ISSN: 2277-5528
Impact Factor: 4.015

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & MANAGEMENT

PERFORMANCE ANALYSIS OF PREAMBLE DETECTION IN WIMAX 802.16E SYSTEM USING FADING CHANNEL WITH OFDM

Kiran Gawande[1], Prof. Mukesh Patidar[2], Prof. A. C. Tiwari[3], Mr. Vijit Mishra[4]
M. Tech. Scholar[1], Asst. Prof.[2], Prof.& HOD[3]
Department of Electronics and Communication Engineering
Lakshmi Narain College of Technology, Indore (M.P.) India

ABSTRACT
Objective of thesis is to study about the WiMAX model, OFDM and detect preamble. Preamble detection can be done by many methods such as correlation so compare the methods and find which one is better for preamble detection techniques. In correlation methods varying the value of correlation lag and find out what is the effect on detection technique. In this preamble detection method (SC, ML, MMSE and MNC-GM) we used communication channel Rayleigh fading also used modulation techniques QAM. The performance has been concluded based Sample versus Detection value and output through MATLAB-R2013a Simulation.

INTRODUCTION OF WI-MAX
The IEEE 802.16 group was formed in 1998 to develop an air interface standard for wireless broadband. The group's initial focus was the development of a LOS-based point-to-multipoint wireless broadband system for operation in the 10GHz-66GHz millimeter wave band. The resulting standard-the original 802.16 standard, completed in December 2001-was based on a single carrier physical (PHY) layer with a burst time division multiplexed (TDM) MAC layer.

The IEEE 802.16 group subsequently produced 802.16a, an amendment to the standard, to include NLOS applications in the 3GHz-11GHz band, using an orthogonal frequency division multiplexing (OFDM)-based physical layer. Additional to the MAC layer, such as support for orthogonal frequency division multiple access (OFDMA), were also included. Further revisions resulted in a new standard in 2004, called IEEE 802.16-2004, which replaced all prior versions and formed the basis for the first WiMAX solution. These early WiMAX solutions based on IEEE 802.16-2004 targeted fixed applications, and we will refer to these as fixed WiMAX. In December 2005, the IEEE group completed and approved IEEE 802.16e-2005 an amendment to the IEEE 802.16e-2004 standard that added mobility support. The IEEE 802.16e-2005 forms the basis for the WiMAX solution for nomadic and mobile applications and is often referred to as mobile WiMAX.

One of the main advantages of WiMAX is that it supports throughput for very robust data in communication. Theoretically this technology could support maximum around 75Mbps per channel. But in real system performance will be relatively lower which would be around 45Mbps per channel for fixed broadband wireless applications. During actual transmission it could be changes widely depending on the carriers selective which basically on a per customer basis.

Channel spacing is dependent on the carrier which we use 3.5MHz channel spacing as the base of our calculation. Frequency of 3.5MHz and 7MHz includes in the channel spacing has used in the WiMAX carrier for the 3.5MHz frequency band. While in the accessing scheme of frequency division duplex then 3.5MHz is to be used and if scheme is time division duplex then 7MHz to be used.The requirement of wireless communication is high speed/high bit rate, Global coverage, High spectral efficiency, Multimedia supported, Wireless, Digital communication systems. Latest techniques like WCDMA, OFDM, Hybrid OFDMA, and MIMO.

PREAMBLE
A problem encountered in the design of receivers for digital communication systems is the detection of data from noisy measurements of the transmitted signals. In any realistic scenario the receiver is, due to the noise, bound to make occasional errors. Therefore, designing a receiver which has the property that this probability of error is minimal is appealing, both from a practical and a theoretical point of view.

Unfortunately, such designs tend to result in computationally complex receivers and for this reason they are often abandoned in favor of computationally simpler but suboptimal receivers. It is however well known that for many scenarios the gap in performance between suboptimal and the optimal receivers is substantial. This alone makes the optimal receivers interesting. Additionally, the decreasing cost of computation will result in computationally feasible optimal designs.

