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# Performance Evaluation of Wireless Communication System Employing DWT-OFDM using Simulink Model

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***Abstract: Advancement in technology has led to unprecedented demand for high speed architectures for complex signal processing applications. In 4G wireless communication systems, bandwidth is a precious commodity, and service providers are continuously met with the challenge of accommodating more users within a limited allocated bandwidth. To increase data rate of wireless medium with higher performance, Orthogonal Frequency Division Multiplexing (OFDM) is used. Recently Discrete wavelet transforms (DWT) is adopted in place of Fast Fourier transform (FFT) for frequency translation. Modulation schemes such as 16-QAM, 32-QAM, 64- QAM and 128-QAM (Quadrature amplitude modulation) have been used in the developed OFDM system for both DWT and FFT based model. In this project work DWT-IDWT based OFDM transmitter and receiver that achieve better performance in terms Bit Error Rate (BER) for AWGN channel is designed performance of the OFDM system by simulating the in examined designed system using MATLAB simulink.***
***Key words: OFDM, DWT, QAM, FFT.***

## I. INTRODUCTION

The communication systems and communication networks of the future will fundamentally improve the way people communicate. One among the services expected to have major impact in the future include wireless communication that will permit mobile telephony and data transfer anywhere on the planet . Delivering and receiving these services to the large and rapidly growing commercial markets has created new technological challenge in signal design, modulation, detection, and signal processing.

## II. METHODOLOGY

### A. *Orthogonal Frequency Division Multiplexing*

For wireless communication systems, limited bandwidth allocations coupled with a potentially large pool of users restrict the bandwidth availability to the users. The success of wirelesses communication systems thus depends heavily on the development of bandwidth efficient data transmission schemes. Wireless multicarrier modulation (MCM-OFDM) is a technique of transmitting data by dividing the input data stream into parallel sub streams that are each modulated and multiplexed onto the channel at different carrier frequencies.

### B. *Fast Fourier Transform Based Ofdm System:*

Orthogonal Frequency Division Multiplexing (OFDM) scheme is based on the multicarrier communications technique. In OFDM the spectra of sub carriers overlap on each other but the frequency spacing between them is selected such that the sub carriers are mathematically orthogonal to each other. shows a block diagram of a basic OFDM system. Discrete Fourier Transform (DFT) efficiently implemented by Fast Fourier Transform (FFT) is used to modulate and demodulate the data constellations on the orthogonal sub-carriers. This base band signal processing algorithm effectively replaces the bank of I/Q modulators and demodulators that would otherwise be required. An OFDM trans-receiver is in the inverse transform block can either be IDWT/IFFT and forward transform block can be DWT/FFT. The data generator used generates a bit stream. It is processed using QPSK or M-ary QAM modulator to map the input data into symbols. These symbols are now sent through IFFT block to perform IFFT operation to generate *N* parallel data streams. Its output in discrete time domain is given by,
The transformed output is now appended with cyclic prefix. The cyclic prefix (CP) is added before transmission, to mitigate ISI effect. It is usually 25% of the last part of the original OFDM symbol and this data is passed through AWGN channel with proper

input power set. At the receiver, the reverse operation is done to obtain the original data back. The CP is removed and processed in the FFT block and finally passed through demodulator for data recovery. The output of the FFT in frequency domain is given by,

$$U_{m(i)} = \sum_{n=0}^{N-1} U_{k(n)} e^{(-j2\pi mi/N)}$$

To generate a base band OFDM symbol, a serial digitized data stream is first channel coded and then modulated using phase shift keying (PSK) or quadrature amplitude modulation (QAM). These data symbols are converted from serial-to-parallel into $N$ data constellation points before modulating the sub carriers using IFFT, where $N$ is the number of IFFT points. The time domain OFDM modulated symbol output of the IFFT is converted back to a serial stream and a guard interval in the form of cyclic prefix is added to each OFDM symbol. The basic pulse shape for the symbols is rectangular which have large bandwidth due to its sinc shaped spectrum. Thus windowing is necessary to reduce the out of band energy of the side lobes. Then the symbol stream is converted to analog form for pass-band processing and transmission.

