International Journal of Engineering Applied Sciences and Technology, 2016
Vol. 1, Issue 7, ISSN No. 2455-2143, Pages 10-14
Published Online May - June 2016 in IJEAST (http://www.ijeast.com)

PERFORMANCE EVALUATION OF WCDMA SYSTEM FOR DIFFERENT MODULATIONS WITH EQUAL GAIN COMBINING SCHEME

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Abstract— **The performance of the WCDMA system is degradation due to network degradation factors such as fading, interference, path loss and noise. The work in this paper analyze the performance of single input single output antenna system (SISO) and single input multiple outputs antenna system (SIMO) using Equal Gain Combining (EGC) diversity technique with binary phase shift keying (BPSK) and quadrature phase shift keying (QPSK) modulation schemes in wide band code division multiple access (WCDMA) system. The performance analysis results showed that SIMO system give better performance compare to SISO system in various network conditions**.

Keywords— **WCDMA, Antenna diversity, SISO, SIMO, Equal Gain Combining**

I. INTRODUCTION

Wireless communication is the fastest growth period in the history of communication technologies. The 3rd generation partnership project (3GPP) and 3rd generation partnership project two (3GPP2) had developed the wideband code-division multiple access (WCDMA) technologies and CDMA2000 respectively [1]. WCDMA is considered to be wideband technologies based on the direct sequence spread spectrum transmission scheme, where user information bits are spread over a wide bandwidth by multiplying the user data with quasi-random bits called chips derived from CDMA spreading codes. In order to support very high bit rates (upto 2 Mbps), the use of a variable spreading factor and multi-code connection is supported. The chip rate 3.84 Mcps leads a carrier bandwidth of 5MHz [2]**.** When a signal is transmitted from source to destination through the channel, there are some factors which degrade the performance of signal and these degradation factors are path loss, noise, fading and interference. One of the most powerful techniques to mitigate the effects of fading is to use diversity combining of independently fading signal paths. The concept behind diversity is: if one signal path undergoes a deep fade at a particular point of time, another independent path may have a strong signal [3]. Here receiver is provided with multiple copies of the same information signal which are transmitted over two or more real or virtual communication channels. The work in this paper evaluates the performance of WCDMA system using diversity scheme with various modulations in presence of varying network conditions. The next section presents the methodology adopted to simulate the system. The section 3 presents the brief review of the related work. The Equal Gain Combining (EGC) diversity scheme is presented in Section 4. The simulation results and discussion is presented in the Section 5. The last section concludes the paper and presents the future work.

II. SIMULATION METHODOLOGY

The signal in WCDMA system is degraded with various factors such as path loss, noise, fading and interference. The work in the present paper analyzed the performance of the EGC diversity scheme in WCDMA system to improve the signal quality. The simulated WCDMA system is designed in Matlab and the performance is analyzed for various modulations under varying network conditions. The bit error rate (BER) performance is evaluated with varying conditions of signal to noise (E_b/N_o). The block diagram of the simulated WCDMA system with proposed diversity scheme is presented in Fig.1.