SYNCHRONIZATION

Synchronization is used to find out the starting of the frame and received signal. Initial symbol timing is measured by the synchronization. Proper synchronization is useful for preparing the system that data is starting.
Synchronization is done by the preamble. Normally synchronization is by adding stream of bits into the data. These bits increase the length of the data. These bits are known by the receiver.

ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM)

OFDM is a modulation technique which offer quite a few interesting features to mitigate frequency-selective channel impairments. Huge bandwidth savings is possible due to the orthogonality among subcarriers. The high-data rate is divided into several low-data rate streams which modulate orthogonal subcarriers. The narrow band signals are multiplexed together and sent through the channel. At the receiver, the signal is de-multiplexed in reverse order creating low-data rate streams which form the original high-data rate signal. Advantage of OFDM system is the efferent channel estimation/equalization as the broadband frequency-selective channel is split into several flat-fading channels due to narrowband subcarriers.

$$x_n = x(\frac{nT}{JN}) = \frac{1}{\sqrt{N}}\sum_{k=N/2}^{N/2-1} X_{(k+N)} \times \exp(\frac{j2\pi nk}{JN}),\ n = 0,1,3,4,4,\ldots\ldots\ldots.JN-1 \quad (1)$$

Service providers can use granularity (due to several narrow band subcarriers) available to offer variety of data rate depending on the service types (e.g. data, voice, video, etc) and Quality of Service (e.g. reliability, priority, etc). Discrete-time OFDM signal can be written as in equation 1.

CYCLIC PREFIX INSERTION

To deal with this problem and to make an OFDM signal truly insensitive to time dispersion of the radio channel, cyclic-prefix (CP) insertion is typically used. As illustrated in Fig. 4.8, cyclic-prefix insertion implies that the last part of the OFDM symbol is copied and inserted at the beginning of the OFDM symbol.

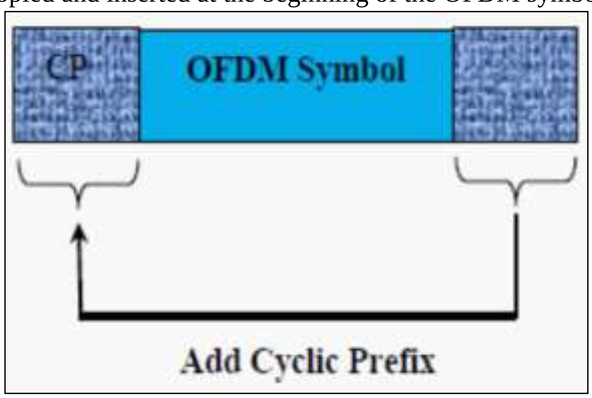

Figure 1: Cyclic prefix insertion

Cyclic-prefix insertion is thus increases the length of the OFDM symbol duration from *T*S to *TS* + *T*CP, where *T*CP is the length of the cyclic prefix. As illustrated in Fig. 4.9, if the correlation at the receiver side is still carried out over a time interval *T*S, subcarrier orthogonality will be preserved in case of a time-dispersive channel, as long as the span of the time dispersion is shorter than the length of cyclic-prefix.

