BER and Gain Analysis of IEEE 802. 16 standard for Broadband Wireless Access (BWA) in 32-QAM Modulation technique in 2x2, 3x3 and 4x4Antenna Diversity

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Abstract- *WiMAX (Worldwide Interoperability for Microwave Access) physical layer is basic of 3G and 4G wireless communication Technology. This technique gives rise to the advanced technique. So in this thesis we are going to estimate the BER and SNR analysis of Wi-MAX Physical layer in symmetrical antenna diversity like n transmit antennas and n receive antenna in 32-QAM modulation technique. For this first we made the MCCDMA system that is basically a multicarrier system for high speed data rate transmission. And finally we merge this system to MIMO diversity for multiple transmit and multiple receive antennas to enhance the capacity of system. So result shows that if we increase the antenna diversity we get lower BER at and higher SNR that leads to enhance the system capability. In this thesis for MIMO implementation ZF equalization technique is used for transmitting for multiple transmit antennas and OSTBC code is used to determining the signals without knowing the channel state information at the receiver end.*

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

I. INTRODUCTION

After learning the performance estimation of MIMO-MC-CDMA w.r.t MC-CDMA [9] results confirm that MC-CDMA carry out well as contrast to MIMO MC-CDMA while the performance analysis of MIMO-MC-CDMA in unusual antenna diversity along with different modulation techniques [12-20] that stimulate us to study on convolution encoder by means of ZF detector in MIMO-MC-CDMA in unusual diversity of antenna seeing that in different modulation techniques. So there is profusion of extent of study for MIMO-MC-CDMA since we perceive lots of research scholars persons are working on the a assortment of detection schemes, a variety of diversity schemes, a assortment of number of equalizers execution by means of different encoding method, a multiplicity of number of FEC coding is used in MC-CDMA via means of MIMO, diverse space time encoding assessment, performance estimation in diverse channels, and so on. MIMO-MC-CDMA clutch a enormous operational area for researchers within there is abundance of scope for study in this area. If we are employing MIMO-MC-CDMA in function phase it can be erudite as the physical layer of WiMAX which is a superior expertise in wireless communication in addition contains plenty of variable furthermore researchable parameters for future study.

So in this concept we had from side to side the performance analysis of Wi-max physical layer in Rayleigh fading channel in assorted modulation techniques, in different antenna diversity technique in multi-user implementation through the ZF-STBC block encoding scheme is utilized in QPSK modulation technique which shows better results than preceding references.

II . THEORETICAL BACKGROUND

2.1. Wi-max physical layer

This section concerns we the construction of the indispensable signal model for the downlink MIMO-MC-CDMA system, in addition to current receiver model. These model possess chip furthermore symbol level linear along with OSIC receivers.

2.1.1 Transmit Signal Model

Let us think of the solitary channel downlink MIMO-MC-CDMA transmitter model by use of Nu amount of users as shown in Figure 3.6. The input signal data are combining into Nt sub-streams and subsequently every sub-stream is encoded and also modulated for P symbols.
The un-coded symbol matrix in ruin for user nu (nu = 1,2,...,Nu) is shown as

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

On that the column vector dntnu denotes the data stream i.e. transmitted from the nt-th antenna (nt = 1, 2, ... Nt), shown as

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

every users are allotted at a unusual spreading code. The spreading series of nu user shown as

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

in which C shown as the spreading code of chip alphabet along with G disclose the spreading code length. The spreading order is develop to lump the symbols of nu-th user input in order to silhouette the chip-level transmit matrix

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

where Ns = P * G that agree to the total of subcarriers. The reciprocated CDMA chips of every users are at the i-th subcarriers shown by

$$x_i = \left[x_i^1 \quad x_i^2 \quad \ldots \quad x_i^{N_t} \right]^T = \sum_{n_u=1}^{N_u} s_{nu,i} \in C^{N_t * 1} \quad (2.5)$$

where xint refers to the combined chip sent by means of the nt-th antenna in addition to that can be shown as

$$x_i^{nt} = \sum_{nu=1}^{Nu} s_{nu,i}^{nt} = \sum_{nu=1}^{Nu} c_{nu}, g(i) d_{nu,p(i)}^{nt} \quad (2.6)$$

where $s_{nu,i}^{nt}$ signify the nu-th user sent chip by the nt-th antenna at i-th subcarriers. The joint chip order for each transmit antenna is converted to time domain by using IFFT. The output signal during the IFFT chases the same method as does with the MC-CDMA. In addition to this, the channel is referred to be the same with the MC-CDMA system. Other assumption does not have any channel state information (CSI) at transmitter and so that perfect CSI at the receiver is obtained. It should be exemplify that if an inter-leaver is working for the intension of MIMO-MC-CDMA system the act will be become perfect. Because of following chips will be sent from interleaved subcarriers, which has higher diverse channel gains. Though for shortness of presentation, the upcoming studies are referred for a system without interleaving. It can be able to be just extended through an interleaved system, that is also used for the simulations.

