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SIMULATION AND ANALYSIS OF OFDM SYSTEM IN MATLAB UNDER NOISY CHANNEL ENVIRONMENT

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ABSTRACT:
Orthogonal Frequency Division Multiplexing (OFDM) is a technique of communication which is designed to overcome the effect of multipath distortion and noise distortion produced during the transmission. The main aim of this paper is to design and develop an OFDM simulation and then test the performance of this system for noisy channel.

Keywords: ISI, OFDM, CDMA, BER, IFFT ,FFT Orthogonal frequency

I. INTRODUCTION

The growing use of mobile technology and internet for the last couple of year has made lots of technocrat to think over a new communication technology which will not only be able to supports high capacity wireless network but also have a capability to perform better under different channel noise condition. Existing WLASN system like IEEE 802.11b support maximum 11 Mbps.While the latest WLAN system like IEEE 802.11 and HyperLAN2 support maximum 64 Mbps using OFDM technology [1].Orthogonal frequency division multiplexing is basically a multicarrier modulation system in which the information is transferred in different carriers which are orthogonal to each other. Since different carriers are orthogonal to each other therefore then are independent of each other. In this technique, a wideband channel is divided into different narrowband sub channel. Since in this system, instead of using whole wide band channel for single communication, different narrowband channel is used for parallel transmission. This is advantageous as it produces least inter-symbol interference (ISI) because it suppress the delay time to 1-symbol time. OFDM is basically a result of modulation technique and multiplexing technique which shows better immunity against noise, inter symbol interference, better spectral efficiency and less complexity [2]. All most all new broadband communication system now a day are using OFDM for its better error rate than the CDMA [3][4] and immunity to multipath environment[5-7].

II. BASIC OFDM SYSTEM

Basic Block diagram of OFDM system is shown in Figure 2.
In this system first of all the input data is modulated using some appropriate modulation technique. Basically modulation is carried to send the data over the channel using carrier wave. Different digital modulation technique such as BPSK,QPSK,4-QAM,16 QAM[8] etc can be used here.
Once the data is modulated then IFFT operation is performed[9-11] on this data to get the time domain signal. Then parallel to serial converter operation is performed and then at last Guard Interval Insertion is performed to avoid inter-symbol interference then it is transmitted in a channel. It is in this phase where all types of noise and interference added in the data and produced distortion.
On the receiver side, reverse operation is performed. Data is first converted to parallel form.FFT convert the time domain signal to frequency domain signal after that the demodulation operation is carried out to get back the baseband signal. Due to requirement of high peak to average power ratio, this system require a device having large dynamic range [12-14].

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III. IMPLEMENTATION METHODOLOGY

For modeling the OFDM system in MATLAB, three different blocks has been designed i.e. first Transmitter section, Channel Block and Receiver block. Transmitter block consists of 4 different sub block i.e. Serial to parallel converter block, Modulation block, IFFT block and then parallel to serial block. The system is designed to take any number of input bit. The serial to parallel block takes the input in serial fashion and convert it into parallel form which is fed to the modulation block for performing the modulation operation.

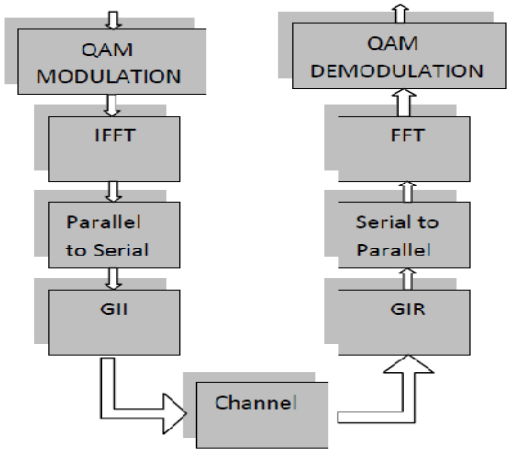

Figure 1 Basic OFDM System

The modulation block is designed to perform only quadrature amplitude modulation (QAM) only. The parallel data is modulated in different frequencies here. IFFT block is designed to convert the frequency domain modulated signal to time domain signal. Parallel to serial block then combine these parallel signal into serial fashion for transmission.

The channel simulation block is designed to produce noise of different density.

User has to select the noise density of the channel. In this way, the performance of OFDM system under different noise condition can be simulated easily.

Receiver Block does just opposite operation of transmitter block. In this block FFT sub block is used to convert the parallel data into frequency domain.

