Performance Analysis of Wi-max Physical Layer in OSTBC Block code in 8-PSK, 8-QAM and QPSK Antenna Diversity

Nilesh Dhangar[1], Prof. Jitendra Singh Dodiya[2]
[1]PG Student, M. Tech.-Digital Communication, VITM, Indore (M.P.)
[2]Assistant Professor, EC Department, VITM, Indore (M.P.)

Abstract- *In this thesis we estimate the performance analysis of Wimax physical layer in 3 by 3 antenna diversity using OSTBC Block code in Rayleigh fading channel in multiple numbers of modulation techniques through MATLAB to conclude optimized BER. For making Wimax physical layer Code Division for Multiple Access (CDMA) is a multiple user technique that performs the spread spectrum system where spreading of sequence complete from PN sequence generator that will be intended through random number generation. This arrangement then combined with OFDM called multi-carrier system where multiple number of broadband frequency selective carrier signals is altered into parallel flat fading narrowband multiple sub-carriers to hoist the performance of system, in addition their incorporation of systems forms MC-CDMA system i.e. Wimax physical layer. Now compilation further enhanced by means of implementing 3 by 3 MIMO system which means three transmit as well as three receive antennas respectively that employed the ZF decoder at the receiver to diminish the bit-error-rate all through transmit diversity of ½ rate convolutionally encoded OSTBC consume which optimized the recital of the 4G in addition to 5G communication system all the way through plummeting BER as well as improving gain in 8-PSK, 8-QAM and QPSK modulation techniques*

Keywords- CDMA, OFDM, MISO, MIMO-MC-CDMA and MC-CDMA.

I. INTRODUCTION

MIMO MC-CDMA systems endure from the MAI persuaded through the loss of orthogonality of multiplexed users to boot to inter-antenna interference (IAI) thanks to multiple antennas. In MIMO MC-CDMA systems, the multiplexed signals cannot exist overtly separated at the receiver as results of there are no orthogonality limitations for the sent signals. Consequently the combining ways that like MRC, EGC or MMSEC, that unit used for dropping exclusively MAI, for single-antenna MC-CDMA systems can't be overtly applied to MIMO MC-CDMA systems [4]. Because, in MIMO MC-CDMA systems, the recipient ought to handle the IAI whereas MAI, it wants an additional leveling technique to eradicate the interference among multiple antennas to boot to joint technique.

For dependable MIMO MC - CDM a sign detection, a spread of detection algorithms area unit planned. traditionally, there unit two grouping that cover linear detections to boot to decision feedback (DF) detections mentioned as interference termination detections. Of course, maximum likelihood (ML) detection is used for MIMO MC-CDMA; although, here we tend to tend to easily believe two detections system. Usually this can be} often as a results of, differing to ml detection having exponential complication the linear to boot to DF detectors can produce use of abstraction filtering by suggests that of lower more as low-cost quality. Primary, the linear detector usually supported two customary ZF more as MMSE that consists of symbol-level more as chip-level linear detector. In [4], symbol-level more as chip-level linear detectors depends on MMSE criterion exist fully derived. The symbol-level linear detector, more mentioned as linear multi-user detection, that options a fine performance, however it's high method quality at what time the system load is not complete and it to boot needs the data on the amount of active users to boot to the corresponding spreading code. Linear chip-level detector captivated with single-user detection offers loads of or less the equivalent performance as a result of the symbol-level detector in associate extremely totally loaded system by suggests that of lower quality.

For DF detections more as at intervals the ZF/MMSE ordered ordered interference cancellation (OSIC) detector, to boot mentioned as chip-level ZF/MMSE V-BLAST detector, that has been projected in[13]. The projected OSIC detector performed on the premise of per subcarrier is applied to MIMOMC-CDMA systems through easy modification of OSIC detector in [14] meant for conformist MIMO systems. as a results of the interference cancellation is succeed before dispreading designed for MIMOMC-CDMA systems to boot to it can't be totally terminate the alternative users' data image, it bear from MAI to boot to error propagation draw back significantly. As a result the chip-level V-BLAST detector has inferior quality presentation than linear MMSE detector. In, MMSE nulling partial parallel interference cancellation (PIC)

recipient was planned to diminish the error propagation hassle of chip-level OSIC detector. for further sweetening in performance, associate unvaried image-level MMSE depends on detectors through parallel / serial interference cancellation (PIC / SIC) by suggests that of soft-decision image realize of from the channel decoder output incline for coded MIMOMC-CDMA systems [4].

