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Review and Analysis of WiMAX Technology using different Modulation scheme with AWGN Channel

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ABSTRACT

The last few decades, there has been a incredible growth in the wireless communication technology. The growing demand of multimedia services and the growth of Internet related contents lead to increasing interest to high speed communications. The Wireless communication technology, affordable wireless service has become a reality. In wireless communication, radio propagation refers to the behavior of radio waves when they are propagated from transmitter to receiver. In the course of propagation, radio waves are mainly affected by three different modes of physical phenomena: reflection, diffraction, and scattering. In this paper, we analysis of MIMO-OFDM system employing different Modulation scheme is analysed using AWGN channel. The Simulation results show that this is a novel technique for next generation wireless systems using MATLAB toll R2013a.

Keywords: *AWGN, MIMO, OFDM, BER, SNR*

I. INTRODUCTION:

The areas of wireless communication have been significantly challenging in the last some years. Over time, several generations have passed to improve the speed and capacity while maintaining an appreciable quality of service [1]. MIMO and OFDM are two combined technology to provide the spectral efficiency and high data rate required for 4G wireless system technology [1]. The major challenge faced in MIMO-OFDM systems is how to obtain the channel state information accurately and promptly for coherent detection of information symbols. The communication system bandwidth demand is become higher and higher. In order to transmit data with high speed, the wireless communication having a high spectral efficiency does not directly lead to overcoming the fading. Fading may lead to the reduction of spectral efficiency. It is very difficult to match these requests for the traditional modulation technique, but the MIMO-OFDM system combines the OFDM and MIMO technologies to meet these requirements [2, 3]. MIMO wireless antenna systems have been renowned as a key technology for future wireless communications. The performance of MIMO system can be enhanced by using multiple antennas at transmitting and receiving side to provide spatial diversity [4].

A. WiMAX

The letters of WiMAX stand for worldwide interoperability for microwave access and it is a technology for point-to-multipoint wireless networking. WiMAX is called the next generation broadband wireless technology which offers high speed, secure and last mile broadband services along with a cellular back-haul and Wi-Fi hotspots. The evolution of WiMAX began a few years ago when scientists and engineers felt the need of having a wireless Internet access and other broadband services which works well everywhere specifically the rural areas or in those areas where it is hard to establish wired infrastructure and economically not feasible. The 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 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. The mobile WiMAX Fig.1[5], is a technology based on IEEE 802.16 standard [6] developed as a feasible and attractive solution to these problems.

