International Journal of Engineering and Technical Research (IJETR)
ISSN: 2321-0869 (O) 2454-4698 (P), Volume-5, Issue-1, May 2016

BER Performance of MC-CDMA Using with MSK Modulation on AWGN and Rayleigh Channel

Rohit Panwar, Sarvda Chauhan

Abstract— **Multi-carrier code division multiple access (MC-CDMA) is method for high speed data rate communication. It skip the problem of inter symbol interference.MC-CDMA too provide spatial diversity, which mitigate the fading. The usage of MC-CDMA can significantly improve the performance of wireless communication system. This paper presents the simulation of MC-CDMA system performance with MSK modulation over AWGN channel and Rayleigh channel. It also represents the BER performance of MC-CDMA system when it has users 2, 4, 16, 32 and 64 for both AWGN and Rayleigh channel. The SNR value between 0dB and 20dB the BER value showed an effect of AWGN and Rayleigh fading channel on the MC-CDMA system. Also the comparison of MC-CDMA BER performance over MSK modulation and BPSK modulation techniques show that minimum BER obtained with MSK modulation technique for both AWGN and Rayleigh channel.**

Index Terms— **MC-CDMA, MSK modulation, Rayleigh channel, AWGN, Walsh code and BER Performance.**

I. INTRODUCTION

Wireless communication is the convey of information over a distance without the utilize of electrical conductors or "wires". The continued increase of data, video and voice communication over the Internet, so that the mobile telephony large potential for mobile multimedia system [1]. Due to normal growth of multimedia communication, the sender require elevated data rate communication systems in wireless communication To provide the requirements new technologies 4G is residential in which the Code Division Multiple Access and Orthogonal Frequency Division Multiplexing (OFDM) are new communication systems. MC-CDMA be customized method for elevated speed data rate communication system [2].

A.MC-CDMA

MC-CDMA is a new inflection method which uses multi-user broadcast of Direct Sequence CDMA signals [8]. MC-CDMA is grouping of Orthogonal Frequency Division Multiplexing (OFDM), a multicarrier modulation, and Code Division Multiple Access (CDMA), a increase spectrum technique .Orthogonal Frequency Division Multiplexing (OFDM) is a multi carrier modulation, where a single data stream is transmit over a number of subcarriers. So that using a great number of sub-carriers, a high sound immunity against multipath can be provide so that the symbol duration Ts on each stream will be added large than the channel time dispersion This result the effects of ISI will exist minimized.

RohitPanwar, M.Tech, ECEE, ECE Department PDMCE Bahadurgarh
Sarvda Chauhan, Assistant Professor, ECE, Department PDMCE Bahadurgarh

II. THE SYSTEM MODEL

A.MCCDMA Transmitter Model

MC-CDMA transmitter is comparable to OFDM transmitter with very small difference. In OFDM many different symbols are transmit by subcarriers but in MC-CDMA similar symbol is transmitted by different subcarriers. The clarification of the above notion is clearly shown in figure1.The input data rate symbols are transformed toward parallel streams. Then each parallel stream is spread using dispersion code like Walsh, Hadamard etc [2].

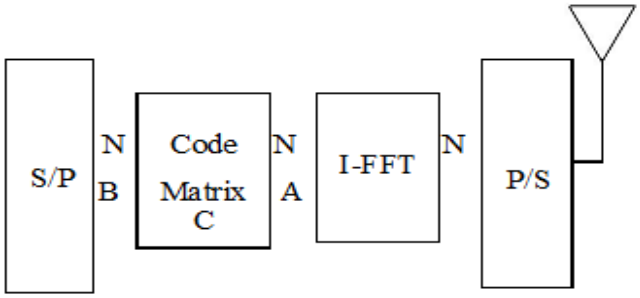

Figure1.MC-CDMATransmitter

In this figure, the major difference between MC-CDMA & OFDM is that the MC-CDMA system transmits the similar symbol in analogous through quite a few subcarriers whereas the OFDM system transmits dissimilar code of the user in the frequency domain. The input data flow is multiplied by the spreading code. The users are divided by different codes. All data analogous to the sum number of sub carriers are modulated inside baseband by an inverse Fast Fourier transform (IFFT) and distorted back into serial data. Then, a cyclic prefix be insert between the symbols which is a replicate of the end of the symbols at start to battle the inter-symbol interference (ISI) and the inter-carrier interference (ICI) And consequently the cyclic prefix length is selected such that it is better than the delay increase of the channel. In MC-CDMA transmission, it is necessary to have frequency non selective fading above each sub carrier. Therefore, if the unique symbol rate be elevated enough to become topic to frequency selective loss the input data contain to be serial to parallel (SIP) converted into parallel data sequences [2].

