

**INDOOR RADIOWAVE PROPAGATION PREDICTION AND MEASUREMENT
FOR INDOOR GEOLOCATION SYSTEM USING WLAN**

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A project report submitted in partial fulfillment of the requirements for the award of the
Degree of Master of Engineering (Electrical-Electronic & Telecommunication)

Faculty of Electrical Engineering
Universiti Teknologi Malaysia

MARCH 2005

**To my beloved mother and father, Hj Ismail bin Othman and Hajjah Zubaidah
bt Zain, without your doa ,help and constant encouragement,
this thesis would not been realized.**

To my brother Ismaida Zamri and all my siblings .

**To my beloved person ,Wan Zatul Hijanah bt. Wan Awang who always be right
beside me all these years.**

ACKNOWLEDGEMENT

The author would like to express sincere appreciation and deep gratitude to a number of individuals who helped make this thesis possible. First of all, I would like to thank my supervisor, Prof. Dr. Tharek Hj. Abdul Rahman for all time, his valuable guidance, suggestions, patience, encouragement and full support in all aspects during the course of this project. His achievement and kindness has motivated me toward excellent.

A special thanks to all Wireless Communication Centre (WCC) staff whose always have open heart to give help on my research. Also my deepest appreciation and thanks to my colleagues and best friends, Abd Shukur, Lester, Teddy, Kesavan and Samsul whose always giving support, cheering and helps when I needed it.

My deepest appreciation, thanks and love goes to my family members who have always been very supportive and willing to share all my joy and pain. All this things I do it because of Allah for you. My appreciation goes to all, who have directly or indirectly helped me in completing my project.

Finally, my warm and deepest appreciation to Wan Zatul Hijanah (Diktu) for your love and support.

ABSTRACT

Propagation prediction and measurement plays an important role in the design and implementation of indoor geolocation system. In this project, a three-dimensional (3-D) ray tracing technique— Site Specific Outdoor / Indoor Propagation Prediction Code will be used to predict indoor propagation effects in Wireless Communication Centre (WCC) ,*Fakulti Kejuruteraan Elektrik*, University Technology Malaysia. Propagation prediction will be done within the first floor of WCC. The carrier frequencies are 2.45 GHz. Then measurements of signal strength using Airmagnet software will be carried out within the research area.

The objective of this project is to study on the losses of signal strength when it travels through Line of sight(LOS), walls ,door ,glasses etc. Then do simulation of signal propagation and signal strength prediction inside Wireless Communication Centre (WCC) building and measurement of signal strength in determines places in WCC. Comparing the two results and find the significant of using the simulation result only for Indoor Geolocation system using IEEE 802.11b.

ABSTRAK

Ramalan perambatan memainkan peranan yang penting dalam rekabentuk dan pemasangan sistem mengesan lokasi di dalam tempat tertutup menggunakan *Wireless LAN*. Dalam projek ini, perisian jenis 3 dimensi *ray tracing- Site Specific Outdoor / Indoor Propagation Prediction Code* akan digunakan untuk melakukan ramalan perambatan dan kekuatan signal di tingkat 1 bangunan WCC, Fakulti Kejuruteraan Elektrik, Universiti Teknologi Malaysia. Frekuensi pembawa ialah 2450MHz .

Objektif projek ini adalah untuk mengkaji kecekapan dan liputan (*coverage*) bagi kawasan tertutup seperti didalam bangunan di samping menentukan faktor yang akan menjejaskan perambatan gelombang radio. Keputusan yang didapati daripada perisian ini adalah dalam bentuk teks. Kemudian satu pengukuran kekuatan signal akan dilakukan menggunakan perisian *Airmagnet*.