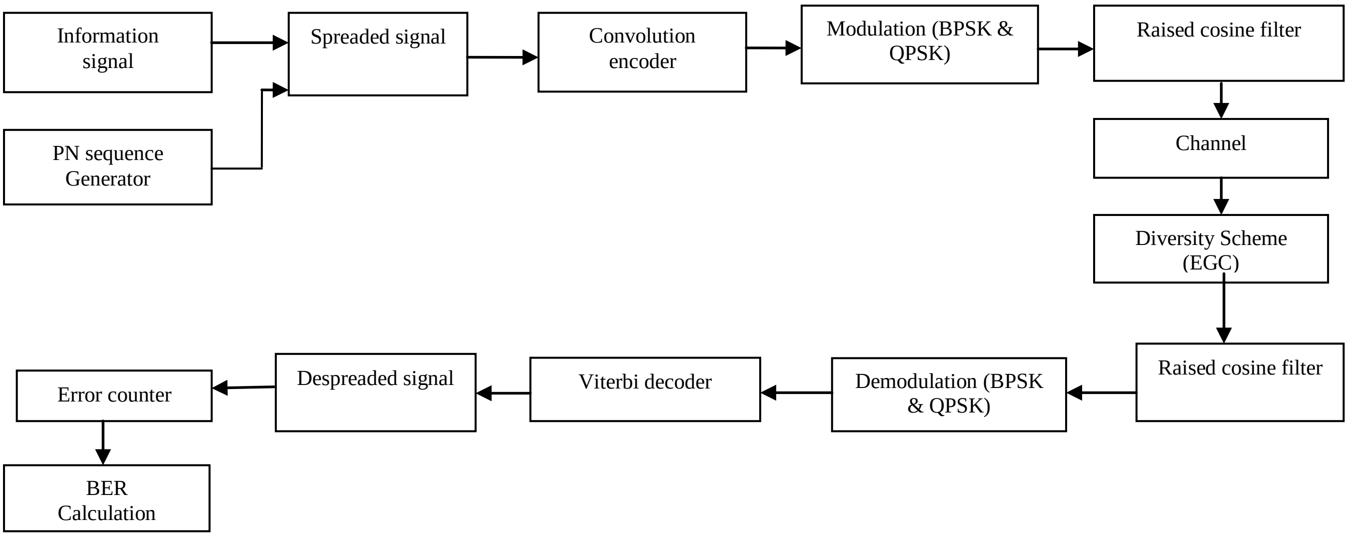

Fig. 1 Block diagram for proposed WCDMA system

III. RELATED WORKS

Masud.M et.al [4] analyzed BER for WCDMA using 16-QAM and QPSK modulation techniques and studied the performance of W-CDMA system with QPSK and 16-QAM modulation technique in different channel such as AWGN, line of sight (LOS), Rayleigh fading channel Hoyong.L et.al [5] proposed a hybrid switched examine combining (SEC) SEC/MRC diversity scheme and studied BER over Rayleigh fading channel using BPSK modulation technique. Tepedelenliog et al [6] analyzed performance of different diversity combining techniques over fading channels with impulsive noise. Thomas et.al [7] studied comparison of different diversity combining techniques for Rayleigh fading channels and studied that combining the two or three largest signals (SC2 or SC3) offers significant improvement over the performance of just selecting the largest signal (SC). Alamouti et. al [8] proposed a new transmit diversity scheme using two transmit antennas and one receive antenna, the new scheme provides the same diversity order as maximal ratio receiver combining (MRRC) with one transmit and two receive antennas. Hemalatha et.al [9] analyzed diversity in CDMA based broadband wireless system and found that the diversity CDMA system with multiple antennas at the transmitter and receiver results in the improvement in SNR and reduction in the multipath fading and interference.

IV. ANTENNA DIVERSITY TECHNIQUES

The diversity scheme is the solution to improve the performance of system in fading environment is to ensure that the information symbols pass through multiple signal paths, each of which fades independently, making sure that reliable communication is possible as long as one of the paths is strong and it can improve the performance over fading channels. Antenna diversity can be obtained by placing multiple antennas at the transmitter and/or the receiver [10]. Antenna diversity techniques use some combining methods such as selection combining, maximum ratio combining, and equal gain combining. The diversity schemes for single input single output (SISO) and single input multiple outputs (SIMO) are presented in Fig.2 and Fig.3.

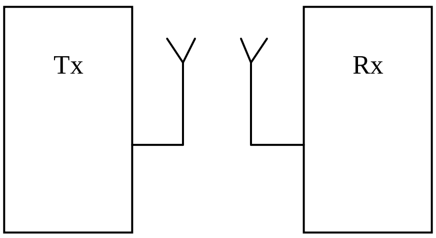

Fig.2 Single Input Single Output Antenna System (SISO)

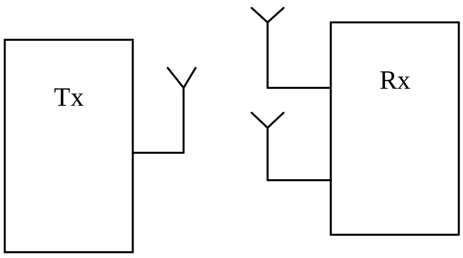

Fig.3 Single Input Multiple Outputs Antenna System (SIMO)

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V. EQUAL GAIN COMBINING

In Equal gain combining (EGC) the outputs of different diversity branches are first co-phased and weighted equally before being summed to give the resultant output. After that the resultant output signal is connected to the demodulator [11]. The weights are all set to one with the requirement that the channel gains are approximately constant and this is usually achieved by using an automatic gain controller (AGC) in the system [12]. Some practical applications of EGC include the use of regenerative circuits to co-phase the received carriers. However, the implementation of EGC diversity is cumbersome due to the additional circuitry required in order to co-phase the signal in each branch.

