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PREAMBLE DETECTION ON OFDM WITH REYLIGH CHANNEL

Sachin Gupta[1], Mukesh Patidar[2], Dr. Pragya Nema[3]
Department of Electronics and Communication Engineering
Lakshmi Narain College of Technology, Indore (M.P.) India
sachin170284@gmail.com

Abstract

A problem encountered in the design of receivers for 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. In wireless-domain, performance evaluation of preamble detection under varying channel conditions is of compelling research interest nowadays. Most of the existing works, based on preamble detection under channel conditions are limited to Reyligh etc in Mobile WiMAX. In this paper correlation of preamble detection (maximum normalized correlation (MNC or MINN), Schmidl and Cox maximum normalized correlation (SC or MSC), maximum normalized correlation using a geometric mean (GM or MGM), maximum likelihood (ML or MML) method are comparison on OFDM using Reyligh Channel. In this model we have used QAM (Quadrature Amplitude Modulation) in modulation technique, and required SNR value is 0dB to 30dB and the performance done by used MATLAB R2013a version.

I. INTRODUCTION

Wireless technology enables high-speed, high-quality communication between mobile devices. Potential wireless applications include cell phones, 802.11-based wireless Local Area Networks (LANs), Bluetooth, smart homes and appliances, voice and data communication over the Internet, and video conferencing. The wireless communications industry has advanced drastically in the past decade and emerged as one of the fastest growing sectors in telecommunications. Although the enormous demand for mobile phones has driven the early developments, the latest generations of wireless systems are also designed to provide broadband multimedia applications. Recently, orthogonal frequency division multiplexing (OFDM) systems are widely used for wireless communication systems. The OFDM is used in the wireless local area network (LAN) based on the IEEE 802.11 standards, WiMAX based on the IEEE 802.16 standards, digital audio broadcasting, digital video broadcasting, etc. One of the primary reasons that OFDM is widely used is its simplicity in the system design due to the use of fast Fourier transform (FFT) instead of a complex equalizer. The IEEE 802.16 family of standards known as Worldwide Interoperability for Microwave Access (WiMAX) has been designed to facilitate high data rate communication in WMAN. It implements both packet-oriented data transmission and standard mobile telephony, and provides better performance than traditional wireless communication standards. The earlier version of the IEEE 802.16 standard operates in the 10–66 GHz frequency band. It requires line of sight towers. Later the standard extended its operation through different physical layer specification to 2–11 GHz frequency band enabling non-line of sight connections. It requires techniques that efficiently mitigate the impairment of fading and multi-path. The maximum likelihood (ML) detection problem for the linear multiple input multiple-output (MIMO) channel was first investigated in the context of CDMA after it was shown that an optimum detector offered a significant gain in performance over conventional symbol by symbol detectors. In the context of CDMA the problem of optimal detection is usually referred to as optimal multiuser detection (MUD) since in this scenario the ML detection problem corresponds to the simultaneous detection of several users' symbols in the presence of multiple access interference. More recently, similar detection problems have also been addressed when studying the joint detection of several symbols transmitted over a multiple antenna fading channel.

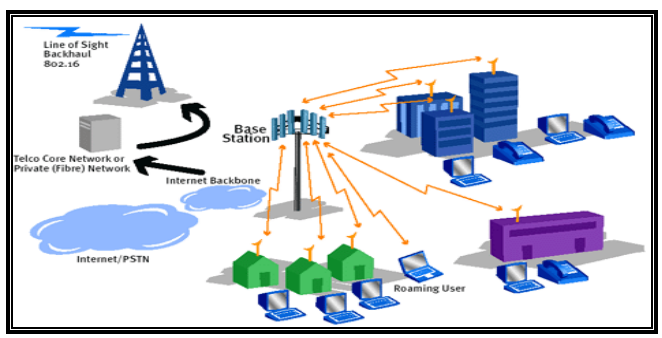

Fig.1: The architecture of WiMAX

II. PREAMBLE

A preamble is used for detection, synchronization (in time and frequency) and possibly initial channel state estimation. 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. With the rapid growth of digital communication in recent years, the need for high-speed data transmission has been increased. The communications industry faces the problem of providing the technology that be able to support a variety of services ranging from voice communication with a bit rate of a few kbps to wireless multimedia in which bit rate up to 2 Mbps. Many systems have been proposed and orthogonal frequency division multiplexing (OFDM) system has gained much attention for many reasons. One of the major problems, encountered in the OFDM systems is their synchronization. The synchronizations tasks sometimes require an extensive processing and highly effective systems and methods for synchronizing OFDM receiver parameters to an OFDM transmitter are provided. These parameters may include carrier frequency, burst timing, frame detection and cyclic prefix length. In this paper I am discussing synchronization through frame detection.

