PROPAGATION MEASUREMENTS AND PREDICTOIN FOR INDOOR WLAN APPLICATION

IBRAHIM .M. ABDALLA ABOHARBA

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To my beloved father, Mokhtar Aboharba and mother Fatemh Salm

To my brothers and sisters

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ABSTRACT

The application of wireless local area network (WLAN) is increasing in offices, it become important to study signal propagation indoor environment. In this project, the Site Ware Technologies` site specific propagation prediction tool is a three-dimensional (3-D) ray tracing code employing modified shoot and bounce ray(SBR) method know as the Vertical Plane Launch (VPL) will be used to predict indoor propagation effects in Wireless Communication Center (WCC), Faculty of Electrical Engineering, University Technology Malaysia (UTM). Propagation prediction will be done within first floor of WCC at carrier frequency 2.4 GHz based on IEEE 802.11 b/g standard while measurement of signal strength will use Airmagent software for measure above mention area. after that presented simulation result into three dimensional using Matlab software .

ABSTRAK

Kajian mengenai perambatan isyarat kawasan bilik dalaman menjadi semakin penting dengan penambahan penggunaan WLAN dalam pejabat. Dalam projek ini, "Site Ware Technologies" adalah ramalan perambatan tiga dimensi (3-D) kod pengesan sinaran memerlukan cara "modified shoot" dan "bounce ray (SBR)" dikenal sebagai "Vertical Plane Launch (VPL)" akan digunakan untuk meramal perambatan dalam bangunan Pusat Komunikasi tanpa Wayar (WCC), Fakulti Kejuruteraan Elektrik (FKE), Universiti Teknologi Malaysia (UTM). Ramalan perambatan akan dilakukan pada tingkat 1 di bangunan WCC pada pembawa frekuensi 2.4 GHz yang berdasarkan piawaian IEEE 802.11 b/g manakala pengukuran kekuatan isyarat di tempat yang dinyatakan diatas adalah berdasarkan kepada perisian Airmagnet. Selepas itu, keputusan simulasi akan dipersembahkan dalam tiga dimensi (3-D) dengan meggunakan perisian Matlab.

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LIST OF SYMBOLS

WLAN	-	wireless local area networks
WCC	-	Wireless Communications Center
IEEE	-	Institute of Electrical and Electronic Engineering
ETSI	-	European Telecommunications Standards Institute
VPL	-	Vertical Plane Launch
Wi-Fi	-	Wireless Fidelity
LOS	-	Line of sight
OFDM	-	Orthogonal frequency division multiplexing
DSSS	-	Direct sequence spread spectrum
P_t	-	Transmitting power
P_r	-	Receiving power
G_t	-	Transmitter antenna gain
G_r	-	Receiver antenna gain
A_r	-	Effective aperture of antenna
λ	-	Wavelength
C	-	Velocity of light
dB	-	Decibels
θ	-	Incidence angle
f	-	Frequency
h_t	-	High of receiver antenna
h_r	-	High of transmitter antenna
A	-	Attenuation factor
ρ	-	Ground reflection coefficient
r1, r2	-	Phase path distance along
h	-	Fresnel zone radius to the knife edge
$\lambda_\circ$	-	Free space wavelength

Δd	-	Distance difference
d_1	-	Distance from transmitter to obstacle
d_2	-	Distance from transmitter to obstacle
τ	-	Delay spread
v	-	Speed of portable
f_c	-	Carrier frequency
L	-	Path loss
L_0	-	Reference loss
L_i	-	Floor loss factor
D	-	Distance
h(t)	-	Impulse response
A_n	-	Amplitude of signal
τ_n	-	Arrival time
ϑ_n	-	Arrival phase
E_i	-	Received field amplitude
E_o	-	Transmitting field strength

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CHAPTER 1

INTRODUCTION

1.1 Overview

The past decade has witnessed a phenomenal growth in wireless communication. Indoor wireless communication such as personal communication (PCs) and wireless local area networks (LAN) are exploding rapidly. The need for an efficient way to evaluate and tracing radio propagation in building is increasing. It is also critical to fiend method for provide beast coverage, consequently we fiend that the ray-tracing technique has been the beast to predict radio propagation in indoor environments.