B.MC-CDMA Receiver model

In MC-CDMA, following improvement of the sub carriers, signals on the output of the FFT have to be “unspread” by apply the inverse code matrix. We openly introduce the FFT, the inverse code matrix C^{-1}, and a general weigh matrix W. While the FFT and $C^{-1}$are non-adaptive and can be implement efficiently using typical butterfly topologies.The received signal is first down converted. After that the cyclic prefix is uninvolved and the residual samples are serial to parallel

converted to get the m-subcarriers components .The m-subcarriers are first demodulated by a fast Fourier transform (FFT)[2].

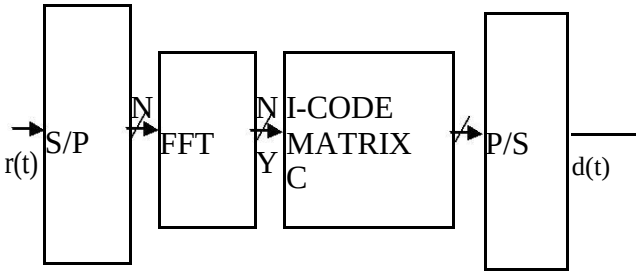

Figure 2.MCCDMA Receiver

III. WALSH CODE

Walsh code are make from the Hadamard matrix which is a square matrix in which every row in the matrix is orthogonal to all rows, and every column in the matrix is orthogonal to all columns. The Hadamard matrix Hn is generate by start with zero matrix and functional the Hadamard transform successively. Every column or row in the Hadamard matrix correspond to a Walsh code series of length n[6].

The Hadamard transform is defined as H_n = [0]

H_{2n}=

H_n	H_n
H_n	$\bar{H_n}$

H_2 =

0	0
0	1

The Walsh code index is as shown in table below:

$u_2u_1u_0$	Walsh code
000	00000000
001	01010101
010	00110011
011	01100110
100	00001111
101	01011010
110	00111100
111	01101001

Table 1.Index for Walsh code of length 8

IV. MSK MODULATION

Minimum Shift Keying (MSK) is a type of continuous-phase frequency-shift key that is used in a amount of applications. MSK is also identified as continuous phase modulation (CPM). The continuous phase modulation minimize BW consumption by eliminating phase discontinuities.
The MSK signal is defined as:

$S(t) = d(t) \cos(\pi t/2T) \cos 2\pi ft + d(t) \sin(\pi t/2T) \sin 2\pi ft.$

The MSK modulation makes the phase change linear and limited to ± (p/2) over a bit time T. This enable MSK toward give a significant development more than QPSK. Because of the result of the linear phase adjust the power spectral density has short side lobes so as to help to control adjacent-channel nosiness but the main lobe become wider than the quadrature shift key.

In MSK baseband signal which is to multiply the carrier is a smooth signal. The spectrum of MSK has a much wider main loop as compare to other modulation system.

V. SYSTEM CHANNEL

A.AWGN Channel

The simplest channel environment is Additive-White-Gaussian-Noise (AWGN) channel. The white noise can come from the thermal noise for each receive antenna. The signal from the mth transmit antenna to the nth receive antenna experiences propagation loss in the wireless channel. Additive white Gaussian noise (AWGN) is the commonly used to transmit signal while signals travel from the channel and simulate background noise of channel.

The arithmetical appearance inside received signal is r(t) = s(t) + n(t)

where s(t) is transmitted signal and n(t) is background noise.

