Impactal Study of Characteristic on Data Rates in WI-MAX System With Variation in Signal to Noise Ratio Using Different MIMO Modulation Techniques

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Abstract
Wireless becomes the backbone of the business organization, educational , social , Govt and Non Govt organization success. By the advent of the information technology , wireless networks becomes the essence of the communication system. Unique properties of the wireless network made the various applications requirements . Normally Wireless networks are less efficient and unpredictable compared to wired networks, which make quality of service (QoS) provisioning a bigger challenge for wireless communications. The evergreen demand for fast delivery of large volumes of data is one of the challenging task for wireless communication technology. Wi-MAX (Worldwide Interoperability for Microwave Access) is a wireless broadband solution that offers a rich set of features with a lot of flexibility in terms of deployment options and potential service offerings. Its main objective is to provide quality with cost effectiveness. The wireless medium has limited bandwidth, higher packet error rate, and higher packet overheads that altogether limit the capacity of the network to offer guaranteed QoS.

Wi-MAX (worldwide inter-operability for microwave access) is an emerging technology for global broadband wireless system offering high speed access to mobile and broadband services. It is based on IEEE 802.16e standard. This standard only deals with MAC and PHY layer specification of network architecture. Considerable research has been done on performance analysis of PHY layer model of Wi-MAX system over AWGN channel model. This paper attempts performance analysis of IEEE 802.16e PHY layer model over AWGN. Different modulation schemes, coding rates and different values of cyclic prefix are considered for comparison using BER (Bit error rate) ratio and SNR (Signal to Noise ratio) as performance parameters.

Keywords
IEEE 802.16e ,Wi-MAX, SNR, OFDM , QoS, probability of error, AWGN, IEEE 802.16e, MAC and PHY Layer, LOS, NLOS

I. Introduction

Internet has becomes the essence of life. Nowadays people are enjoying wireless internet access for telephony, radio and television services when they are in fixed or mobile conditions. The rapid growth of wireless internet causes a demand for high-speed access to the World Wide Web. To serve the demand for access to the internet "any where any time" and ensure quality of service, the IEEE802.16 working group brought out a new broadband wireless access technology called "Wi-MAX". Wi-MAX is a new broadband wireless access technology that provides very high data throughput over long distance in a point-to-multipoint and line of sight (LOS) or non-line of sight (NLOS) environments. In terms of the coverage, WiMAX can provide services up to 20 or 30 miles away from the base station. WiMAX standards were developed by IEEE 802.16 group. These standards are based on wireless metropolitan area networking (WMAN) standards. The Wi-MAX Forum has two different system profiles: one based on IEEE 802.16-2004 OFDM PHY, called the fixed system profile; the other is based on IEEE802.16e- 2005 scalable OFDMA PHY, called the mobility system profile.

Fig. 1: No. of the Towers and Users. Source : You Tube)

The majority of aspects which make Wi-MAX technology different from others that can be applied to the same scenario reside in its physical layer [4]. To this level, many numerical approximation models which are able to predict the behavior of radio channels can be found[5]. However, this work contains the description of mandatory and optional features of Wi-MAX PHY layers and simulates them in fading environment. The rest of this document is structured as follows: some of the basic features for fixed Wi-MAX PHY layer are described.

It can be used for many applications, including "last mile" broadband connections, cellular backhaul, and high-speed enterprise connectivity for business, due to its high spectrum efficiency and robustness in multipath propagation. The Wi-MAX Broadband Wireless Access Technology based on the IEEE 802.16 standard, is at the origin of great promises for many different markets covering fixed wireless Internet Access, Backhauling and Mobile cellular networks and provide for the transmission of multimedia services (voice, Internet, email, games and others) at high data rates (of the order of MB/s per user), which can offer high speed voice, video and data service up to the customer end.

