International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
Vol.4,No.7, July 2015 DOI:10.15693/ijaist/2015.v4i7.107-110

Performance enrichment of mobile WiMAX in presence of Forward Error Correction (FEC) codes

Saurabh Maheshwari
M.Tech scholar EC Dept. SOE, S.I.M.S
INDORE, INDIA

Virendra Verma
Assistant professor EC Dept.SOE,S.I.M.S
INDORE, INDIA

Abstract

IEEE 802.16e mobile WiMAX, is a wireless standard used to provide very high speed data over large areas to a large number of users where broadband is not available. It uses OFDMA (Orthogonal Frequency Division Multiple Access) as a transmission scheme and it is based on multicarrier modulation. The performance or capacity improvement is a major factor of this. In order to enhance the performance or capacity we use forward error correction codes (FEC). We used convolution code (CC) for achieving the high capacity[1]. BER is also a major factor of WiMAX & performance with BER is compared using different modulation technique for mobile WiMAX.

Index terms- Bit Error Rate(BER), Convolution Code (CC),Forward Error Correction Code (FEC), WIMAX

1.Introduction

The rapid growth of wireless internet causes a require for high speed access to the World Wide Web. In order to serve the demand for high speed access to the internet "anywhere any time" and ensure quality of service, the IEEE 802.16 working group brought out a new broadband wireless access technology called WiMAX meaning Worldwide Interoperability for Microwave Access[3]. It is the most recent solution for the condition of fixed broadband wireless service in a wide geographical scale and proved to be a real effective solution for the establishment of wireless metropolitan area networks[4]. WiMAX will represent a serious competitor to third generation cellular system as high speed mobile data application will be achieved with the 802.16 specification. WIMAX is especially popular in wireless application because of its resistance to forms of interference and degradation. In short, WiMAX deliver a wireless signal much farther with less interference than competing technologies. The first version of IEEE 802.16 standard operates in the range of 10-66 GHz frequency band of and requires Line Of Sight (LOS) towers. Later the standard extended its operation through different physical specification to 2-11 GHz frequency band enabling Non Line Of Sight connection (NLOS).

Adding support for mobility (soft and hard handover between base stations). This is seen as one of the most important aspects of 802.16e-2005, and is the very basis of Mobile WiMAX. Scaling of the Fast Fourier Transform (FFT) to the channel bandwidth in order to keep the carrier spacing constant across different channel bandwidths (typically 1.25 MHz, 5 MHz, 10 MHz or 20 MHz). Constant carrier spacing results in higher spectrum efficiency in wide channels, and a cost reduction in narrow channels. Also known as Scalable OFDMA (SOFDMA). Other bands not multiples of 1.25 MHz are defined in the standard, but because the allowed FFT subcarrier numbers are only 128, 512, 1024 and 2048, other frequency bands will not have exactly the same carrier spacing, which might not be optimal for implementations. Transporter spacing is 10.94 kHz.

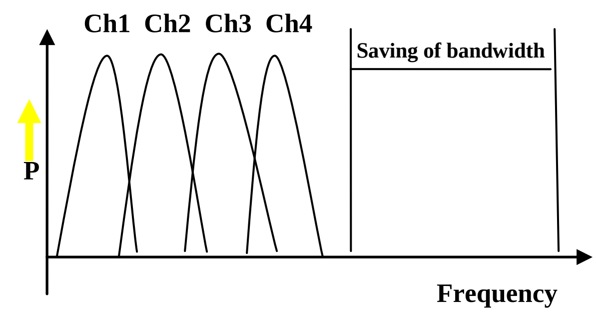


Fig.1

2.WiMAX MODEL FOR PHYSICAL LAYER

The main task of the physical layer is to process data Frames delivered from upper layers to a suitable format for the wireless channel. This task is done by the following processing: channel estimation. FEC (forward error correction) coding, modulation, mapping in OFDMA (Orthogonal Frequency Division Multiple Access) symbols. etc

A. RANDOMIZATION

This is the first process which is carried out in the WiMAX physical layer after the data is received From the upper layers and each of the burst in Downlink as well as in the Uplink is randomized. It is generally scrambling of data to generate random Sequence of data in order to improve coding performance and data integrity of the input bits.

B. FORWARD ERROR CORRECTION (FEC)

In order to detection and correction of errors due to path loss and fading that leads to distortion in the signal. There are number of coding systems that are involved in the FEC process like RS codes. Convolution codes, Turbo codes, etc. basically we will be focusing upon the convolution codes.