B.Rayleigh Channel

The delays associated with different signal paths in a multipath fading channel change in an unpredictable manner and can only be characterized statistically. while present are a large sum of paths, the central bound theorem can be useful to mold the time-variant impulse response of the channel as a complex-valued Gaussian chance process. When the impulse reaction is model as a zero mean complex-valued Gaussian course the channel be supposed toward be a Rayleigh loss channel.

The Rayleigh fading is primarily caused via multipath response Rayleigh fading is a numerical model intended for the effect of a propagation environment on a radio signal. The Rayleigh distribution is frequently used to model multipath fading with no direct line-of-sight (LOS) path [7].

VI. SYSTEM MODEL & RESULTS

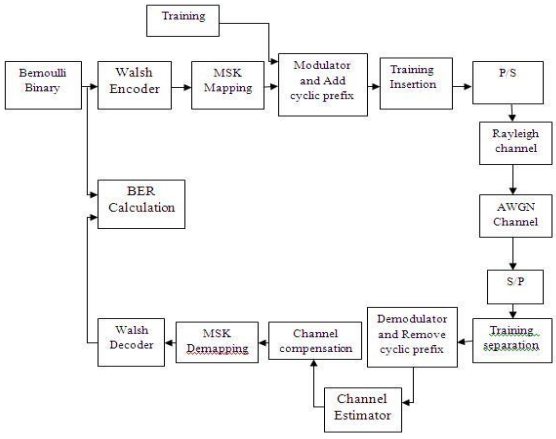

Figure 3:MC-CDMA System using walsh code with

MSK Modulation

The MC-CDMA is simulated and analysis using Matlab Software. The MC-CDMA was simulated on an Rayleigh multipath fading and Additive White Gaussian Noise (AWGN) channe for show the effect of both channel on BER performance of MC-CDMA with respect to SNR(signal to noise ratio) [12].

A.BER Performance of MC-CDMA on AWGN Channel

The Effect of AWGN channel on MC-CDMA system having two and four users which are sending 10^4 bits on the channel. The users data were spread using 4-bit Walsh code and modulated by Minimum Shift Keying modulation.

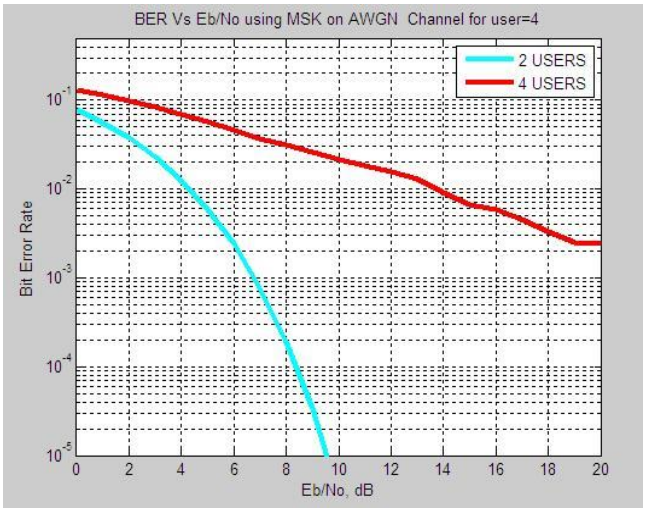

Figure4:MC-CDMAon AWGN for 2,4 users

The simulation shows that in figure 4.The signal to noise ratio values for 2 user more than 10dB reduced
the effect of the additive white Gaussian noise channel.Bit error rate for 4 users is more than 2 users.
MC-CDMA Performance effected on AWGN channel which have 4 users and 16 users each user has 10^4 bits on the channel. The users data were spread using 16-bit Walsh code and modulated using Minimum Shift Keying modulation Shift Keying modulation.

