Performance Analysis of WiMAX System in MIMO-OFDM Using Ordered Successive Interference Cancellation (OSIC) Technique

Neeraj Yadav[1], Mr. Sandeep Gupta[2]
[1, 2] Department of Electronics and Communication
[1, 2] SDBCT,Indore(M.P.), India

Abstract- *(OSIC) with candidates (MMSE-OSIC2). In this paper we have try to compare fixed WiMAX and mobile WiMAX respectively IEEE 802.16d standard and IEEE802.16e standard, firstly we have done detail study on both the standard of IEEE in our paper one by one, after that we have done comparative analysis on both WiMAX technology using all standard defined by IEEE 802.16. In spatially multiplexed MIMO systems that enable high-data-rate transmission over wireless communication system, spatial demultiplexing at the receiver is a challenging task. The proposed method is based on the well-known minimum mean squared error (MMSE) ordered successive interference cancellation (OSIC) technique. However, unlike the conventional minimum mean squared error (MMSE) ordered successive interference cancellation (OSIC), a number of candidates are selected at each layer, hence; it has been termed minimum mean squared error (MMSE) ordered successive interference cancellation.*

Keywords- WiMAX, OFDM, MIMO, STBC, OSIC, FEC, etc.

I. INTRODUCTION

Orthogonal frequency division multiple accessing (OFDMA) is expected to be the enabling technology for the fourth generation (4G) wireless communication systems. One of the features that make OFDMA the primary choice for 4G is its compatibility with the multiple input multiple output (MIMO) technology [1], [2], because MIMO has a very significant potential for enhancing wireless systems in capacity, coverage aspects, and data rate.

In fact, the understanding of wireless channels will lay the foundation for the development of high performance and bandwidth-efficient wireless transmission technology. Compared to a conventional single antenna system, the channel capacity of a multiple antenna system with NT transmit and NR receive antennas can be increased by the factor of min (NT; NR), without using additional transmit power or spectral bandwidth. In due to the ever increasing demand of faster data transmission speed in the recent or future telecommunication systems, the multiple antenna systems have been actively investigated and successfully deployed for the emerging broadband wireless access networks. Even when a wireless channel with high channel capacity, we still need to find good techniques to achieve high-speed data transmission or high reliability. Multiple antenna techniques can be broadly classified into two categories: diversity techniques and spatial-multiplexing techniques.

A basic idea of the diversity techniques is to convert Rayleigh fading wireless channel into more stable AWGN-like channel without any catastrophic signal loss. In the spatial–multiplexing technique, on the other hand over, the multiple independent data streams are simultaneously transmitted by the multiple transmit antenna, there by achieving a higher transmission speed.

II. ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM)

OFDM is similar to FDM but much more spectrally efficient by spacing the sub channel much more spectrally efficient by spacing much closer as one. This is done by finding frequencies that are orthogonal, which means that are perpendicular in a mathematical intelligence, allowing the spectrum of each sub-channel to overlap another without Interfering with it. In the effect of this is seen as the required bandwidth is greatly reduced by removing guard bands and allowing signals to overlap .In order to demodulate the signal ,a discrete Fourier transform (DFT) is needed .Fast Fourier transform (FFT) chips are commercially available making this a relatively easy operation.

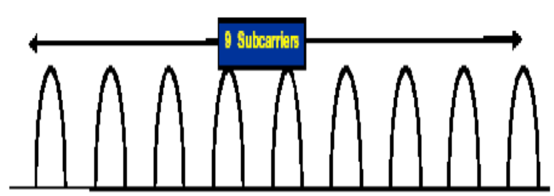

Fig.1 Signal for FDM

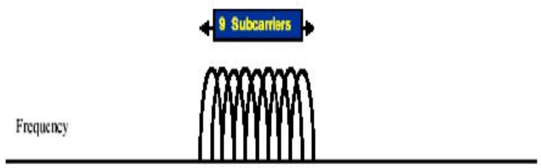

Fig.2 Signal for OFDM

III. SPACE TIME BLOCK CODE

A complex orthogonal space-time block code for two transmit antennas was developed by Alamouti [4]. In the Alamouti encoder, two consecutive symbols x_1 and x_2 are encoded with the following space-time codeword matrix as follows:

$$X = \begin{bmatrix} x_1 - x_2^* \\ x_2 x_1^* \end{bmatrix} \qquad (1)$$

Alamouti encoded signal is transmitted from the two transmit antennas over two symbol periods. During the first symbol period at $+T$, two symbols $x_1$and $x2$are simultaneously transmitted from the two transmit antennas. During the second symbol period$t = 2T$, symbols are transmitted another time, where $-x_2^*$is transmitted from the first transmit antenna and x_1^*transmitted from the second transmit antenna. Maximum Likelihood signal detection of Alamouti's space-time coding system, we assume that two channels gains $h1(t)$ and $h2(t)$ remain constant over two consecutive symbol periods such that

$$h1(t) = h1(t + T) = h1 = |h1|e^{j\theta 1} \qquad (2)$$
$$h1(t) = h2(t + T) = h2 = |h2|e^{j\theta 2} \qquad (3)$$