C. CONVOLUTION CODES (CC)

These CC codes introduce redundant bits in the
Data stream with the use of liner shift registers (m).
The information bits are applied as input to shift register and the output encoded bits are obtained with the use of modulo-2 addition of the input information bits. The contents of the shifts register in 802.11a physical layer uses convolution codes as the mandatory FEC [8]. These convolution codes are used to correct the random errors and are easy to implement than RS codes. Coding rate is defined as the ratio of the input bits to the output bits. Higher rates like 2/3 and 3/4, are derived from it by employing "puncturing." Puncturing is a procedure that involves omitting of some of the encoded bits in the transmitter thus reducing the number of the transmitter bits and hence increasing the coding rate of the convolution codes code and inserting a dummy "zero" metric into the convolution viterbi decoder on the receive side of WiMAX physical layer in place of the omitting bits. Code rate of convolution encoder is given fig.2

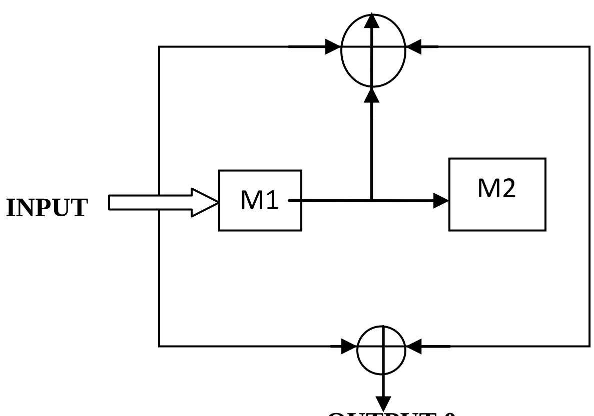


Fig.2

D . Interleaving

It aims to achieve desirable bit error of distributing transmitted bits in time or frequency domain or both after the demodulation process. In this process, data is mapped onto non-adjacent subcarriers to overcome the effects of multipath distortion and burst errors. Block interleaving mainly operates on one of the block of bits at a time. The number of bits in each block is known as interleaving depth, which defines the delay introduced by interleaving process at the transmitter side. A block interleave can be described as a matrix to which data is Written in column format and data is read in row wise format, or vice versa.

E. Modulation

This process involves mapping of digital information onto analog form such that it can be transmitted over the channel. In every digital communication system modulator is involved that performs the task of modulation. The amplitude, phase, as well as the frequency of a sinusoidal carrier can be changing by using modulation. In this paper we are concerned with the digital modulation techniques. Various digital modulation techniques can be used for data transmission, such as M-PSK and M-QAM, where M is the number of constellation points in the constellation diagram. Inverse process of modulation called demodulation is done at the receiver side to recover the original transmitted digital information.

F. Pilot Insertion

For channel estimation & synchronization purpose we used pilot insertion method. In this step, pilot carriers are inserted whose magnitude and phase is known to the receiver.

G . Inverse Fast Fourier Transform (IFFT)

An Inverse Fast Fourier transform converts the input data stream from frequency domain to time domain representing OFDM Subcarrier as the channel is basically in time domain. It is apply at the transmitter end

H . Cyclic Prefix

To prevent ISI is basically to create a cyclically extended guard interval in between the data bits, where each of the OFDM symbol is preceded by a periodic extension of the signal itself which is known as the Cyclic Prefix as shown in fig. 3. When the guard interval is longer than the channel impulse response, or the multipath delay, the ISI can be eliminated

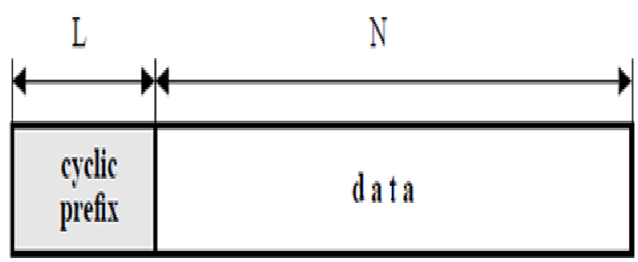


Fig.3

I .Communication Channels

There are different types of communication channel. Communication channels are link between transmitter and receiver. These channels may be divided into fast and slow fading channels according to their characteristics. A channel is known as fast

International Journal of Advanced Information Science and Technology (IJAIST) ISSN: 2319:2682
Vol.4,No.7, July 2015 DOI:10.15693/ijaist/2015.v4i7.107-110

fading if the impulse response of the channel changes approximately at the symbol rate of the communication system, whereas in slow fading channel, impulse response stays unchanged for several symbols.