This is a technology that enables anywhere and anytime access to information and applications at low cost and with a small investment. This technology can reach a theoretical 30 mile coverage radius and achieve data rates up to 75 Mbps. The Wi-MAX Wireless communication technique uses orthogonal frequency division multiplexing technique that has a higher sensitivity to frequency offsets and noise pulses. An orthogonal frequency division multiplexing is used by Wi-MAX. As soon as the orthogonal frequency division multiplexing use adaptive modulation technique such as (BPSK, QPSK, 16-QAM and 64-QAM) of WIMAX and it uses the concept of cyclic prefix that adds additional bits at the transmitter end. The signal is transmitted through the channel and it is received at the receiver end. Then the receiver removes these additional bits in order to minimize the inter symbol interference, to improve the bit error rate and to reduce the power spectrum.

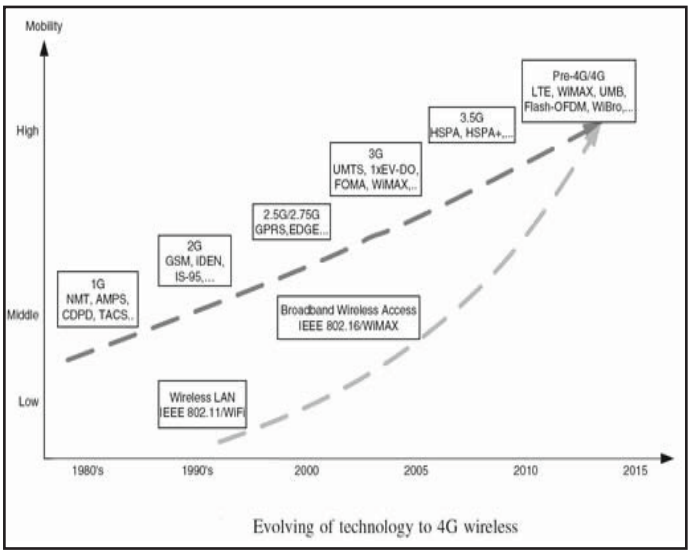

Fig. 2: Existing Technology to 4G

In fixed Wi-MAX profile, the size of OFDM symbols are fixed at 256, 192 subcarriers are using for carrying data, for channel estimation and synchronization purposes 08 subcarriers used as pilot, and the rest symbols used as guard band. Since the FFT symbols are fixed in size, the spacing between subcarrier varies with channel bandwidth. When larger bandwidths are in use subcarrier spacing increases and symbol time decreases. According to, decreasing symbol time implies a larger fraction needs to be allocated as guard time to overcome delay spread. To allow system designers to make appropriate trade-offs between spectral efficiency and delay spread robustness IEEE 802.16 OFDM-PHY allows a wide range of guard times.

II. Methodology for System Model

In basic model binary data is transmitted by modulating the input signal by QAM modulator. Simply then data is carried by the AWGN channel and then phase noise is introduced in input signal. At the receiver side the data is demodulated by the QAM demodulator and then received at the receiver. This is the basic QAM model design. In MATLAB 12a, this design is simulated and checks the bit error rate of the basic OFDM system. High speed communication leads to the rising needs of invention. Orthogonal frequency division multiplexing assembles the rising needs. OFDM converts the high speed information to the lower speed information stream that can be transmitted over a large no. of subcarriers. Basically the Wi-MAX physical layer is based on the OFDM modulation technique. OFDM based Wi-MAX physical layer is an efficient scheme for high data rate transmission in a non-line of sight or multipath environment.

