ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 3, Issue 10, October 2015

A survey "Evaluation of WIMAX 802.16 technology performance by evaluating the Bit-Error Rate (BER) of OFDM physical layer under different modulation schemes and channel conditions"

Rajkanwar Singh[1], Sarabjit Singh[2]

M.Tech. Student, E.C.E. Department, Guru Kashi University, Talwandi Sabo, India [1]

Assistant Professor, E.C.E Department, Guru Kashi University, Talwandi Sabo, India[2]

Abstract: WiMAX (Worldwide Interoperability for Microwave Access) is a technology that bridges the gap between fixed and mobile access and offer the same subscriber experience for fixed and mobile user. In this work, with the performance investigation of the WIMAX system under different applications generating high load data traffic, various modulation schemes like GMSK, BPSK, DPSK, QAM 64 etc. were introduced. The performance of WIMAX physical layer is analyzed based on the simulation results of Bit-Error Rate (BER) and Signal-to-Noise Ratio (SNR) and the results are represented in the form of tables and graphs.Creating the simulation scenario that is equivalent to real world is the first step of simulation. In this work, various modulation techniques used by OFDM physical layer of WIMAX 802.16 are implemented. To generate data in the network, applications generating high load data traffic at VBR will be designed. A discrete event simulator called OPNET (Optimized Network Engineering Tool) Modeller version 14.0 is used to implement all the mechanisms by using the process models provided by the library of the simulator. In the last various performances evaluation metrics are used to gather the results of Bit Error Rate (BER) and Signal to Noise Ratio (SNR) in tabular and graphical form and conclusion is drawn based on the gathered results.

Keywords*:* IEEE 802.16 WiMAX, Physical layer, OPNET, Modulation techniques, Bit Error Rate.

I. INTRODUCTION

802.16 WiMAX: WiMAX stands for Worldwide Interoperability for Microwave Access. WiMAX technology enables ubiquitous delivery of wireless broadband service for fixed and/or mobile users, and became a reality in 2006 when Korea Telecom started the deployment of a 2.3 GHz version of mobile WiMAX service called WiBRO.

The fixed wireless versions of WiMAX (IEEE 802.16-2004) have mostly been applied to broadband wireless backbone applications. Because this technology was developed for commercial licensed applications, the quality of service feature was well established. , thus, it can support differentiated service levels.

The fixed version of WiMAX operates with a TDM (Time Division Multiplexing) data stream on the downlink and TDMA (Time Division Multiple Access) on the uplink communications with a centralized scheduler controlling access. Mobile WiMAX on the other hand utilizes Scalable Orthogonal Frequency Division Multiple Access (S-OFDMA) with a scheduler controlling frequency selective access both on the uplink and downlink depending on five different service categories.

The following table summarizes some of the key attributes of the WiMAX technology standard:

Standardization	**IEEE 802.16**	**IEEE 802.16-2004**	**IEEE 802.16e**
Date	2003	2005	2006
Spectrum Band	Licensed 10-66 GHz	Licensed and Unlicensed sub-11 GHz	Licensed, Sub-6 GHz
Â Channel Bandwidths		1.75, 3.5, 5, 7, 10, 20 MHz	1.25, 2.5, 5, 7, 10, 14, 20 MHz
Air Interface	OFDM / OFDMA	OFDM / OFDMA	S-OFDMA
Channel Capacity	Up to 134 Mbps	Up to 70 Mbps	Up to 35 Mbps

Mobile WiMAX (IEEE 802.16-2005) is the mobile extension version of WiMAX that has been developed as the industry standard. In 2007, Mobile WiMAX was approved by the International Telecommunication Union (ITU-R) as a new IMT-2000 standard7.

The WiMAX Forum, serving as the industry lead, is developing specifications for conformance, interoperability and certification (set of profiles) that

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 3, Issue 10, October 2015

leverage the standards-based technical specifications defined by the standards bodies.

The mobile version of WiMAX (IEEE 802.16e) is drawing considerable international attention because its data rate is far higher than current 3G wireless technologies. However, it will face competition in the near future with nascent advanced broadband wireless technologies such as the 3G-LTE (Long Term Evolution) technologies currently under development. 3G LTE is an advanced version of 3G UMTS (Universal Mobile Telecommunications System) being developed by the 3rd Generation Partnership Project (3GPP). Both have considerable promise for serving the public safety community with broadband capabilities.

