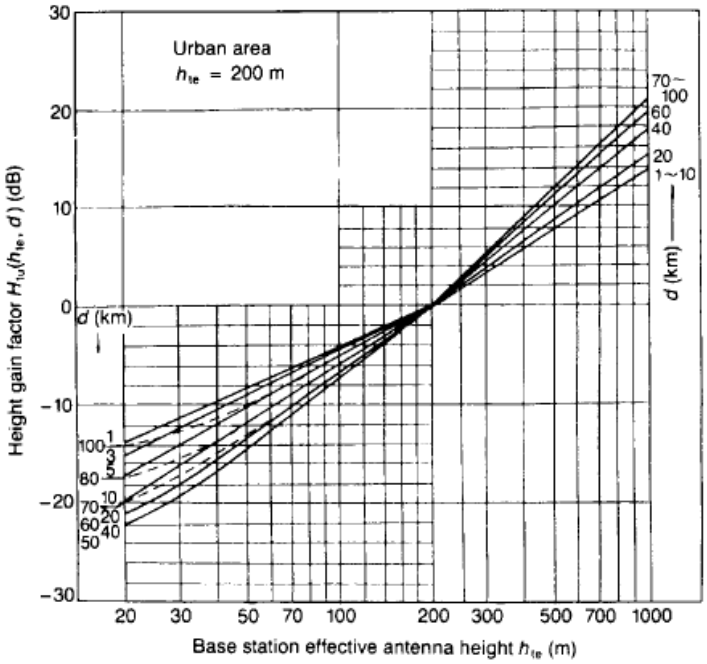

Figure 1.2 - Base station antenna height/gain factor in urban areas as a function of range

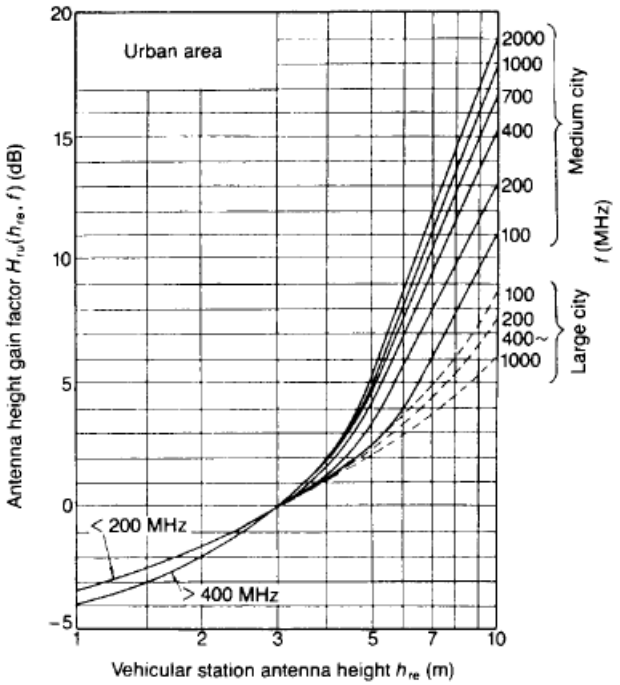

Figure 1.3 - Mobile station antenna height/gain as a function of frequency and urbanisation

2 METHOD

Every student is required to choose system parameters for four cases (scenarios) using the following values assuming urban medium size city.

Frequency of operation: 477 MHz
Path length from BS to MS: 1 – 30 km
BS antenna height: 30 – 200 m
MS antenna height: 1 – 10 m

Example:

Scenario	Frequency	Path Length	BS Ant. Height	MS Ant. Height
1	477 MHz	13 km	30 m	1.5 m
2	477 MHz	17 km	60 m	3 m
3	477 MHz	22 km	120 m	7 m
4	477 MHz	27 km	155 m	10 m

1. Write a MatLab program for Hata's model
2. Estimate the path loss for your four scenarios using Okumura's method
3. Calculate the path loss for your four scenarios using the MatLab program
4. Tabulate your results for comparison

3 RESULTS

Document your results

4 DISCUSSION

Discuss the results and compare Okumura's and Hata's methods

5 SUBMISSION

Due date: Monday 21 August 2006, 2:00 pm

Reports to be deposited in the appropriate box opposite Room PS2 118 and statement of authorship MUST accompany the laboratory report.

✂ *(Attach to the front of your assignment)*

Name: _____ **Student No**: _____

Subject: _____ **Assignment No**: _____

Lecturer: _____ **Date Due**: _____

DECLARATION

I certify that the attached assignment is my original work and that no part of it has been copied or reproduced from any other person's work without acknowledgement.

Signed: _____ **Date**: _____