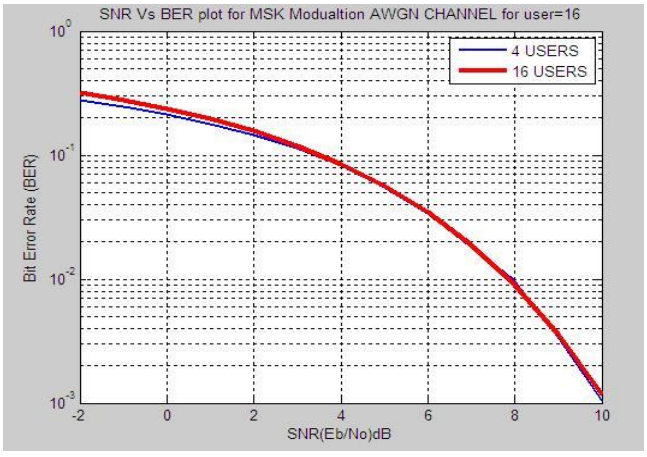

Figure 5:MC-CDMA on AWGN for 4,16 users

The simulation result shows that in figure 5. The Result indicates that the bit error rate is directly vary with the number of users, therefore increasing the number of users more affects the BER.Bit error rate for 16 users is more than 4 users.

MC-CDMA Performance effected on AWGN channel which have 4 users,16 users, 32 users, each user has 10^4 bits on the channel. The data were spread using 32,64 bit Walsh code and modulated, using Minimum Shift Keying modulation.

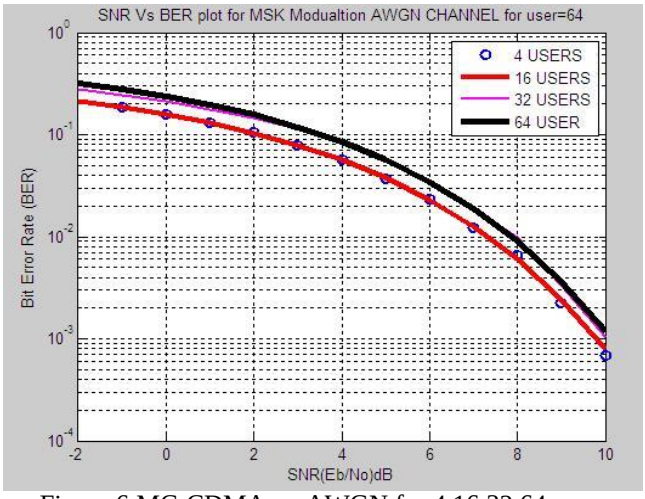

Figure 6:MC-CDMA on AWGN for 4,16,32 64 users

The simulation result indicates that the bit error rate is direct vary with the number of users.In figure 6 BER of 64 user shows in black colour is maximum. BER of 32 user is lower than 64 users but higher than 16 and 4 users.

B.BER Performance of MC-CDMA System on Rayleigh and AWGN Channel

when Rayleigh fading is added to AWGN the channel and simulation result show the behavior of fading on the BER of MC-CDMA system.MC-CDMA Performance effected on AWGN and Rayleigh channel which have two user,four users every user sends ten thousand bits on both the channel. The data were spread using 4-bit Walsh code and modulated using Minimum Shift Keying modulation. For user 2 the simulation result shows that bit error rate is higher compare to user 4 and starts to decrease from SNR= -1dB to 6dB.

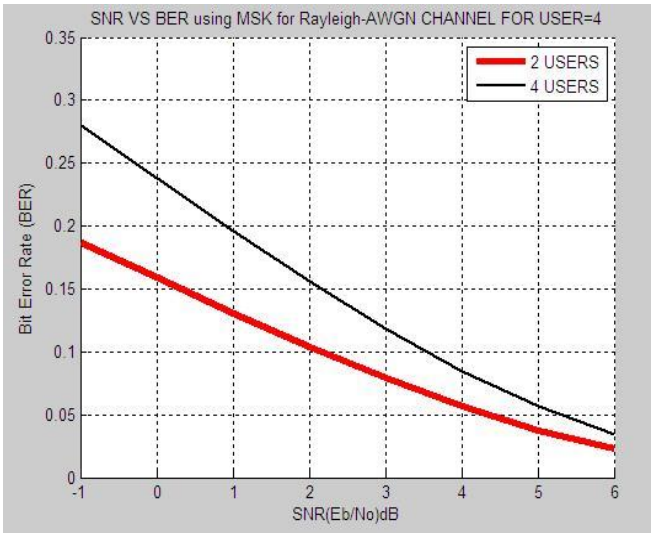

Figure 7 :MC-CDMA on AWGN and Rayleigh for 2,4 users

In figure 7 simulation result shows that bit error rate of 4 user higher compare to user 2 and starts to decrease from SNR= -1dB to 6dB.

