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Throughput Analysis of Mobile WiMax under Rician Fading Channel

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Abstract- *The wireless communication is a hot topic for research and innovation. The Major contributions of research in this area are to analyze the capacity and throughput of the communication scheme and enhance the performance of communication. The WiMAX (Worldwide Interoperability for Microwaves Access) is a broadband wireless data communication technology based around the IEEE 802.16. This paper discusses the model of mobile WiMAX MAC layer with Rician fading channel using simulink in MATLAB. This model is used for performance evaluation of the mobile WiMAX with QPSK and QAM modulation schemes and channel condition. The throughput and packet error rate are compared in the result section of this paper.*

Keywords- *WiMAX (Worldwide Interoperability for Microwave Access), MAC (Media access control), QoS (Quality of* ***service),*** *OFDM (Orthogonal Frequency Division Multiple Access)*

1. INTRODUCTION

As day passes more and more technologies are moving towards fully wireless technology. Some of recent services like Digital video broadcast (DVB), Digital audio broadcast (DAB), Internet, WLAN etc are trying to fulfill the demand. WiMAX is a rapidly growing broadband wireless access technology based on IEEE 802.16 and IEEE 802.16e providing fixed, nomadic, portable and mobile wireless broadband connectivity without the need for direct line of sight (LOS) with the base station. And is the also responsible for bringing the broadband wireless access (BWA) to the world as an alternative to wired broadband.[2] IEEE 802.16, also known as IEEE Wireless-MAN (Metropolitan Area Network)[1], explored both licensed and unlicensed band of 2-66 GHz which is standard of fixed wireless broadband and included mobile broadband application and It is provide to connection internet access up to 30 miles (50 km) of distance at transmission data rates of up to 75 Mbps. The IEEE- 802.16 standards only specify the Physical layer and MAC (Media access control) layer of air interface while the upper layers are not considered. IEEE-802.16 suite of standards (IEEE-802.16- 2004 and IEEE-802-16e-2005) [3] defines within its scope four physical layers, any of which can be used with the MAC layer to develop a broadband wireless system. The IEEE 802.16e air interface [5] based on Orthogonal Frequency Division Multiple Access (OFDMA) which main aim is to give better performance in non-line-of-sight (NLOS) environments. The IEEE has subdivided the data link layer into two sub-layers. Logical link control (LLC) and Media access control (MAC).

The rest of the paper has been organized as follows: In the section II, blocks of the simulink model of WiMAX MAC Layer has been provided. The modulation schemes described in section III, Experimental simulation results has been given in section IV, and conclusion is given in section V.

2. SIMULATION MODEL

The WiMAX MAC layer simulation model implemented using Simulink and interface with MATLAB code to find the performance under varying condition. The WiMAX MAC layer model [6] is manly consisting of three major parts, transmitter, channel and receiver. The WiMAX (MAC LAY and PHY LAY) system is shown in figure 1.In our model we have used the transmitter section, the MAC layer received data is called service data unit (SUD) from upper layer. These SDU is then fragmented and packetize in the form of packets called MAC protocol data unit. The data of each packet pass through the physical layer having modulator QPSK and QAM followed by OFDM transmitter.

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The Rician fading model is implemented to introduce the fading in the transmitter data.[8] Receiver section received data coming from channel is fed into the OFDM demodulation, which consist of removal of cyclic prefix, Fast Fourier Transform and disassemble OFDM frame.

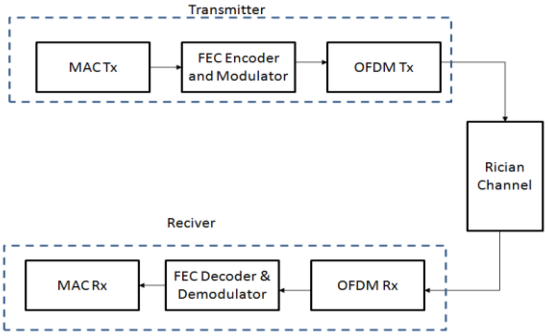

Figure 1: Block diagram of WiMAX Simulation Model

Table 1: Characteristics of WiMAX Simulation Model [6]