Currently, mobile WiMAX can be implemented in three spectrum bands (2.3-2.4 GHz, 2.5-2.7 GHz, and 3.4-3.6 GHz) which have mostly common allocations worldwide. However, the technology is applicable in other bands as well (remember - a standard looking for some spectrum?). For example, it can be applied even in some unlicensed and public safety bands such as 2.4 GHz, 4.9 GHz and 5.8 GHz if needed. Due to such wide operational spectrum bands, the WiMAX Forum is developing feature sets - or profiles - to meet worldwide interoperability within each profile. Additional work to extend WiMAX into other spectrum bands such as 4.9 GHz is under way. Also, a profile for the newly available 700 MHz spectrum is expected soon.

a) How WiMAX works

In practical terms, WiMAX would operate similar to Wi-Fi but at higher speeds, over greater distances and for a greater number of users. WiMAX could potentially erase the suburban and rural blackout areas that currently have no broadband Internet access because phone and cable companies have not yet run the necessary wires to those remote locations.

A WiMAX system consists of two parts: A WiMAX tower is similar in concept to a cell-phone tower and a single WiMAX tower can provide coverage to a very large area as big as 3,000 square miles (~8,000 square km). A WiMAX receiver - The receiver and antenna could be a small box or they could be built into a laptop the way Wi-Fi access is today. A WiMAX tower station can connect directly to the Internet using a high-bandwidth, wired connection it can also connect to another WiMAX tower using a line-of-sight, microwave link. This connection to a second tower along with the ability of a single tower to cover up to 3,000 square miles is what allows WiMAX to provide coverage to remote rural areas. WiMAX offers the kind of service where you can get a connection and wherever u may be when WiMAX is fully developed,you will no longer be limited to 300 feet within the Wi-Fi hotspot and u won't have to drive around looking for a connection. WiMAX is very cost effective and has the ability to get a higher connection speeds farther away from the transmitter. WiMAX operates on the same general principles as Wi-Fi and it sends data from one computer to another via radio signals. A computer (either a desktop or a laptop) equipped with WiMAX would receive data from the WiMAX transmitting station, probably using encrypted data keys to prevent unauthorized users from stealing access.

II. WIMAX SURVEY

Most researchers are familiar with the technical features of Wimax technology but the evolution that WiMAX went through, in terms of standardization and certification, is missing and unknown to most people. Knowledge of this historical process would however aid to understand how WiMAX has become the widespread technology that it is today.

DaanPareit, Bart Lannoo[5] presents a survey on all relevant activities that took place within three important organizations: the 802.16 Working Group of the IEEE (Institute of Electrical and Electronics Engineers) for technology development and standardization, the WiMAX Forum for product certification and the ITU (International Telecommunication Union) for international recognition. An elaborated and comprehensive overview of all those activities is given, which reveals the importance of the willingness to innovate and to continuously incorporate new ideas in the IEEE standardization process and the importance of the WiMAX Forum certification label granting process to ensure interoperability.The WiMAX technology based on the IEEE 802.16 standard is a Broadband Wireless Access (BWA) technology and considered to be an important ingredient of the composition of the Next Generation Networks (NGN). Till date, due to lack of deployment not enough data is available in terms of its operational capabilities and efficiencies.

MortezaNabipoor [13] given some methodologies and paths for controlling and evaluating of IEEE802.16 standard. Their main focus is on classifying and evaluating some basic subjects and topics in IEEE802.16, based on WiMAX technology.

A. Bacioccola, C. Cicconetti [1]first presented a historical overview of the IEEE 802.16 standard from the first version released in 2001 to the current version. Then, they have provided a detailed technical analysis of the PHY, MAC layer, and other relevant aspects of the new standard, including a detailed description of its relay architecture and support for self-organizing networks and Femto cells. To better understand the technical impact of the new release, they have also presented a comparison of the downlink control overhead between IEEE 802.16-2009 and IEEE 802.16m. In fact, one of the biggest problems in IEEE 802.16-2009 and its previous revisions was the high signalling overhead.