MC-CDMA Performance effected on AWGN and Rayleigh channel which have four user,16 users each user sends ten thousand bits on both the channel. The data were spread using 16-bit Walsh code and modulated using Minimum Shift Keying modulation. It is clear that the BER is higher at the minimum SNR and then starts to decrease.

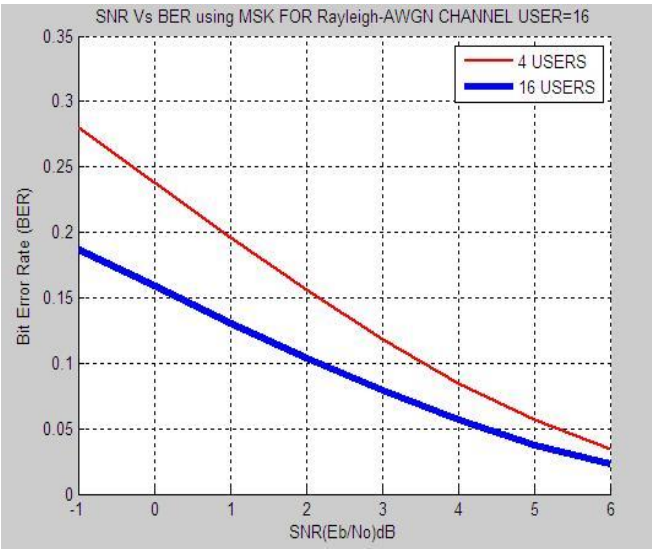

Figure 8: MC-CDMA on AWGN and Rayleigh for 4,16,32,64 users

In figure 8 Results show that BERs at SNR=-1db for 4 users are higher compared to 16 users, and then also starts to decrease until SNR to 6db.

BER Performance of MC-CDMA system has 32 users sending data on Rayleigh fading and AWGN channel. Every user sends and receives 10^4 bits with 32, 64 bit Walsh code and MSK modulation.

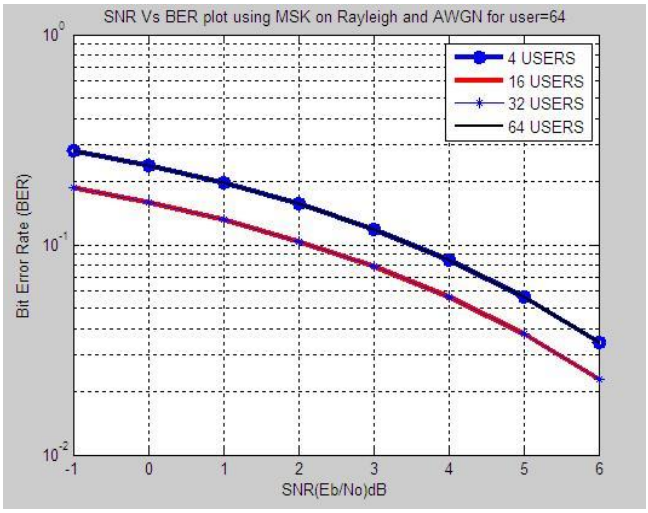

Figure 9:MC-CDMA on AWGN and Rayleigh for 4,16,32,64 users

The BER simulation plot is shown in Figure 9., where at SNR = -1dB all users show high value of BER and then starts to decrease . BER of 64 users is higher than 32 users and continually decrease until SNR =6db.

C. Comparison Results of MC-CDMA With BPSK and MSK Modulation on AWGN Channel

The Effect of AWGN channel on MC-CDMA system having 2 user,4 users,16 users,32 users and 64 users sending 10^4 bits on the channel. The data were spread using Walsh code and modulated by Minimum Shift Keying and BPSK Modulation.