Standard	802.16e
Data Rate	70Mbps
Carrier Frequency	10GHz
Channel Size (Bandwidth)	1.5 MHz to 20 MHz
Modulation	QPSK, QAM
Topology	Mesh
Radio Technology	OFDM and OFDMA

A. MAC Layer of WIMAX

WiMAX MAC layer provide an interface between higher transport layer and the physical. The 802.16-2004 and IEEE 802.16e-2005[3] MAC design includes a convergence sub-layer (CS). This can interface with a variety of higher layer protocols, such as ATM, IP, and Ethernet. The CS provides a mapping to and from the higher layer (IP) addresses to MAC addresses. It also supports packet header suppression to reduce MSDU overheads.
The WiMAX MAC layer designed to support very high peak bit rate and deliver QoS similar to that of ATM. Each MAC frame is prefixed with a generic MAC header (GMH) that contains, Length of frame,[7]connection identification (CID), bit to quality the presence of CRC, sub-headers, secure key and encryption flag. WiMAX MAC also supports ARQ (Automatic Repeat Request) [4] to request retransmission.MAC is further divided into three sub-layers:
a. Convergence Sub-layer (CS),
b. Common Part Sub-layer (CPS),
c. Security Sub-layer (SS).

B. QoS (Quality of service)

The WiMAX MAC Layer has connection oriented architecture; it's designed to support a verity of application including voice and multimedia services. The system offers support for constant bit rate, variable bit rate time, non-real-time traffic and best effort data traffic. It's designed to support multiple users, with multiple connections per terminal. Each connection with a different QoS control is achieved by using a connection identifier. The QoS parameters include by traffic priority, maximum burst and tolerable rate, ARQ type, maximum delay, data unit type and size etc.

C. OFDM

The idea of OFDM comes from Multi-Carrier Modulation (MCM) [4] transmission technique. The principal of MCM describe the division of input bit stream into several parallel bit streams and then they are used to modulation several sub carriers. Each sub-carrier is separated by a guard band to ensure that they do not overlap with each other. In the receiver side, bandpass filters are used to separate the spectrum of individual sub-carriers. OFDM is a special form of spectrally efficient MCM technique, which employs densely spaced orthogonal sub-carriers and overlapping spectrums. The orthogonality is achieved by performing Fast Fourier Transform (FFT) on the input stream. Because of the combination of multiple low data rate sub-carriers, OFDM provides a composite high data rate with long symbol duration. Depending on the channel coherence time, this reduces or completely eliminates the risk of Inter-Symbol Interference (ISI), which is a common phenomenon in multi-path channel environment with short symbol duration.

D. Communication Channel

In wireless communication, the data are transmitting through the wireless channel with respective bandwidth to achieve higher data rate and maintain quality of service. The transmitting data has to take environmental challenge when it is on air with against unexpected noise. That's why data has to encounter various effects like multipath delay spread, fading, path loss, Doppler spread and co-channel interference. These environmental effects play the significant role in WiMAX Technology.

E. Additive White Gaussian Noise (AWGN)

AWGN is a noise channel. This noise channel model is good for satellite and deep space communication but not in terrestrial communication because of multipath, terrain blocking and interference. AWGN is used to simulate background noise of channel. The mathematical expression as in received signal. This passed through the AWGN channel where s (t) is transmitted signal and n (t) is background noise. The AWGN Channel block adds white Gaussian noise to a real or complex input signal. If the average received power is and the noise power spectral density is N_0 [W/Hz], the AWGN channel capacity equation 1 is.

Where is the received signal-to-noise ratio (SNR).

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The channel capacity concept to an additive white Gaussian noise channel with B Hz bandwidth and signal-to-noise ratio S/N is the Shannon–Hartley theorem equation 2 is.

F. Channel Coding

The channel coding can be used the transforming of signal to improve communication performance by increasing the robustness against channel impairments such as noise, interference and fading. The channel coding can be described as a three phase process including Randomization,

FEC and Interleaving.

G. IFFT and FFT

The inverse Fourier transform converts the frequency domain data stream into the corresponding time domain. Then a parallel to serial convertor is used to transmit time domain samples of one symbol. The Fast Fourier Transformation (FFT) is used to convert data in time domain to the frequency domain at the receiver. The serial to parallel block convertor is placed to convert this parallel data into a serial stream to the original input data. IFFT block allocates the different orthogonal subcarrier for transmitted bits and thus no interference exists between subcarriers. In this situation sub-carriers can be closer together, which means that bandwidth can be saved signification.