III. SURVEY FOR MODULATION TECHNIQUES IN IEEE 802.16/WIMAX

The demand for high-speed services and multimedia applications anywhere and anytime has led to the rise of wireless communications. In particular, WiMAX technology is nowadays considered one of the most prominent solutions capable to provide a Broadband Wireless Access (BWA) in metropolitan areas with a

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 3, Issue 10, October 2015

simpler installation and lower cost than traditional wired alternatives.

Romano Fantacci et al. [14] given work that deals with the proposal of efficient adaptive modulation and coding techniques to be used in WiMAX based wireless networks, that allow to improve network performance in the case of Non Line-of-Sight communications, which are typical in urban environments. In particular, two approaches have been proposed by taking into account the channel behaviour both in terms of attenuation and frame error rate. The first approach selects the most suitable MCS on the base of the estimation of the channel attenuation on the uplink. This technique has been implemented according to two different algorithms: TBLER, aiming to keep the error rate under a specified value and to employ the MCS which guarantees the highest efficiency while respecting the error target, and MT that, conversely, aims to maximize the system throughput without controlling the error rate performance. A frame error rate approach has been then considered by taking into account the effect of the errors in previous frames. After the intensive computer based simulations, that all the proposed techniques allow to satisfy different QoS constraints in terms of BLER or throughput and allow significant advantages with respect to the FMC where the modulation and coding scheme are fixed. Through the given techniques it is possible to switch the modulation order and coding rate in order to better match the channel conditions, and, hence, obtaining better performance both in terms of error probability and data throughput.

Dania Mafabissi et al. [6] proposed a state model based on the state transition diagrams (STD) that are used to compare the performance of two different adaptation algorithms based on the maximization of different functional costs suitable for use in WiMAX system with an OFDMA physical structure. Two techniques have been considered by taking onto account the channel behaviour in terms of attenuation and the frame error rate. The first technique is based on the physical channel estimation on the uplink, and selects the best modulation order by using a three state model. Three algorithms such that Maximum Throughput technique, Target SER technique and Minimum SER technique have been introduced with the aim of minimizing the SER, maximize the throughput or select the best modulation order for a certain SNR value. On the other side the frame error rate technique has been considered also by taking into account the effect of the previous frames to the actual one. The proposed techniques allow to view with a different flavor of the QoS in terms of SER or throughput, even if all of them show advantages with respect to statistical modulation schemes.

Dania Marabissi [7] says that, Two another adaptive modulation and coding schemes or techniques such that Target Block Error Rate Technique and Maximum Throughput Technique, with the aim of improving performances in Non Line-of-Sight communications, typical of urban environments. The two proposed adaptive techniques differentiate from the procedure of the calculation of the thresholds needed to perform the adaptation. Each adaptation algorithm is basically characterized by five thresholds, representing the changing events between different transmission schemes: when a threshold is reached, the modulation order and/or the coding rate change and the state machine keeps a different state until another threshold is reached. Both of the techniques are based on the physical channel estimation on the uplink and foresee the selection of the best transmission scheme by using a finite state model. The first algorithm aims to keep the error rate under a fixed limit and to employ the MCS which guarantees the higher efficiency while respecting the error target. The second technique reflects an opposite approach and aims at maximizing the system throughput, through the use of the most efficient MCS among the available ones for each SNR. The proposed techniques allow to satisfy different QoS constraints in terms of BLER or throughput. Moreover, both of them shows significant advantages with respect to statistical MCS selection technique.

Ali H. Al-Qahtani and Rabah W. Aldhaheri [3] presented a performance comparison of Fixed and Mobile Frequency Division Multiplexing (OFDM) based WiMAX transmission system with adaptive modulation and coding (AMC) over different fading channelsby using MATLAB. Various modulation techniques such that BPSK, QPSK, GMSK, 16-QAM and 64-QAM have considered to realize the proposed work. The simulation results show that depending on the channel conditions, an optimizing mechanism of AMC can be chosen that employ multiple modulation and coding schemes in order to instantaneously adapt spectral efficiency to the variations in the channel SNR while maintaining an acceptable BER. According to this mechanism, as the range increases, the system steps down to a lower modulation, but as closer to the base station, higher order modulations can be used for increased throughput. By setting threshold Eb/No, adaptive modulation schemes can be used to attain highest transmission speed with a target BER.

