PERFORMANCE OF WORLDWIDE INTEROPERABILITY FOR MICROWAVE ACCESS (WIMAX) IN NON LINE OF SIGHT AND MULTIPATH ENVIRONMENT

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To all my loving family members,

Especially to my beloved HUSBAND & my dearly children

Siti Sabariah

Siti Aishah

Muhammad Saifuddin

Muhammad Jazman

Thank you for all your support and understanding

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ABSTRACT

The requirement of BWA to operate in the non line of sight and multipath environment has lead to the amendment of IEEE 802.16 standard. The amended standard which is 802.16a covers fixed BWA in the spectrum of 2 to 11 GHz has become a stepping stoned to the enhancement of the wireless broadband technology. A discrete channel model based on the Stanford University Interim (SUI) model was used in the standard. This project evaluates the effect of empirical models on the 802.16a physical layer performance at 3.5 GHz. The empirical propagation model used in the project are COST 231[8] and ECC 33 model[9]. The comparison of the system performance of the OFDM between SUI, COST 231 and ECC 33 model were evaluated in terms of bit error rate (BER). The simulation results of these propagation model on 802.16a physical layer specification were used to validate their applicability in urban, suburban and rural environment.

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ABSTRAK

Keperluan di dalam capaian jalur lebar tanpa wayar di dalam untuk beroperasi di dalam perambatan tanpa pandangan penglihatan dan berbagai laluan telah mendorong kepada perubahan di dalam piawai "IEEE 802.16". Piawai yang telah diubah adalah "IEEE 802.16a" yang mana ianya meliputi capaian jalur lebar tanpa wayar tetap, ia beroperasi di dalam specktrum frekuensi 2 x 10^9 hingga 11 x 10^9. Piawai baru ini merupakan satu lonjakan paradigma kepada teknologi jalur lebar tanpa wayar. Saluran perambatan yang digunakan di dalam piawai jalur lebar tanpa wayar yang baru ini ialah "Standford University Interim (SUI)". Projek ini menilai tindakbalas saluran perambatan "empirical" pada system digital piawai jalur lebar tanpa wayar yang baru ini. Saluran perambatan "empirical" pada piawai jalur lebar tanpa wayar yang digunakan adalah perambatan "COST 231" dan "ECC 33". Perbandingan tindakbalas system "OFDM" terhadap perambatan di antara "SUI", "COST 231" dan "ECC 33" akan dinilai dalam bentuk kadar kesilapan bit yang diterima. Keputusan simulasi daripada ketiga-tiga jenis perambatan akan digunakan untuk mengesahkan kegunaan piawai yang baru ini pada keadaan di dalam bandar, luar bandar dan kampung.

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LIST OF ABBREVIATIONS

BWA	-	Broadband Wireless Access
FWA	-	Fixed Wireless Access
WIMAX-	-	Worldwide Interoperability for Microwave Access
OFDM -	-	Orthogonal Frequency Division Multiplexing
BER	-	Bit error rate
SUI	-	Stanford University Interim
ECC 33	-	Electronic Communication Committee Report 33
TDD	-	Time Division Multiplexing
FDD	-	Frequency Division Multiplexing
LAN	-	Local Area Network
LOS	-	Line of Sight
NLOS	-	Non Line of Sight
CPE	-	Customer Premise Equipment

LIST OF SYMBOLS

f	-	frequency
d	-	distance
h_b	-	Access Panel antenna height above ground level in metres
n_{COST}	-	Path loss exponent for COST 231
λ	-	wavelength
γ	-	path-loss exponent of SUI

CHAPTER 1

INTRODUCTION

1.1 Introduction

WiMax stands for Worldwide Interoperability for Microwave Access. WiMax refers to broadband wireless networks that are based on the IEEE 802.16 standard, which ensures compatibility and interoperability between broadband wireless access equipment. WiMax, which will have a range of up to 31 miles, is primary aimed at making broadband network access widely available without the expenses of stringing wires (as in cable-access broadband) or the distance limitations of Digital Subscriber Line. The rapid demand of Wimax is increasing because of the services provided which includes the broadband internet access, landline telephone bypass, cable/satellite TV bypass and mobile data plus cell phone services.

1.1.1 Wimax spectrum allocation

The IEEE Wireless Metropolitan Area Networks (Wireless MAN) Standard 802.16a is a new standard for BWA. Announced on January 30, 2003, the extension of the 802.16 standard covers fixed broadband wireless access in licensed and unlicensed spectrum from 2 to 11 GHz. It is also known as 802.16-2004 standards. 802.16-2004 WiMAX only supports fixed access, and products are already available. It provides service from a base station to a subscriber station, also known as customer premise equipment (CPE). Some goals for Wimax include a radius of service coverage of 6 miles from a Wimax base station for point-to-multipoint non-line-of-sight service. This service should deliver approximately 40 Mbps for fixed and portable access applications. While for point-to-point line-of-sight provides 30 miles of coverage with 72 Mbps.[4].

1.2 Objectives

The objectives of this project is to model and simulate the IEEE 802.16a (fixed access) OFDM physical layer at 3.5 GHz using LabView 8.0. The project will focus on the channel model of the standard. The channel models used are COST 231, ECC 33 and Stanford University Interim (SUI) model. The system performance of the OFDM through these channel models were evaluated under urban, suburban and rural environment.

1.3 Scope of Work

The scope of work of the project is to study the OFDM system through fixed broadband wireless access by evaluating the effects of modified path loss parameter in the 802.16a physical layer. This project will simulate the 256-point transform of OFDM physical layer at frequency allocation of 3.5 GHZ. The project modeled, simulated, and evaluated the performance of OFDM in different path loss algorithm in terms of bit-error-rate (BER). By this performance study, it is hoped that it could be a reference for network developer to deploy a fixed WiMax access in a different path loss model in Malaysia.

1.4 Outline of the Thesis

The thesis comprises of six chapters and the overview of all the chapters is as below:

Chapter 1: This chapter provides the introduction, objective and scope of work involved in accomplishing the project.

Chapter 2: This chapter presents the literature reviews on Wimax technology and description of 802.16a fixed Wimax simulator.

Chapter 3: This chapter comprises the literature review on propagation path loss used and the verification of the system performance in 802.16a simulator.

Chapter 4: This chapter describes the methodology used in setting up the path loss parameter in the OFDM.

Chapter 5: The simulation and results obtained are discussed in this chapter.

Chapter 6: Conclusion of the project and suggestions for future work are presented in this final chapter.