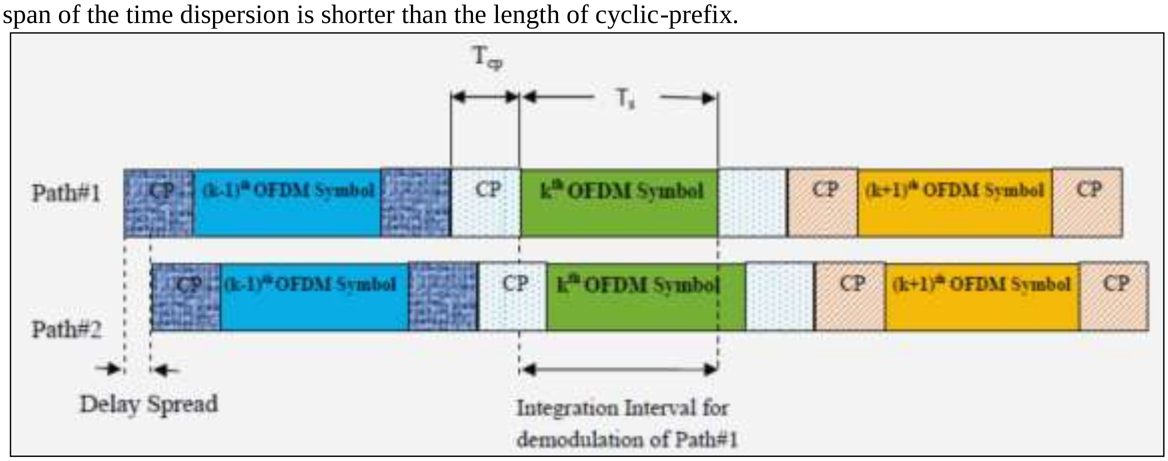

Figure 2: Time dispersion and corresponding received signal using cyclic prefix insertion

At the receiver side, the corresponding samples are discarded before OFDM subcarrier demodulation i.e. before DFT processing.

MULTI PATH FADING

When an object comes on the way between a wireless transmitter and a receiver, it blocks the signal and creates several signal paths known as multi path. Even though the signal makes till the receiver but with variant time and it is hard to detect the actual signal. Multi path degrade the quality of the signal.

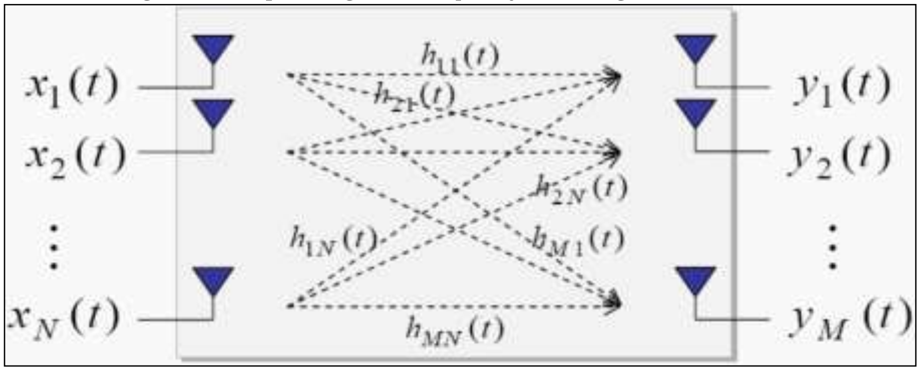

Figure 3: Multipath (Multiple input and Output)

- Fast Fading
- Slow Fading
- Flat Fading (Non-Selective Fading)
- Frequency Selective Fading
- Frequency Selective Fading.

A. Rayleigh channel

The Rayleigh channel model assumes that at the sink a number of signals with varying amplitude and delay are received. The multipath components of the signal are reacted on still obstacles i.e. buildings, mountains, water surfaces and moving obstacles like vehicles and aircrafts.

Moving objects change their positions and hence the received multipath components reflected from these vary over time. This effect is called slow fading. Additionally fast fading can complicate the mobile reception. Fast fading is induced by the Doppler effect and is encountered on moving receivers. The amount of Doppler shift depends on the velocity, the carrier frequency and the angle between moving direction and direction of the sender. The maximum Doppler shift is:

$$F_{D_{max}} = \frac{v.f_c}{c} \qquad (2)$$

The Doppler shift depending on the angle between sender and receiver is:

$$f_D = f_{D_{max}}.cos\alpha = \frac{v.f_c}{C}.cos\alpha \qquad (3)$$

The In-Phase and the Quadrature part of each QAM symbol face statistically independent normal distributed variance. The sum of these variances is the sum of two zero-mean Gaussian distributions and called Rayleigh distributed:

$$f(x,\sigma) = \frac{x}{2\sigma} e^{\frac{x^2}{2\sigma^2}} \qquad (4)$$

It is shows good performance in NLOS condition as it is based on OFDM which can handle delays caused in NLOS, perfectly.