Lei Zhang, Patrick S´enac et al. [18]introduced a Optimization of WiMAX modulation scheme with a cross layer erasure code and introduced a new cross layer based modulation adaptation mechanism which leverages on high layer (i.e.IP layer) adaptive erasure code and low layer information such as SNR and packet loss rate to significantly improve the goodput and transmission efficiency of WiMAX connections. The detailed investigation results in a smoother goodput evolution rather than the default coarser evolution entailed by the brutal modulation rate changes. Indeed, instead of downgrading the transmission rate immediately when signal degrades, propose the mobile node to keep its current high transmission rate and enforce its flows reliability with FEC redundancy packets at higher layer. The analytical study and the simulation results introduced demonstrate a significant improvement on the good output and transmission efficiency offered to WiMAX mobile nodes.

Salah-EddineElayoubi and Benoit Fourestie [26] proposed Analysis of Performance Evaluation of Admission Control and Adaptive Modulation in OFDMA WiMax Systems. In this the performance of multi-cell

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 3, Issue 10, October 2015

OFDMA WiMAX systems, in both downlink and uplink. It calculates analytically the number of collisions when the number of users in each cell is known. Then calculate the QoS indicators (e.g., blocking rates, download time and bit error rates) taking into account the physical layer conditions (modulation, propagation and MIMO), the MAC layer techniques (HARQ and radio resource management algorithms) and the traffic characteristics, in a cross-layer approach. Finally evaluate the impact of using adaptive modulation and coding on the overall performance of the system. This analysis allows us to calculate the Erlang capacity of a WiMAX system. Finally studied the impact of adaptive modulation and coding on the performance of elastic traffic. The model presented here can then be used to set engineering rules and to design efficient CAC schemes, for each given mix of traffic. However, a more general model considering the impact of several collisions on one subcarrier may also be useful when considering high-loaded networks.

IV. SURVEY FOR QUALITY OF SERVICES AND TRANSMISSION CONTROL PROTOCOL IN WIMAX

The IEEE 802.16 is a standard for broadband wireless communication in Metropolitan Area Networks (MAN). To meet the QoS requirements of multimedia applications, the IEEE 802.16 standard provides four different scheduling services: Unsolicited Grant Service (UGS), real-time Polling Service (rtPS), non-real-time Polling Service (nrtPS), and Best Effort (BE).

Claudio Cicconetti, Alessandro Erta et al. [4] done the Verification of effectiveness of these four different scheduling services in managing traffic generated by data and multimedia sources. Performance is assessed for an IEEE 802.16 wireless system working in Point-to-Multipoint (PMP) mode, with Frequency Division Duplex (FDD), and with full-duplex Subscriber Stations (SSs). Results show that the performance of the system, in terms of throughput and delay, depends on several factors. These include the frame duration, the mechanisms for requesting uplink bandwidth, and the offered load partitioning, i.e., the way traffic is distributed among SSs, connections within each SS, and traffic sources within each connection. The results also highlight that the rtPS scheduling service is a very robust scheduling service for meeting the delay requirements of multimedia applications.

To ensure meeting the QoS requirements, the 802.16 base station must run some algorithm to allocate slots between connections.

Alexander Sayenko , Olli Alanen [2] proposed A simple and an efficient solution that is capable of allocating slots based on the QoS requirements, bandwidth request sizes, and the 802.16 network parameters. To test the proposed solution, 802.16 MAC and PHY layers are implemented in the NS-2 simulator. According to the simulation results, the proposed scheduling solution ensures the QoS requirements of all 802.16 service classes. The solution shares free resources fairly and demonstrates work-conserving behaviour. The frame-based medium access of 802.16 requires rigorous protection against interference from wireless local area networks in order to operate properly. The 802.11e enhancements of the medium access control of 802.11 introduce the capability to support QoS. These enhancements define a central entity as main element: The Hybrid Coordinator. It realizes a contention free, centrally controlled medium access and introduces QoS limitations to the contention based access of 802.11e.

Lars Berlemann et al. [9] proposed a central coordinating device which combines the central base station of 802.16 with the hybrid coordinator of 802.11e and thus referred to as Base Station Hybrid Coordinator. The Base Station Hybrid Coordinator is capable to operate in an 802.16 and an 802.11(e) protocol mode in the same frequency band. It has been shown that interworking influences the medium access of all spectrum sharing wireless networks. Restrictions and requirements of each protocol have to be combined to enable QoS support under coexistence. The adherence of a common frame structure can be regarded as extreme cooperation.IEEE 802.16 can provide wireless broadband access with its support to both single-hop and multi-hop mesh modes. But, it is not quite clear how well an IEEE 802.16 network could support real-time services such as video streaming and voice over Internet protocol services, especially in its mesh-mode operation.