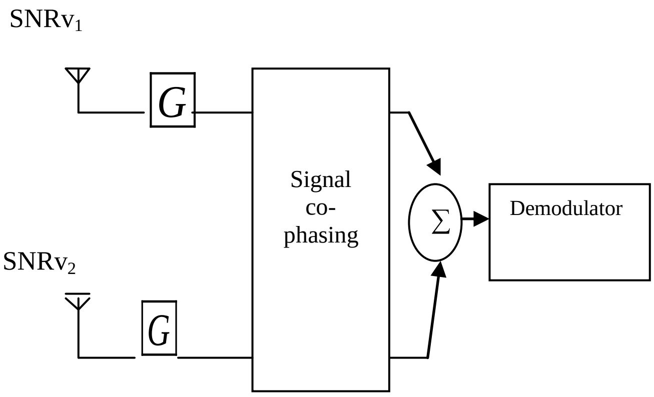

Fig.4 Block diagram of a two-branch equal gain combiner for equal noise powers in both branches

Fig. 4 describes the equal gain combining technique in which all branches are pre-multiplied by G and then co-phased, such that the amplitude of the output signal is the direct addition of branch envelopes. The signal envelope after equal gain combining at a time t_0 is [13, 14]

$$V_{S,E}(t_0) = r_1(t_0)(G) + r_2(t_0)(G) = G\left(r_1(t_0) + r_2(t_0)\right) \quad (1)$$

The noise component after EGC for all time t, $V_{N,E}(t)$ also gets multiplied by the gain G in both branches and evaluates after co-phasing and branch addition to

$$V_{N,E}(t) = n_1(G) + n_2(G) = G(n_1 + n_2) \quad (2)$$

The voltage signal-to-noise ratio or $SNR_{V_E}(t_0)$, after equal gain combining can be given by

$$SNR_{V_E}(t_0) = \sqrt{SNR_{P_E}} = \frac{1}{\sqrt{2N}}\left(r_1(t_0) + r_2(t_0)\right) \quad (3)$$

VI. SIMULATION RESULTS

The performance of WCDMA system is analyzed for the maximum ration combining diversity scheme with two antennas (nRx1 and nRx2) at the receiver. The BER v/s Eb/No relationship for the WCDMA system with nRx= 1, 2 is shown in Fig. 5 with QPSK modulation scheme using EGC technique. As can be seen from graph, in case of nRx=1, initially the BER can be obtained around 0.1946 and at higher value of Eb/No, the achievable BER decreases around 0.0109 for 10 dB Eb/No. In case of nRx=2, initially the BER can be obtained around 0.1116 and at higher value of Eb/No, the achievable BER decreases around 0.0006 for 10 dB Eb/No.