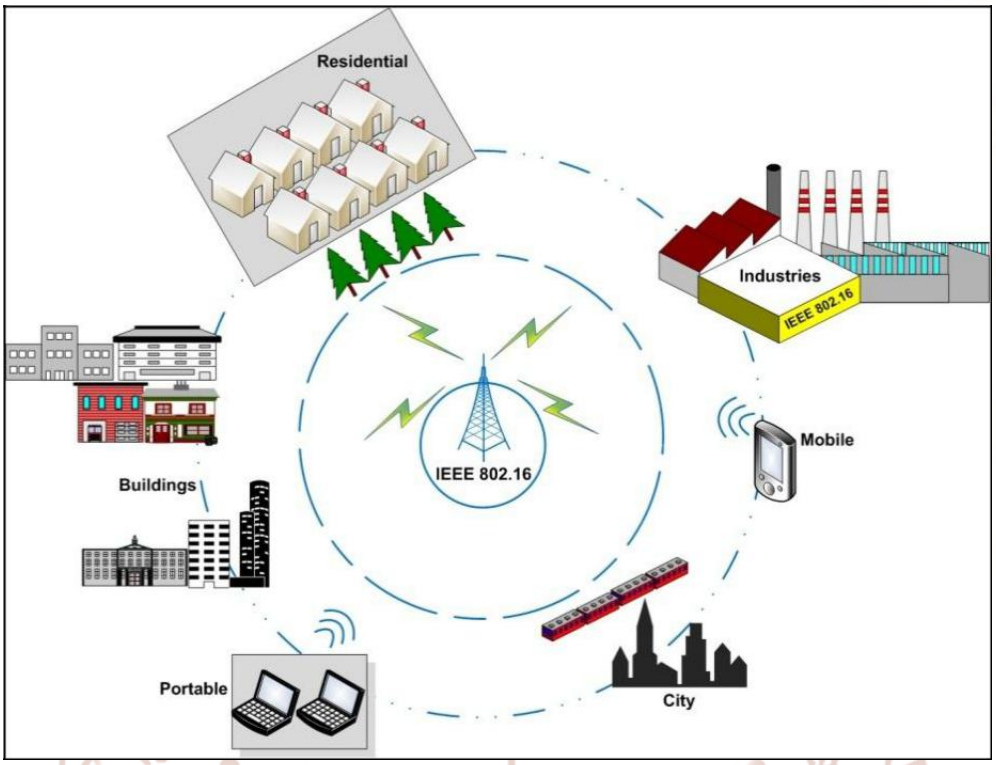

Fig. 1: WiMAX (IEEE 802.16) network architecture

II. MIMO- OFDM

A multiple-input multiple-output (MIMO) communication system combined with the orthogonal frequency division multiplexing (OFDM) modulation technique can achieve reliable high data rate transmission over broadband wireless channels. OFDM is techniques to digital encode data on the multiple-frequencies. It is widely used in wireless communication networking, Video, audio broadcasting, TV, wireless networks and 4G [7, 8]. OFDM plays a major role in both for wireless and wired communications. It started in the 1870 when it was used to carry the information via multiple channels using a telegram [7, 8]. Among many possible technologies for the secondary users' transmission in the spectrum pooling systems, OFDM has already been widely recognized as a particularly novel candidate. This is mainly due to its great flexibility in dynamically allocating the unused spectrum among secondary users as well as its ability to monitor the spectral activities of the licensed users at no extra cost [11, 12, 13].

OFDM divides the high-rate stream into parallel lower rate data and hence prolongs the symbol duration, thus helping to eliminate Inter Symbol Interference (ISI). It also allows the bandwidth of subcarriers to overlap without Inter Carrier Interference (ICI) as long as the modulated carriers are orthogonal. OFDM therefore is considered as an efficient modulation technique for broadband access in a very dispersive environment. DAB (Digital Audio Broadcasting), High Definition TV, Wireless LANs, Mobile broadband [7].

- IEEE 802.16: It operates in licensed spectrum of 2Ghz to11 Ghz.
- IEEE 802.20: It operates below 3.5 GHz in the licensed band.
- Up to 155 miles/ h speed [7, 10].

After inserting pilots either to all subcarriers with a specific period of blocks or within a uniform period of frequency bins in all blocks, IDFT block is used to transform the data sequence of length into time domain signal with the following equation 1.