Y. Li [16] has done an analysis of delay and throughput properties of an IEEE 802.16 mesh network for evaluating the performance of various real-time applications. An analytical model was proposed to calculate delay and throughput of IEEE 802.16 distributed scheduling schemes. The proposed model helps to investigate how delay and throughput vary in terms of network parameters in order to optimise the system design via proper parameter configuration and by deriving three metrics, such that MSH-DCSH access delay, three-way handshaking delay and throughout explicitly. After the extensive simulations done to demonstrate the accuracy of the model, It was revealed that the increase of MCL helps to reduce both MSH-DCSH access delay and three way handshaking delay, and there exists an optimal value of MCL which maximises the throughout. One fundamental issue in IEEE 802.16 mesh networks is QoS provisioning. Although IEEE 802.16 standard has made certain efforts to address this issue, many technical problems still exist in this field. Yajun Li et al. [15] presented a detailed investigation of QoS issues in IEEE 802.16 mesh networks in order to provide a better understanding of the research challenges of QoS provisioning under Mesh mode.

Focusing on QoS issues in the IEEE 802.16 mesh mode, four major aspects of QoS provisioning, such as Differentiation Schemes, Reservation schemes, Fairness and scheduling were addressed. An analysis of possible types of routing protocols was done by Min Kim [12] that have been studied for MANET was done by QoS Mesh Routing Protocol for IEEE 802.16 based Wireless Mesh Networks. On the basis of analysis, a network model for IEEE 802.16 based wireless mesh networks and propose a proactive hop-by-hop QoS Mesh routing protocol (QMRP) for IEEE 802.16 based wireless mesh networks. Through

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526
INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 3, Issue 10, October 2015

the simulation, it was shown that the proposed routing protocol outperforms QOLSR protocol in terms of end-to-end delay, packet delivery ratio and routing overhead.

Mehmet S. Kuran [11]proposed aQoS mechanism SAQoS for the Mesh mode of IEEE 802.16 and a BS scheduler for the Mesh mode. Simulation results show that the default meshQoS mechanism, DMQoS, introduces a delay of at least 100 ms from MSS to MBS for the UGS and ertPS services. Considering also the delay from the MBS to the correspondent node, it is apparent that DMQoS is not suitable for real-time and multimedia services. Using SAQoS, it was possible to limit this delay to 5 ms. However, it was observed that BE service suffer beyond the second hop level. This is mainly due to the fact that lower level SSs suffer from contention at all levels above.

L. D. Malviya [10] presented the throughput and packet loss ratio comparison of various Transmission Control Protocol (TCP) variants such that TCP, TCP Reno, TCP NewReno, TCP Sack1, TCP Fack, and TCP Vegas transport protocols for digital modulation techniques used in adaptive modulation scheme in WiMAX. From the simulation and comparison it is clear that TCP Reno transport protocol is performing best in terms of throughput and packet loss ratio for all the used digital modulation techniques used for adaptive modulation in WiMAX. The TCP (Transmission Control Protocol) and the CBR (Constant Bit Rate) are traffic and mobility models. These models play an important role in evaluating different factors, namely: quality of service, scalability, and traffic and mobility models. Traffic and mobility models play an important role in evaluating the performance of the networks, despite criticism and assumption from various researches on TCP's weaknesses.

Dr. PanosBakalis and Bello Lawal [8] evaluate the performance of CBR over TCP on MANET using DSR routing protocol. Although CBR and TCP have significant different manufacture behaviour on MANET, these differences lead to significant performance of CBR over TCP with better throughput and less average maximal end-to-end delay. Based on the traffic and mobility models used in this paper, the performance evaluation results revealed that CBR performed better than TCP at both low and high mobility with high throughput of receiving bits, less maximal end-to-end delay and significantly less packets dropped. DSR routing protocol was able to respond quickly to link failure which avoids TCP's congestion control scheme response at low pause time.

