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PREAMBLE DETECTION IN WIMAX 802.16E USING OFDM WITH AWGN CHANNEL

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Abstract

WiMAX works on high data rate and it is a wireless technique so fading and attenuation in the signals is presence due to noise, inter symbol interference, inter carrier interference etc. OFDM modulation technique is used to work on multicarrier. OFDM works on orthogonality so presence of ISI is neglected. In this paper we used different methods are MSC, MGM, MINN, MML. MINN method is batter than the other is shown by the results. In correlation methods varying the value of correlation lag and find out what is the effect on detection technique. In this preamble detection method we used different communication channel AWGN and also used modulation techniques QAM with OFDM. The performance has been concluded based Sample versus Detection value and output through MATLAB-R3013a Simulation.

Keywords: WiMAX (World Interoperability for Microwave Access), 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), OFDM.

I. Introduction

The IEEE WiMAX/802.16 is a promising technology for broadband wireless metropolitan area networks (WMANs) as it can provide high throughput over long distances and can support different qualities of services. WiMAX/802.16 technology ensures broadband access for the last mile. It provides a wireless backhaul network that enables high speed Internet access to residential, small and medium business customers, as well as Internet access for Wi-Fi hot spots and cellular base stations [1]. It supports both point-to-multipoint (P2MP) and multipoint-to-multipoint (mesh) modes. IEEE 802.16, also known as IEEE Wireless-MAN, explored both licensed and unlicensed band of 2-66 GHz which is standard of fixed wireless broadband and included mobile broadband application. WiMAX forum, a private organization was formed in June 2001 to coordinate the components and develop the equipment those will be compatible and inter operable. After several years, in 2007, Mobile WiMAX equipment developed with the standard IEEE 802.16e got the certification and they announced to release the product in 2008, providing mobility and nomadic access. The IEEE 802.16e air interface based on Orthogonal Frequency Division Multiple Access (OFDMA) which main aim is to give better performance in non-line-of-sight environments [4]. The architecture of WiMAX is shown in figure 1.

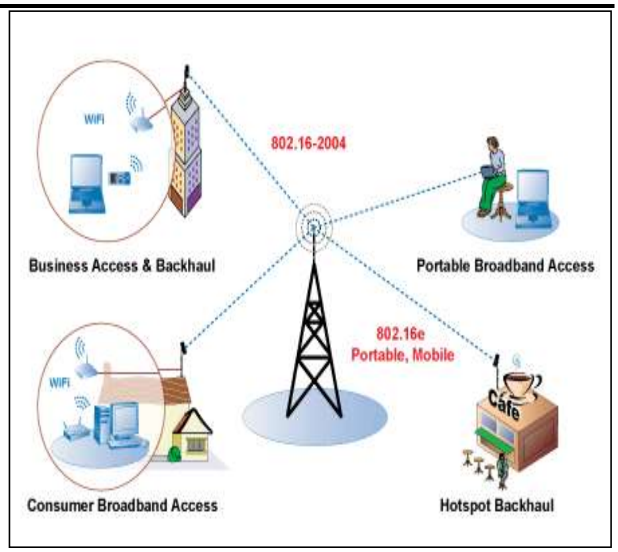

Fig. 1: Architecture of WiMAX

II. Preamble Detection

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.

III. 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.

A. Framework Description

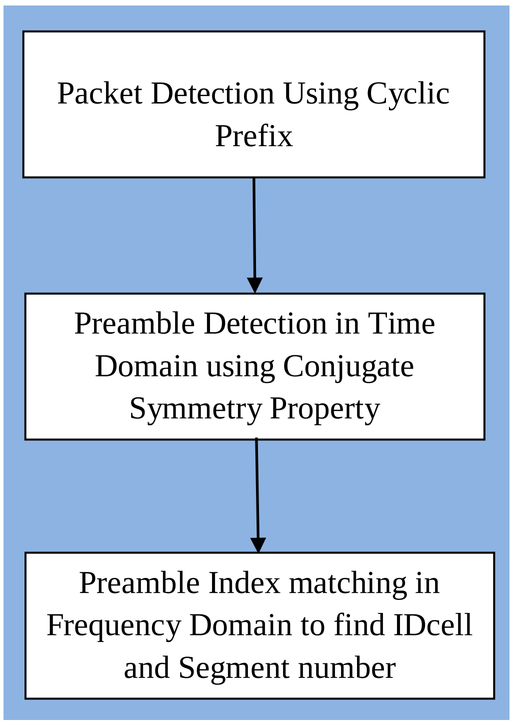

Fig. 2: Steps in Preamble detection

1. Packet Detection using Cyclic Prefix.
2. Preamble Detection in Time Domain using the conjugate symmetric property.
3. Preamble Index matching in Frequency Domain to find IDcell and Segment number.