2.1.2 Receive Signal Model

Let us think about the receiver for chosen user with Nr received antennas. On receiving the signal, frequent prefix (CP) is disconnected and FFT of size Ns is carried out. The received signal model at the i-th subcarrier subsequent to FFT is expressed as

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

in which the received signal is characterize by

$$r_i = \left[r_i^1 r_i^2 . . . . . r_i^{Nr} \right] \text{€}\ C^{Nr*1} \quad (2.8)$$

The AWGN channel vector with σn2 power can be exemplify also as

$$H_i = \left[h_i^1 \quad h_i^2 \quad \ldots \quad h_i^{N_t} \right] = \begin{bmatrix} h_i^{(1,1)} & \cdots & h_i^{(1,N_t)} \\ \vdots & \ddots & \vdots \\ h_i^{(N_r,1)} & \cdots & h_i^{(N_r,N_t)} \end{bmatrix} \in C^{N_r * N_t} \quad (2.9)$$

$$n_i = \left[n_i^1 n_i^2 . . . . . n_i^{Nr} \right]^T \text{€}\ C^{Nr*1} \quad (2.10)$$

in which hi(nr,nt) shows the channel reaction through the i-th subcarrier along with the transmit antenna nt and the receive antenna nr (nr = 1,2,...,Nr), and ni represents the Nr * 1 AWGN noise vector through the i-th subcarrier. The received signal as expressed in equation 2.8 can be additional extended to

$$r_i = \overbrace{h_i^{nt} s_{nu,i}^{nt}}^{desired} + \overbrace{\sum_{n_u^{'} \neq nt}^{N_t} h_i^{nt} s_{nu,i}^{n_t^{'}}}^{CAI} + \overbrace{\sum_{n_u^{'} \neq nu}^{N_t} h_i^{nt} s_{nu,i}^{n_t^{'}}}^{MAI\,1} + \overbrace{\sum_{n_u^{'} \neq nu}^{N_t} \sum_{n_u^{'} \neq nt}^{N_t} h_i^{n_t^{'}} s_{nu,i}^{n_t^{'}}}^{MAI\,2} + n_i \quad (2.11)$$

Let us take the RHS of equation 2.11, according to the transmitted chips the initial term chosen through the sub-stream nt of the chosen user nu. The next term shows the CAI which arising from auxiliary sub-streams of the chosen user. The subsequent or third term elaborate MAI 1 and the fourth term shows MAI 2 represented as MAI next through other users of nt-th sub-stream and all further sub-streams correspondingly.

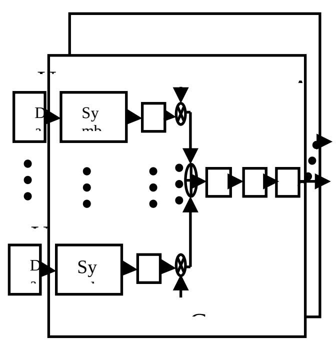

Figure 2.1. WI-MAX transmitter.

III. SIMULATION RESULTS AND DISCUSSION

Table 3.1 illustrates the simulated model parameters of Wi-max physical layer in 32-QAM modulation technique in different antenna diversity. Figure.3.1. demonstrate performance investigation of wi-max physical layer in 32-QAM modulation scheme in 2 by 2*2 antenna diversity, Table 3.2 shows the BER in addition to gain comparison in 2*2 antenna diversity as reference diversity, results shows that 4*4 antenna diversity have very low BER in addition to high gain w.r.t. all other modulation technique. This gain evaluation is done at -5-dB of SNR since at 0-dB BER of 32-QAM accomplishes to zero so high performance is get in 4*4 antenna diversity. For 3G and 4G wireless communication to improve system performance we use wi-max physical layer procedure for make high performance in 32-QAM modulation technique.

Table.3.1. Summary of simulated model constraint.

No. of bits transmitted by user	1560
No. of transmitting and receiving antennas	2*2, 3*3, 4*4
Modulation Schemes	32-QAM
Signal detection scheme	Zero forcing
Channel	Rayleigh Fading Channel
Signal to Noise Ratio	-50dB to 20 dB
CP Length	1280
OFDM Sub-carriers	6400
No. of bits transmitted by user	1560

Table.3.2. Performance analysis of wi-max physical layer in various number of antenna diversity in terms of gain w.r.t 2*2 antenna diversity at -5dB SNR:

Antenna Diversity in QPSK	BER	Gain w.r.t 2 by 2 in dB
2*2	0.2955	0
3*3	0.2165	2.70
4*4	0.1722	4.69

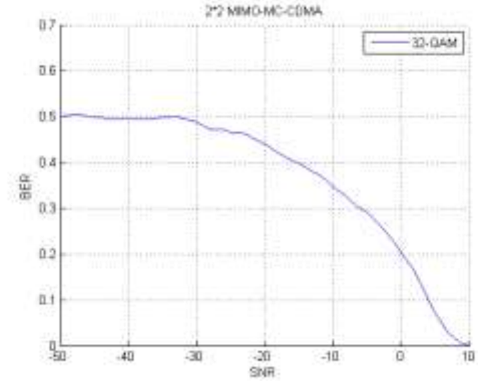

Figure.3.1. BER analysis of 2by2 wi-max physical layer in 32-QAM.

