

Global Journal of Advance Engineering Technologies and Sciences**PERFORMANCE OF WIMAX 802.16e MIMO OFDM SYSTEM****USING 2×2 ALAMOUTI SCHEME**Ashish M Sitapara¹, Mukesh Patidar², Dr. Pragya Nema³M. Tech. Scholar¹, Asst. Prof.², Prof. & HOD³**Department of Electronics and Communication Engineering
Lakshmi Narain College of Technology, Indore (M.P.) India****ABSTRACT**

The new area of wireless communication technology, currently employed in some parts of the world, is Worldwide Interoperability for Microwave Access (WiMAX). It is the latest 4G-technology which is approved by IEEE 802.16 group, which is a standard for point to multipoint wireless networking. The multipoint MIMO-OFDM system is a key technology for next-generation cellular communications (Mobile WiMAX, IMT Advanced) as well as Wireless Personal Area Network (WPAN), wireless Local Area Network (IEEE 802.11a, IEEE 802.11n) and broadcasting (DAB, DVB). In this paper analysis of the multiple antenna technologies MIMO-OFDM system under different combination of modulation technologies like BPSK, QPSK, 8-QAM and 16-QAM and Additive white Gaussian noise (AWGN) Channel with a new scheme Alamouti used and the performance results shows under the bit error rate (BER) versus signal to noise ratio (SNR).

INTRODUCTION

The WiMAX Forum develops system profiles, which define mandatory and optional capabilities for WiMAX products. The list of features tested in system profiles is more stringent than the underlying standards, but does not include any new feature that is not included in the standards [7]. Initially, the WiMAX Forum focused on the 10-66GHz frequencies in the Wireless MAN-SC physical layer specifications of IEEE Standard 802.16-2001.

The WiMAX Forum collaborated on the IEEE Std 802.16c-2002 amendment to develop the system profiles for Wireless MAN-SC, it is forum helped developing IEEE Std 802.16-Conformance Jan-2005, IEEE Std 802.16-Conformance Feb-2005 and IEEE Std 802.16-Conformance Mar-2005 for a Protocol Implementation Conformance Statement (PICS) Performa, Test Suite Structure (TSS) and Test Purpose (TP) and Radio Conformance Test (RCT), respectively [7]. It is a new broadband wireless data communication technology or mobile internet based around the IEEE 805.16 standard that will provide high-speed data communication up-to 70 Mb/s over a wide area. The letters of WiMAX stand for worldwide interoperability for microwave access and it is a technology for point-to-multipoint wireless networking. The WiMAX technology is expected to meet the needs of a large variety of users from those who are in developed nations wanting to install a new high speed wireless data network very cheaply with the minimum cost and time required.

The standard for WiMAX is a standard for wireless metropolitan networks (WMAX) that has been developed by working group number 16 of IEEE 805, specializing in broadband wireless access. It is also supported by a wide number of industry companies. WiMAX technology will support traffic based on transport technologies ranging for Ethernet, Internet protocol (IP), and asynchronous transfer mode (ATM), the forum will only certify the IP-related elements of the 805.16 products. The WiMAX has two important standards/usage models, a fixed usage model

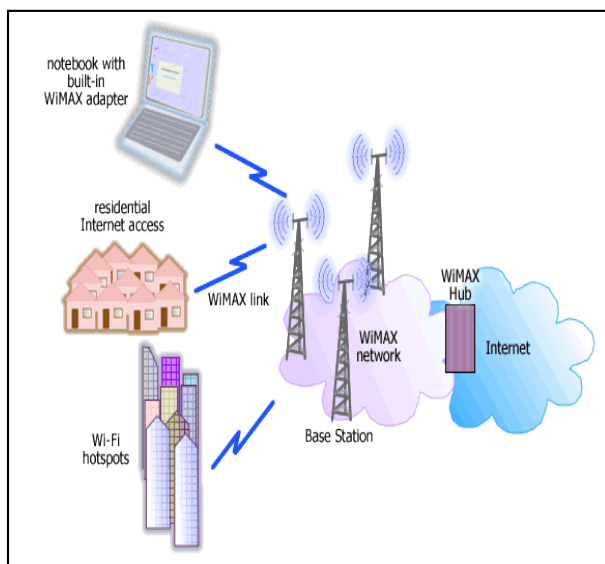


Fig. 1: The architecture of WiMAX

IEEE 805.16d for fixed wireless broadband access (FBWA) and a portable usage model IEEE 805.16e for mobile wireless broadband access (MBWA). The architecture of WiMAX is show figure 1.