1.2 Problem Statement

Now days , he use of indoor wireless LAN in offices increasing .The signal strength of these systems became wake due to placement of walls, window, glasses, overlapping channels, interference , etc. This is important to conduct studies research to improve coverage.

1.3 Wireless LAN

1.3.1 Introduction

Recently wireless local area networks (WLANs) have emerged as flexible communication systems, which have been implemented as an extension or alternation for a wired LAN within buildings. Using electromagnetic waves WLANs transmit and receive data over air interface, minimizing need for wired connection, thereby it enables user mobility in covered area without losing connectivity to the backbone net. The system implementations vary from simple peer-to-peer connection between two computers to cover entire buildings by many transmitter/receiver devices - access points (AP), which are connected to the wired network as in Figure 1.1 [1].

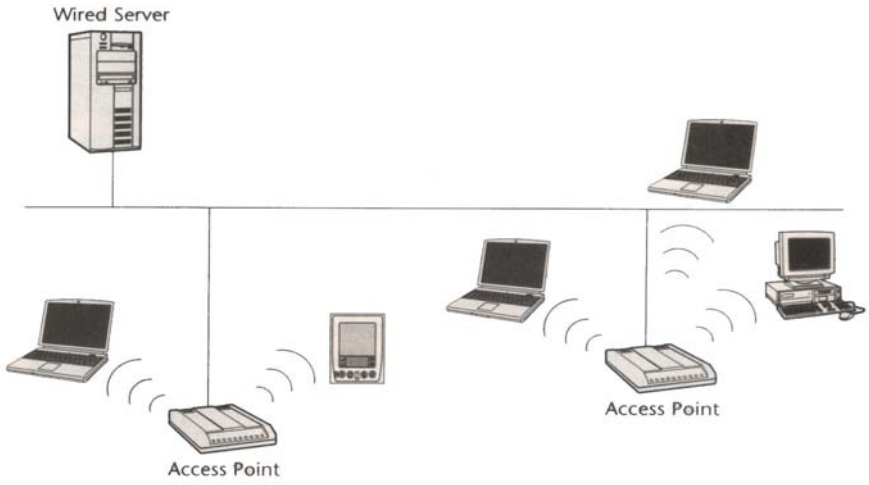

Figure 1.1: WLAN configurations with access point

1.3.2 Wireless LAN Standards

Tow standards bodies, IEEE ad European Telecommunications Standards Institute (ETSI) and one technology alliance (homeRF) promote WLAN standards. IN the IEEE 802.11family of WLANs, three standards deserve individual attention, and a handful of others are worth a quick mention. The leasing standard is 802.11 b , or Wi-Fi, short for Wireless Fidelity, The cleat challenger is 802.11a, which provides

increased throughput at a higher, less cluttered frequency; the outside contender is 802.11g, which just completed the final stage of IEEE approval at the time of writing .other WLAN standards that are worth consideration are HIPERLAN/1 and HIPERLAN/2.

1.3.2.1 802.11 standards

The IEEE 802.11 standard specification was approved in July 1997, making it the first wireless LAN standard to be defined. It used the same switching protocols wired Ethernet, but allows communication to happen without wires, instead using unlicensed 2.4GHz frequency radio communication .Two frequency modulation techniques are supported in 802.11 FHSS and DSSS. 802.11 predicts are not commonly sold anymore, as updated versions (802.11a and 802.11b) have take its place, providing higher bandwidths at a lower cost.