In this chapter, primary we tend to tend to shed light-weight on on the linear detections more as analyze the presentation of ZF more as MMSE linear detections. Depends on derivations in preceding chapter, we tend to tend to shows an exact BER expression for MIMOMC-CDMA systems through ZF detection. sequent we tend to tend to propose the detection technique for MIMO MCCDMA systems. To diminish the high method quality of the symbol-level linear detection, we tend to tend to counsel a DF detector depends on noise-prediction technique. Also, we tend to tend to propose a partial MMSE-OSIC dependent multi-user detection.

II. THEORETICAL BACKGROUND

2.1. Wi-max physical layer

In this segment, we put up the mandatory signal model for the downlink. Wi-max physical layer system, in adding together to current receiver model. These consist of the chip in addition symbol level linear all along with OSIC receivers.

2.1.1 Transmit Signal Model

Let us imagine the introverted channel downlink Wi-max physical layer transmitter model adjacent to means of Nu sum of users as shown in Figure 2.1. The input signal data are coalescing hooked on Nt sub-streams and subsequently every sub-stream is encoded as well as modulated designed for P symbols.

The uncoded symbol matrix ramshackle for user nu (nu = 1,2,...,Nu) is revealed as

$$D_{nu} = (d^1_{nu} d^2_{nu} \ldots d^{Nt}_{nu})^T \in C^{Nt*P}$$
(2.1)

On that the column vector dntnu symbolize the data stream i.e. transmitted from the

nt-th antenna (nt = 1, 2, ... Nt), given away as

$$d^{nt}_{nu} = \left[d^{nt}_{nu,1} d^{nt}_{nu,2} \ldots . d^{nt}_{nu,P} \right]^T \in C^{p*1}$$
(2.2)

each consumer are owed at a extraordinary spreading code. The spreading series of nu user given away as

$$c_{nu} = [c_{nu,1} c_{nu,2} \ldots . c_{nu,G}] \in C^{1*G}$$
(2.3)

in which C made known as the spreading code of chip alphabet in adding together to G discovered the spreading code length. The spreading order is expand to protuberance the symbols of nu-th user put in regulate to figure the chip-level transmit matrix

$$S_{nu} = \left[s_{nu,1} \quad s_{nu,2} \quad \ldots \quad s_{nu,Ns} \right] = D_{nu} \otimes c_{nu} \in C^{Nt*Ns}$$
(2.4)

where Ns = P * G that keep up a association to the full amount of subcarriers. The communal CDMA chips of every users are at the i-th subcarriers keep going shown by

$$x_i = \left[x^1_i \quad x^2_i \quad \ldots \quad x^{Nt}_i \right]^T = \sum_{nu=1}^{Nu} s_{nu,i} \in C^{Nt*1}$$
(2.5)

where xint refers to the collective chip sent in consequence of the nt-th antenna in adding together to that can be revealed as

$$x^{nt}_i = \sum_{nu=1}^{Nu} s^{nt}_{nu,i} = \sum_{nu=1}^{Nu} c_{nu}, g(i)d^{nt}_{nu,p(i)}$$
(2.6)

where $s^{nt}_{nu,i}$ given away the nu-th user sent chip by the nt-th antenna at i-th subcarriers. The joint chip order for each transmitted antenna is misrepresented to time domain through IFFT. The output signals during the IFFT trail the matching method as through the MC-CDMA. In addition to this, the channel is referred to be the analogous in the midst of the MC-CDMA system. Complementary assumption does not encompass channel state information (CSI) at transmitter furthermore so that superlative CSI at the receiver is obtained. It is supposed to be demonstrated that if an inter-leaver is functioning for the principle of Wi-max physical layer system the act will be optimized. Because of subsequent chips will be sent from interleaved subcarriers, which has supplementary diverse channel gains. In spite of the fact that for shortness of presentation, the succeeding study are referred for a system devoid of interleaving. It can be proficient to be just comprehensive through an interleaved system that is furthermore worn for the simulations.