III. MATHEMATICAL DESCRIPTION ON PREAMBLE SIGNAL MODEL

The Mobile WiMAX Preamble waveforms are defined in the frequency domain and can be represented by:

$$X_k\left(3m + s_k - \frac{N}{2} + N_{GL}\right) = W_k(m) \quad (1)$$

For m = 0…., NPSC −1, where S_k = 0, 1, 3 represents the segment index, *Wk* is the unique sequence of ± 1's representing the preamble index k = 0, ..., 113. NGL represents the number of the guard subcarriers on the left (low frequency) side. *NPSC* is the number of subcarriers assigned for preambles in each segment. For the 10 MHz case N = 1034, NGL = 86, and NPSC = 384.]. Modulating each subcarrier the time domain preamble waveform can be written as in equation 2.

$$x_k(n) = \frac{1}{N}\sum_{m=0}^{N_{PSC}-1} X_k\left(3m + s - \frac{N}{2} + N_{GL}\right).e^{\frac{j2n\pi\left(3m+s-\frac{N}{2}+N_{GL}\right)}{N}} \quad (2)$$

$$x_k(n) = \frac{1}{N}\sum_{m=0}^{N_{PSC}-1} e^{\frac{j2n\pi\left(s-\frac{N}{2}+N_{GL}\right)}{N}} W_k(m) e^{\frac{j2\pi m(3n)}{N}} \quad (3)$$

In the frequency domain define the zero padded signals:

$$V_k(m) = \begin{cases} e^{\frac{j2n\pi\left(s-\frac{N}{2}+N_{GL}\right)}{N}} W_k(m), & if\ m < N_{PSC} \\ 0, & otherwise \end{cases} \quad (4)$$

for m = 0, 1, ...,N − 1. Then it can be rewritten as:

$$x_k(n) = \frac{1}{N}\sum_{m=0}^{N-1} V_k(m) e^{\frac{j2\pi(3n)m}{N}} \quad (5)$$

The right side of the expression is easily seen to be $vk(3n)$, therefore

$$x_k(n) = v_k(3n), n = 0,1, \ldots, N-1 \quad (6)$$

Where $v_k(n)$ is the IDFT of $v_k(m)$.
Since $NPSC + 3 < N$ 3 the N point IDFT is zero padded with > 3N 3 zeros. It is band-limited by a factor of 3, therefore the time domain sequence is smooth and can be decimated by up to three. Since 3 and N are relatively prime (for all values of N), as n goes from 0 to N – 1 the argument 3n cycles through the range 3 times, taking each value only once. Then equation (7) can be rewritten as

$$x_k(n) = \begin{cases} v_k(3n) & if\ 0 \le n < \left\lceil\frac{N}{3}\right\rceil \\ v_k(3n+1) & if \left\lceil\frac{N}{3}\right\rceil \le n < \left\lceil\frac{2N}{3}\right\rceil \\ v_k(3n-1) & if \left\lceil\frac{2N}{3}\right\rceil \le n < N \end{cases} \quad (7)$$

These three cycles can be separated into three sets, We can define three news sequences:

$$v_{k,0}(n) = v_k(3n), v_{k,1}(n) = v_k(3n+1), v_{k,2}(n) = v_k(3n+2) \quad (8)$$

These can be viewed as a polyphone filter factorization or a fractional delay of the decimated v_k. The time domain preamble waveform $x_k(n)$ can be written as the concatenation of these three sequences $\{v_{k,0}(n), v_{k,1}(n), v_{k,2}(n)\}$, i.e.

$$x_k(n) = \begin{cases} v_{k,0}(n) & if\ 0 \le n < \left\lceil\frac{N}{3}\right\rceil \\ v_{k,1}\left(n - \left\lceil\frac{N}{3}\right\rceil\right) & if \left\lceil\frac{N}{3}\right\rceil \le n < \left\lceil\frac{2N}{3}\right\rceil \\ v_{k,2}\left(n - \left\lceil\frac{2N}{3}\right\rceil\right) & if \left\lceil\frac{2N}{3}\right\rceil \le n < N \end{cases} \quad (9)$$