Despite criticism and assumptions by many researchers on TCP's weaknesses on MANET, TCP was able to deliver a reasonable number of packets at low pause time and it has been observed, the decrease of maximal end to end delay at low pause time. Therefore, TCP traffic models can be used for small networks where frequent topology changes are limited and could be controlled by DSR routing protocol. It is believed that most packets dropped are due to high maximal end-to-end delay, time-to-live (TTL) of the routing protocol and end of simulation time.

D.Feng et al [17] proposedwireless communication technologies can provide the high speed access and long range communication in future 4G networks. Different simulations performed in to demonstrate the advantages of using techniques such as high order modulation schemes, diversity configurations for the antennas and OFDMA in the IEEE 802.16 standard. The techniques used are not specific to WiMAX. In addition, the IEEE 802.11n, the Wi-Fi standard use techniques such as MIMO, OFDMA and Adaptive Modulation. The proposed model helps to investigate how higher order modulation increases the bandwidth efficiency but affects the performance of the system in terms of BER. A trade-off between reliability and efficiency is required to have the best system performance. Through various simulations it is observed how diversity and multiple antennas improve the performance of a wireless communication. The highest data rate could be achieved using the hybrid of the Adaptive Modulation, OFDM and coding technique. The OFDMA supports Adaptive Modulation and Multiple Diversity, which also increases the performance and data rate of the transmission.

P. Delannoy et al. [19]presented aWiMAX quality-of-service estimations and measurement. WiMax is the main technology for high speed wireless access network. Which provides a larger coverage as compared to WiFi while supporting string QoSand security mechanism. It presents performance measurements in term of achievable rate of an operational WiMax network to evaluate its capability to support different types of media transmission. An extensive experimental study of WiMax communications to evaluate its performance in various contexts is very important and was achieved. The investigation proposed GPS synchronization. The developed codes can also be used for other types of networks as far as the terminal is equipped with GPS and able to run a Java Virtual Machine.

Arathi.R.Shankar et al. [20] has given an Analytical Approach to Qualitative Aspects of WiMAX Physical Layer. The investigation focuses on the comparison of quality of service parameters between different channels in WiMAX physical layer. Orthogonal frequency division multiple access is used by WiMAX on its physical layer. OFDMA uses adaptive modulation technique on the physical layer 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. In the analysis, a WiMAX module developed based on popular network simulator MATLAB is used

V. WiMAX RF PHYSICAL LAYER AND MODULATION TECHNIQUES

The use of WiMAX is starting to grow rapidly, and many manufacturers are producing WiMAX equipment. One of the areas of particular interest is the WiMAX RF physical layer, or air interface as this governs the radio signal that is transmitted and received.

ISSN (Online) 2321 – 2004
ISSN (Print) 2321 – 5526

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH IN ELECTRICAL, ELECTRONICS, INSTRUMENTATION AND CONTROL ENGINEERING
Vol. 3, Issue 10, October 2015

The WiMAX, 802.16-2004 standard describes four different RF or air interfaces dependent upon the application envisaged. Of these the one that is intended for non-line of sight applications up to 30 km and for frequencies below 11 GHz is the most widely implemented at the moment. As a result it is often thought of as the WiMAX air interface. The WiMAX RF signal uses OFDM (orthogonal frequency division multiplex) techniques and the signal incorporates multiples of 128 carriers in a total signal bandwidth that may range from 1.25 to 20 MHz.

Parameters for download and upload

PARAMETER	DOWNLINK	UPLINK
Modulation	BPSK, DPSK, GMSK, QPSK, 16 QAM, 64 QAM; BPSK optional for OFDMA-PHY	BPSK, DPSK, GMSK, QPSK, 16 QAM; 64 QAM optional
Coding	**Mandatory:** convolutional codes at rate 1/2, 2/3, 3/4, 5/6 **Optional:** convolutional turbo codes at rate 1/2, 2/3, 3/4, 5/6; repetition codes at rate 1/2, 1/3, 1/6, LDPC, RS-Codes for OFDM-PHY	**Mandatory:** convolutional codes at rate 1/2, 2/3, 3/4, 5/6 **Optional:** convolutional turbo codes at rate 1/2, 2/3, 3/4, 5/6; repetition codes at rate 1/2, 1/3, 1/6, LDPC

A summary of the different modulation access/ modulation technologies and oversampling rates is given in the table below:

Channel bandwidth

ATTRIBUTE	1.25	3.5	5	10
Physical layer modulation / access mode	128 OFDMA	256 OFDMA	512 OFDMA	1024 OFDMA
Oversampling	28/25	8/7	28/25	28/25

VI. PROBLEM DEFINITION

Due to emergence of 802.16 WIMAX, day by day new applications and network scenarios are getting designed for 802.16 WIMAX technologies. It is mandatory to evaluate the performance of WIMAX 802.16 technology by evaluating the Bit-Error Rate (BER) of OFDM physical layer under different modulation schemes and channel conditions.