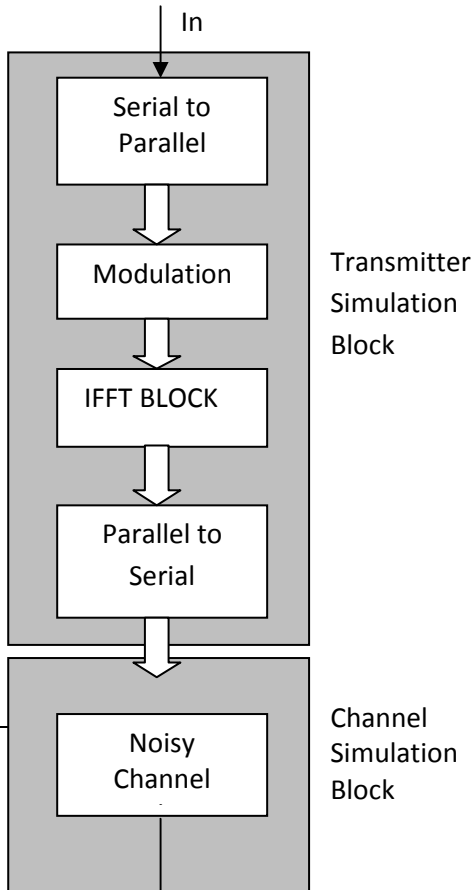

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Figure2 OFDM Simulation Flowchart (Transmitter and Channel section)

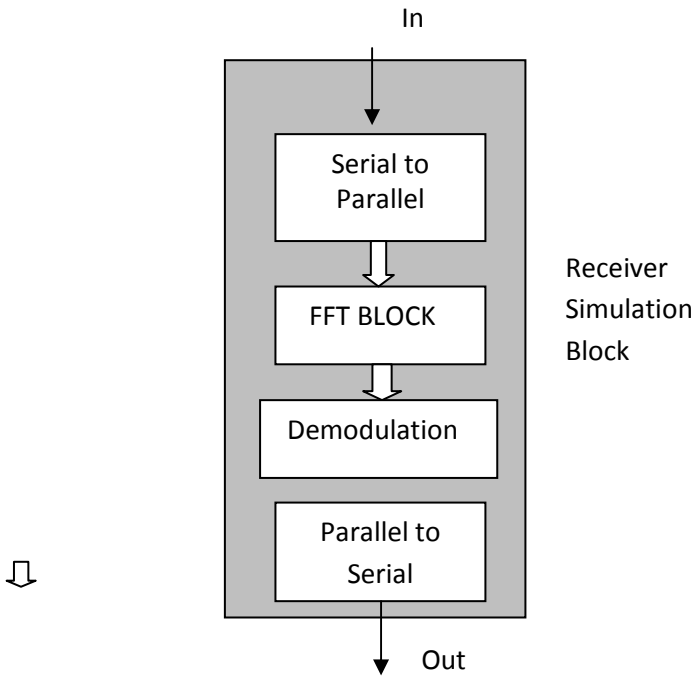

Figure 3 OFDM simulation Flowchart (Reciever Section)

The demodulation block is designed to demodulate the received data and extract the base-band signal.

IV. EXPERIMENTAL RESULT

A simulation operation is performed in a system having core2due processor and 2GB RAM.A 256 bit wide message is fed to the OFDM simulator and output is obtained for noisy channel. The result obtained by simulation is shown in figure 5,6,7,8.

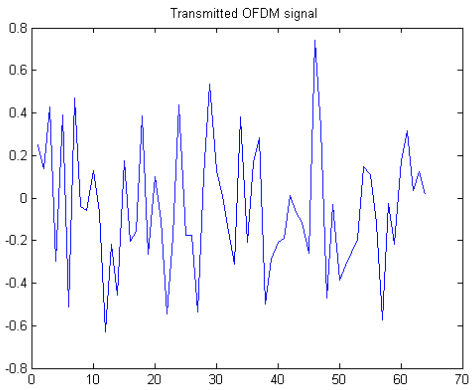

Figure 5 Transmitted OFDM signal

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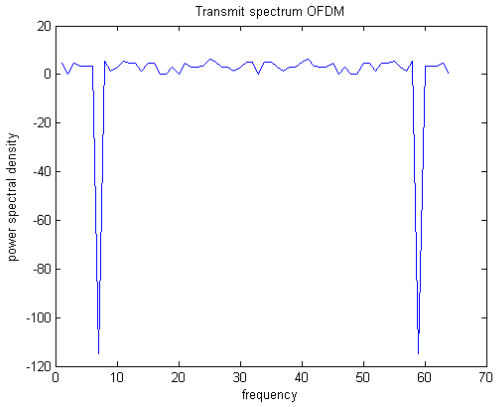

Figure 5 Frequency Spectrum of Transmitted OFDM signal

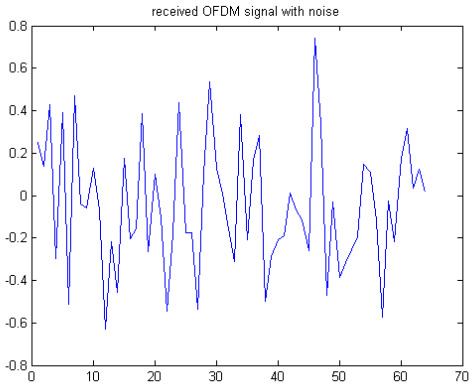

Figure 5 Received noisy OFDM signal

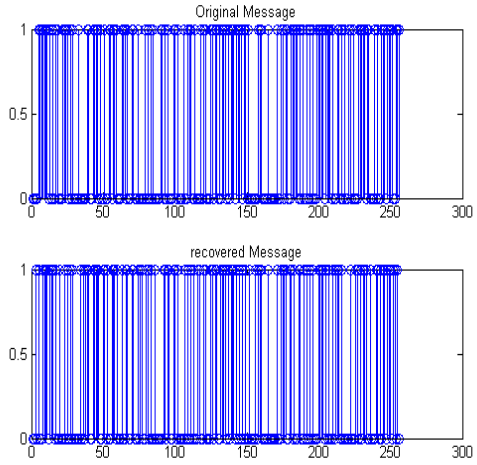

Figure 5 Original signal and recovered signal

The different parameter and its value is shown in Table-1 while Table-2 shows the bit error rate for different SNR.

