ISSN: 2278 – 1323
International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 2, Issue 12, December 2013

Simulation Model of MB-OFDM for short range indoor wireless environment

Ms. Surabhi Tankkar , Mrs. Bhosale J.D

Abstract— **Growth in technology has led to unprecedented demand for high speed architectures for complex signal processing applications. To increase data rate of wireless medium with higher performance, OFDM (orthogonal frequency division multiplexing) is used. Recently DWT (Discrete wavelet transforms) is adopted in place of FFT (Fast Fourier transform) for frequency translation. Multiband Orthogonal Frequency Division Multiplexing (MB-OFDM) approach using UWB(Ultra Wide Band) signals with short duration of pulses provide unique advantages in short-range high data rate wireless applications which include easy penetration through obstacles, high precision ranging and low processing power. In this paper we propose a DWT-IDWT based OFDM transmitter and receiver that achieve better performance in terms SNR and BER for AWGN channel. The OFDM model is developed using Simulink , various test cases have been considered to verify its performance. By using the Discrete Wavelet Transform,it is seen that the spectral containment of the channels is better as they are not using CP. By comparing with the conventional FFT-OFDM system it is found that DWT platform based MB-OFDM is superior as compared to others as it has less error rate.**

Index Terms— ***DWT,FFT, OFDM , MB-OFDM, SIMULINK MODELLING, UWB***

INTRODUCTION

The ECMA-368 standard specifies the physical layer (PHY) and medium access control (MAC) layer of the MB-OFDM ultra wideband (UWB) technology. The MAC layer supplies a reliable delivery mechanism for data transfer over noisy, unreliable wireless media. It reduces interference between systems by dictating when transmissions occur and how long they last. MAC is a sublayer of the Data Link Layer defined in the OSI reference model. In 2002, the Federal Communications Commission (FCC) allocated a large spectral mask from 3.1 GHz to 10.6 GHz for unlicensed use of commercial UWB Communication devices [1], [2]. Since then, UWB systems have gained high interest in both academic and industrial research community. UWB was first used to directly modulate an impulse like waveform with very short duration occupying several GHz of bandwidth [3], [4]. 'Multi-banding' consists in dividing the available UWB spectrum into several sub-bands, each one occupying approximately 500 MHz (minimum bandwidth for a UWB system according to FCC definition) [5]. By interleaving symbols across different sub-bands, UWB system can still maintain the same transmit power as if it was using the entire bandwidth. Narrower sub-band bandwidths also relax the requirement on sampling rates of ADCs consequently enhancing digital processing capability. Multiband-OFDM (MB-OFDM) is one of the promising candidates for PHY layer of short-range high data-rate UWB communications [6].It combines Orthogonal Frequency Division Multiplexing (OFDM) with the above multi-band approach enabling UWB transmission to inherit all the strength of MB-OFDM technique which has already been proven for wireless communications. The wavelet based MB-OFDM or Wavelet Packet Modulation (WPM) is an alternate approach to conventional MB-OFDM that exploits the self and mutual orthogonality properties of wavelet packet basis functions. Unlike the traditional FFT MB-OFDM which divides the whole bandwidth into several orthogonal and overlapping subbands of equal bandwidths, WPM uses discrete wavelet packet transform to multiplex transmission. DWPM improves spectral efficiency due to the exclusion of CP. Nevertheless, it requires an efficient equalization technique to counter the ISI and ICI. [7].The paper is organized as follows. In Section I we study the software framework development of MB-OFDM system. Section II discusses Discrete Wavelet Packet Transform (DWPT) MB-OFDM. Simulation results are discussed in Section III. Section IV concludes the paper.