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LIST OF NOTATION

λ	Wavelength
λ_o	Free space wavelength in meter
2 D	2 dimension
A_{eff}	Effective area
C	Velocity of light
C/N	Carrier to noise ratio
dB	Decibels
E	Total received E strength
E_d	Field strength at the receiving antenna due to the direct wave
ERP	Effective radiated power
f	Frequency
v	Fresnel –Kirchhoff diffraction parameter
GHz	Giga Hertz
G_R	Receiver antenna gain
G_T	Transmitter antenna gain
GUI	Graphic user interface
ISI	Intersymbol interference
$L_{(\text{sim})}$	Predicted path loss from simulation
L_c	Medium loss
L_{FSL}	Free space loss
LOS	Line of sight
MHz	Mega Hertz
P_D	Power density
P_R	Power received

P_T	Power transmitted
R/r_e	Effective radius of the earth
ψ	Reflecting angle
ρ	Reflection coefficient of the earth
RF	Radio frequency
SBR	Shoot and Bounce ray
UHF	Ultra high frequency
UTD	Uniform Theory of Diffraction
VHF	Very high frequency
VPL	Vertical Plane Launch
WCC	Wireless Communication Centre

CHAPTER 1

INTRODUCTION

1.1 Project Background

Nowadays, due to the increasing complexity of wireless network design, wireless network simulation engines have become a necessary tool . A signal-strength prediction system lies at the foundation of every wireless simulator, making signal-strength prediction for indoor propagation an important research topic in the radio field. Efficient and accurate methods are needed for use in current wireless network design systems and future wireless network application.

This project will use Site Specific Outdoor/Indoor Propagation Prediction Code to predict the radio wave propagation path loss in indoor area and Airmagnet software to measure signal strength. The main focus will be the indoor radio wave propagation and its accuracy.

Mainly, this project can be divided into three parts: First part is the simulation by using the simulator mentioned above. Before the simulation is done, a site survey is carried out in order to create necessary databases: building database, receiver database and building interior database, which will be needed for simulation.

Secondly, measurement on the locations that been use as experiment testbed that is Wireless Communication Centre (WCC).

Lastly ,comparison between the simulation result which are in text format and measurement result will be done.

1.2 Objectives

- To study on the indoor propagation environment within WCC building in order to obtain the efficiency and coverage of signals in WCC for building the offline database.
- To study on the mobile indoor propagation environment and also the environmental effects which affect the radio wave propagation
- To obtain a study on accuracy of signal simulation prediction compare to the measurement method.

1.3 Scope Of Project

The scope of my project is mainly about the study of indoor radio wave propagation prediction. The prediction area is within first floor of Wireless Communication Centre (WCC).The transmitters location that have choose is near the chamber ,at the mobile lab ,at the pathway and infront of the office. Propagation prediction will be done at a carrier frequency of 2450 MHz.

All the information about the building interior features and the building layout will be digitalized by creating the building interior database and building database respectively.

The main simulation result is the predicted path loss. It will be compared to the measurement result and then be analyzed

1.3 Summary Of Chapters

The first chapter briefly introduces this project by elaborating on the project background, objectives, and scope of the project. Second and third chapter are written based on the findings from the literature review. Chapter two concentrates on Wireless Lan and its application, whereas chapter three discuss about the Radiowave propagation.

Details of methodology and software/hardware used are explained in the fourth chapter. The whole process of doing this project will be discussed in detail in this chapter. Simulation and measrument result is analyzed in the fifth chapter. Finally, the whole project is concluded in the last chapter.

6.1 Future Work

There are some tasks required in the future. For my research , although the result is quite match but there are several factors that effect propagation environment, have been ignored to reduce complexity.

At the moment, all the programs including the simulation program and the three subprograms are run in dos command. Thus, graphical user interface (GUI), can be developed in future so that all these programs can run under one graphical .This program should be able to accept CAD building plan automatically without have to construct again using normal format.

In this research I didn't include contour distribution of signal strength and ray path tracing for each transmitter and receiver due to software and time constraint. For the future work it will be best if it can be realize and include for further works of this related research.

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