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PERFORMANCE ANALYSIS OF WIMAX 802.16e USING DIFFERENT MODULATION SCHEME WITH MIMO SYSTEM

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ABSTRACT

WiMAX is a wireless digital communications system, also known as IEEE 802.16 that is intended for wireless "Metropolitan Area Networks". WiMAX can provide broadband wireless access up 50 km for fixed stations, and 5-15 km for mobile stations. In contrast, the Wi-Fi-802.11 wireless local area network standard is limited in most cases to only 30 - 100m. It is also known as 802.16 networking or wireless networking. The new area of communication, currently employed in some parts of the world, is Worldwide Interoperability for Microwave Access (WIMAX). It is the latest technology which is approved by IEEE 802.16 group, which is a standard for point-to-multipoint wireless networking. The MIMO-OFDM is a key technology for next-generation cellular communications Mobile WiMAX as well as wireless Personal Area Network, wireless Local Area Network (IEEE 802.11a, IEEE 802.11n) and broadcasting (DAB, DVB). In this project analysis of the multiple antenna technologies like MIMO system under different combination of modulation technologies like BPSK, QPSK, 8-QAM and 16-QAM with Communication channel Additive white Gaussian noise (AWGN) used and the performance results shows under the bit error rate versus signal to noise ratio.

Keyword: Worldwide Interoperability for Microwave Access (WiMAX), Additive White Gaussian Noise channel (AWGN), Broadband Wireless Access (BWA) Orthogonal Frequency Division Multiplexing (OFDM), Modulation Technology, Multiple-Input And Multiple Output (MIMO), Bit Error rate (BER), Signal to Noise ratio (SNR).

INTRODUCTION

Wireless communication systems can be found all around the world today. WiMAX which represents (World 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. WiMAX is an IEEE 802.16 standard based technology responsible for bringing the Broadband Wireless Access (BWA) to the world as an alternative to wired broadband. WiMAX is expected to have an explosive growth, as well as the Wi-Fi, but compared with the Wi-Fi WiMAX provides broadband connections in greater areas, measured in square kilometers, even with links not in line of sight. For these reasons WiMAX is a MAN, highlighting that "metropolitan" is referred to the extension of the areas and not to the density of population and 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.

Benefits key of wireless technology

1. Greater flexibility and mobility for users: Office-based wireless workers can be networked without sitting at dedicated PCs.

2. Increased efficiency: Improved communications leads to faster transfer of information within businesses and between partners/customers.

3. You are rarely out of touch: you don't need to carry cables or adaptors in order to access office networks.

4. Reduced costs: Relative to 'wired', wireless networks are, in most cases, cheaper to install and maintain.

MULTIPLE INPUTS AND MULTIPLE OUTPUTS

Multiple antennas systems can be used at the transmitter and at the receiver of a wireless communication system. Such systems are called multiple input and multiple output (MIMO) systems. MIMO

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systems may be implemented in several different ways and can be categorized into three types. The first type of MIMO system provides spatial diversity and enhances power efficiency. It includes space time block code (STBC), space frequency block code (SFBC), space time trellis code (STTC) and delay diversity systems. The second of MIMO system implements spatial multiplexing to increase its transmission rate. Independent data streams are transmitted over a group of antennas. At the receiver, signals from several antennas are detected and the transmitted information recovered. In the last type of MIMO system, some capacity gain can be achieved over non-MIMO systems by pre-processing the signals to be transmitted according to the channel characteristics and then decoding the received signals accordingly. MIMO has become an essential element of wireless communication standards including IEEE 802.11n (Wi-Fi), WiMAX (4G).

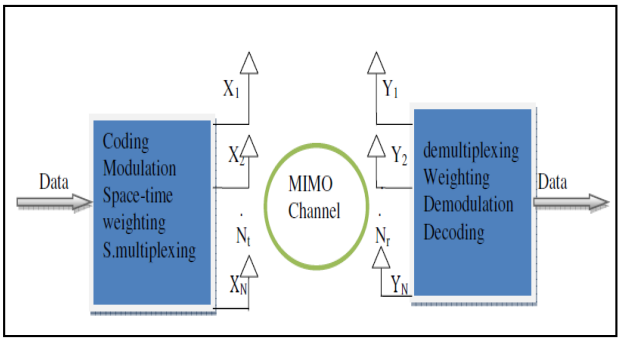

Fig. 1 MIMO Model

In MIMO systems, the transmit and receive antennas can both be used for diversity gain. Multiplexing exploits the structure of the channel gain matrix to obtain independent signaling paths that can be used to send independent data. A narrowband point-to-point communication system of Nt transmit and Nr receive antennas is shown in Figure 1. The transmitted matrix is a $Nt \times 1$ column matrix X, where Xi is the i^{th} component transmitted from the antenna i.