A. Features of WiMAX

An important and very challenging function of the WiMAX system is the support of various advanced antenna techniques, which are essential to provide high spectral efficiency, capacity, system performance, and reliability,

a. Beam forming using smart antennas provides additional gain to bridge long distances or to increase indoor coverage; it reduces inter-cell interference and improves frequency reuse.

b. Transmit diversity and MIMO techniques using multiple antennas take advantage of multipath reflections to improve reliability and capacity.

MIMO SYSTEM

Wireless MIMO channels have been recently attracting a great interest since they provide significant improvements in terms of spectral efficiency and reliability with respect to single input single-output (SISO) channels. The gains obtained by the deployment of multiple antennas at both sides of the link are the array gain, the diversity gain, and the multiplexing gain. The array gain is the improvement in signal-to-noise ratio (SNR) obtained by coherently combining the signals on multiple-transmit or multiple-receive dimensions while the diversity gain is the improvement in link reliability obtained by receiving replicas of the information signal through independently fading dimensions.

A. Spatial Diversity

When a channel is rich in multipath signal components, it is possible to simulate independent virtual paths which can then be used to transmit signal copies for redundancy. The ability to transmit redundant data through independently faded channel is called Diversity. Diversity techniques like space, time and frequency are well known techniques used to improve reliability of wireless communication systems. Among them, spatial diversity technique is the most promising one, because it does not require any additional bandwidth and does not introduce additional delays in signal transmission. Space-Time Block Codes (STBCs) are the simplest types of spatial temporal codes that exploit the diversity offered in systems with several transmit antennas. It was designed to achieve maximum diversity order for the given number of transmit and receive antennas subject to the constraint of having a

simple decoding algorithm. In addition, space-time block coding provides full diversity advantage. Alamouti designed a simple transmission diversity technique for systems having two transmit antennas [15]. This method provides full diversity and requires simple linear operations at both transmission and reception side. The encoding and decoding processes are performed with blocks of transmission symbols. Detail analysis of 2X2 Alamouti space time coding is given below.

B. Alamouti space-time coding scheme (2x2)

The Alamouti space-time coding scheme for the system with two transmission antennas and two reception antennas in a memory less channel, as proposed in is shown in Figure 2. The transmission scheme is the same as with the 2x1 system. **Received signals at receive antenna 1 are:**

$$R_0(t) = h_{11}(t)X_1(t) + h_{21}(t)X_2(t) + n_0(t) \quad (1)$$

and

$$R_1(t) = -h_{11}(t)X_2^*(t) + h_{21}(t)X_1^*(t) + n_0(t+T) \quad (2)$$

Where n_0 represents noise at receive antenna 1.

At receive antenna 2 the received signals are:

$$R_2(t) = h_{12}(t)X_1(t) + h_{22}(t)X_2(t) + n_1(t) \quad (3)$$

and

$$R_3(t) = -h_{21}(t)X_2^*(t) + h_{22}(t)X_1^*(t) + n_1(t+T) \quad (4)$$

At time instances t and $t+T$, respectively, where n_1 represents noise at receive antenna 2. Again, the estimates of the signals in the decoder/combiner are given as in equation 5 and 6.

$$\widehat{X}_1 = h_{11}^*(t)R_0(t) + h_{21}(t)R_1^*(t) + h_{12}^*(t)R_2(t) + h_{22}(t)R_3(t) \quad (5)$$

$$\widehat{X}_2 = h_{11}^*(t)R_0(t) - h_{21}(t)R_1^*(t) + h_{12}^*(t)R_2(t) - h_{22}(t)R_3(t) \quad (6)$$

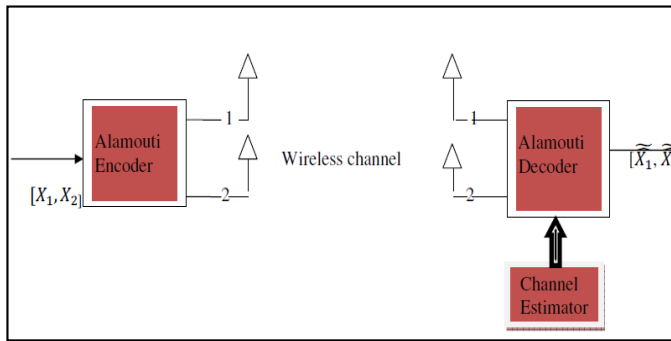


Fig.2 Alamouti 2x2 scheme flat slow fading channel

Decoded symbol blocks are obtained using a maximum likelihood (ML) detector. A maximum likelihood detector maps the estimated symbols \hat{X}_1 and \hat{X}_2 to the most probable reference symbols from the phase shift keying modulation (PSK) or quadrature amplitude modulation (QAM) constellation being used. The measure used for mapping is the two dimensional distance between the estimated and the reference symbol on the constellation grid.