*C. OFDM Advantages And Disadvantages*

1) *OFDM Advantage:* OFDM has been used in many high data rate wireless systems because of the many advantages it provides.
2) *Immunity to selective fading:* One of the main advantages of OFDM is that is more resistant to frequency selective fading than single carrier systems because it divides the overall channel into multiple narrowband signals that are affected individually as flat fading sub-channels.
3) *Resilience to interference:* Interference appearing on a channel may be bandwidth limited and in this way will not affect all the sub-channels. This means that not all the data is lost.
4) *Spectrum efficiency:* Using close-spaced overlapping sub-carriers, a significant OFDM advantage is that it makes efficient use of the available spectrum.
5) *Resilient to ISI:* Another advantage of OFDM is that it is very resilient to inter-symbol and inter-frame interference. This results fromhe low data rate on each of the sub-channels.
6) *Simpler Channel Equalization*: One of the issues with CDMA systems was the complexity of the channel equalization which had to be applied across the whole channel. An advantage of OFDM is that using multiple subchannels, the channel equalization becomes much simpler
7) *OFDM Disadvantages:* Whilst OFDM has been widely used, there are still a few disadvantages to its use which need to be addressed when considering its use
8) *High Peak To Average Power Ratio:* An OFDM signal has a noise like amplitude variation and has a relatively high large dynamic range, or peak to average power ratio. This impacts the RF amplifier efficiency as the amplifiers need to be linear and accommodate the large amplitude variations and these factors mean the amplifier cannot operate with a high efficiency level.
9) *Sensitive to Carrier Offset and drift:* Another disadvantage of OFDM is that is sensitive to carrier frequency offset and drift. Single carrier systems are less sensitive.

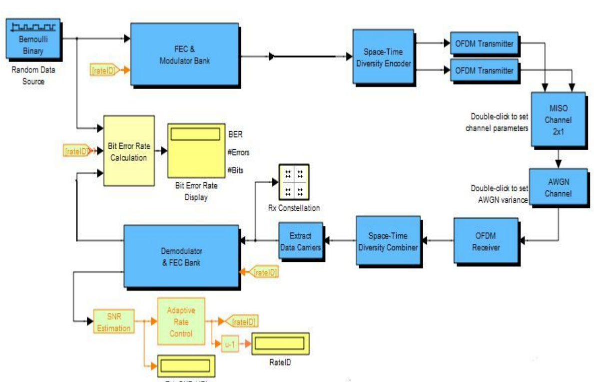


Fig 1.OFDM Physical Link

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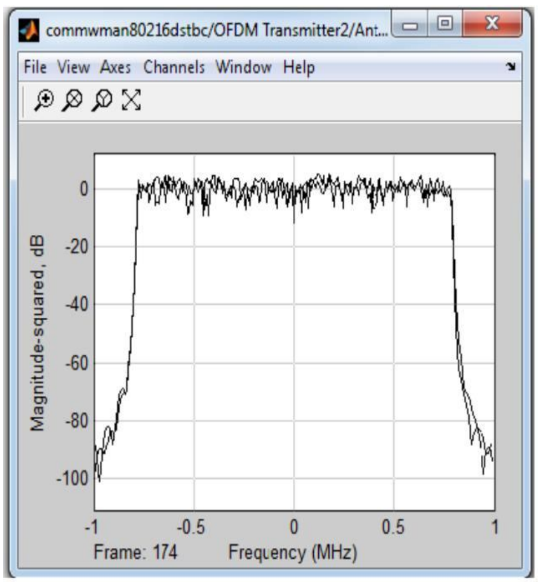
## III. RESULT

In this paper, according to the block diagram and the graph we can conclude that here how we can improve the signal strength and the speed of the signal for the transmission of the signal in the field of the communication of the signal and the use of the net. By the help of this we can improve the signal strength by the help of maintaining the BER of the signal by the introduction of the suitable value in the parameter here in the block diagram of the OFDM Physical Model.