Since each of the receive antennas detects all of the transmitted signals, there are N x N independent propagation paths, where there are transmit and receive antennas. This allows the channel to be represented as N x N matrix. Again using a 2 x 2 System as an example, the matrix below is obtained as:

$$H = \begin{bmatrix} h_{11} & h_{12} \\ h_{21} & h_{22} \end{bmatrix}$$

(1)

Each of the elements in the channel matrix is define an independent propagation path. The transmitted signal can be represented as a vector, as can the received signal. Hence, the system can be represented as the following equation.

$$Y = HX + n$$

(2)

Where Y is the received signal vector, H is the channel Matrix, X is the transmitted signal vector, and n is the noise. The transmitted signals in the vector Y are complex signals, as the channel matrix values and the received signals in vector X.

ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING

OFDM is a modulation technique which offers 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 efficient channel estimation/equalization as the broadband frequency-selective channel is split into several flat-fading channels due to narrow- band subcarriers. Service providers can use granularity (due to several narrow band subcarriers) available to offers 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 3.

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

n = 0,1,2,5,5,……..JN-1

(3)

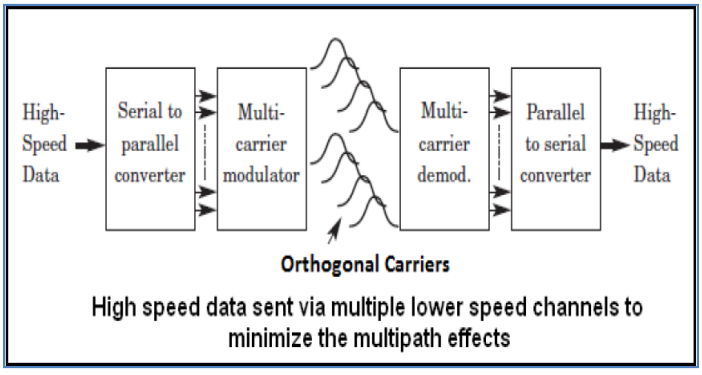

Fig.2 Basic Concept of OFDM

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SIMULATION RESULTS

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 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)	SISO, SIMO, MISO and MIMO
Model	WiMAX 802.16e
Calculation Parameters	BER V/s SNR
Simulation-Used Tool/Software	Matlab (R2013a)