IV. 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:

$$F_{D_{max}} = \frac{v_r f_c}{c} \quad (10)$$

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:

$$f(x,\sigma) = \frac{x}{2\sigma} e^{\frac{x^2}{2\sigma^2}} \quad (11)$$

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

V. 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 2, 3, 4 and 5 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	Reyligh
Modulation	QPSK
Preamble Techniques	MSC, MML, MINN, MGM

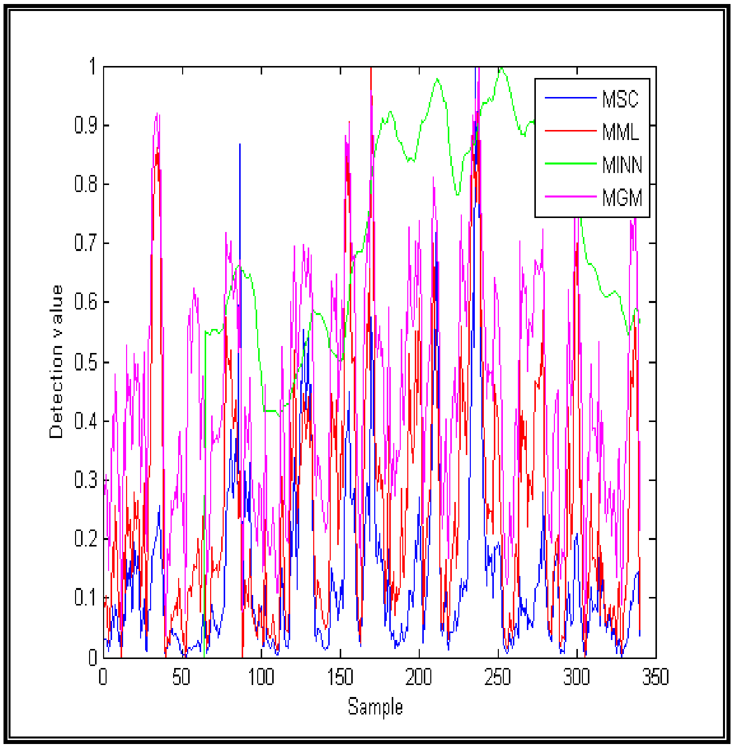

Fig.2: Correlation vector which tell about synchronization SNR=10 in Rayleigh

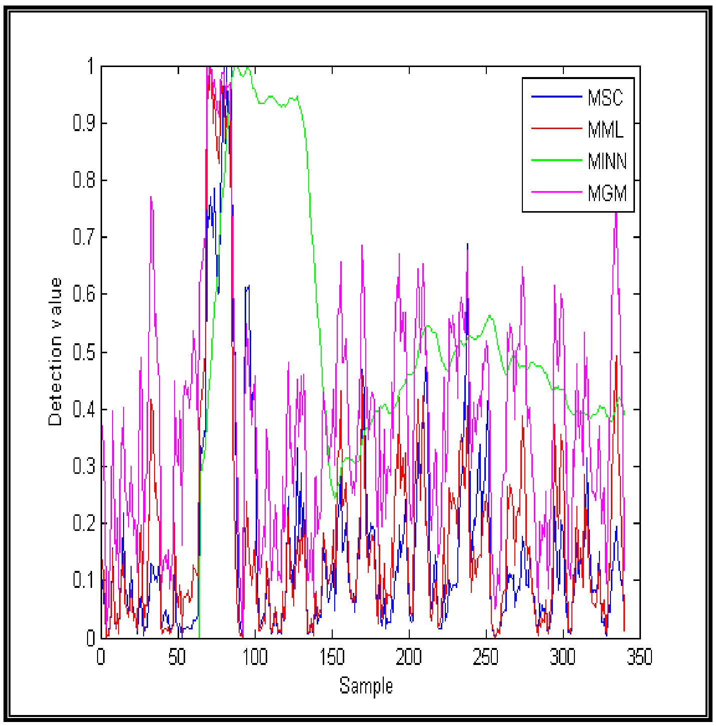

Fig. 3: Correlation vector which tell about synchronization SNR=15 in Rayleigh

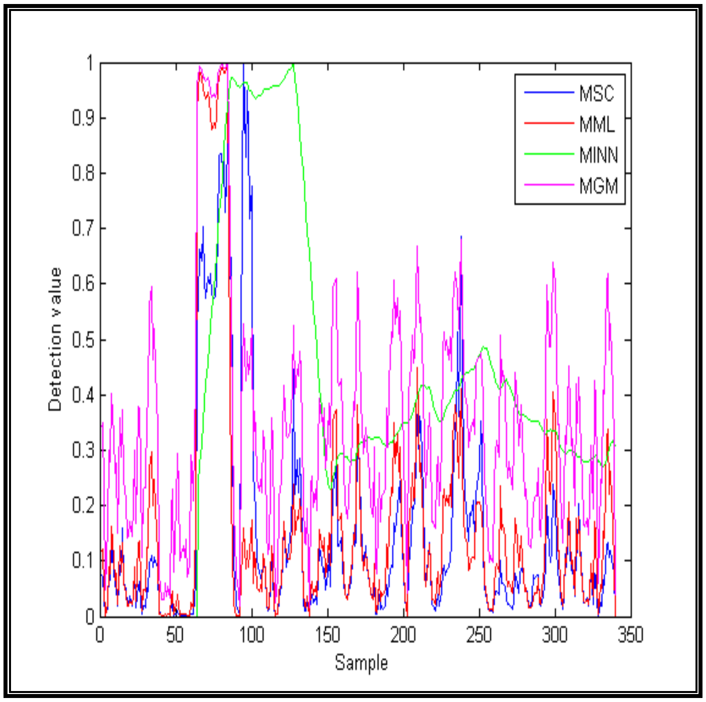

Fig. 4: Correlation vector which tell about synchronization SNR=25 in Rayleigh

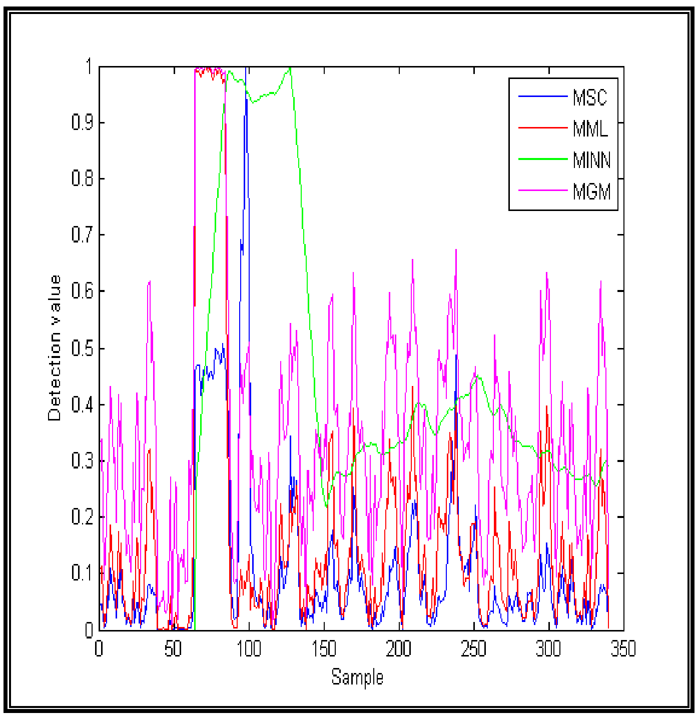

Fig. 5: Correlation vector which tell about synchronization SNR=30 in Rayleigh

Table 2: Preamble Simulation result analysis

SNR	Sample			
	MSC	MML	MINN	MGM
10	ND	ND	103	ND
15	ND	ND	70	ND
25	ND	ND	60	58
30	ND	ND	58	58

VI. CONCLUSION

