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EFFICIENT ANALYSIS AND SIMULATION OF WIMAX MIMO SYSTEM USING 802.16E MODEL

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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 (BWA) up to 30 miles (48.2803 km) for fixed stations, and 3-10 miles (4.8-16.0 km) for mobile stations. In contrast, the Wi-Fi-802.11 wireless local area network standard is limited in most cases to only 100 - 300 feet (30.8 – 91.44 meter). 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 minor project we analysis the multiple antenna technologies MIMO system under different combination of modulation technologies with mobile wireless channel AWGN used and the results shows under the bit error rate versus signal to noise ratio.

Keyword: - AWGN, BER, Embedded System, IOT, MAN, MIMO, OFDM, SNR, WiMAX.

INTRODUCTION

Recent advances in wireless communication technology and portable computing devices such as wireless handhelds, Personal Digital Assistants (PDAs) and other mobile information terminals are driving a revolutionary change in our information society towards the era of mobile communications. Mobile users can utilize several electronic platforms simultaneously through which they can access all the necessary information whenever and wherever required. Some decades ago, we were purely dependent on analog system. Both the sources and transmission system were on analog format but the advancement of technology made it possible to transmit data in digital form.

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.

4G is the Fourth Generation of mobile communication. A successor to 3G standards, it promises higher speed and better performance. ITU-Advanced specifications state that it should be able to provide 1Gbps speed for low mobility and at least 100Mbps for high mobility.[1] 4G technology follows Multiple Input Multiple Output Technology that uses signal multiplexing between multiple transmitting antennas (space multiplex) and time or frequency[1]. 4G network accesses requires substantial increase in the number of transmitters and receivers in the device, which means lowering of available battery backup which can be removed by efficient charger design for 4G device [1]. Embedded system can interconnect and network without wire using IrDA, Bluetooth, 802.11 or Zig-Bee protocol compatible hardware and software support.

ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM)

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.

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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.

These gains are not exclusive to MIMO channels and also exist in single-input multiple output (SIMO) and multiple-input single-output (MISO) channels. In contrast, the multiplexing gain, which refers to the increase of rate at no additional power consumption, is a unique characteristic of MIMO channels. The cost of this increased rate is the added cost of deploying multiple antennas, the space requirements of these extra antennas (spatially on small handheld units), and the added complexity required for multi-dimensional signal processing.

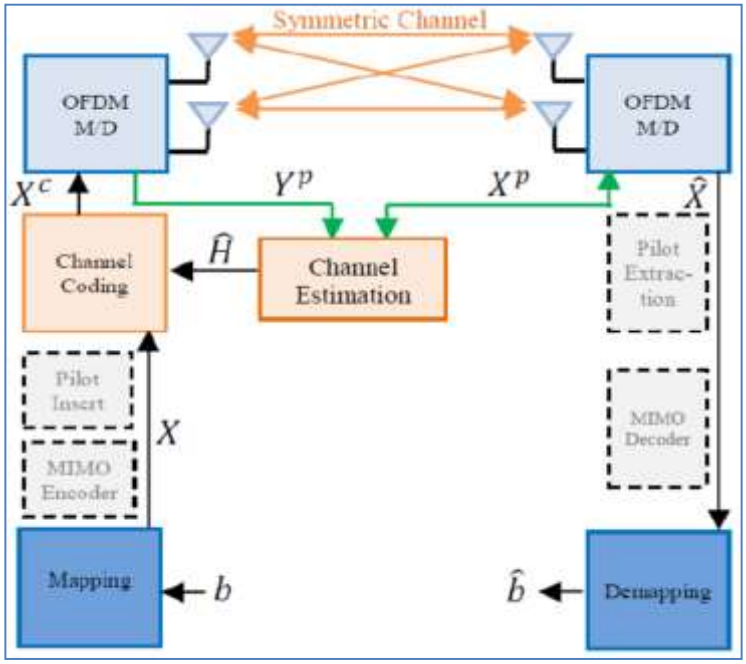

Fig.1: MIMO-OFDM system model for symmetric channel [2].

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).

Table 1: Performance result analysis of 2 × 2 system

Modulation Techniques	Bits/symbol	System	Bit Error rate	Signal to Noise Ratio (dB)
BPSK	1	MIMO	10^{-3}	1.52
QPSK	2	MIMO	10^{-3}	5.10
8-QAM	3	MIMO	10^{-3}	9.89
16-QAM	4	MIMO	10^{-3}	15.22

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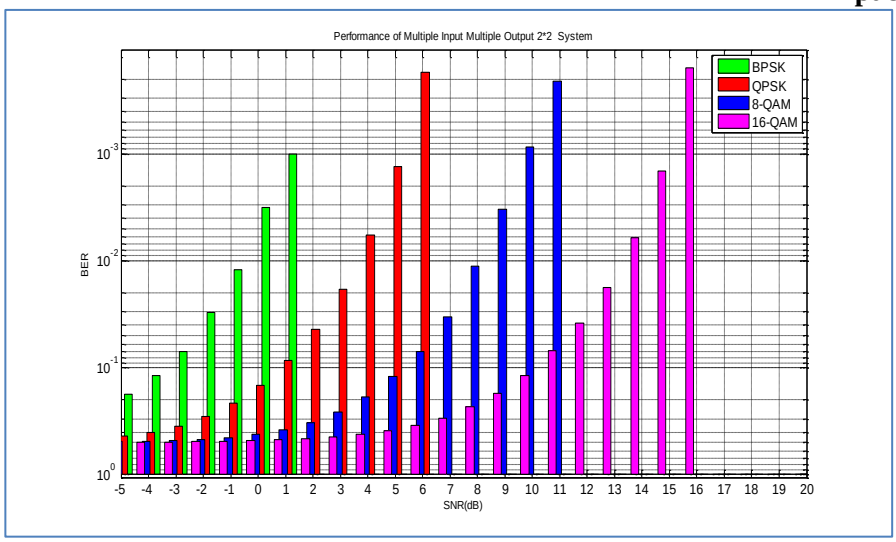

Fig. 2: Analysis of 2×2 system with AWGN channel

Result Analysis: In this performance, we have used the Alamouti scheme with communication AWGN channel and different modulation techniques. In the table 1 in this plot we analysis the 16-QAM, SNR is 15.22dB on BER at 10^{-3} as compared to 8-QAM and Modulation Techniques at a constant signal power.

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.

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