In this work, with the performance investigation of the WIMAX system under different applications generating high load data traffic, various modulation schemes like GMSK, BPSK, DPSK, QAM 64 etc. will be introduced. The performance of WIMAX physical layer will be analyzed based on the simulation results of Bit-Error Rate (BER) and Signal-to-Noise Ratio (SNR) and the results will be represented in the form of tables and graphs.

VII. OBJECTIVES

Various objectives of the research are:

1) Thorough study of all the modulation techniques used by the physical layer of WIMAX 802.16 will be done.

2) Various WIMAX network scenarios will be designed by using a discrete event simulator called OPNET 14.0.

3) New high traffic load data applications will be designed for WIMAX networks to generate intensive data in the networks.

4) To evaluate the networks we to choose the best modulation techniques under the given channel and traffic conditions, various performance evaluation metrics will be chosen like Delay, Throughput, Traffic Sent, Traffic Received.

REFERENCES

[1] A. Bacioccola, C. Cicconetti et al. "IEEE 802.16: History, status and future trends." In the proceeding of Computer Communication, p.p. 113-123, vol. 33, November 2009.

[2] Alexander Sayenko, Olli Alanen et al. "Scheduling solution for the IEEE 802.16 base station." In the proceeding of Computer Networks, p.p. 96-115, vol. 52, October 2008.

[3] Ali H. Al-Qahtani and Rabah W. Aldhaheri, "Performance Study of Adaptive Modulation and Coding Schemes in WiMAX OFDM-based System." IEEE 9th Malaysia International Conference on Communications, p.p. 836-839, December 2009.

[4] A. Md. Anamul Islam, B. Md. Abdul Kader, C. Md. Julkarnain, "BER Performance Analysis f a Real Data Communication through WiMAX-PHY Layer over an AWGN and Fading Channels." International Journal of Electrical & Computer Sciences IJECS-IJENS, p.p. 13-16, Vol. 10, No. 04, August 2012.

[5] A. SudhirBabu and K.V SambasivaRao, "Evaluation of BER for AWGN, Rayleigh and Rician Fading Channels under Various Modulation Schemes." International Journal of Computer Applications, p.p.23-28, Volume 26, No.9, July 2011.

[6] Biswojit Bose, Iftekhar Ahmad and DaryoushHabibi, "Bit Error Rate Analysis in WiMAX Communication at Vehicular Speeds Using Nakagami-m Fading Model." IEEE Vehicular Technology Conference (VTC Fall), p.p. 1-5, September 2012.

[7] Claudio Cicconetti, Alessandro Erta et al. "Performance Evaluation of the IEEE 802.16 MAC for QoS Support." In IEEE Transactions on Mobile Computing, p.p. 26-38, vol. 6, no. 1, January 2007.

[8] DaanPareit, Bart Lannoo et al. "The History of WiMAX: A Complete Survey of the Evolution in Certification and Standardization for IEEE 802.16 and WiMAX." In IEEE Communications Surveys and Tutorials, p.p. 1-29, October 2011.

[9] Dania Marabissi, Daniele Tarchi, Romano Fantacci, and Francesco Balleri," Efficient Adaptive Modulation and Coding techniques for WiMAX systems." IEEE International Conference on Communication (ICC' 08), p.p. 3383-3387, May 2008.

[10] Lars Berlemann, Christian Hoymann et al. "Coexistence and Interworking of IEEE 802.16 and IEEE 802.11(e)" In IEEE, p.p. 27-31, June 2006.

[11] MortezaNabipoor, "Controlling and Evaluating of IEEE 802.16 WiMAX standard." In 2nd International Conference on Software Technology and Engineering (ICSTE), p.p. 22-25, vol. 2, October 2010.