IV. OFDM

The concept of orthogonal frequency division multiplexing (OFDM) first appeared in the 1950s. It has nearly 64 years of development history. OFDM have been proposed for many different types of systems from digital audio broadcasting to radio local area networks [5]. Orthogonal frequency-division multiplexing is a method of transmitting data simultaneously over multiple equally spaced carrier frequencies, using Fourier transform processing for modulation and demodulation. OFDM offers many well-documented advantages for multicarrier transmission at high data rates, particularly in mobile applications. Specifically, it has inherent resistance to dispersion in the propagation channel. Figure 3 illustrates the difference between the conventional non overlapping multicarrier technique and the overlapping multicarrier modulation technique. By using the overlapping multicarrier modulation technique, we save almost 50% of bandwidth. To realize this technique, however, we need to reduce cross talk between SCs, which means that we want orthogonality between the different modulated carriers. Discrete-time OFDM signal can be written as in equation 1.

$$x_n = x\left(\frac{nT}{JN}\right) = \frac{1}{\sqrt{N}} \sum_{k=N/2}^{N/2-1} X_{(k+N)} \times \exp\left(\frac{j2\pi nk}{JN}\right),$$

$$n = 0,1,3,4,4,\ldots\ldots\ldots\ldots JN-1 \qquad (1)$$

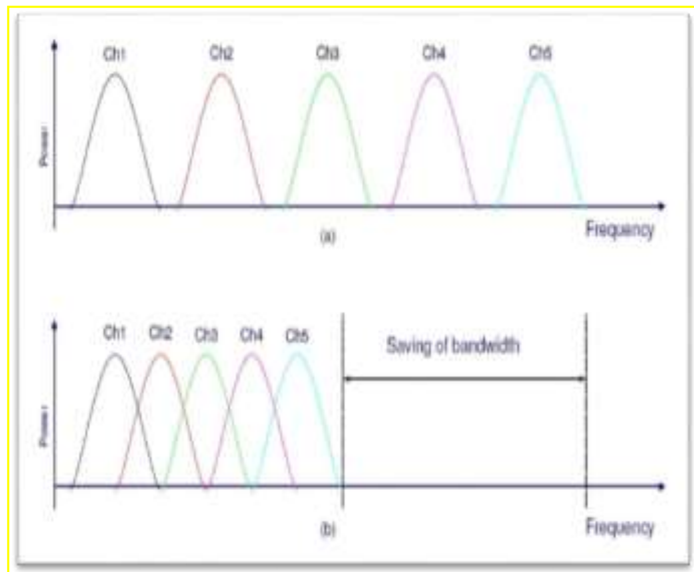

Fig. 3: Comparison between conventional FDM and OFDM

A. Cyclic Prefix

Under ideal conditions the OFDM signal can be demodulated without any interference between the subcarriers. But in case of time dispersive channel, the orthogonality between the subcarriers gets disturbed because the demodulator correlation interval for one path will overlap with the symbol boundary of different path, it can be observed from Figure 4.

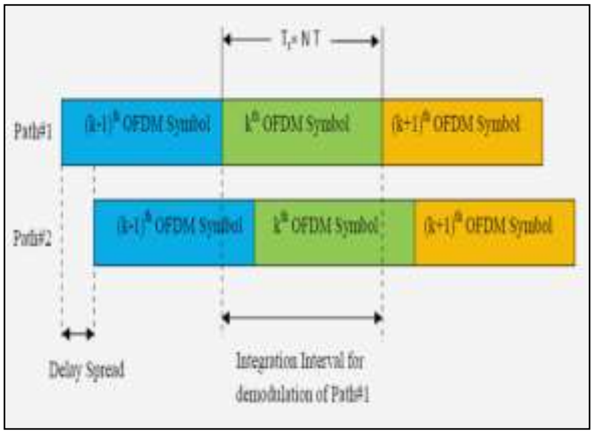

Fig. 4: Time dispersion and corresponding received signals timing.

V. Modulation

Modulation is the process of facilitating the transfer of information over a medium. Sound transmission in air has limited range for the amount of power your lungs can generate. To extend the range your voice san reach, we need to transmit it through a medium other than air, such as a phone line or radio. The process of converting information (voice in the case) so that it can be successfully sent through a medium (wire or radio waves) is called modulation.

$$S(t) = \begin{cases} A\cos(2\pi f_c t), & for\ binary\ 1 \\ A\cos(2\pi f_c t + \pi), & for\ binary\ 0 \end{cases}$$

$$\begin{cases} A\cos(2\pi f_c t), for\ binary\ 1 \\ -A\cos(2\pi f_c t), for\ binary\ 0 \end{cases} \quad (1)$$

VI. Communication Channel

A. AWGN Channel

The AWGN channel model is a simple but basic concept for modeling channel effects on electromagnetic signals in communication systems. The simplest channel model in wireless commutations is the well known Additive White Gaussian Noise (AWGN) model. The AWGN channel adds white noise $n(t)$ to the signal $x(t)$:

$$y(t) = x(t) + n(t) \quad (2)$$

If the average received power is $P'[W]$ and the noise power spectral density is N_0 [W/Hz], the AWGN channel capacity is:

$$c_{awgn} = W \log_2\left(1 + \frac{p'}{N_0 W}\right) \text{ Bit/Hz} \quad (3)$$

Where P'/NoW is the received signal-to-noise ratio (SNR).