2.1.2 Receive Signal Model

Let us presume the receiver of the preferred user by way of Nr received antennas. On receiving the signal, numerous prefix (CP) is standing apart and FFT of size Ns is passed out. The received signal model at the i-th subcarrier ensuing to FFT is expressed as

$$r_i = H_i x_i + n_i$$
(2.7)

in which the received signal is correspond to

$$r_i = \left[\; r_i^1 r_i^2 \ldots \ldots r_i^{Nr}\;\right] \in C^{Nr*1}$$

(2.8)

The AWGN channel vector by way of σn2 power can be show in addition as

$$H_i = \left[\; h_i^1 \quad h_i^2 \quad \ldots \quad h_i^{N_t}\;\right] = \begin{bmatrix} h_i^{(1,1)} & \cdots & h_i^{(1,N_t)} \\ \vdots & \ddots & \vdots \\ h_i^{(N_e,1)} & \cdots & h_i^{(N_e,N_t)} \end{bmatrix} \in C^{N_e * N_t}$$

(2.9)

$$n_i = \left[\; n_i^1 n_i^2 \ldots \ldots n_i^{Nr}\;\right]^T \in C^{Nr*1}$$

(2.10)

in which hi(nr,nt) be proof for the channel reaction from beginning to end the i-th subcarrier all along with the transmit antenna nt along with the receive antenna nr (nr = 1,2,...,Nr), moreover ni represents the Nr * 1 AWGN noise vector from end to end the i-th subcarrier. The received signal as expressed in equation 3.48 can be additional wholesale to

$$r_i = \overbrace{h_i^{nt} s_{n_u,i}^{n_t}}^{desired} + \overbrace{\sum_{n_u' \neq n_t} h_i^{nt} s_{n_u,i}^{n_t'}}^{CAI} + \overbrace{\sum_{n_u' \neq n_u} h_i^{nt} s_{n_u,i}^{n_t'}}^{MAI1} + \overbrace{\sum_{n_u' \neq n_u} \sum_{n_u' \neq n_t} h_i^{n_t'} s_{n_u,i}^{n_t'}}^{MAI2} + n_i$$

(2.11)

Let us assume the RHS of equation 2.11, the opening term according to the transmitted chips all the way through the chosen sub-stream nt of the preferred user nu. The consequent term demonstrate the CAI which come to pass from auxiliary sub-streams of the preferred user. The succeeding or third term articulate MAI 1 and the fourth term confirm MAI 2 obtainable MAI next from end to end other users of nt-th sub-stream and all supplementary sub-streams equally.
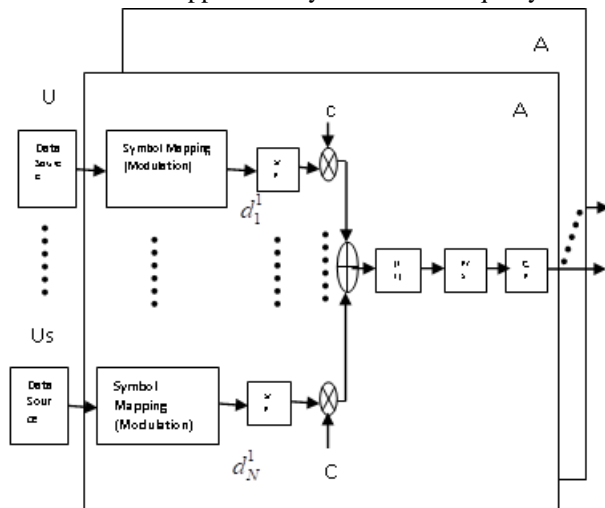

Figure 2.1. WI-MAX transmitter.

III. SIMULATION RESULTS AND DISCUSSION

Table 3.1 illustrates the simulated model constraint of Wimax Physical layer within QPSK, 8-PSK, 8-QAM, modulation practice. Figure.3.1 to Figure.3.3. prove the performance examination of Wi-max Physical Layer in 8-PSK, QPSK modulation method, Table 5.2 establish the BER as well as gain outcome reveal that QPSK have very next to to the ground BER in totaling to high gain in evaluation to all accompanying modulation practice. This gain measurement is finished at -7-dB SNR because at 0-dB BER of QPSK accomplishes to zero so elevated performance is bring about in QPSK. Figure.3.1 to figure.3.6 proves MIMO-MC-CDMA in a diversity of number of modulation procedure. For 3G and 4G wireless communication to advance system recital we employ MIMO-MC-CDMA practice for accomplish far above the ground performance in QPSK modulation method.

Table.3.1. Summary of simulated model constraint.