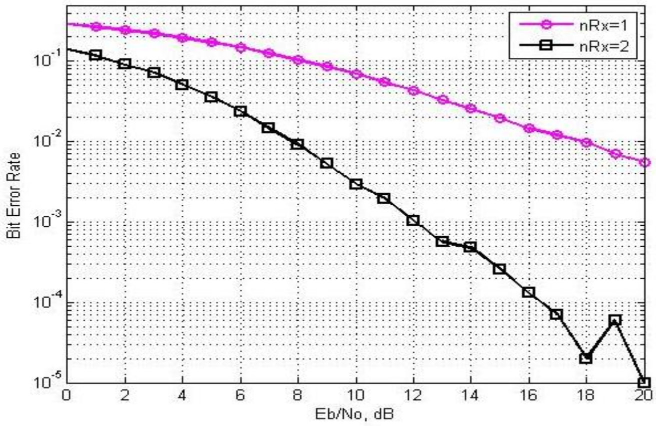

Fig.5 BER for QPSK using EGC

The BER v/s Eb/No relationship for the WCDMA system with nRx= 1, 2 is shown in Fig.6 with QPSK modulation scheme and with convolution encoding using EGC technique. As can be seen from graph, in case of nRx=1, initially the BER can be obtained around 0.4656 and at higher value of Eb/No, the achievable BER decreases around 0.0034 for 10 dB Eb/No. In case of nRx=2, initially the BER can be obtained around 0.3514 and at higher value of Eb/No, the achievable BER decreases around 0.0000 for 10 dB Eb/No.

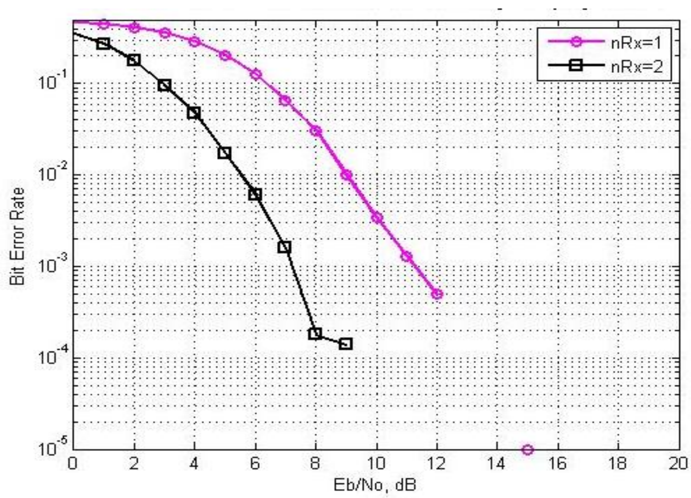

Fig.6 BER for QPSK with convolution encoding using EGC

The BER v/s Eb/No relationship for the WCDMA system with nRx= 1, 2 is shown in Fig. 7 with BPSK modulation scheme using EGC technique. In case of nRx=1, initially the BER can be obtained around 0.1162 and at higher value of Eb/No, the achievable BER decreases around 0.0022 for 10 dB Eb/No. In case of nRx=2, initially the BER can be obtained around 0.0461 and at higher value of Eb/No, the achievable BER decreases around 0.0001 for 10 dB Eb/No.

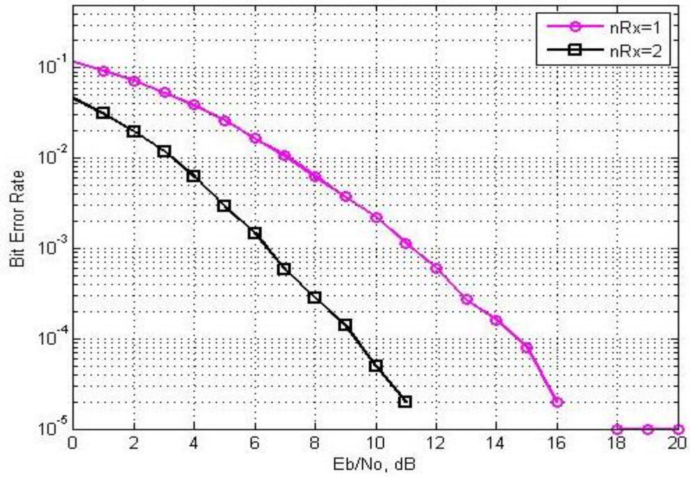

Fig.7 BER for BPSK using EGC

The BER v/s Eb/No relationship for the WCDMA system with nRx= 1, 2 is shown in Fig. 8 with BPSK modulation scheme and with convolution encoding using EGC technique. As can be seen from graph, in case of nRx=1, initially the BER can be obtained around 0.3600 and at higher value of Eb/No, the achievable BER decreases around 0.0001 for 10 dB Eb/No. In case of nRx=2, initially the BER can be obtained around 0.0929 and at higher value of Eb/No, the achievable BER decreases around 0 for 10 dB Eb/No.