This result shows the characteristics of 2*2 Antenna Diversity Wi-max physical layer in 32-QAM modulation technique. The result demonstrates that error rate is finished at 10dB of SNR. That shows that the efficiency of system that uses the 32-QAM modulation is very prone to noise. So this method is used for very high noise environment. In this technique we engaged 2 transmit antenna and 2 receive antenna i.e. we make use of the symmetrical antenna diversity structure. Zero-forcing detection technique is also employed to receive the signal without knowing the channel state information at the receiver end. All the analysis is achieve in Rayleigh fading channel environment.

For the creation of Wimax physical layer we at first formed the OFDM multicarrier method for transmission in addition to we also employed CDMA method for multi user method to communicate the multiple information transmission as well in addition to for multiple user data transfer method.

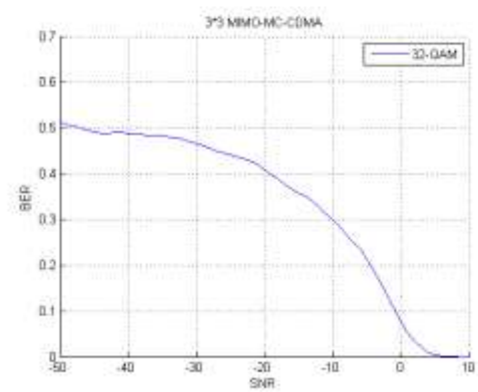

Figure.3.2. BER analysis of 3by3 wi-max physical layer in 32-QAM.

This result shows the characteristics of 3*3 Antenna Diversity Wi-max physical layer in 32-QAM modulation technique. The result demonstrates that error rate is finished at

7dB of SNR. That shows that the efficiency of system that uses the 32-QAM modulation is very prone to noise w.r.t 2*2 antenna diversity. So this method is used for very high noise environment. In this technique we engaged 3 transmit antenna and 3 receive antenna i.e. we make use of the symmetrical antenna diversity structure. Zero-forcing detection technique is also employed to receive the signal without knowing the channel state information at the receiver end. All the analysis is achieve in Rayleigh fading channel environment.

For the creation of Wimax physical layer we at first formed the OFDM multicarrier method for transmission in addition to we also employed CDMA method for multi user method to communicate the multiple information transmission as well in addition to for multiple user data transfer method.

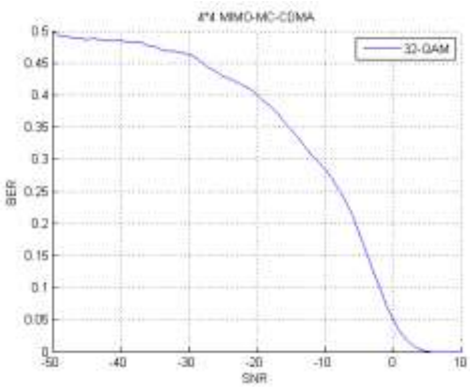

Figure.3.3. BER analysis of 4by4 wi-max physical layer in 32-QAM.

This result shows the characteristics of 4*4 Antenna Diversity Wi-max physical layer in 32-QAM modulation technique. The result demonstrates that error rate is finished at 5dB of SNR. That shows that the efficiency of system that uses the 32-QAM modulation is very prone to noise w.r.t 2*2 and 3*3 antenna diversity. So this method is used for very high noise environment. In this technique we engaged 4 transmit antenna and 4 receive antenna i.e. we make use of the symmetrical antenna diversity structure. Zero-forcing detection technique is also employed to receive the signal without knowing the channel state information at the receiver end. All the analysis is achieve in Rayleigh fading channel environment.

For the creation of Wimax physical layer we at first formed the OFDM multicarrier method for transmission in addition to we also employed CDMA method for multi user method to communicate the multiple information transmission as well in addition to for multiple user data transfer method.

IV. CONCLUSION

Results shows the characteristics of different Antenna Diversity Wi-max physical layer in 32-QAM modulation technique. The result shows that 4*4 antenna diversity perform well as compared to other diversity. That illustrate that the efficiency of system that uses the 32-QAM modulation in 4*4 antenna diversity is very prone to noise. So this practice is used for very high noise environment. In this technique we can engaged 4 transmit antenna and 4 receive antenna i.e. we utilize the symmetrical antenna diversity structure. Zero-forcing detection is also employed to receive the signal devoid of knowing the channel state information at the receiver end. All the analysis is carry out in Rayleigh fading channel environment.

For the generation of Wi-max physical layer we at first formed the OFDM multicarrier method for transmission and we also employed CDMA system for multi user method to communicate the multiple information transmission in addition to multiple user data transfer method.

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