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PERFORMANCE ANALYSIS OF 2 × 2 MIMO AND 1 × 2SIMO SYSTEM USING DIFFERENT MODULATION TECHNIQUES WITH AWGN CHANNEL

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ABSTRACT

WiMAX which represents (Worldwide Interoperability for Microwave Access) is a major part of broad band wireless network having IEEE 802.16 standard provides innovative fixed as well as mobile platform for broad-band internet access anywhere in anytime. IEEE 802.16 standard has bandwidth of 2GHz-11GHz for fixed applications and 2-6GHz for mobile applications. It is considered the most interesting opportunity which is able to provide data throughput up to 70 Mbps and radio coverage distances of almost 50 kilometers, and to complete wired network architectures, ensuring a cheap flexible solution for the last-mile. WiMAX can be seen as the fourth generation (4G) of mobile communications systems. Pursuance for better ways of living has been instrumental in advancing human civilization. In this project analysis of the multiple antenna technologies like Single input signal output antenna system, multiple input multiple output antenna system under different combination of modulation technologies (BPSK, QPSK, 8-QAM and 16-QAM) with Additive white Gaussian noise channel used and the performance results shows under the bit error rate versus signal to noise ratio.

Keyword: -Additive White Gaussian Noise channel (AWGN), Orthogonal Frequency Division Multiplexing (OFDM), multiple-input and multiple output (MIMO) Bit Error rate (BER), Signal to Noise ratio (SNR).

INTRODUCTION

Based on the IEEE 802.16, 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.

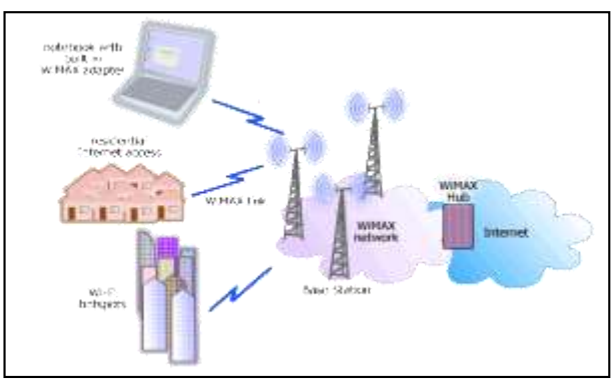

Figure 1: The architecture of WiMAX

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 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.

METHODOLOGY

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.

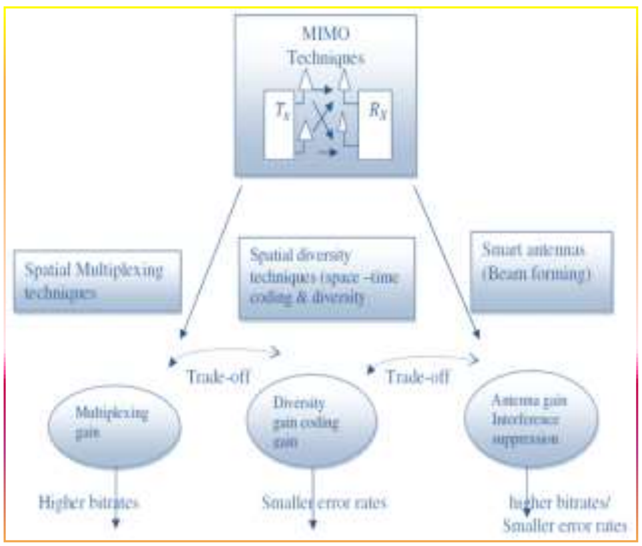

Fig.2 Benefits of multiple antenna techniques for wireless communication

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.

ALAMOUTI SPACE-TIME CODING SCHEME (2×2)

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 3. The transmission scheme is the same as with the 2×1 system.

Received signals at receive antenna 1 are:

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

and

$R_1(t) = -h_{11}(t)X^*{}_2(t) + h_{21}(t)X^*{}_1(t) + n_0(t+T)$(2)

Where $n_0$represents noise at receive antenna 1.

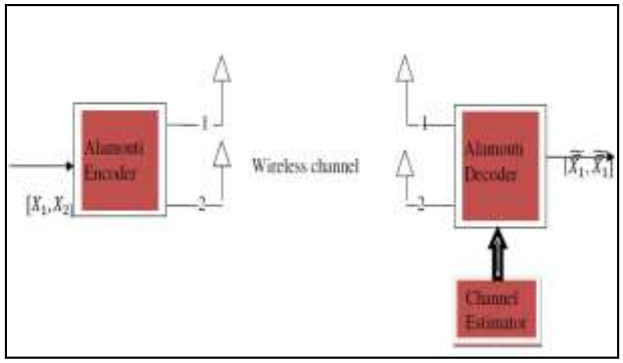

Fig.3 Alamouti 2×2 scheme flat slow fading channel At receive antenna 2 the received signals are:

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

and

$$R_5(t) = -h_{21}(t)X^*{}_2(t) + h_{22}(t)X^*{}_1(t) + n_1(t+T) \quad (4)$$

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 4.8 and 4.9.

$$\widehat{X_1} = h^*{}_{11}(t)R_0(t) + h_{21}(t)R^*{}_1(t) + h^*{}_{12}(t)R_2(t) + h_{22}(t)R_5(t) \quad (5)$$

$$\widehat{X_2} = h^*{}_{11}(t)R_0(t) - h_{21}(t)R^*{}_1(t) + h^*{}_{12}(t)R_2(t) - h_{22}(t)R_5(t) \quad (6)$$

Decoded symbol blocks are obtained using a maximum likelihood (ML) detector. A maximum likihood detector maps the estimated symbols $\widehat{X_1}$and $\widehat{X_2}$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.

SIMULATION RESULT

During our simulation we used cyclicprefix to minimize the Inter Symbol Interference (ISI) on the basis of different modulation techniques like Binary Phase Shift Keying, Quadrature Phase Shift Keying, and Quadrature Amplitude Modulation (8-QAM and 16-QAM) through Matlab. With the help of digital modulation techniques we got the Bit Error Rate (BER) versus Signal to Noise Ratio (SNR in dB) results.

This is the simulation environment which we used in our simulation MATLAB (R2013a) version also we have used communication channel AWGN and Alamouti scheme with evaluation in different combination of (M×N) system.

The basic min of this thesis is to analyze the performance of WiMAX (OFDM -M × 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 1: Performance of IEEE 802.16e 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)	SIMO and MIMO
Model	WiMAX 802.16
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 4 and the result analysis are shown in table 2.

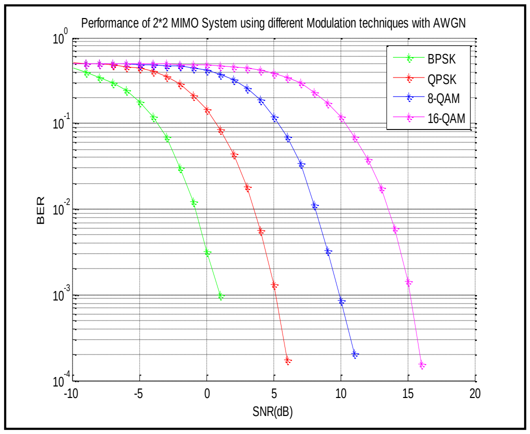

Fig. 4 Performance analysis of 2 × 2 MIMO system using different modulation techniques with AWGN channel

B. Performance of 1 × 2 SIMO system over AWGN channel

We are consider all above parameter in table 1,the simulation results 1 × 2 SIMO system are shown in figure 5 and the result analysis are shown in table 3.

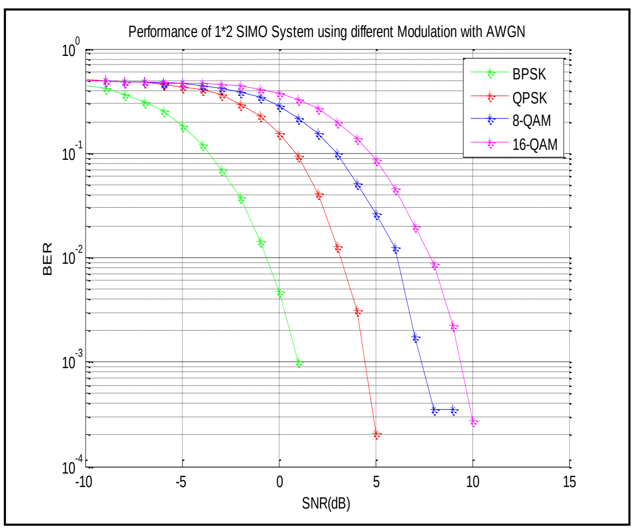

Fig. 5: Performance analysis of 1 × 2 SIMO system using different modulation techniques with AWGN channel

CONCLUSION AND FUTURE WORK

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. A MIMO-OFDM modulation technique can achieve reliable high data rate transmission over broadband wireless channels. We developed a program in MATLAB, to study MIMO and MIMO-OFDM systems behavior under different conditions. We have used the parameters data rate1Mbps, number of transmitted bits 100000, AWGN channel, 64 subcarriers OFDM signal, four types of modulation BPSK, QPSK, 16QAM and 64QAM.

In this performance, we have used the Alamouti scheme with communication AWGN channel and different modulation techniques. The performance is displayed in figure 4 in terms of the BER verses SNR logarithmic 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. The performance is displayed in figure 5 in terms of the BER verses SNR logarithmic plot. We analysis the 16-QAM, SNR is increased 1.6 dB on BER at 10^{-3} as compared to 8-QAM and Modulation Techniques at a constant signal power. The overall performance is SNR very power as compared to above all (MIMO and MISO).

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