ADDITIVE WHITE GAUSSIAN NOISE (AWGN) CHANNEL

The simplest radio environment in which a wireless communications system or a local positioning system or proximity detector based on Time-of-flight will have to operate is the Additive-White Gaussian Noise (AWGN) environment. Additive white Gaussian noise (AWGN) is the commonly used to transmit signal while signals travel from the channel and simulate background noise of channel. The mathematical expression in received signal:

$$r(t) = s(t) + n(t) \tag{7}$$

That passed through the AWGN channel where $s(t)$ is transmitted signal and $n(t)$ is background noise. In AWGN channel adds white Gaussian noise to the signal that passes through it. It is the basic communication channel model and used as a standard channel model. The transmitted signal gets disturbed by a simple additive white Gaussian noise process.

RESULT ANALYSIS

Performance results of Different combination of $M \times N$ System The basic min of this thesis is to analyze the performance of WiMAX (OFDM - $M \times N$ systems) based on the different simulation parameters consider and obtain simulation results. We investigated the BER Vs SNR plot by using AWGN channel. The performance of WiMAX

model analysis on used the following parameters as shown in table 1.

Table 6.1: Performance of IEEE 802.16e Physical layers Parameters

Parameters	Value
Communication Channel	AWGN
Modulation Techniques	BPSK, QPSK, 8-QAM and 16-QAM
IFFT (Input port size)	256
CC Code Rate	1/2
Radio Technology	OFDM
Used Scheme	Alamouti
System (Single and Multiple)	MIMO
Model	WiMAX 802.16e
Calculation Parameters	BER V/s SNR
Simulation-Used Tool/Software	Matlab (R2013a)

A. Performance of 2×2 -MIMO system over AWGN channel

In this analysis we are used in AWGN (Additive White Gaussian Noise) and different modulation schemes used like BPSK, QPSK, 8-QAM and 16-QAM. The performance of used New scheme Alamouti with combination of MIMO (multiple input and multiple output). The simulation results are shown in figure 6.7 and the result analysis are shown in table 3.

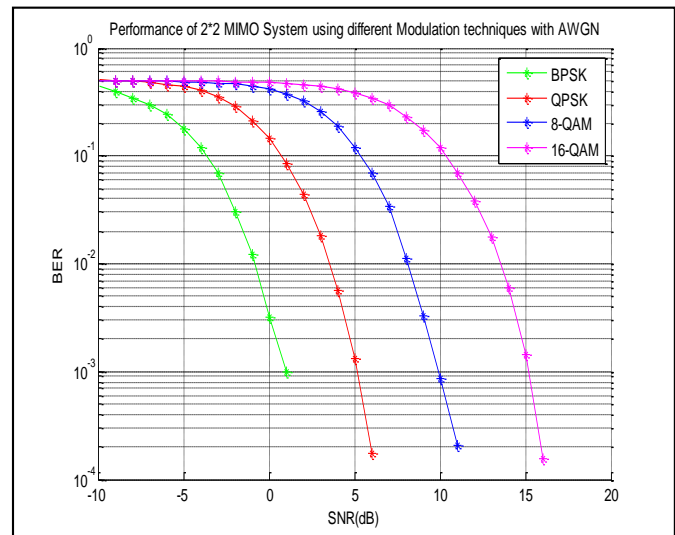


Fig.3 Performance analysis of 2×2 MIMO system using different modulation techniques with AWGN channel

Result Analysis: In this performance, we have used the Alamouti scheme with communication AWGN channel and different modulation techniques. The performance is

displayed in figure 6.7 in terms of the BER verses SNR logarithmic plot. In the table 6.3 in this plot we analysis the 16-QAM, SNR is increased 5.3dB on BER at 10^{-3} as compared to 8-QAM and Modulation Techniques at a constant signal power. In this analysis SNR is increased 1.6dB as compared to the 2*1-MISO system.

CONCLUSION

Multiple-Input Multiple-Output (MIMO) systems offer considerable increase in data throughput and link range without additional bandwidth or transmit power by using several antennas at transmitter and receiver to improve wireless communication system performance. At the same time, Orthogonal Frequency Division Multiplexing (OFDM) has becoming a very popular multi-carrier modulation technique for transmission of signals over wireless channels. Finale we conclude 2*2 MIMO systems was better SNR for 16-QAM modulation. As expected, the similar slopes of the BER curves for the modulation BPSK, QPSK, 16QAM and 64QAM systems indicate an 1.50, 5.00, 9.90 and 15.20 dB SNR differences for 2x2 MIMO-OFDM with Alamouti systems in Figure 6.7

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