3. Simulation Parameter & Result

Fig.3.1 show the Performance of Mobile Wimax without Fec code

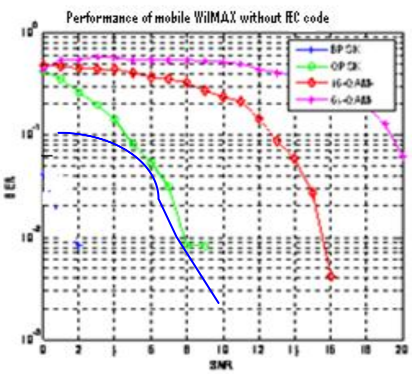
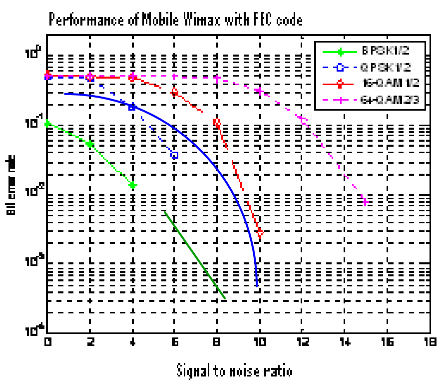


Fig.3.2show the Performance of Mobile Wimax with Fec code



4.Conclusion

Modulation	BPSK	QPSK	16 QAM	64QAM
Without Fec	**6db**	**8db**	**15db**	**20db**
With Fec	**4db**	**7db**	**9db**	**15db**

A performance analysis of Wimax (Worldwide Interoperability for Microwave Access) system with convolution code has been carried out. The BER curves were used to compare the performance of different modulation techniques over AWGN channels. with and without FEC codes. The BER performance

PARAMETER	SELECTED TYPE OR VALUES
Digital Modulation Type	BPSK, QPSK, 16-QAM, 64-QAM
FEC Code	Convolution Code
Considered Channel	AWGN
FFT Size	256
Cyclic Prefix	1/8
Channel Bandwidth	25 MHz

of Convolution code defines at the lower SNR value.fig 3.1 and fig 3.2 is the graph of mobile WiMAX without and with FEC codes respectively. it is clear from the table that mobile WiMAX with FEC code give 2db,1db,6db and 5db gain for the modulation technique of BPSK,QPSK,16QAM and 64QAM respectively.

5.References

[1]Puneet garg, Nitin arora Tajender malik, "capacity improvement of WiMAX in presence of different codes "international journal of computational engg. & management, 12 april 2011

[2] Venkatesh sekar, V. Palanisamy, K. Baskaram,"Performance Analysis of IEEE 802.16d using Forward Error Correction, "journal of computer science 2011

[3] IEEE standard for Local and Metropolitan Area Networks-Part 16: Air interface for Fixed Broadband Wireless Access Systems, IEEE Std. 802.16, Oct. 2004.

[4] IEEE standard 802.16-2005, IEEE standard for Local and Metropolitan Area Networks-Part16: Air Interface for Fixed and Mobile Broadband wireless Access system, Feb 2006

[5] A. Yarali, B. Mbula, A. Tumula, "WiMAX: A Key to Bridging the Digital Divide", IEEE Volume, 2007, pp.159 – 164.

[6] WiMAX Forum, "Fixed, Nomadic, Portable and Mobile Applications for 802.16-2004 and 802.16e WiMAX Networks", November, 2005.

[7] Md. Ashraful Islam, "Performance Evaluation of Wimax Physical Layer under Adaptive Modulation Techniques and Communication channels", International Journal of Computer Science and Information Security, Vol. 5, No.1, 2009

[8] T. TAN BENNY BING,"The World Wide Wi-Fi:Technological Trends and Business Strategies", JOHN WILEY & SONS, INC.,2003

[9] M. Nadeem Khan, S. Ghauri,"The WiMAX 802.16e Physical Layer Model",IET International Conference On wireless, mobile and multimedia networks , 2007, pp.117 – 120.

[10] V. Erceg, K.V.S. Hari, M.S. Smith, D.S. Bauml, "Channel Models for Fixed Wireless Applications", IEEE 802.16.3 Task Group Contributions 2001, Feb. 01

[11] Gazi Faisal Ahmed Jubair, Muhammad Imran Hasan, Md. Obaid Ullah,"Performance Evaluation of IEEE 802.16e (Mobile WiMAX) in OFDM Physical layer", August 2009

Authors Profile

S.Maheshwari received the **B.E.** degree in electronics and communication engineering from the indore institute of science and technology Engineering, indore, RGTU University, Bhopal, India, in 2009.Currently doing **M.E.** in electronics and communication engineering (Digital Communication Systems) in RGTU University Bhopal, India. His research interest includes wireless communication (**WiFi,WiMax**), Mobile Ad hoc networks , and fuzzy logic, Communication networks

V.Kumar Verma received the B.E.degree in electronics and communication engineering from the, RGTU University, Bhopal, India, in 2001 and M.E. in electronics and communication engineering (APPLIED VLSI) in RGTU University, Bhopal in 2008, India. He is cuurently working as a Ass. Professor, pursuing his PhD. His research interest includes VLSI design.