B. 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.

VII. Simulation Results

The Schmidl and Cox reach the threshold value at the 64 for CP ¼ for the total number of symbol used is 256 and preamble starts from the 64^{th} symbol. for Schmidl and Cox correlation performance for detection of the preamble as shown in fig 5, figure 6.

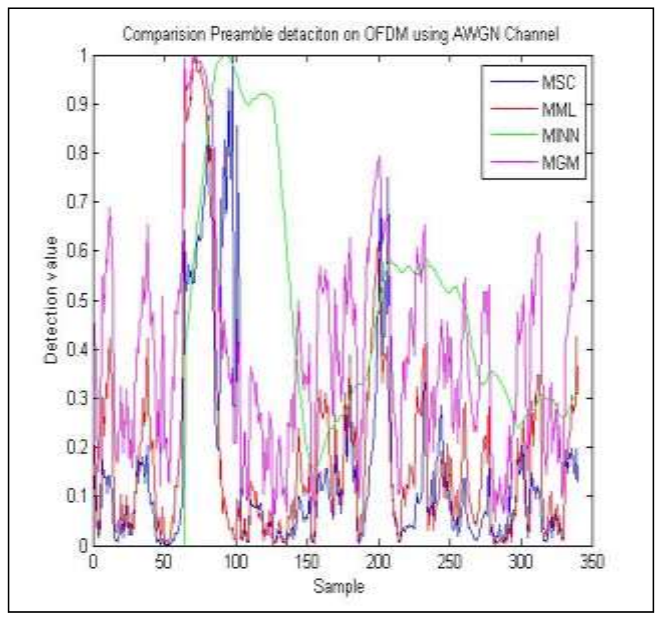

Fig. 5: Preamble detection on OFDM using AWGN Channel at SNR 20dB

Table 6.3: Performance analysis of Preamble detection

Preamble Technique	SNR	Maximum Detection Value	Sample
MSC	20dB	1.0	95
MML		1.0	70
MINN		1.0	90
MGM		1.0	65

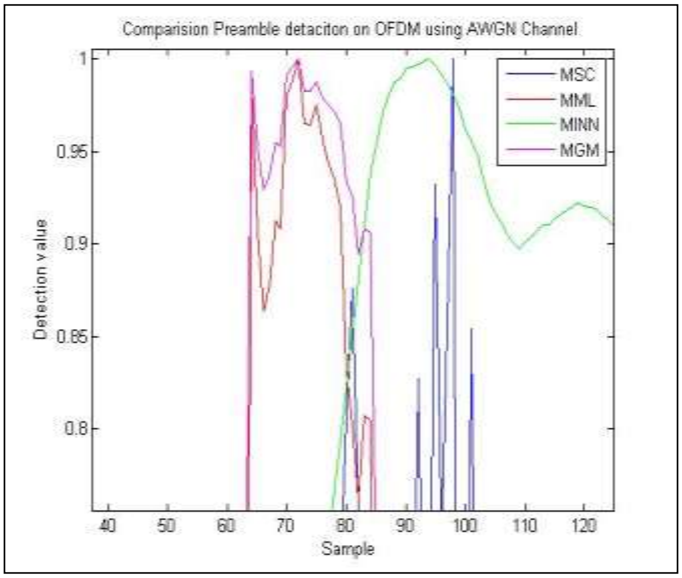

Fig. 6: Preamble detection on OFDM using AWGN Channel at SNR 30dB

Table 6.2: Performance analysis of Preamble detection

Preamble Technique	SNR	Maximum Detection Value	Sample
MSC	30dB	1.0	98
MML		1.0	72
MINN		1.0	95
MGM		1.0	72

VIII. Result Analysis and Conclusion

An above result we analysis all preamble technique (MSC, MML, MSC and MGM) at different SNR value (0dB, 20dB, 30dB and 50dB). In the SNR at 30dB have best performance is obtain in MML and MGM but some time both result suddenly down over performance. But in the MINN techniques has batter than all techniques because its performance is smoothly down and rise at all point so that MINN is batter techniques.

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