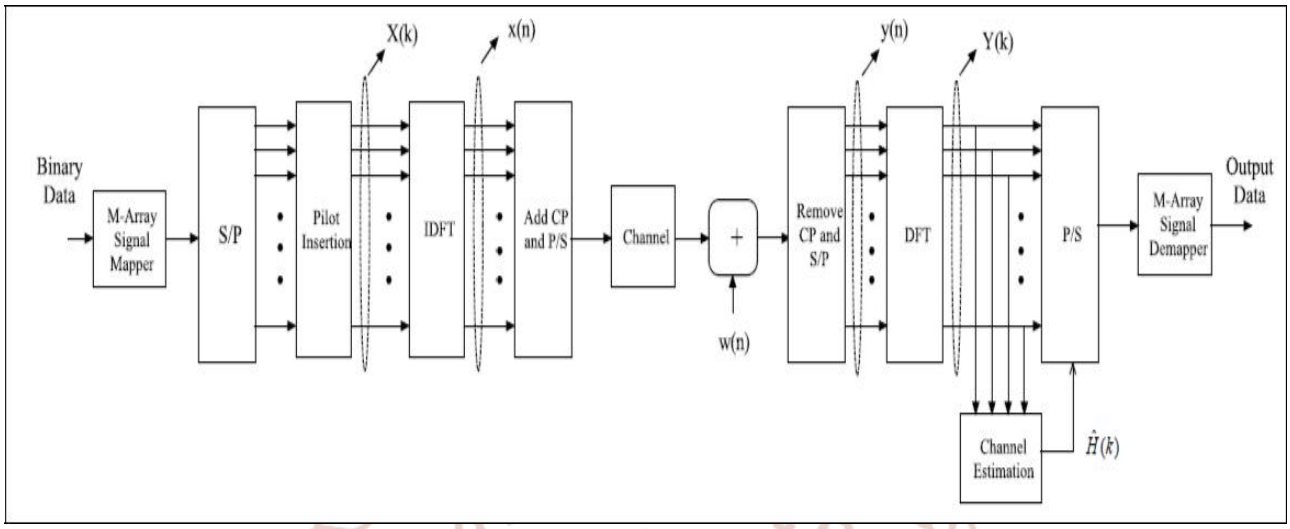

Fig. 2: SISO OFDM System Block Diagram

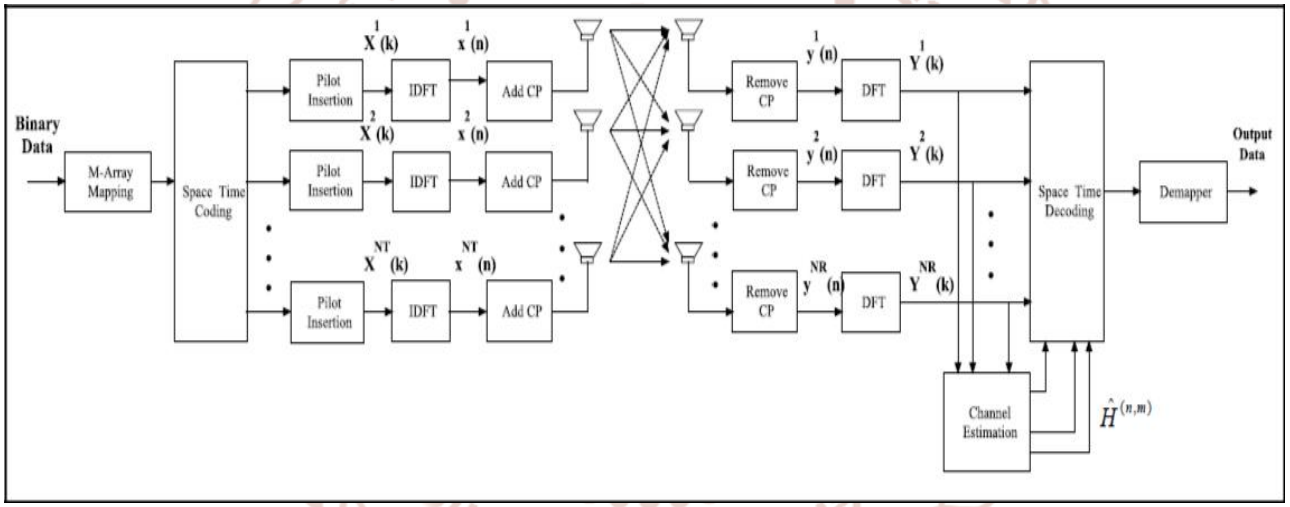

Fig. 3: MIMO OFDM System Block Diagram

Spatial multiplexing Gain: the transmission of multiple data streams over more than one antenna is called spatial multiplexing. The advantage of spatial multiplexing is linear capacity gains in relation to the number of transmit antennas. This gain, referred to as spatial multiplexing gain, is realized by transmitting independent data signals from the individual antennas [14]. Spatial diversity gain: spatial diversity improves the signal quality and achieves a higher signal to noise ratio at the receiver side. Signal power in a wireless channel fluctuates randomly or fades. Diversity is a powerful technique to mitigate fading in wireless links. Consider a space time block coded MIMO-OFDM system [15] equipped with transmit antennas and receive antennas as illustrated in Figure 4.