3. MODULATION TECHNIQUES

WiMAX uses a special type of modulation technique which is a mixture of ASK and PSK with a new name called Quadrature Amplitude Modulation (QAM). In QAM, amplitude and phase changes at the same time. Different types of QAM are available for WiMAX networks depending on throughput and range. 64 QAM has higher throughput but lower range where as 16 QAM has lower throughput but higher range to cover from the BS. WiMAX has the freedom to select Quadrature Phase Shift Keying (QPSK) and QAM as its modulation techniques depending on the situation.

A. Binary Phase Shift Keying (BPSK)

This is also known as two-level PSK as it uses two phases separated by 180º to represent binary digits (0, 1). This kind of phase modulation is very effective and robust against noises especially in low data rate applications as it can modulate only one bits/symbol. The principle equation 3 is.

B. Quadrature Amplitude Modulation (QAM)

The QAM is popular modulation technique used in various wireless standards. It combined with ASK and PSK which has two different signals sent concurrently on the same carrier frequency but one should be shifted by 90º with respect to the other signal. The principle equation 4 is.

Quadrature Phase Shift Keying (QPSK)

This is also known as four-level PSK where each element represents more than one bit. Each symbol contains two bits and it uses the phase shift of π/2, means 90º instead of shifting the phase 180º. The principle equation 5 is.

In this mechanism, the constellation consists of four points but the decision is always made in two bits. This mechanism can ensure the efficient use of bandwidth and higher spectral efficiency.

4. EXPERIMENTAL SIMULATION RESULTS

The WiMAX MAC (Medium Access Control) layer simulink model is shown in figure 1, in this model we are used in AWGN (Additive White Gaussian Noise) and different modulation schemes used like QPSK (Quadrature Phase Shift Keying) and QAM (Quadrature Amplitude Modulation). The performance of WiMAX MAC layer based of the simulation results are shown in figure 2, 3, and 4 in this analysis used the following parameters as shown in table 2.

Table 2: Performance of IEEE 802.16e MAC layers Parameters

Parameters	Value
Channel	AWGN ,Rician
Modulation Techniques	QPSK and QAM
IFFT (Input port size)	512
CC Code Rate	1/2
Channel Size (Bandwidth)	10 MHz
Radio Technology	OFDM
RS Encoding (Codeword length N)	255
RS Encoding (Message length K)	239
Input Signal Power	0.01 ohm(Watts)
Simulation Mode	Normal
Simulation time	1 Sec
Trellis structure	poly2trellis(7, [171 133])
Generator polynomial input bit by PN- sequence	[1 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1]

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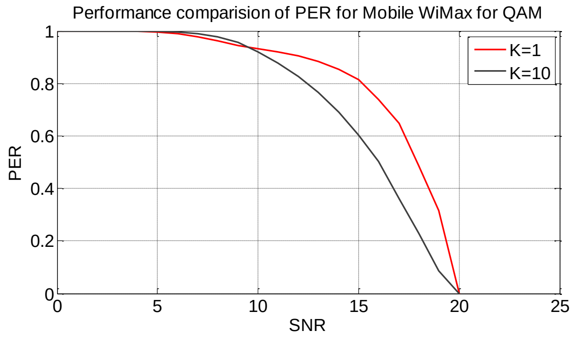

Figure 2: Performance of IEEE 802.16e MAC Layer over AWGN with QPSK Modulation Scheme

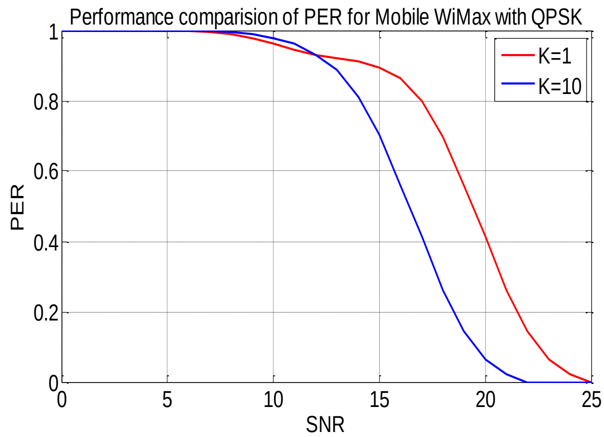

Figure 3: Performance of IEEE 802.16e MAC Layer over AWGN with QAM Modulation Scheme