## IV. OUTPUTS



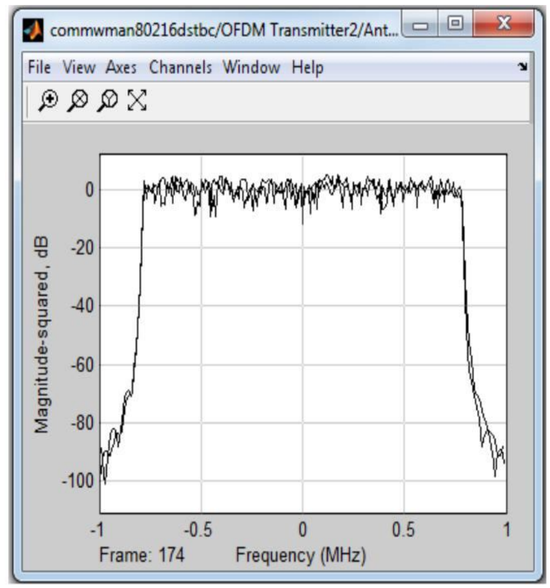
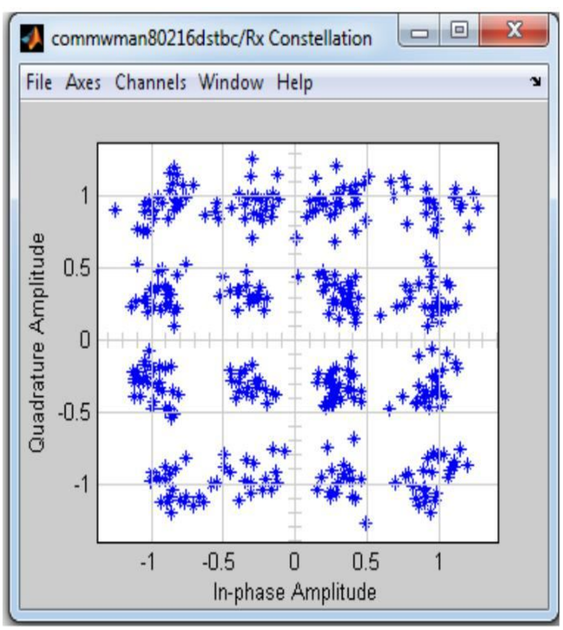




Fig2. Spectrum of T Fig3. Spectrum of Receiver Section



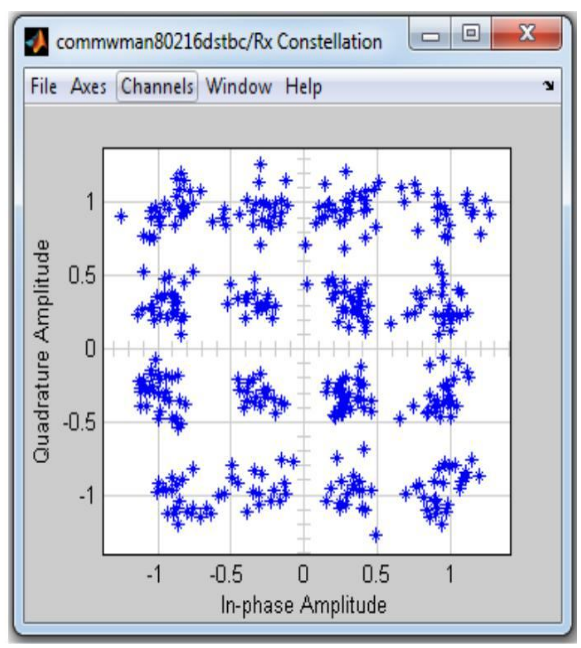




Fig4. Constellation of Transmitter Section

Fig5. Constellation of Receiver Section

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## V. CONCLUSION

In this paper, a base band OFDM scheme, as shown in Fig.1 is implemented in MATLAB-Simulink environment. Both the FFT-based and Wavelet-based MCM schemes are implemented and their comparative performance study is carried out under AWGN channel scenario. The measure of performance used is bit error rate for the given SNR. The implemented model simulates a 64 sub carrier OFDM system. Constellation mapping or message modulation is performed using quadrature amplitude modulation (16-QAM) for FFT and DWT. The Additive White Gaussian Noise (AWGN) channel model is used for this study. As a case study, FFT-OFDM and DWT-OFDM system with 16-QAM modulation is simulated for channel SNR of -5 dB and -7 dB. From the simulated output , it is observed that the performance of DWT-OFDM is superior to FFT-OFDM. In case of FFT-OFDM a BER of 0.5021 is achievable at -5 dB SNR, whereas DWT-OFDM gives BER of 0.49 at -5 dB SNR. For channel SNR of -7dB, for FFT-OFDM a BER of 0.5038 is achievable, whereas DWT-OFDM gives BER of 0.5017.