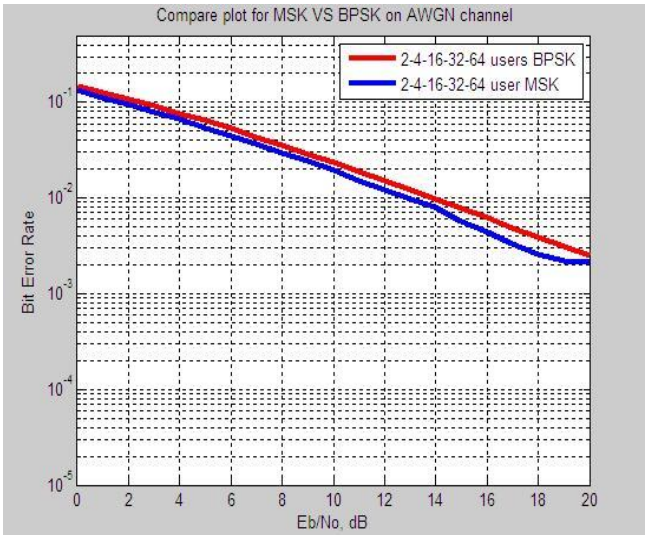

Figure 10 :BER VS Eb/No on AWGN For 2,4,16,32,64 users Comparison graphs show that BER Of MC-CDMA using Walsh code with MSK Modulation technique is reduced as compare to BER Of MC-CDMA With BPSK Modulation on AWGN channel.So that MSK Modulation is much better than BPSK modulation.

M	USER	USER	USER	USER	USER
TYPE	2	4	16	32	64
BPSK	0.92	0.103	0.85	0.88	0.88
MSK	0.1	0.101	0.81	0.83	0.87

Table 2:Channel Type = AWGN (Bit Error Rate VS SNR)

Comparison Table 2 show that Bit Error Rate using the MSK modulation is found to be quite efficient than using the BPSK modulation technique .so that MC-CDMA Performance is better with MSK Modulation rather BPSK Modulation technique. Because BER of MC-CDMA is reduced with MSK modulation.

D. Comparison Results of MC-CDMA With BPSK and MSK Modulation on AWGN and Rayleigh Channel

Effect of AWGN and Rayleigh channel on MC-CDMA system having 2 user,4 users,16 users,32 users and 64 users sending 10^4 bits on the channel. The data were spread using Walsh code and modulated by Minimum Shift Keying and BPSK Modulation on AWGN and Rayleigh Fading Channel.

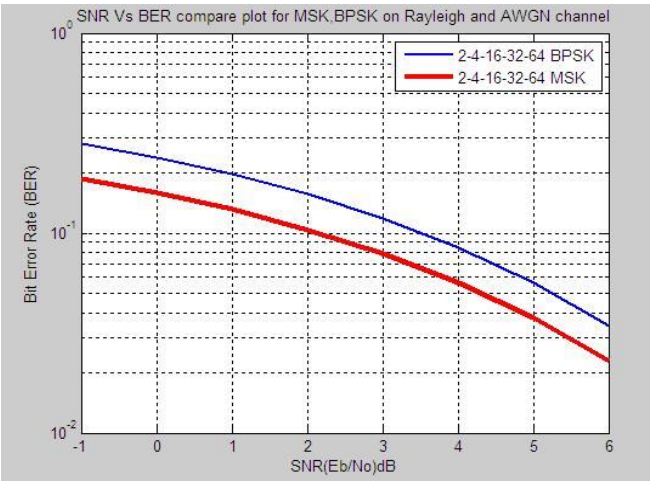

Figure 11 :BER VS Eb/No on AWGN and Rayleigh Channel for 2,4,16,32,64 users

Comparison graphs show that BER Of MC-CDMA using Walsh code with MSK Modulation technique is reduced as compare to BER Of MC-CDMA With BPSK Modulation on AWGN and RAYLEIGH channel.So that MSK Modulation is much better than BPSK modulation in BER Performance of MC-CDMA on AWGN and Rayleigh Fading channel.

