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A Review WiMAX in Orthogonal Space Time Block Coding

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ABSTRACT: MIMO-OFDM technology is a combination of multiple-input multiple-output (MIMO) wireless technology with orthogonal frequency division multiplexing (OFDM) that has been recognized as one of the most promising techniques to support high data rate and high performance in different channel conditions. The purpose of this research work is to implement of Wi-MAX system for MIMOOFDM receiver. To improve system performance of Wi- MAX Radio Technology communication, using transmit and receive mode and with suitable modulation technique. We have focused on developing the six symbol detection algorithm of WiMAX system for the MIMO-OFDM Receiver. To find best signal detection technique for WiMAX system in MIMO-OFDM environment. MIMOOFDM system gives BER that we required for next generation wireless system i.e. WiMAX and also gives high data rates that can be useful for many wireless systems.

Keywords: MIMO, OFDM, Channel capacity,

I. INTRODUCTION

The key challenge of future wireless communication systems is to provide high data rate wireless access at high quality of service. During the last decade, many researchers have proposed multiple-input multiple-output (MIMO) wireless technology that seems to meet these demands by offering increased spectral efficiency through spatial multiplexing gain and improved link reliability due to antenna diversity gain [1, 2]. In addition, the MIMO system multiple antennas both at transmitter and receiver end can potentially meet the growing demand for higher capacity in wireless communications [3, 4].The information capacity of wireless communication systems increases dramatically by using multiple transmitting and receiving antennas. Space-time coding, an effective approach for increasing data rate over wireless channels, employs coding

Techniques appropriate to multiple transmitting and receiving antennas. Hence, a new generalized complex orthogonal space time block code for several transmit antennas with full rate has been proposed in [5, 6]. In the 4G wireless communication systems the data rate may be as high as 1Gbps. For that, space-time coding techniques may be employed in conjunction with the multi-carrier code division multiple access (MC-CDMA) system to achieve very high data rate [7]. In this paper, we preset a MIMOOFDM system for various antenna configurations to fulfill the demand of WIMAX wireless technology.

II. WIMAX

WiMAX (Worldwide Interoperability for Microwave Access) is a wireless communications standard designed to provide 30 to 40 megabit-per-second data rates, with the 2011 update providing up to 1 Gbit/s for fixed stations. The name "WiMAX" was created by the WiMAX Forum, which was formed in June 2001 to promote conformity and interoperability of the standard. The forum describes WiMAX as "a standards-based technology enabling the delivery of last mile wireless broadband access as an alternative to cable and DSL.The new WiMAX radio technology worldwide interoperability for microwave access is based on wireless transmission methods defined by the IEEE 802.16 standard. WiMAX has been developed to replace broadband cable network such as DSL and to enable mobile broadband wireless access [8].

III. SYST EM MODEL

The first step on the physical layer of WiMAX is the decision of the modulation scheme that has to be used as shown in Fig.1. Initially the transmitter transmits the bits using [16] 16-QAM modulation. The modulated data is then mapped on to orthogonal channels using IFFT.

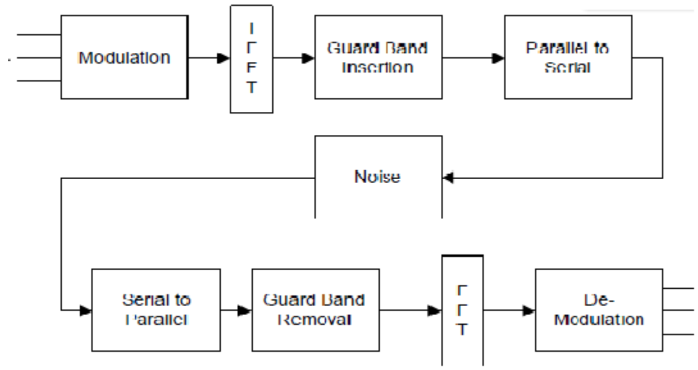

Fig. 1. WiMAX Module**.**

In this mapped data, to avoid inter-carrier interference a guard band (of 1/8 of the total number of bits) is added. The data is then transmitted over the channel and at the receiver end the guard band removed and the data decoded back into the original form. The receiver calculates the error in the received data and informs the transmitter of this. The transmitter uses this informant ion to change its modulation scheme as per the requirement.

A. STBC in WiMAX System

Fat the transmitter the STBC Encoder takes the data from the guard band insertion block as shown in Fig and transmits that data over two spaced antennas [19]. Different symbols are simultaneously transmitted over these antennas to reduce noise interference. The receiver after receiving the signal retrieves the bits using Maximum Likelihood decoding algorithm and passes the data to the guard band removal block. As shown in the Fig. 2.

B. Turbo Codes in WiMAX System

Turbo Encoder uses the bits passed on to it by the MAC layer of WiMAX and with help of Recursive Systematic Convolution Encoder encoded the bits and passes them on to the modulation scheme block. At the receiver the Log MAP decoder takes bits from the demodulation block and passes this data on to the MAC layer after decoding it [5].

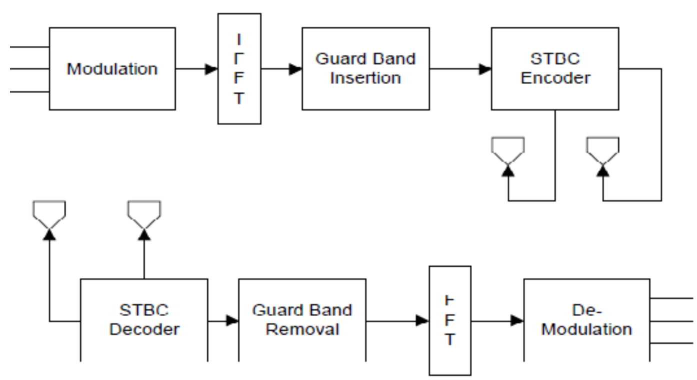

Fig. 2. WiMAX Module with STBC.

