Performance Evaluation of OFDM and Modulation Techniques in Mobile WiMAX (IEEE 802.16e)

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Dedication

....To My Family

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ABSTRACT

Mobile communication has developed very during the last few years. Due to this fast development in this field, subscribers of today are enjoying the use of many applications ranging from data, voice, audio to video irrespective of the place where they are stationed or moving about.

WiMAX technology is fast capturing the market in the field of mobile broadband access. WiMAX uses Orthogonal Frequency Division Multiple Access (OFDMA) at the physical layer. WiMAX uses an adaptive modulation technique to modulate the signal prior to transmitting it. Under adaptive modulation, BPSK, QPSK, 16-QAM and 64 QAM are used for modulating the data depending on the channel conditions.

Cyclic Prefix is used to improve the quality of the signal under hostile environments especially Rayleigh fading. Cyclic prefix adds bits to the start and end of data stream to spread the signal. The receiver removes the bits added prior to further processing of the signal. Cyclic prefixing improves the error performance of signals by minimizing Inter Symbol Interference (ISI).

This study focused on the performance of the WiMAX system in terms of Bit Error Rate (BER), Signal to Noise Ratio (SNR), Power Spectral Density (PSD) and Probability of Error (Pe). Two models namely one without the Cyclic Prefix and the other with the Cyclic prefix were built to study these parameters. On analyzing the results, it was observed that adding cyclic prefix improved the error performance marginally especially when the signal is BPSK modulated. The results of BER vs SNR and Pe vs SNR are different as Pe is the expected value of BER where BER approaches Pe when the simulation is run for a long period of

time and the BER is very high. Other situations, Pe and BER show different results under same conditions.

Finally based on the evaluation and conclusion, recommendations were made for further work.

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List of Abbreviations

3GGP	-	3rd Generation Partnership Project
AAA	-	Authentication, Authorization and Accounting
AM	-	Amplitude Modulation
ASK	-	Amplitude Shift Keying
ASN-GW	-	Access Service Network Gateways
ASP	-	Application Service Provider
AWGN	-	Additive White Gaussian Noise
BER	-	Bit Error Rate
BPSK	-	Binary Phase Shift Keying
BS	-	Base Station
BWA	-	Broadband Wireless Access
CC	-	Convolution Code
CEPT	-	European Conference of Postal and Telecommunications Administrations
CSN	-	Connectivity Service Network
DAA	-	Detect and Avoid
DL	-	Downlink
DoS	-	Denial of Service
DPSK	-	Differential Phase Shift Keying
DSL	-	Digital Subscriber Line
DUR	-	Downlink to Uplink Ratio
ETSI	-	European Telecommunication Standard Institute
ECC	-	Electronic Communications Committee

FDM	-	Frequency Division Multiplexing
FDMA	-	Frequency Division Multiple Access
FEC	-	Forward Error Correction
FFT	-	Fast Fourier Transform
FM	-	Frequency Modulation
FSK	-	Frequency Shift Keying
GW	-	Gateway
HAP	-	High Altitude Platform
HiperMAN	-	High Performance Radio Metropolitan Area Network
IEEE	-	Institute of Electrical and Electronic Engineers
IFFT	-	Inverse Fast Fourier Transform
IMS	-	IP Multimedia Subsystem
IP	-	Internet Protocol
ISI	-	Inter Symbol Interference
ITU	-	International Telecommunication Union
LOS	-	Line of Sight
LTE	-	Long Term Evaluation
MAC	-	Media Access Control
MB-OFDM	-	Multiband OFDM
MFSK	-	Multiple Frequency Shift Keying
MGF	-	Moment Generating Function
MPSK	-	Multilevel Phase Shift Keying
MS	-	Mobile Station
MTRNG	-	Mersenne Twister Random Number Generator
NSP	-	Network Service Provider

NWG	-	Network Group
OECD	-	Organization for Economic Co-operation and Development
OFDM	-	Orthogonal Frequency Division Multiplexing
OFDMA	-	Orthogonal Frequency Division Multiple Access
PAPR	-	Peak-to-Average Power Ratio
Pe	-	Probability of Error
PSD	-	Power Spectral Density
PSK	-	Phase Shift Keying
PSTN	-	Public Switched Telephone Network
QAM	-	Quadrature Amplitude Modulation
QoS	-	Quality of Service
QPSK	-	Quadrature Phase Shift Keying
SNR	-	Signal to Noise Ratio
RNG	-	Random Number Generator
RS	-	Reed-Solomon
TDMA	-	Time Division Multiple Access
UP	-	Uplink
WiFi	-	Wireless Fidelity
WiMAX	-	Worldwide Interoperability for Microwave Access
WLAN	-	Wireless Local Area Network
WMAN	-	Wireless Metropolitan Area Network

CHAPTER 1: Introduction

1.0   Background

The telecommunication industry is facing unprecedented competition due to rapid changes in technology [1]. Customers also demand high levels of services from the service providers. The telecommunication service providers try new ways to meet customer demands and add value to their existing products and services using new technologies to gain competitive advantage and to increase customer loyalty.

Wireless technologies are used for many different applications today. Communication is one such industry where wireless technologies are heavily used. The telecommunication industry uses many wireless technologies ranging from fixed wireless to cellular mobile technologies. Worldwide Interoperability for Microwave Access or WiMAX in short is a telecommunication protocol or technology that has captured the attention of both the service providers and customers due to its ability to carry high speed data in a fixed or mobile wireless environment.

ITU, the United Nations specialized agency for telecommunications, is committed to playing a positive role in the development of the information society and to extending the benefits of advances in telephony and new information and communication technologies (ICT), such as broadband, broadband is expected to be one of the highlights of this year's show[3]. For the purpose of monitoring the growth of broadband uptake, as well as in the interest of consumers, each country needs to

The contents of the thesis is for internal user only

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