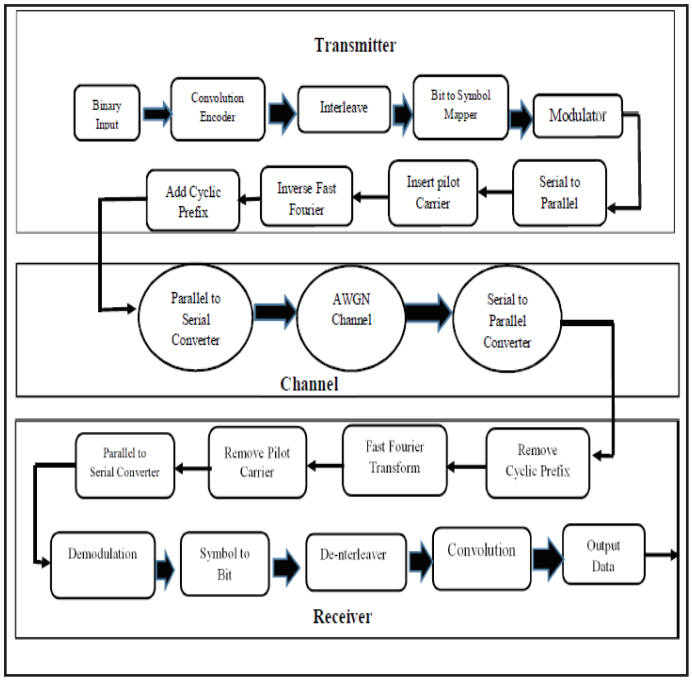

Fig. 3: Shows the High Data Rate Reception and Transmission

III. Results and Discussion of Simulated Study

In this section simulation results of basic OFDM model and OFDM based Wi-max model along with BER curves analysis of AWGN channel are presented. In basic model by increasing the signal power with respect to noise power of channel the interference reduces due to which the BER of the system reduces High data rate transmission for a longer distances use OFDM technique for Wi-max model. In Wi-max based OFDM model cyclic prefix can be used to overcome the effect of ISI. In Wi-max model analysis by reducing the average power of channel the BER performance of the system reduces. Increase in SNR values reduces the bit error rate of the OFDM system.