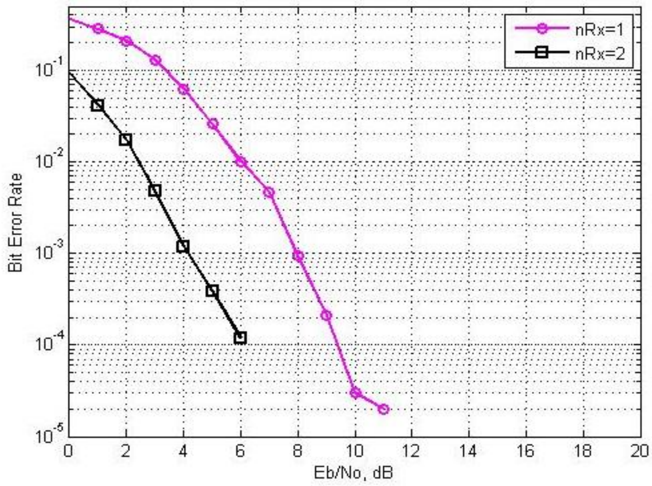

Fig.8 BER for BPSK with convolution encoding using EGC

VII. CONCLUSION AND FUTURE WORK

The work in this paper analyzed the BER performance for SISO and SIMO using EGC with different modulation techniques. Hence SIMO give better performance compare to SISO. Results with BPSK modulation technique are better compare to QPSK for SISO and SIMO. In future work the same analysis will be carried out for MIMO system and implement on FPGA vertex pro II.

VIII. REFERENCES

[1] Olavarrieta L.D., *Wireless communications education: A Guide to Important Topics*, Microwave Review, 2005.

[2] Prasad R. and Ojanpera T., *An overview of CDMA evolution towards wideband CDMA*,IEEE communication survey, fourth quarter 1998, Vol.1,pp.2-29.

[3] Proakis J.G.,Digital Communications, McGraw-Hill, 1995.

[4] Masud.M.A, Samsuzzaman.M, Rahman.M.A, *Bit Error Rate Performance Analysis on Modulation Techniques of Wideband Code Division Multiple Access*, Journal of Telecommunications, 2010, vol.1,no.2,pp.22-29.

[5] Lee.H, Park.S.K, Song.Y, *Performance analysis of a hybrid SEC/MRC diversity scheme over Rayleigh fading*, Advanced Communication Technology , 13th International Conference on , 2011, pp.1115-1118.

[6] Tepedelenlioglu.C,Gao.P, *On diversity reception over fading channels with impulsive noise*, IEEE Transactions on vechicular technology, 2005, vol. 54, no. 6, pp.2037-2047.

[7] Eng.T,Kong.N, *Comparison of diversity combining techniques for Rayleigh fading channels*, IEEE Transactions on communication, 1996, vol. 44, no. 9.pp.1117-1129.

[8] Alamouti S.M., *A Simple Transmit Diversity Technique for Wireless communications*, IEEE journal on select areas in communications, vol. 16, no. 8, pp 1451-1458,1998.

[9] Hemalata.M, Prithviraj V., Jayalalitha S.,Thenmozhi K, *Diversity analysis in CDMA based broadband wireless system* , Research Journal of Applied Sciences, Engineering and Technology, 2012, 4(6),pp.660-663.

[10] Sedani B.S,Kulkarni G.R., *Implementation of quality based algorithm for Wimax simulation using SISO and MIMO techniques*,Global journal of researches in engineering,2010, vol.10,no.4,pp. 106-112.

[11] Annamalai A. ,Tellambura A. ,Bhargava V.K., *Exact Evaluation of Maximal-Ratio and Equal- Gain Diversity Receivers for M-ary QAM on Nakagami Fading Channels*,IEEE Transactions on Communication, 1999, vol. 47, pp. 1335-1344.

[12] Brennan B.G. ,*Linear Diversity Combining Techniques*, In Proc. IRE, 1959, pp. 1075-1102**.**

[13] Jakes W.C., *Microwave Mobile Communications*, Wiley, New York, NY,1993.

[14] Clarke R.H., *A Statistical Theory of Mobile Radio Reception*, Bell Sys. Tech. J., 47, 1968, pp. 957-1000.