M TYPE	USER 2	USER 4	USER 16	USER 32	USER 64
BPSK	.15	.43	.45	.35	.39
MSK	.12	.18	.19	.21	.25

Table 3:Channel Type = AWGN & Rayleigh (Bit Error Rate VS SNR)

Comparison Table 3 show that Bit Error Rate of MC-CDMA using the MSK modulation on AWGN and Rayleigh channel is found to be much better than using the BPSK modulation technique .

We have implemented the results on 2 users, 4 users,16 users ,32 users and 64 users. BER Performance of MC-CDMA using MSK is more decrease for 4 users , 16 user. Bit error rate of MC-CDMA for 2 user, 32user and 64 user also decrease by using MSK than BER of MC-CDMA using BPSK modulation technique .

VII. CONCLUSION

This paper has presented and showed that BER Performance of MC-CDMA using walse code with MSK modulation on AWGN and Rayleigh Fading channel.Walsh code sequences have the advantage to be orthogonal, because under a perfect synchronization, the rid of any multi-access interference is certainly obtained.

The BER of MC-CDMA with MSK modulation on AWGN channel show that BER is directly vary with number of users .But BER is decrease with MSK modulation as compare BPSK modulation.

The BER of MC-CDMA with MSK modulation shows that when, Rayleigh fading was added to the AWGN channel the variation in bit error rate with fading in addition to the number of users. But BER is decrease with MSK modulation as compare BPSK modulation on AWGN and Rayleigh channel. When compare the BER of MC-CDMA using MSK modulation with BPSK modulation, the result show that BER is more decrease for 2, 4,16,32,64 users on the AWGN channel.BER of MC-CDMA with MSK is also decrease for 2,4,16,32,64 users on AWGN and Rayleigh fading channel.so that MSK modulation is quite efficient for BER of MC-CDMA rather than BPSK on both AWGN and Rayleigh channel.

REFERENCES

[1]S.Sivanesskumar, R.Sukanesh, "Performance Analysis of Multi-Carrier Code Division Multiple Access System under Clipping Noise,"

[2]A. Sharmila and Srigitha S. Nath"Performance of MIMO Multi-Carrier CDMA with BPSK Modulation in Rayleigh Channel" International Conference on Computing and Control Engineering (ICCCE 2012), 12 & 13 April, 2012.

[3] [3] Poonam Singh R. V. Raja Kumar T. S. Lamba"Performance analysis of MC-CDMA System in Multipath fading channel "IEEE,May 2006 .

[4] Dinan, E.H.; Jabbari, B., "Spreading Codes forDirect Sequence CDMA and Wideband CDMA Cellular Networks," IEEE Communications Magazine, Vol. 36 Issue 9, pp.5-54, September 1998.

[5]Mosa Ali Abu-Rgheff, "Introduction to CDMA Wireless Communications," Elsevier Ltd., 2007, pp. 222-223.

[6]Marvin K. Simon, Mohamed-Slim Alouini, "Digital Communication over Fading Channels ," John Wiley & Sons, Inc., 2000, pp.18-20.

[7]V.Jagannaveen,K.MuraliKrishna , K.RajaRajeswari "performance analysis of MC-CDMA and OFDM in wireless rayleigh channel"International Journal of Advanced Science and Technology Vol. 25, December, 2010.

[8]N.Kumaratharan, P.Dananjayan, and M.Padmavathy, " Performance Improvement Of Mc-Cdma System Through Dstbc Site Diversity," Journal of Theoretical and Applied Information Technology, pp.1075-1082, 2008.

[9]K. Fazel, S. Kaiser, "Multi-Carrier and Spread Spectrum Systems From OFDM and MC-CDMA to LTE and WiMAX," John Wiley & Sons Ltd.,2008, pp.55-59.

[10]M.F.L.Abdullah, M.F. Ghanim," An Overview of CDMA Techniques for Mobile Communications," Medwell Journals Vol. 5, Issue 1, pp.16-24, 2011.

[11]Dr. K.V Sambasiva Rao, A. Sudhir Babu"

Evaluation of BER for AWGN, Rayleigh and Rician Fading Channels under Various Modulation

Schemes"international generalVolume 26– No.9, July 2011