Where $|h_1|$and $e^{j\theta 1}$ denote the amplitude gain and phase rotation over the two symbol periods. At the receiver the received signals y_1 and y_2 at time t and $t + Ts$ can be given as

$$y_1=h_1x_1+h_2x_2+z_1 \qquad (4)$$

$$y_2=h_1x_2^* + h_2x_1^* +z_2 \qquad (5)$$

Where z_1 and z_2 are the additive noise at time t and $t + Ts$ respectively. This paper we have proposed Alamouti's space time block code for two transmit antenna and more than one receive antenna case.

IV. MULTIPLE INPUT MULTIPLE OUTPUT (MIMO) SYSTEM

Multi-antenna systems can be classified into three main categories. The multiple antennas at the transmitter side are usually applicable for beam forming purpose. The transmitter or receiver side multiple antennas for realizing different diversity scheme. The third class includes systems with multiple transmitter and receiver antennas realizing spatial multiplexing. In radio communications MIMO means multiple antennas both on transmitter and receiver side of a specific radio connection. In case of spatial multiplexing different data symbols are transmitted on the radio link by different antennas on the same frequency within the same time intermission. Multipath propagation is assumed in order to ensure the correct operation of spatial multiplexing schemes, since MIMO is performing better in terms of channel capacity in a rich scatter multipath environment than in case of environment with LOS. This fact was spectacularly shown in.

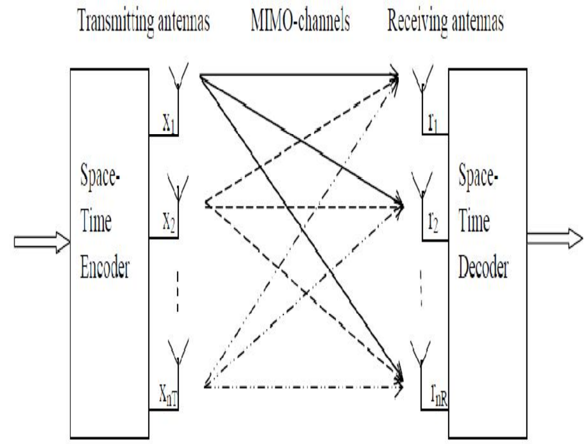

Fig. 3 Block Diagram of a generic MIMO system with nT transmitters and nR Receiver

Spatially Multiplexed MIMO Systems

Spatially multiplexed MIMO (SM-MIMO) systems can transmit data at a higher speed than MIMO systems using antenna diversity technique. The NR NT MIMO system in Figure 4.

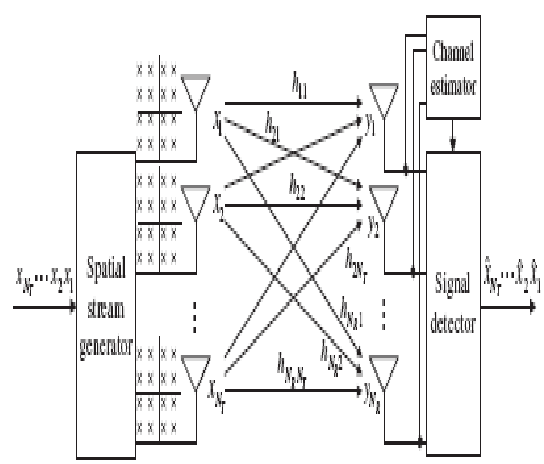

Fig. 4 Spatially Multiplexed MIMO Systems

Let H denote a channel matrix with it (j, i)th entry h_{ji} for the channel gain between the ith transmit antenna and the

jth receive antenna, $j = 1,2,\ldots,NR$ and $i = 1,2,\ldots,NT$. The spatially-multiplexed user data and the corresponding received signals are represented by $x = [x1, x2,\ldots,xNT]T$and y =[y1,y2, . . . ,yNR]^T ,respectively, where xi and yj denote the transmit signal from the i th transmit antenna and the received signal at the jth receive antenna, respectively. Let zj denote the white Gaussian noise with a variance of σ^2z at the jth receive antenna, and hi denote the ith column vector of the channel matrix H. Now, the $NR \ x \ NT$ MIMO system is represented as

$$y = Hx + z,$$
$$y = h1\,x1 + h2\,x2 + h3\,x3 + \cdots + HNT\,xNT + z \quad (4)$$
$$where\ z = [z1\ , z2\ ,\quad z3,\ldots\ldots,zNR].$$

Forward error correction code

Forward error correction codes are those codes which detect error at receiver end and correct the data received with error by using error correcting code. This technique used to enhance data reliability. It introduced redundant data, called error correcting code, prior to data transmission or storage. FEC provides the receiver with the ability to correct errors without a reverse channel to request the retransmission of data. Forward error correcting code is further divide in two groups which are as follows.