I. SOFTWARE FRAMEWORK DEVELOPMENT

Multi Band OFDM UWB is a form of ultra wideband technology that differs in approach to the impulse, or direct sequence form of ultra wideband. MB-OFDM UWB transmits data simultaneously over multiple carriers spaced apart at precise frequencies. Fast Fourier Transform algorithms provide nearly 100 percent efficiency in capturing energy in a multi-path environment, while only slightly increasing transmitter complexity. Beneficial attributes of MB-OFDM include high spectral flexibility and resiliency to RF interference and multi-path effects .Although a wide band of frequencies could be used from a theoretical viewpoint, certain practical considerations limit the frequencies that are normally used for MB-OFDM UWB. Based on existing CMOS technology geometries, use of the spectrum from 3.1GHz to 4.8GHz is considered optimal for initial deployments. Limiting the upper bound simplifies the design of the radio and analogue front end circuitry as well as reducing interference with other services. Additionally the frequency band from 3.1 GHz to 4.8 GHz is sufficient for three sub-bands of 500 MHz when using MB OFDM UWB [11].

ISSN: 2278 – 1323
International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 2, Issue 12, December 2013

Puncturing

Puncturing omits some of the encoded at the transmitter. Dummy "zeros" are inserted at the receiver before de decoding process. Different bit stealing at the transmitter and insertion at the receiver. Here presents the mode where only 2 of the 3 bits are sent. Therefore the code rate is ½ (1/3×3/2) present coding rates of 5/8 (1/3×15/8) and 3/4 (1/3×6/4), respectively possible.

Frequency and Time Domain Spreading

In addition to puncturing, frequency domain spreading (FDS) and time domain spreading also reduce data rate. FDS and TDS involve the transmission of the same information on two separate sub-carriers. These two sub-carriers belong to the same OFDM symbol in FDS, or to two consecutive OFDM symbols in TDS.

Channelization

Logical channels are defined by the time-frequency codes. They are identified by a number. There are three types of TFCs: one where the coded information is interleaved over three bands, referred to as Time-Frequency Interleaving (TFI) (Figure 5); one where the coded information is interleaved over two bands, referred to as two-band TFI or TFI2; and one where the coded information is transmitted on a single band, referred to as Fixed Frequency Interleaving (FFI).

II. METHODOLOGY

A block-set approach is carried out for the simulation of the MB-OFDM. This is as per the figure 1 shown below

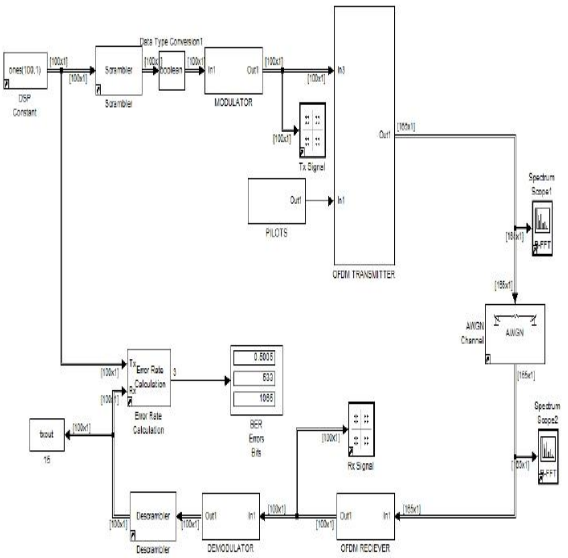

Fig.1. Simulation Model of MB-OFDM.

In this set of transmitter receiver pair is used along with the MB-OFDM transmitter receiver pair to suppress the CP to achieve the low power in the processing. The result is seen in the scope through the AWGN channel.

III. RESULTS AND DISCUSSION

The result of the scope output in discussed in detail as below. The figure 2 and 3 shows the scope output given by the system as per the block diagram of MB-OFDM shown in figure 1.The output gain we get when we plot frequency in mHz with respect to the magnitude in dB.