BER for BPSK modulation in Rayliegh fading channel and compared to AWGN channel

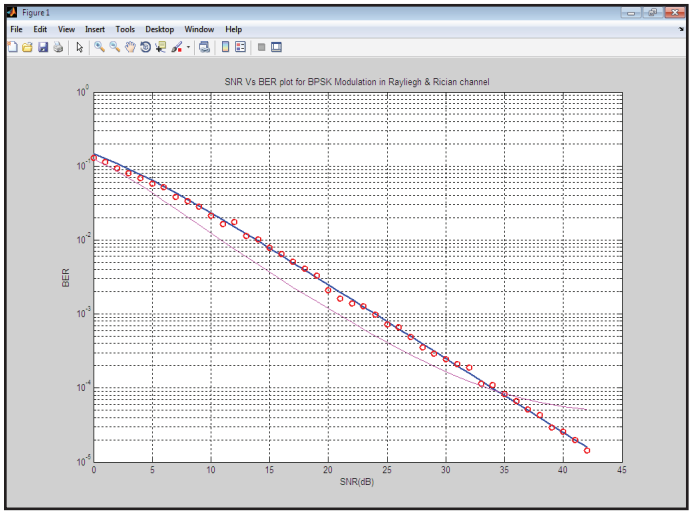

Fig. 4: BER Vs SNR(dB) Curve on Lagarithmic scale using 16-QAM Modulation

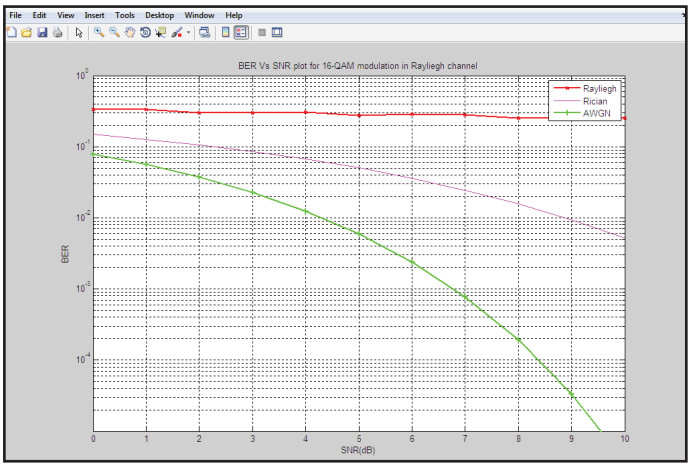

Fig. 5: Showing the Simulated Result

IV. Conclusion

Wi-MAX networks promise to offer an easy deployable and relatively low cost solution for the wireless broadband access. In usual operating conditions, Wi-MAX will likely support traffic belonging to a wide range of broadband applications and it is claimed to provide differentiation among heterogeneous demanding flows. Channel encoding and QoS service classes are the key components to provide QoS capability and proportional fairness in the bandwidth sharing over a changing radio environment. In Wi-max system the main aim is to get high data rate transmission for a long range of communication. A comparative study between different channels model implemented with Wi-MAX, each one of them is described by appropriate parameters and specified for specific environment of propagation, these channels have been implemented using different modulation schemes. Analysis demonstrated that the modulation and coding rate have a considerable impact on the relative performance between the different channel conditions. It has been also observed that, lower modulation and coding scheme provides better performance with less SNR.

V. Future Work

Multiple-Input Multiple-Output (MIMO) systems offer considerable increase in data throughput and link range without additional bandwidth or transmit power by using several antennas at transmitter and receiver to improve wireless communication system performance. At the same time, Orthogonal Frequency Division Multiplexing (OFDM) has becoming a very popular multi-carrier modulation technique for transmission of signals over wireless channels. A MIMO-OFDM modulation technique can achieve reliable high data rate transmission over broadband wireless channels. We developed a program in MATLAB, to study Wi-MAX and MIMO-OFDM systems behavior under different conditions. We have used the different types parameters ,data rate, AWGN channel, subcarriers OFDM signal, four types of modulation BPSK, QPSK, 16QAM and 64QAM.

References

[1] S. Elayoubi, B. Fouresti´e,"Performance evaluation of admission control and adaptive modulation in ofdma wimax systems," IEEE/ACM Transactions on Networking(TON), Vol. 16, No. 5, pp. 1200–1211, 2008

[2] Raajan, N.R. Prabha, S. and Meenakshi, S. (2013) —Improved performance in OFDM system by PAPR reduction techniques," International Conference on Computer Communication and Informatics (ICCCI -2013), Jan. 04 - 06, 2013.

[3] Anamul Islam, A.Md. Julkarnain C.Md. and Abdul Kader, B.Md. (2010) —BER Performance analysis of a real data communication through WiMAX-PHY layer over an AWGN and fading channel," International Journal of Electrical & Computer Sciences IJECS-IJENS Vol:10 No:04, August 2010.

[4] Vikram Mehta ,"Performance Analysis of QoS Parameters for Wimax Networks", International Journal of Engineering and Innovative Technology, Volume 1, Issue 5, May 2012.

[5] Z. M. Elkwash, N. M. Shebani, A. Mjahed ,"Effect of Cyclic Prefix on Data Rates in WiMAX System with Variation in Delay Vector, Gain Vector, Signal to Noise Ratio and Coding Rates for Different Modulation", International Conference on Technological Advances in Electrical, Electronics and Computer Engineering (TAEECE), IEEE,2013, pp. 538 – 545. , 2008.

[6] P Omprakash ,R Sabitha ," PERFORMANCE ANALYSIS OF TCP OVER WiMAX", Electronics Computer Technology (ICECT), 2011 3rd International Conference on ,Volume 6 2011.

[7] Mandeep Kaur, Hardeep Kaur , Jaipreet Kaur, BER analysis of OFDM based WIMAX using Punctured Convolutional codes: International Journal on Recent and Innovation Trends in Computing and Communication Volume: 2 Issue: 5 1244–1248,2014.

[8] Jaipreet Kaur, Manjit Sandhu, Sukhdeep Kaur, "OFDM: A System Based Comparison with Cyclic Prefix", International Journal of Advanced Research in Computer and Communication Engineering Vol. 5, Issue 3, March 2016.

[9] Smriti Shrivastava and Md. Abdullah, "A Survey: IEEE 802.16 Wireless MAN (WIMAX) using Various Modulation Techniques, International Journal of Computer Applications, Volume 92, Issue 14, Pages: 27-33, April 2014.

[10] Data Communication by Tannonboum.

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