SIMULATION RESULTS AND PARAMETER

In this chapter, we will discuss our simulation results and Parameters. During our simulation we used cyclic prefix to minimize the Inter Symbol Interference (ISI) on the basis of following modulation techniques through Matlab.

Quadrature Phase Shift Keying (QPSK), Quadrature Amplitude Modulation (QAM) with the help of above modulation techniques we got the parameters, Sample (Time in second) Represent in X-axis Detection Value Represent in Y-axis. This is the simulation environment which we used in our simulation, MATLAB R2013a version; we used Cyclic Prefix to minimize the Inter Symbol Interference (ISI). We have used AWGN and multipath fading channel.

A. Simulation Results in Rayleigh Channel

The Preamble techniques (MSC, MML, MINN and MGM) was analysis in this paper with used in Rayleigh channel with threshold value at the 64 for CP ¼ for the total number of symbol used is 256 and preamble starts from the 64th symbol. In this model we have used QAM (Quadrature Amplitude Modulation) in modulation technique, and required SNR value is 0dB and the performance done by used MATLAB R2013a version. In the figure 4, 5, 6 and7 shows the different-different SNR value cosider with all preamble detection methiod.

Table 1 Used Simulation Parameter Rayleigh channel

Parameter	Value
No. of symbol	2
Number of bits per symbol	8
Ncbps	384
M	4
NFFT	256
Channel	Rayligh
Modulation	QPSK
Preamble Techniques	MSC, MML, MINN, MGM
SNR Value Consider	11, 16, 22, 25, 33