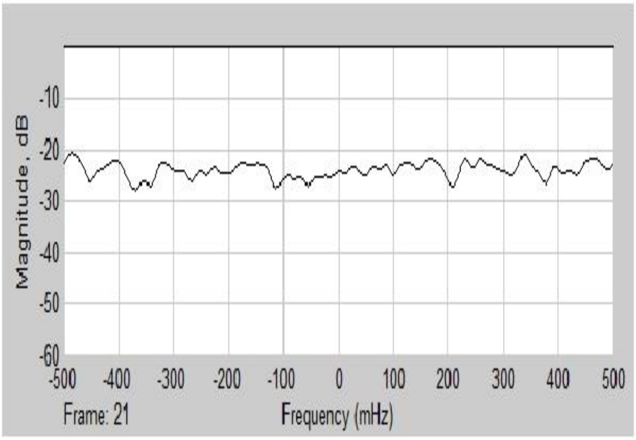

Fig.2 Result of scope 1

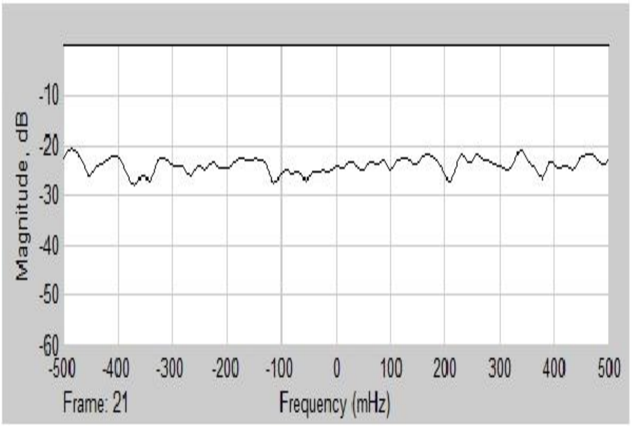

Fig.3 Result of scope 2

Figure 4, 5 shows the result of the scatter plot Before Channel Add 5dB SNR and after Channel Add 5dB SNR

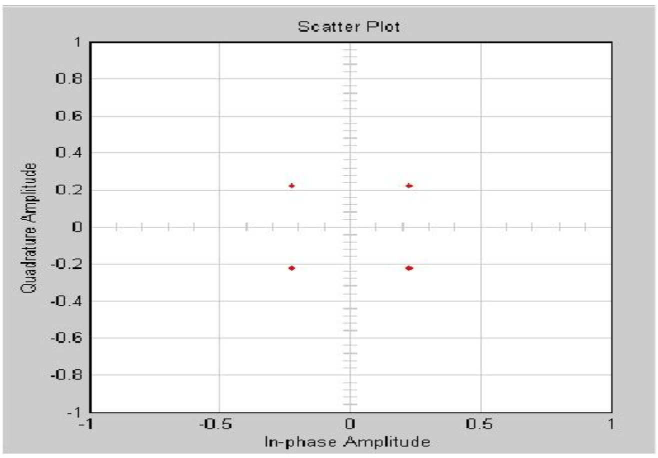

Fig.4 scatter plot before Channel Add 5dB

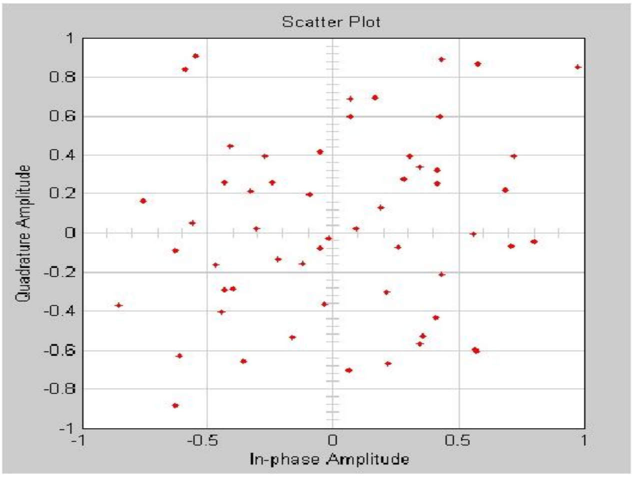

Fig.5 scatter plot after Channel Add 5dB SNR

The QPSK and BPSK results are studied for various aspect of bit rate error vs. the signal to noise ratio. Figure 6 gives the result of bit rate error to the signal to noise ratio with the code rate ½.