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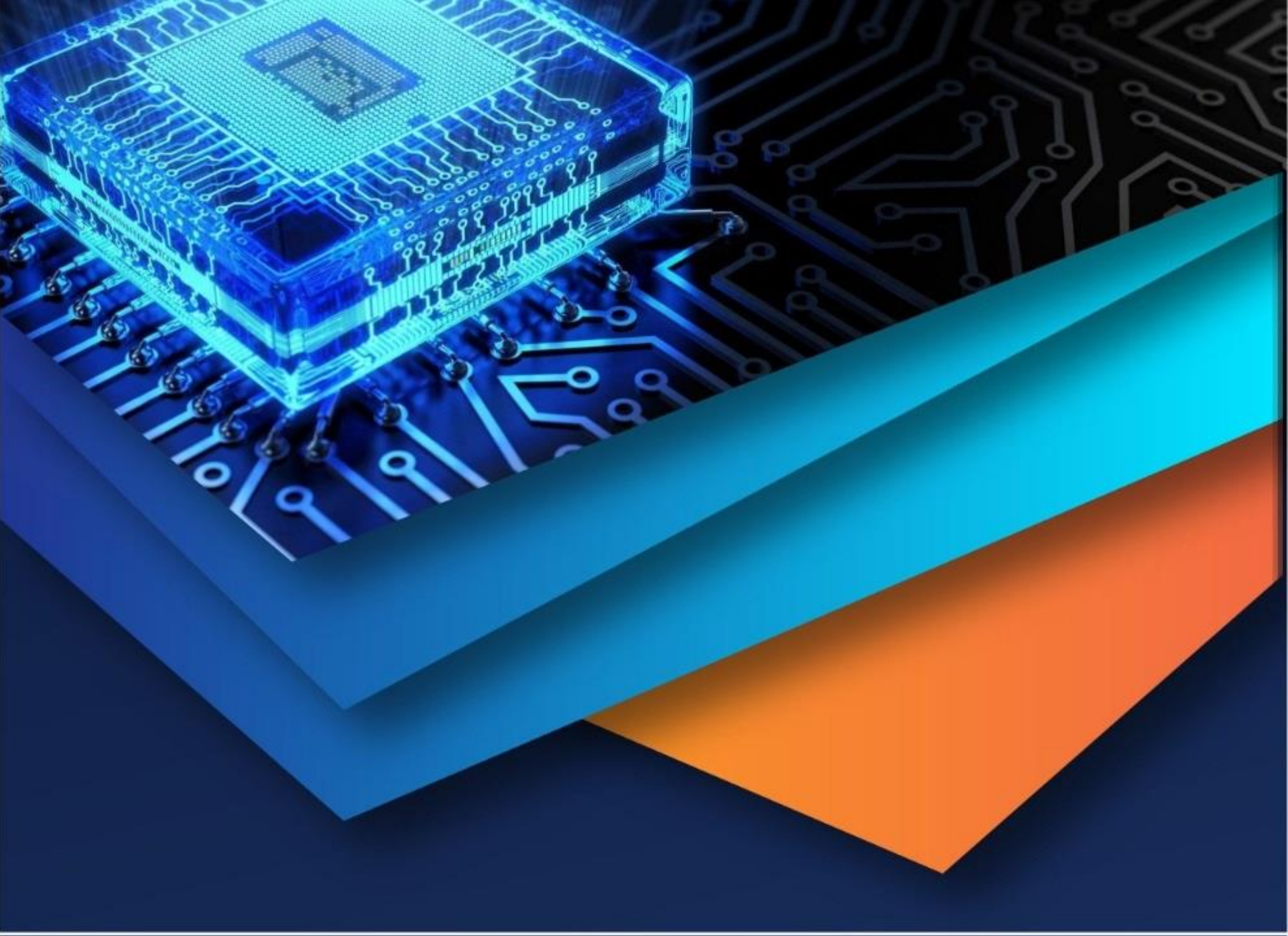


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