Recursive Systematic Convolutional Encoder (RSC): This type of encoder works on a bit by bit basis. For every input bit it generates a parity bit depending on the structure of the encoder and outputs the same input bit at the output known as the systematic bit. The encoder is implemented using Linear Feedback Shift Register (LFSR). [18] These registers are the main reason why we call it Recursive process. The output is feed back to the input and every new output is dependent on the previous input to the encoder.

In Fig.3 the D denotes the registers which are init ially at a known state of 00. After a packet is encoded the registers can be in any one of the four possible states 00,01,10,11 depending on the previous input. These states cause problem for the next packet. To remove this problem and to bring the registers back into a known state of 00, Memory Flushing or Trellis Termination is done. For memory flushing we pad Trail Bits at the end of each packet depending on the state of the registers.

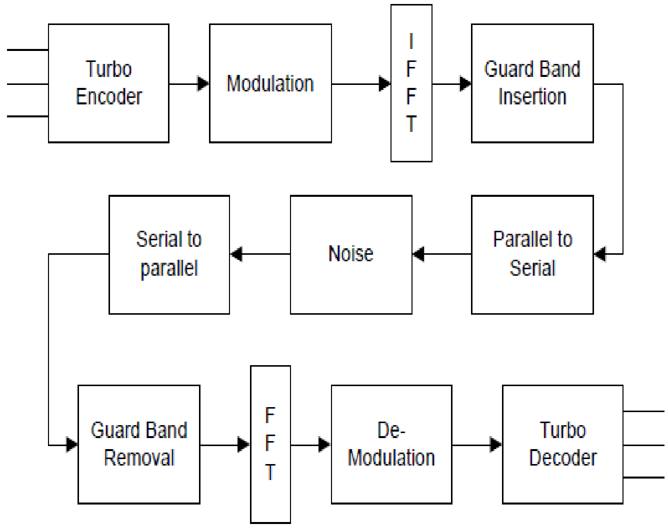

Fig. 3. WiMAX Module with Turbo Codes.

IV. FEATURES OF MIMO-OFDM

Spatial multiplexing gain: the transmission of multiple data streams over more than one antenna is called spatial multiplexing [2]. 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. 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. Among many different types of antenna diversity techniques, transmit diversity techniques have been widely adopted in practice since it is useful in reducing the processing complexity of the receiver and it requires multiple antennas only on the transmitter side.

V. CLASSIFICATION OF MIMO DETECTION

-TECHNIQUE
-ZF zero forcing
-MMSE minimum mean square error
-SIC successive interference cancellation
-PI pseudo inverse
-MIMO detection techniques are mainly classified in two
-Part that is linear and non-linear technique. We are
-Concentrating on the Non-linear based detection of MIMO

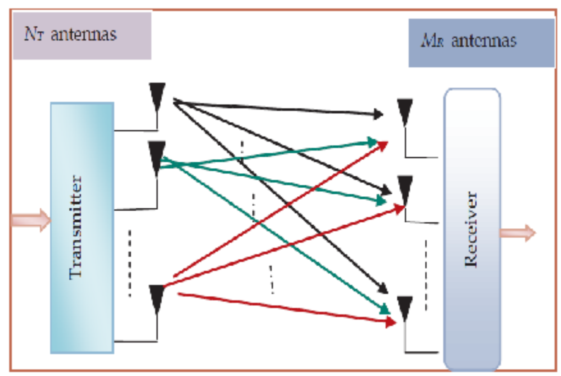

Fig. 4. Block Diagram of single User MIMO System.

A. MIMO channel gain

The key to the performance gain in MIMO systems lies in the additional degree-of-freedom provided by the spatial domain and associated with multiple antennas. These additional degree-of-freedom can be exploited and utilized in the same way as the frequency and time resources have been used in the classical Single Input Single Output (SISO) systems. The initial promise of an increase in capacity and spectral efficiency of MIMO systems ignited by the work of Telatar [1] and Foschini [2] has now been validated where by adding more antennas to the transmitter and receiver, the capacity of the system has been shown to increase linearly with the *NT* or *M***R**,which is minimum, i.e the min(*NT* , *M***R**) [12]. This capacity can be extracted by making use of three transmission techniques, namely: spatial multiplexing, spatial diversity, and beam-forming.

B. MIMO in the current WiMAX standard

MIMO techniques have been incorporated in all recent wireless standards including IEEE 802.16e, IEEE 802.16m, IEEE 802.11n, and the Long-Term Evaluation (LTE). The WiMAX profile IEEE 802.16e defines three different single user open loop transmission schemes in both uplink and downlink channel summarized as below: Scheme defined as matrix *A* which describes spatial multiplexing mode of operation for two different symbol streams through two different antennas. Scheme defined as matrix *B* which describes the spatial diversity mode of operation for two different symbol streams through two different antennas with the basic Alamouti Space- Time Block Code (STBC) [4]. Scheme defined as matrix **C** which combines the respective advantages of diversity and spatial multiplexing modes of operation for two different symbol streams through two different antennas. More details of these schemes are given in [20].

VI. CONCLUSIONS

It is concluded that when we introduce WiMAX we have a very improved BER, but the Trellis Termination bits, the tail bits and the parity bits make up an over head that is not feasible for a wireless link like WiMAX. On the other hand by the introduction of STBC we have an improved BER compared to simple WiMAX architecture with a very low overhead. So we suggest that to improve the performance of WiMAX, STBC should be introduced in it.

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