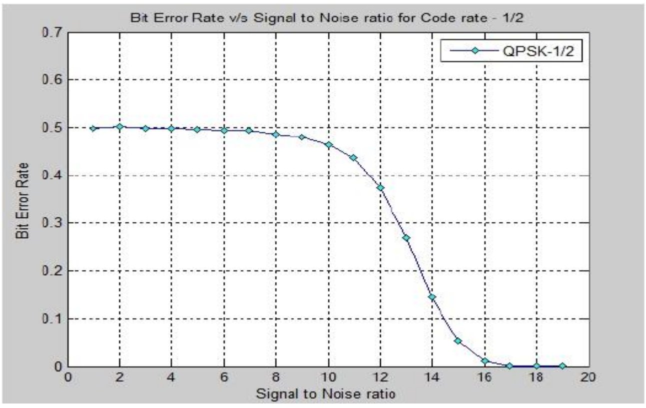

Fig.6 bit rate error vs. signal to noise ratio with the code rate ½.

Figure 7 gives the result of bit rate error to the signal to noise ratio with the BPSK rate 1/2 and QPSK rate 1/2.

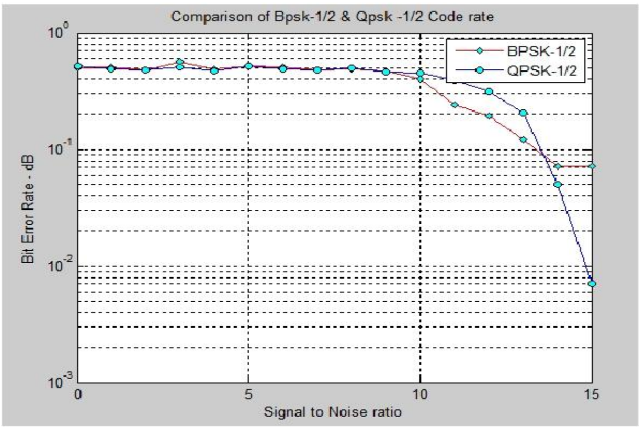

Fig.7 bit rate error vs. signal to noise ratio with BPSK and QPSK code rate ½.

Figure 8 gives the result of bit rate error to the signal to noise ratio with the BPSK rate 3/4 and QPSK rate 3/4.

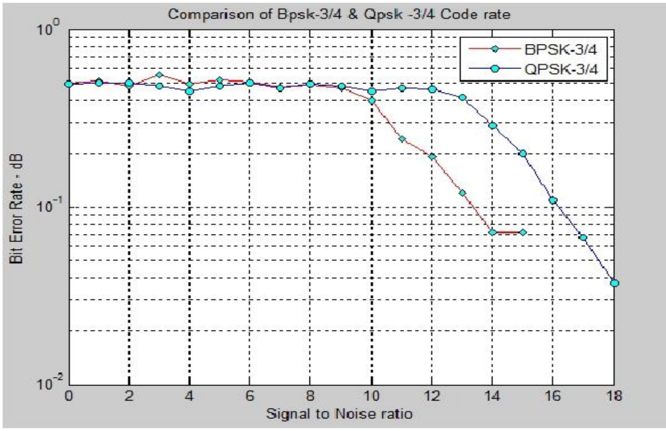

Fig.8 bit rate error vs. signal to noise ratio with BPSK and QPSK code rate 3/4.

Figure 9 gives the result of bit rate error to the signal to noise ratio with the BPSK rate 1/2 and 3/4.

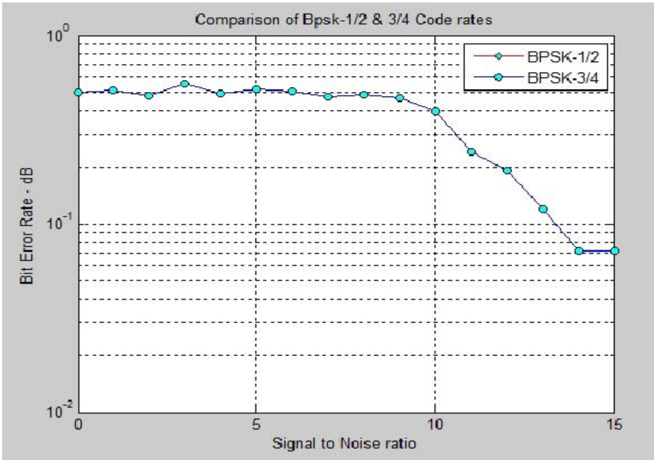

Fig.9 bit rate error vs. signal to noise ratio with BPSK code rate ½ and 3/4.