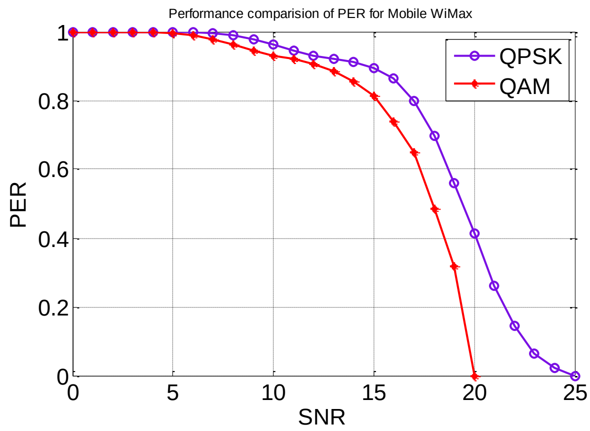

Figure 4: Performance of IEEE 802.16e MAC Layer over AWGN with QAM Modulation Scheme

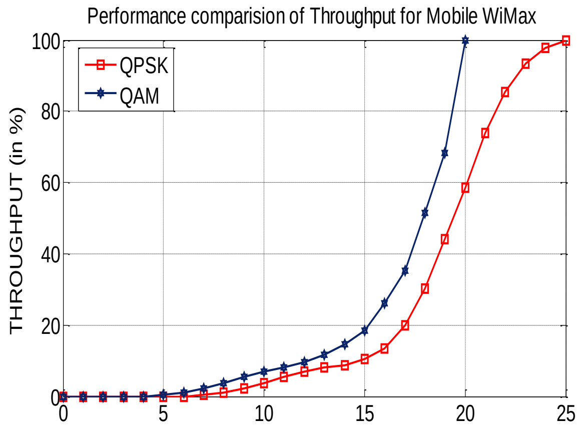

Figure 5: Performance of IEEE 802.16e MAC Layer over AWGN Channel with comparison Modulation Techniques of QPSK and QAM

5. CONCLUSION

This paper presents performance over MAC layer under various modulation schemes in Rician channel. A key performance measure of a wireless communication system is the PER versus SNR. It can be concluded that for a certain value of SNR at some signal power the performance in terms of BER is less in QAM system than that of a QPSK system.

REFERENCES

[1] IEEE 802.16-2006: "IEEE standard for Local and Metropolitan Area Network- Part 16: Air Interface for Fixed Broadband Wireless Access Systems"

[2] "Performance Analysis of WiMAX PHY" by S.M. Lalan Chowdhury, P. Venkateswaran, IEEE CASCOM Post Graduate Student Paper Conference 2010 jadavpur university, Kolkata, India. Nov. 27, 2010; pp 13-16

[3] IEEE 802.16e-2005, "IEEE Standard for Local and Metropolitan Area Networks, part 16, Air Interface for Fixed and Mobile Broadband Wireless Access Systems", IEEE Press, 2006

[4]Nuaymi Loutfi, 2007, WiMAX Technology for Broadband Wireless Access, Wiley London

[5] " The WiMAX 802.16e Physical Layer Model" by Muhammad Nadeem Khan, Sabir Ghauri, University of West of England, United Kingdom,

[6] "Simulation of WiMAX 802.16 MAC Layer Model: Experimental Results" by Neha Rathore, IJECT Vol. 3 Issue 1, Jan.- March 2012, R.K.D.F. Institute of Technology & Science, Bhopal, MP,India

[7] Muhammad Nadeem Khan, Sabir Ghauri, "The WiMAX 802.16e Physical Layer Model", University of the West of England, United Kingdom, ndm62 1 @hotmail.com,

[8] IEEE 802.16-2004, "IEEE Standard for Local and Metropolitan Area Networks Part 16: Air Interface for Fixed Broadband Wireless Access Systems", Rev. of IEEE 802.16-2001, 1 Oct.2001