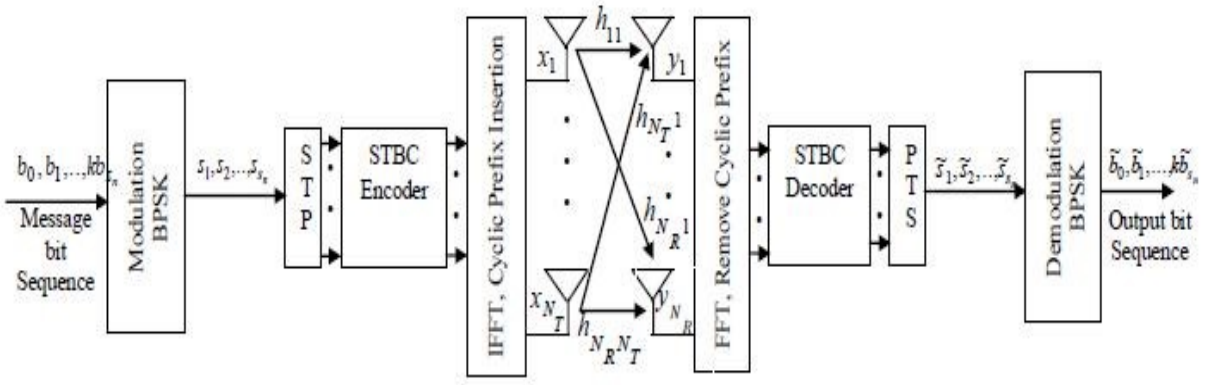

Fig. 4: Block Diagram of Space Time Block Coded MIMO-OFDM system Structure[9]

III. 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 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.

IV. CHANNEL ESTIMATION

When a signal containing audio or video is transmitted through the air medium or wireless medium to the receiver (Rx), some of its characteristics are changed due to present noise and interference in the atmosphere[9]. This distorted signal is unable to provide useful information; some of these characteristics are change like frequency, amplitude and Phase. A wideband radio channel is normally time variant and Frequency selective. For an OFDM communication system, the channel transferred at different subcarriers appears in the receiver with unequal frequency and time domains. Therefore, dynamic estimation of the signal is necessary [7, 9].

V. PERFORMANCE ANALYSIS

To analyze the performance of WiMAX (OFDM-systems) based on the different simulation parameters consider and obtain simulation results. We investigated the BER V/s 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	2-PSK, 4-PSK, 8-QAM and 16-QAM
IFFT (Input port size)	256
CC Code Rate	½
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)

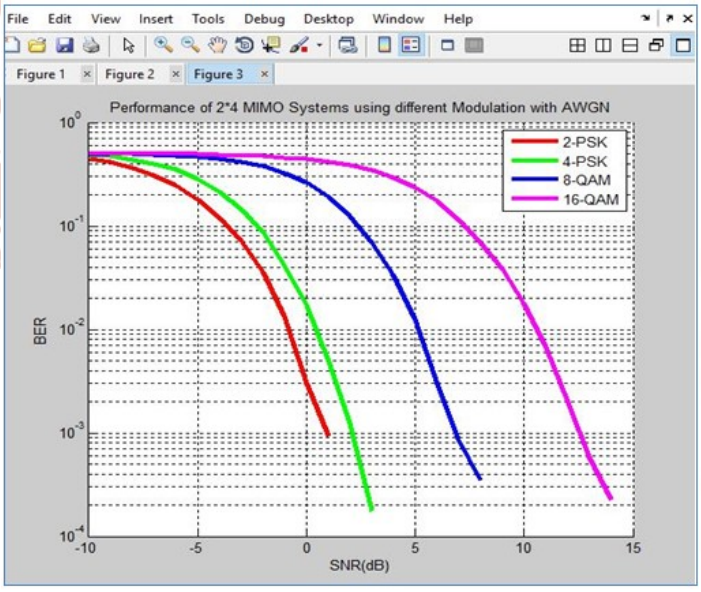

Fig. 5: Performance Analysis of 2*4 MIMO systems using different modulation with AWGN Channel

VI. CONCLUSION

The WiMAX technology is a broadband wireless data communications technology based around the IEEE 802.16 standard providing high speed data over a wide area. In this performance result is shown in figure 5, we have used the Alamouti scheme with communication AWGN channel and different modulation techniques. The performance is displayed in terms of the BER verses SNR logarithmic plot.

We analysis the 16-QAM, SNR is increased 6.1dB on BER at as compared to 8-QAM and Modulation Techniques at a constant signal power.

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