DEVELOPMENT OF MIMO – WIMAX BASED COMMUNICATION SYSTEM FOR TRANSPORTATION NETWORK

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ABSTRACT: The geographical coverage area of communication is increased for the efficiency of the ITS (Intelligent Transportation System) customers. The maximum extent of coverage area provides the beneficiary of satisfying the customers with the desired needs of the customers, as it keeps changing rapidly. Convergence of the noble technologies WIMAX and MIMAX helps to achieve the desired goal. The convergence also provides compatibility with the existing standards of ITS.

Keywords: Intelligent Transportation System, WIMAX (Wireless Interoperability Microwave Access), MIMAX.

1. INTRODUCTION

In recent years, Mobile WiMax has received wide interest for next generation wireless communications [1, 2]. Two key technologies, Multiple Input Multiple Output (MIMO) and Orthogonal Frequency Division Multiplexing (OFDM) have been adopted in Mobile WiMAX standard [3], which enable high data rate transmission over multipath and fading channels. An ITS (Intelligent Transportation System) is to make the vehicles more intelligent in order to enhance the safety and at the same time increases the efficiency of highway utilization [4], is the deployment environment where the work will be implemented. WIMAX provides broadband wireless access up to 30 miles for fixed stations and 3 - 10 miles for mobile stations [5].

2. OVERVIEW OF THE SYSTEM

The system comprises of developing the deployment of MIMO unit for exploring the data throughput and link range without additional bandwidth or increased transmit power. The system capacity can be significantly improved if multiple transmit and receive antennas are used to form MIMO channels [6]-[9]. The system proceeds with the deployment of WIMAX unit as it helps to cover the intended coverage area nearly a range of approximately the size of a city [10]. WIMAX communications consist of management and data messages. Management messages are used to govern communications parameters, and data messages carry the data to be transmitted over wireless links [10]. This work actually takes control at this point of the system by the convergence of two units MIMO and WIMAX. The implementation of MIMO in WIMAX i.e. the MIMAX is done to improve the geographical coverage distance of communication.

3. SYSTEM DESCRIPTION

The system description starts with the explication of the MIMO deployment unit proceeding with the WIMAX unit, convergence of both the WIMAX and MIMO unit and coming to the completion of the system with the description of Spread Spectrum based DSRC system.

3.1 MIMO SYSTEM

Deployment of the MIMO unit is carried as the initial step of the work to exploit the full spatial diversity order and employs symbol-wise Maximum Likelihood (ML) decoding. MIMO is a noble technology that can dramatically increase the spectral efficiency by using antenna arrays at both the transmitter and receiver [11].

![Figure 1: Block Diagram of MIMO System - MATLAB Simulation](image)

The STBC (Space Time Block Codes) system consists of a transmitter, a channel, and a receiver. The antenna diversity is exploited by using a communication system equipped with multiple antennas at the receiver [12]. The IEEE 802.11n standard exploits the use of MIMO systems to acquire throughputs as high as 600Mbps [13],[14].
3.2 WIMAX System

WiMAX is a communication technology used to deliver high-speed internet service to large geographical areas, wirelessly. The demo assumes that the fading parameters are identical for the two links. The Space-Time Diversity Combiner block uses the channel estimates for each link and combines the received signals as per [15].

4. SIMULATION RESULTS

4.1 WiMAX System Simulation

The WiMAX system, displays the calculation of the Bit Error Rate (BER), with the number of error count and number of bits along with the compatible rate ID and the Estimation of SNR (Signal to Noise Ratio). It also displays the Spectrum scope of the transmitter to antenna respectively i.e. (2×1).

Figure 2: WIMAX System Model

The System is explored with the 2×1 MISO channel i.e. 2 transmitter and 1 receiver and assuming that the fading parameters are identical for both the links. Space-time block codes try to exploit the presence of independent multipath propagation to improve the reliability of transmission [16].

3.3 MIMAX System

MIMO is the use of multiple transmitters and receivers (multiple antennas) on both WiMAX base stations and subscriber devices to achieve improved performance in terms of bandwidth and distances. With MIMO, two simultaneous data streams can be sent, which doubles the bandwidth.

Figure 3: MIMAX - Block Diagram

The MIMAX is implemented with two channels and achieved with the same Bit Error Rate (BER) values for both the channels. The implementation of the MIMAX on WiMAX helps to take the integrated advantage of both the techniques MIMAX and WIMAX which mainly provides a supporting hand of the aim at covering a large geographical area of up to nearly 35 miles which is a very big advantage for the communicating vehicles of the vehicular network on the Intelligent Transportation System.

4.2 MIMAX System Simulation

The simulation results of the MIMAX on WIMAX is shown which is aimed for two channel and achieved with the goal of an approximately coequal Bit Error Rate (BER). The MIMAX model is designed with two channels with different data values with different properties and the simulation result is achieved with the almost same Bit error rate for both the channels designed. The simulation also displays the spectrum scope graphs to confirm that the same bandwidth is achieved. Recent research on MIMO systems shows that STBC is effective to reduce the fading effect in the wireless channel by providing diversity [17], [18] and this improves BER performance in receiver.

Figure 5: MIMAX - Running Simulation - Screen Shot

The spectrum scope of the subsystems is shown below. It shows the transmitted data point's constellation, with the axes of in-phase amplitude and quadrature amplitude. The constellation diagram reveals that the system is maintaining equally similar performance in each channel while the system is increased with the number of channels.
5. CONCLUSION

The demanding needs of the ITS (Intelligent Transportation System) is fulfilled to a maximum extent. The coverage of data transmission is improved for a larger geographical area by converging the technologies of communication. Communication and RADAR technology will be converged in ITS using DSRC channels.

REFERENCES


Figure 6: MIMAX - Constellation - Data Carrier

Figure 7: MIMAX - Constellation - Data Carrier 1