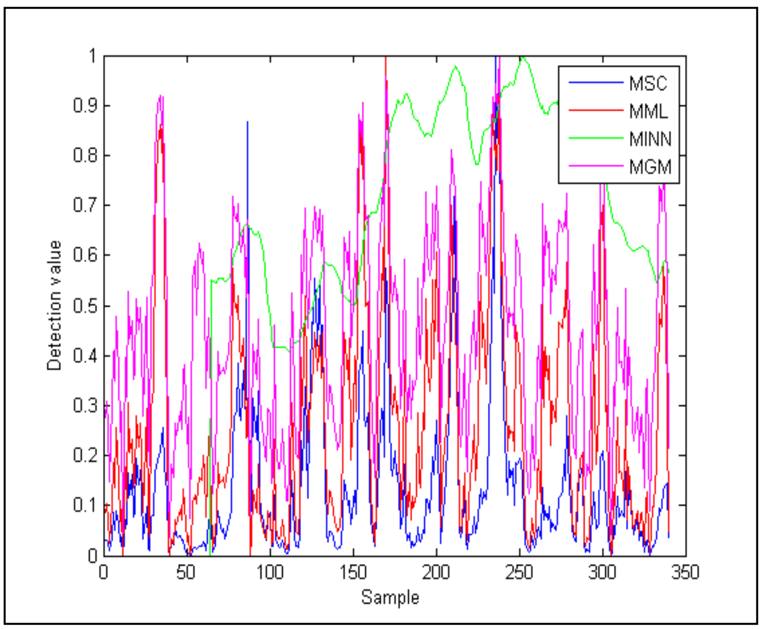

Fig. 4: Correlation vector which tell about synchronization SNR=11 in Rayleigh

ISSN: 2277-5528
Impact Factor: 4.015

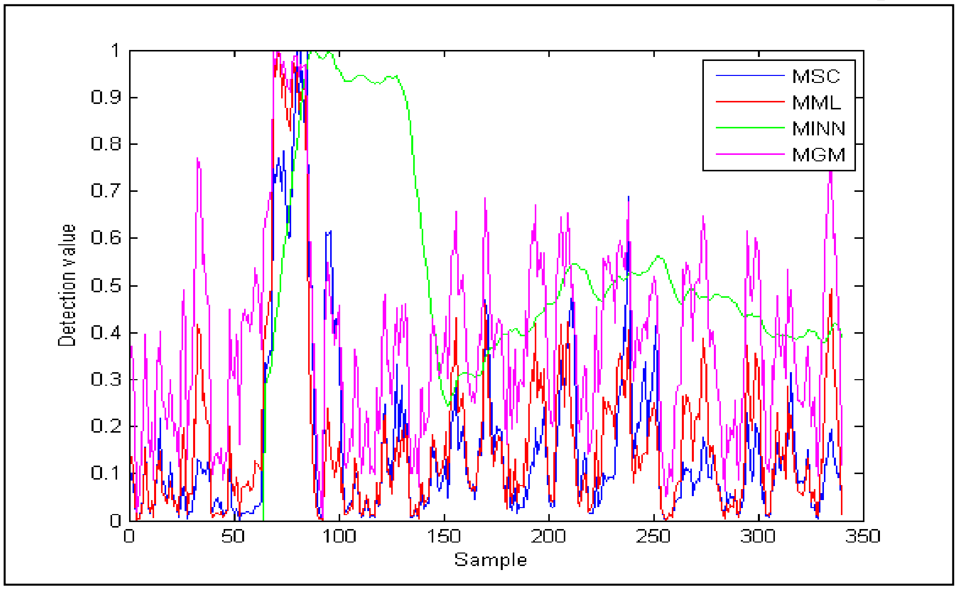

Fig. 5: Correlation vector which tell about synchronization SNR=16 in Rayleigh

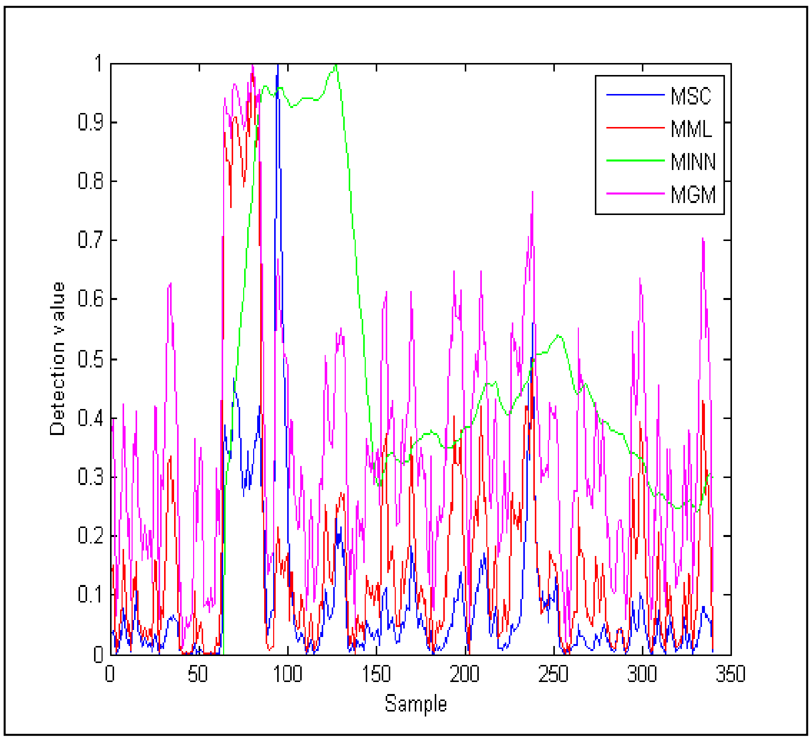

Fig. 6: Correlation vector which tell about synchronization SNR=22 in Rayleigh

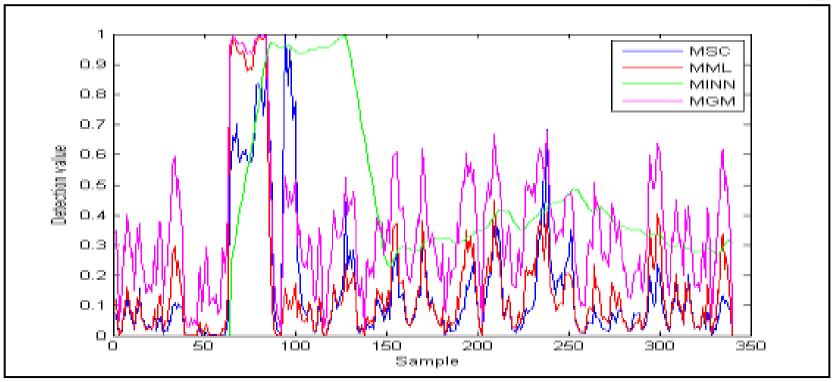

Fig. 7: Correlation vector which tell about synchronization SNR=25 in Rayleigh

CONCLUSION

In this thesisPreamble detection of WiMAX is compared using four methods Schmidl and Cox maximum normalized correlation (SC), maximum normalized correlation using a geometric mean (GM), minimum mean squared error (MMSE/MINN), maximum likelihood (ML). Different correlation lag is used and the different integer length is applied. MINN method starts the detection of the preamble correctly but the detection period is large rather than other methods. SC gives the sharp peak but it peak cannot takes exact position for preamble detection it detects after the redundancy occurred.

REFERENCES

1. Md. Ashraful Islam, Md. ZahidHasan***"Performance Evaluation of Wimax Physical Layer under Adaptive Modulation Techniques and Communication Channels"*** (IJCSIS) International Journal of Computer Science and Information Security, Vol. 5, No.1, 2009.
2. Rakhi Thakur and KavitaKhare***"Synchronization and Preamble Concept for Frame Detection in OFDM"***International Journal of Modeling and Optimization, Vol. 3, No. 1, February 2013.
3. Shigenori Kinjo ***"An MMSE Channel estimation algorithm based on the conjugate gradient method for OFDM systems"*** (ITC-CSCC 2008).