Table-1 Parameters of Simulation

Parameter	Values
Number of bits to process	256
Number of bits per symbol	4

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Length of Guard Interval	0.8e-8
Carrier Frequency	3.6e9
SNR	20
Total Number of Sub-carrier	64
Noise type	White Gaussian Noise

Table-2 Bit Error for Different SNR

SNR	BER (in %)
10	0.3281
20	0.3281
30	0.3281
40	0.3281
50	0.3281
60	0.3281

V. CONCLUSION

Main aim of this paper is to develop an OFDM system simulation and then testing its performance for noisy channel. From figure 5 -8 , it is clear that the simulation program is able to simulate the OFDM system successfully. From Table-2 it is clear that increasing the noise level of channel does not increase the BER. The result obtained by carrying out the simulation process is matching with the expected result. In this simulation program, 64 subcarrier are used which gives very good spectral response. By designing this system for multipath distortion, clipping etc, a detail analysis of the performance of OFDM can be carried out in future.

References

1] Jigisha N. Patel & Prof.(Mrs.) Upena D Dalal, “A Comparative Performance Analysis of OFDM using MATLAB Simulation with M-PSK and M-QAM Mapping”, International Conference on Computational Intelligence and Multimedia Applications 2007Ding, W. and Marchionini, G. 1997 A Study on Video Browsing Strategies. Technical Report. University of Maryland at College Park.

[2] Wang, Zhengdao, and Georgios B. Giannakis. “Wireless Multicarrier Communications.” *IEEE Signal Processing Magazine* (May, 2000): 29-48.

[3] Mehul Jain and M. Mani Roja, “ Comparison of OFDM with CDMA System in Wireless telecommunication for multipath delay spread,” The 1st IEEE and IFIP International Conference in Central Asia, 26-29 Sept., 2005, Pages 5.

[4]Bernard Sklar, Digital Communication Fundamentals and Applications, Second Edition, Pearson Education, Asia, 2000.

[5] Shaoping Chen and Cuitao Zhu, “ICI and ISI Analysis and Mitigation for OFDM Systems with Insufficient Cyclic Prefix in Time-Varying Channels” IEEE Transactions on Consumer Electronics, Vol. 50, No. 1, February 2004.

[6] M. S. Islam, G. R. Barai, and A.Mahmood, “Perfor-mance analysis of different schemes using OFDM techniques in Rayleigh fading channel,” International Journal of Funda-mental Physics Science, Vol. 1, No. 1, pp. 22-27, June, 2011.

[7] Van Wyk, J. and Linde, L., “Bit error probability for a M-ary QAM OFDM- based system,” in IEEE Trans. On Wireless Comm., , pp. 1-5, 2007.

[8] P. Banelli and S. Cacopardi, “Theoretical analysis and performance of OFDM signals in channels,” IEEE Trans. Commun.,vol. 48, pp. 430–441, Mar. 2000. [9]P. H. Moose, \A technique for orthogonal frequency division mul-tiplexing offset correction", *IEEE Trans. Commun.*, vol. 42, no. 10,pp. 2908{2914, 1994.

[9] A. D. S. Jayalath and C. Tallambura, “Reducing the peak to average power ratio of an OFDM signal by interleaving" in *3rd Int.Symp. Wirel. Pers. Multimed. Commun.*, Bangkok, Thailand, 2000, pp. 698{703.

[10] L. W. Couch, *Digital and Analog Communication Systems*. 6th ed. Singapore: Pearson Education, 2002.

[11] D. A. Wegandt, Z. Wu, and C. R. Nassar, “High through-put, high performance OFDM via pseudo-orthogonal carrier inter-formely spreading codes", *IEEE Trans. Commun.*, vol. 51, no. 7,pp. 1123{1134, 2003.

[12] A. F. Molish, *Wideband Wireless Digital Communications*. Singapore: Pearson Education, 2003, Chapt. 18 and 20.

[13] T. May, H. Rohling, and V. Engels, “Performance analysis of Viterbi decoding for 64-DAPSK and 64-QAM modulated OFDM signals", *IEEE Trans. Commun.*, vol. 46, pp. 182{190, 1998.

[14] D. H. Guo and Ch.-Y. Hsu, \Minimization of the PARP of OFDM by linear systematic block coding", in *Asia-Paci_c Conf. Commun.APCC*, Malaysia, 2003, pp. 129.

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