IV. CONCLUSION

In this paper our main aim is to study the conventional FFT MB-OFDM system for designing the discrete wavelet packet based MB-OFDM system using UVW for indoor wireless environment. During this study we found that due to the extinction of CP the spectral efficiency drastically improved which leads to the better power lowering in the side lobes in the actual directivity of the signal which is again helps in the better penetration of the signal through the object.

REFERENCES

[1] S. Roy, J.R. Foerster, V. S. Somayazulu and D.G. Leeper "Ultrawideband radio design: the promise of high- speed, short-range connectivity," *Proceedings of the IEEE*, Vol. 92,Issue 2, pp. 295-311, 2004

[2] M.Z. Win and R. A. Scholtz, "Ultra-wide bandwidth time-hopping spread-spectrum impulse radio for wireless multiple-access communications," *IEEE Trans. Comm.*, Vol. 48, Issue 4,pp. 679-689, 2000.

[3] B. R. Vojcic and R. L. Pickholtz, "Direct sequence code division multiple access for ultra wide bandwidth impulse radio," *Military Communications Conference*, Vol. 2, pp 898-902, 2003

[4] A. Batra, J. Balakrishnan and A. Dabak, "Multiband OFDM: a new approach for UWB,"*Internat. Symp. On Circuits Systems*,May 2004.

[5] A. Batra, J. Balakrishnan, G. R. Aiello, J. R. Foerster and A. Dabak, "Design of a multiband OFDM system for realistic UWB channel

ISSN: 2278 – 1323
International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 2, Issue 12, December 2013

environments," *IEEE Transactions on Microwave Theory and Techniques*, Vol. 52, Issue 9, pp. 2123-2138, 2004.
[6] L. Hanzo, M. Munster, B. J.Chol, and T. Keller, *OFDM and MC-CDMA for Broadband* Multi-user Communications, WLANs and Broadcasting, John Wiley & Sons 2003.
[7] Haitham J. Taha and M. F. M. Salleh "Performance Comparison of Wavelet Packet Transform(WPT) and FFT-OFDM System Based on QAM Modulation Parameters in Fading Channels,", *seas Transactions on Communications*,Vol. 9, Issue 8, pp. 453-462, 2010.
[8]] D. Gupta, V. B Vats and K. K. Garg, "Performance Analysis of DFT-OFDM, DCTOFDM, and DWT-OFDM Systems in AWGN Channel", *IEEE Fourth International Conference Wireless and Mobile Communications,(ICWMC '08),* Athens, 2008, pp. 214-216.
[9] S. Baig, F.-ur-Rehman, M. J. Mughal, "Performance Comparison of DFT, Discrete Wavelet Packet and Wavelet Transforms, in an OFDM Transceiver for Multipath Fading Channel", *in Proc. 9th International Multitopic Conference, INMIC'05, 2005,* pp. 1-6.
[10] "Performance study of discrete wavelet packet based OFDM system for short range indoor wireless" Bikramaditya Das, Suryakant Tiwari, Susmita Das, IEEE member.
[11] http://www.radio-electronics.com.

Ms. Surabhi Tankkar : Ms. Surabhi Tankkar is currently pursuing her master of engineering degree in Electronics from Pillai Institute of Information Technology,Panvel, Navi Mumbai under Mumbai University. She received B.E Electronics & Telecommunication from A. C. Patil College of Engineering, Kharghar,Navi Mumbai in 2008.Her research interest includes Wireless Communication, OFDM, Wireless Sensor Networks & Digital Signal Processing..

Mrs. Bhosale J. D. : Mrs. Bhosale J. D. is currently working as Assisstant Professor, Department of Electronics, Pillai Institute of Information Technology, Panvel, India. She received her Master of Engineering degree (M.E) Electronics from Walchand Institue of Technology, Solapur, India .She has authored papers in reputed journals and transactions and international and national conferences. Her research interest includes Wireless Communication, Statistical Communication, Digital Signal Processing & Image Processing.