802.11b standard is the most popular standard in the 802.11x family. The specification was approved at the same time as 802.11 in 1999, but since then has achieved broad market acceptance for wireless networking. 802.11b is based on the direct sequence spread spectrum (DSSS) is easier to implement than orthogonal frequency division multiplexing (OFDM) as used in 802 .11a , 802.11b products came to market much sooner than their 802.11a counterparts. In addition, the 2.4GHz spectrum is available globally for WLAN configurations. While the 5GHz spectrum that 802.11a uses is for limited uses in many countries.

802.11b standard is able to reach a maximum capacity of 11 Mbps. This surpassed the 10 Mbps speed that is part of the original Ethernet standard, making 802.11b a practical alternative to, or extension of, a wired LAN. The use of his 2.4GHz band for communication has advantages and disadvantages. The 2.4GHz signals are able to penetrate physical barriers. Such as walls and ceilings more effectively than higher frequencies can. The downside of using the 2.4GHz spectrum is congestion. Since it is unlicensed, meaning anyone can use it without obtaining a special license; other electronic products also use this frequency for communication. In typical indoor office configurations, an 802.11b access can communicate with

devices up to 100 meters (around 300 feet) away. The further away a terminal is from the access point, the slower the communication will be devices within about 30 meters can usually achieve a data transfer rate of 111 Mbps ; beyond 30 meters, the rate drops to 5.5Mbps,and then to 2 Mbps around 65 meters away, and finally , to 1 Mbps around the outer edge. These numbers represent the anticipated coverage area and transmission speeds, but the products from each vendor will differ in performance.

802.11a standard is a high speed alternative to 802.11bstandard, transmitting at 5GHz and speeds up go 54Mbps. The move to the 5GHz band and OFDM modulation provides two important benefits over 802.11b. First, it increases the maximum speed per channel from11Mbps to 54Mbps.this is a tremendous boost, especially considering that the bandwidth is shared among all the user on an access point. The increased speed is especially useful for wireless multimedia, large file transfers, and fast internet access. Second, the bandwidth available in the 5GHz range is larger than available at 2.4GHz, allowing for more simultaneous users without potential conflicts. Additionally, the 5GHz band is not as congested at the 2.4GHz band, resulting in less interference.

IEEE 802.11g standard brings high speed wireless communication to the 2.4GHz band, while maintaining backward compatibility with 802.11b. This accomplished on two layers. First, 802.11g operates on the same 2.4GHz frequency band as 892.11b, with DSSS modulation types for speeds up to 11 Mbps .For 54Mbps; 802.11g uses the more efficient OFDM modulation types, still within the 2.4GHz band.

Other 802.11 Standards Just as 802.11g improved upon 802.11b, other 802.11 task groups are in place to improve upon the exiting 802.11x standards. His areas of concentration are security, quality of service, compliance and interoperability. All of these are still in the task group stage of the specification process:

IEEE 802.11e standard**,** aimed at providing quality of service (QoS) capabilities to enable reliable voice communication to complement 802.11b systems.802.11e will also provide enhanced security and authentication mechanisms.

IEEE 802.11f standard aimed at developing the recommended practices for an Inter-Access Point Protocol to achieve MultiFinder access point interoperability.

IEEE 802.11h standard**,** aimed at enhancing the 802.11 a High-Speed Physical layer in the 5GHz band to make IEEE 802.11a products compliant with European regulatory requirements.

Table1.1 and the figure2.2 below provide an overview of the characteristic and frequencies that use in IEEE 802.11.