No. of bits transmitted by user	1560
No. of transmitting and receiving antennas	3*3
Modulation Schemes	QPSK, 8-PSK, 8-QAM
Signal detection scheme	Zero forcing
Channel	Rayleigh Fading Channel
Signal to Noise Ratio	-20dB to 10 dB
CP Length	1280
OFDM Sub-carriers	6400
Block code	OSTBC

Table.3.2. Performance psychotherapy of 3x3 Antenna diversity of MIMO-MCCDMA in OSTBC Block Code at -7dB of SNR

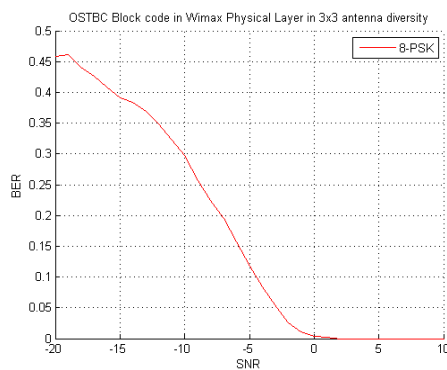| Modulation	BER	Gain
QPSK	0.009231	-11.347dB
8-QAM	0.1021	-10.472dB
8-PSK	0.1879	-5.174dB

Figure.3.1. Performance psychotherapy of 3x3 Antenna diversity of MIMO-MCCDMA in OSTBC Block Code in 8-PSK.

Above results shows OSTBC 8-PSK modulation technique performance estimation in 3 by 3 antenna diversity that represents the superior results that the BER completed at 1 dB of SNR that present enhanced error handling capabilities correspond to 3 by 3 MIMO-MCCDMA systems.
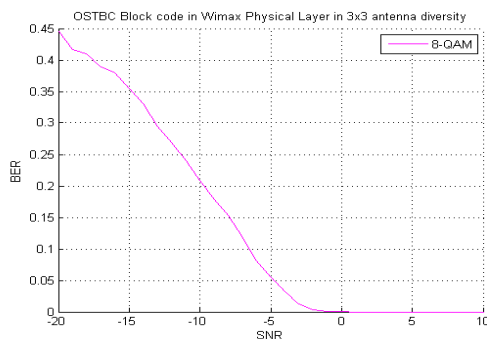

Figure.3.2. Performance psychotherapy of 3x3 Antenna diversity of MIMO-MCCDMA in OSTBC Block Code in 8-QAM.

Above graph illustrate the 8-QAM modulation technique for 3 by 3 antenna diversity, the performance estimation that represents the superior results that the BER finished at -1 dB of SNR that offer better error handling capabilities than 8-PSK represented by 3 by 3 MIMO-MCCDMA systems.
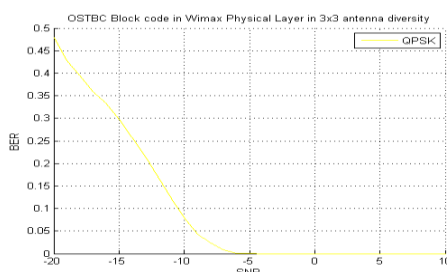

Figure.3.3. Performance psychotherapy of 3x3 Antenna diversity of MIMO-MCCDMA in OSTBC Block Code in QPSK.

Above results demonstrate the QPSK modulation technique recital estimation that correspond to the good results that the BER finished at -4 dB of SNR that offer great error handling capabilities than all modulation techniques signify by 3 by 3 MIMO-MCCDMA systems excluding very low data rate w.r.t. all.

IV. CONCLUSION

Simulation results prove the qualified examination of WiMax Physical layer in a variety of number of modulation methods that according to the comparative analysis for distorted modulation techniques which shows that as modulation order is bigger than before after that there is expand in BER. This proposition aims to diminish bit error rate which is correspond to QPSK modulation plan at the gain of 11.347 dB with admiration to gain that prove that the gain of QPSK is superior as contrast to former modulation technique with a slighter amount of error. For 3G, 4G and 5G communication 8-QAM modulation arrangement is make use of that enclose BER up to 8dB, that means errors are detached in 8-QAM at 8dB of SNR that marks by using 3 by 3 Wimax Physical layer system. Finally 3 by 3 MIMO-MC-CDMA present optimized output as match up to the other diversities in 8-QAM modulation procedure that is mainly employed for 3G & 4G wireless communication.

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