In this thesis Preamble 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.

REFRENCES

[1] Jungwon Lee *"Joint Maximum Likelihood Estimation of Channel and Preamble Sequence for WiMAX Systems"* IEEE Transactions on Wireless Communications, Vol. 7, NO. 11, November 2008.

[2] Dahiru Sani Shuabu, Sharifah Kamilah, Norsheila Faisal and Yakubu S. Baguda *"Simulation and Performance Analysis of Partial Usage Subchannels in WiMAX IEEE802.16e"* International Journal of Recent Trends in Engineering, Vol 2, No. 5, page no 126-129 November 2009.

[3] Miray Kas, Burcu Yargicoglu, Ibrahim Korpeoglu, and Ezhan Karasan *"A Survey on Scheduling in IEEE 802.16 Mesh Mode"* IEEE Communications Surveys & Tutorials, VOL. 12, NO. 2, Second Quarter 2010 page no 205-221.

[4] Md. Ashraful Islam, Md. Zahid Hasan *"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.

[5] Rakhi Thakur and Kavita Khare *"Synchronization and Preamble Concept for Frame Detection in OFDM"* International Journal of Modeling and Optimization, Vol. 3, No. 1, February 2013.

[6] Sumeeth Nagaraj, 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-Karim Tamimi, *"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.