- Block code.
- Convolution code.

Block Code:

Block codes operate on a block of bits. block codes" are error correcting code that acts on a block of k bits input data to produce n bits of output data (n,k).Block codes are referred to as (n, k) codes. A block of k information bits are coded to become a block of n bits.n=k + r where r is the number of parity bits. k is the number of information.

Convolution Code

Convolution codes were first mentioned by Elias in 1955. They can be seen as an attempt to generate the random codes that were successfully used by Shannon.

Convolution codes differ from block codes in that the encoder contains memory and the n encoder outputs at any given time unit depend not only on the k inputs at that time unit but also on m previous input blocks. An (n, k, m) convolutional code can be implemented with a k-input, n-output linear sequential circuit with input memory m. typically, n and k are small integers with k < n, but the memory order m must be made large to achieve low error probabilities. The information and code words of convolutional codes are of infinite length, and therefore they are mostly referred to as information and code sequence.

V. RESULTS AND DISCUSSION

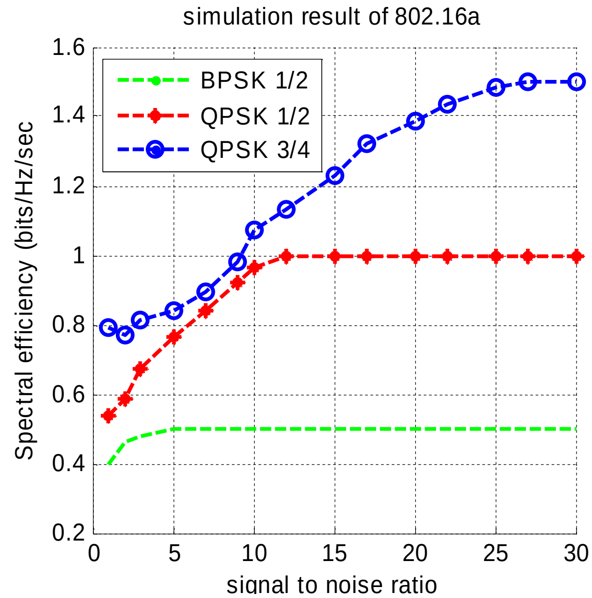

Fig. 5 Performances of the proposed scheme in the MIMO ISI channels

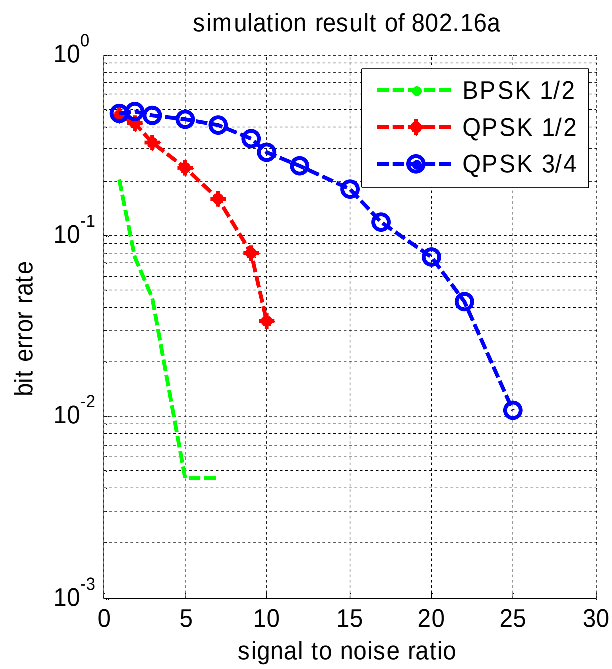

Fig. 6 Performances of the proposed scheme in the MIMO ISI channels

VI. CONCLUSION

The emergence of WIMAX protocol has attracted various interests from almost all the fields of wireless communications. MIMO systems which are created according to the IEEE 802.16 standard (WIMAX) under different fading channels can be implemented to get the benefits of both the MIMO and WIMAX technologies. The proposed method is based on the well-knownMMSE-(OSIC) technique. In this paper, theoretical analysis and simulation results show that the ordering schemes and also bit-error-rate (BER) performance can be improved.

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