4. Muhammad Nadeem Khan, SabirGhauri, ***"The WiMAX 802.16e Physical Layer Model",***University of the West of England, United Kingdom.
5. UpenDalal***"Wireless Communication"*** Oxford University Press, fourth impression 2011. Pp 365-413, pp 591-631.
6. SumeethNagaraj, Sheehan Khan and Christian Schlegel ***"On Preamble Detection in Packet-Based Wireless Networks"*** 2006 IEEE Ninth International Symposium on Spread Spectrum Techniques and Applications.
7. Mithun Sarode ***"Preamble Detection Of IEEE 802.16"*** proceedings of international conference on nanoscience, engineering & advanced computing (ICNEAC-2011).
8. Chakchai So-In,Raj Jain and Abdel-KarimTamimi, ***"Scheduling in IEEE 802.16e Mobile WiMAX Networks: Key Issues and a Survey"*** IEEE Journal on Selected Areas in Communications, VOL. 27, NO. 2, February 2009 page no 156-171.
9. L. J. Cimini, ***"Analysis and simulation of a digital mobile channel using orthogonal frequency division multiplexing"*** IEEE Trans. Commun., vol. 33, no. 7, pp. 665–675, Jul. 1985.
10. P. H. Moose, ***"A technique for orthogonal frequency division multiplexing freuency offset correction"*** IEEE Trans. Commun., vol. 42, no. 10, pp. 2908–2924, 1994.
11. H. Kim and S. Choe, ***"A timing synchronization of OFDMA-TDD systems over multipath fading channels"*** in Proc. IEEE ICACT'06, Feb 2006, pp. 398–400.
12. E. Seagraves, C. Berry, F. Qian, ***"Robust Mobile WiMAX Preamble Detection"*** IEEE Trans. Commun. Vol.1, pp. 1-7 2008.
13. M. Khan, S. Ghauri, ***"The WiMAX 802.16e Physical Layer Model".***
14. T. Pollet, M. V. Bladel, and M. Moeneclaey, ***"BER sensitivity of OFDM systems to carrier frequency offset and Wiener phase noise"*** IEEE Trans. Commun., vol. 43, no. 2, pp. 191–193, Feb. 1995.