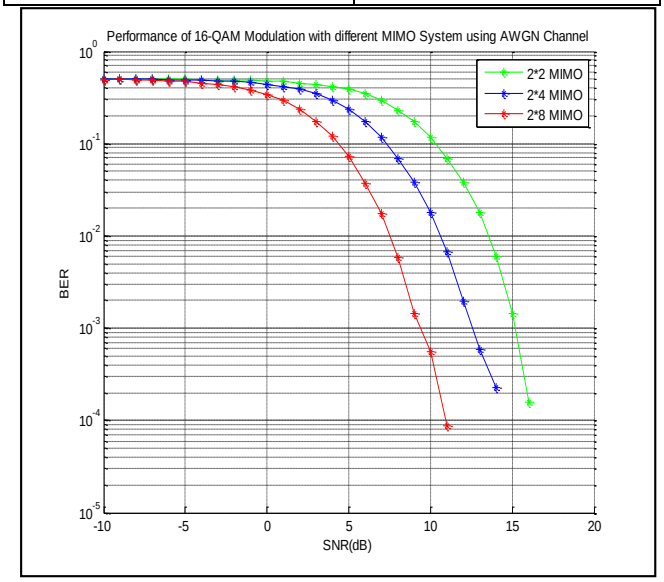

Fig. 2 Performance of 16-QAM Modulation with different MIMO system

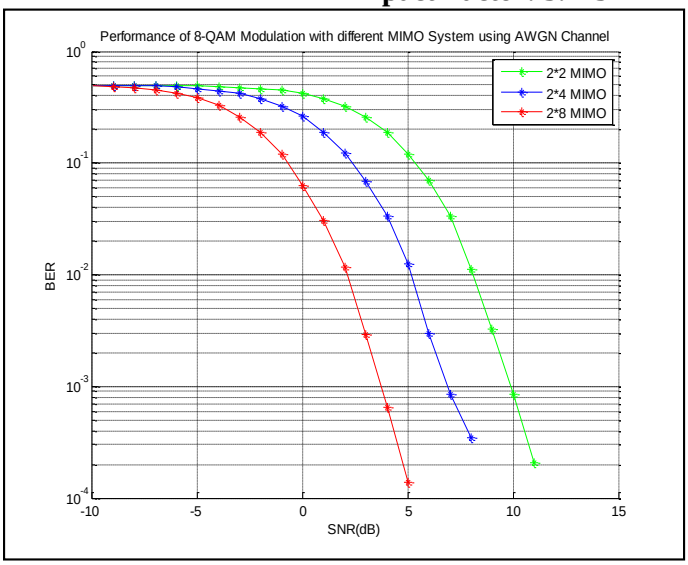

Fig. 3 Performance of 8-QAM Modulation with different MIMO system

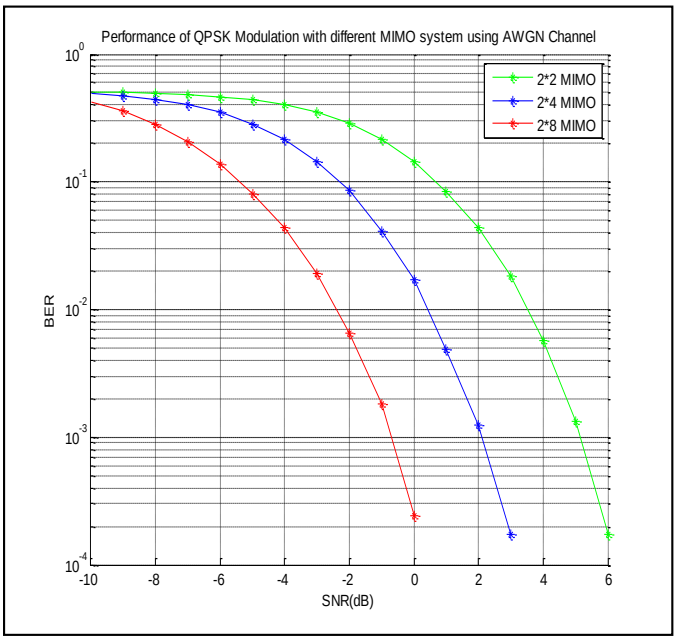

Fig. 4 Performance of QPSK Modulation with different MIMO system

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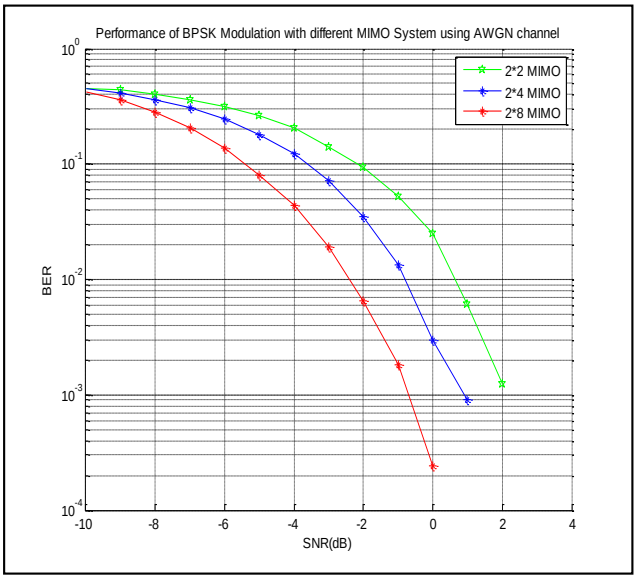

Fig. 5 Performance of BPSK Modulation with different MIMO system

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.

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