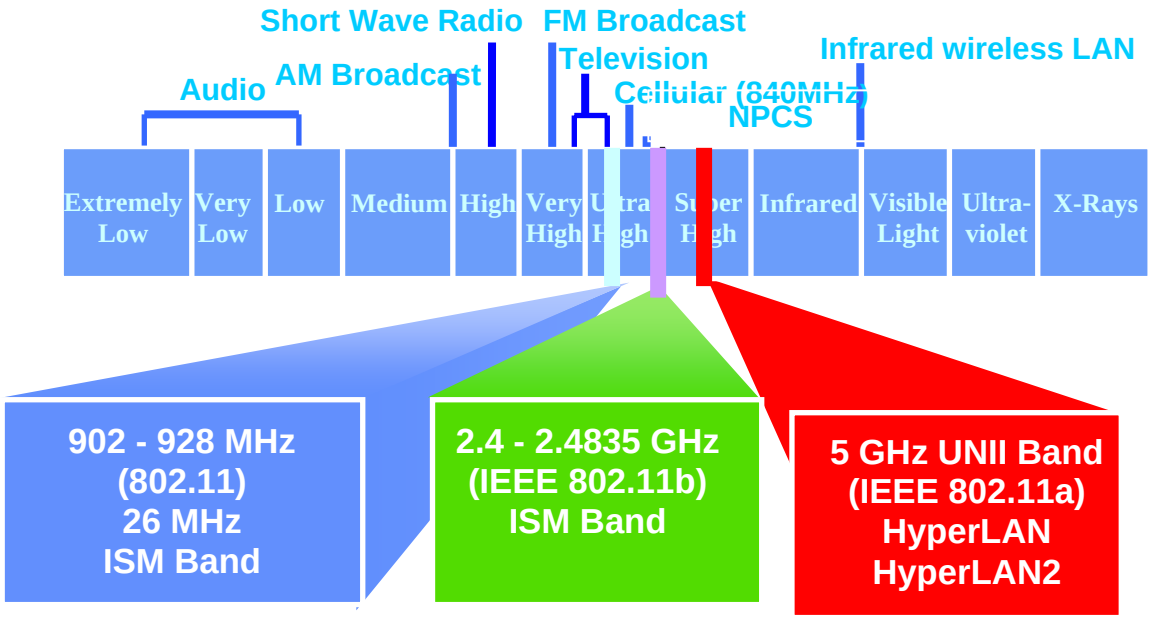

Figure 1.2: Frequency band for IEEE 802.11

	802.11	802.11b	802.11a
Approved	July 1997	September 1999	September 1999
Bandwidth (MHz)	83.5	83.5	300
Frequency Band (GHz)	2.4-2.835	2.4-2.835	5.15-5.25, 5.25-5.35, 5.725-5.825
Number of Non-Overlapping Channels	3 (Indoor/Outdoor)	3 (Indoor/Outdoor)	4 (Indoor) 4 (Indoor/Outdoor) 4 (Indoor/Outdoor)
Data Rate (Mbps)	1,2	1,2,5.5,11	6,9,12,18,24,36,48,54

Table1.1: Comparison of WLAN technologies

1.4 Objective of Project

To study indoor wireless local area network (WLAN) signal propagation within Wireless Communications Center (WCC) building, in order to obtain the best efficiency and coverage and compare with prediction.

1.5 Scope of Project

To provide proper study of WLAN propagation signal within WCC building of University Technology Malaysia in which tracing signal and visualizing them are needed .The prediction area will be within room and corridor which tracing signal that transmitting for access point to receivers inside the lab room and the per diction will be done at a carrier frequency 2.4 GHz based on IEEE 802.11 b/g standard. Present simulation results into three dimensional using Matlab software for visualization while measurement part will use AirMagent software.

1.6 Organization of the Thesis

Chapter 1 contains overview about project and method that will be used in this project, problem statement is presented factor that effect wireless LAN, wireless LAN presented IEEE 802.11standard and frequency that used in wireless LAN objective and scope for this project.

The literature review is performed in chapter 2. Some introduction of propagation paths and mobile radio propagation mechanism are introduced such as reflection, refraction, diffraction, delay spread and multipath fading, the last part shows some prediction and propagation model.

Chapter 3 contains the methodology process by; showing up the detailed diagram of the project methodology and highlights briefly the steps have been taken meet the objectives of this project.

Chapter 4 contains the results from VPL, result from AirMagnet software, Visualization Code and result in 3D by Matlab, in this chapter also include some analysis that is done based on the wireless communication principles and fundamentals. Finally, Chapter 5 contains the summary of the thesis and also includes some suggestions for future work.

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