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Study On Ber Performance Of Ofdm System

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Abstract- Multicarrier modulation is a form of signal transmission that utilizes multiple carrier. An advantage for multicarrier modulation includes the avoidance of intersymbol interference making it a key in 4G Technology [1]. Multicarrier modulation uses a modulator called the Orthogonal Frequency Division Multiplexing (OFDM) to generate subcarriers that are orthogonal to each other. Orthogonal Frequency Division Multiplexing (OFDM) and Multiple Input and Multiple Output (MIMO) are two main techniques employed in 4thGeneration Long Term Evolution (LTE). The Orthogonal Frequency Division Multiplexing (OFDM) is the popular modulation technique for the many wireless communication systems. In the wireless system, the signal transmitted into channel bounces off from the various surfaces resulting in the multiple delayed versions of the transmitted signal arriving to the receiver. The OFDM has trusted to be very effective in mitigating adverse multi-path effects of a broadband channel. In this paper we study different techniques which are used to enhance the performance of the OFDM system and discuss the author's view for performance of ofdm system.

Keywords: **LTE; OFDM; DFT; Wavelet transform; BER, BPSK, QPSK, QAM,MIMO**

I. INTRODUCTION

The Orthogonal frequency division multiplexing (OFDM) is a wireless communications technique that breaks a communications channel into a number of equally spaced frequency bands. A sub-carrier having a portion of the user information is sanded in each band. Each sub-carrier is the orthogonal (i.e. independent of each other) with other subcarrier; distinguishing OFDM from the commonly used frequency division multiplexing (FDM) technique.

The FDM is a modulation technique that transmits multiple signals simultaneously over a single transmission path. The Orthogonal frequency-division multiplexing (OFDM) is the modulation technique for the European standards such as the Digital Audio Broadcasting (DAB) and the Digital Video Broadcasting (DVB) systems. The Orthogonal frequency-division multiplexing (OFDM) is a process of encoding digital data on the multiple carrier frequencies. The data are transmit over parallel sub-Rates of a conventional scheme with the same bandwidth. The Orthogonal Frequency Division Multiplexing has become one of the main physical layer techniques used in the modern communication systems OFDM and MIMO are the two main techniques used in forth Gen. LTE. OFDM uses multiple carriers and has a higher degree of spectral efficiency than FDM.

ICI and ISI occur in OFDM due to a lack of orthogonality between the subcarriers, and to resolve this issue, CP is needed, which consumes 20% of the available bandwidth. However, we are employing the proposed process.Wavelet-based OFDM offers strong orthogonality, and the Bit Error Rate (BER) is increased when it is used. The spectrum efficiency of a wavelet-based device is improved because it does not require a cyclic prefix. . Wavelet transform (WT) are very powerful compared to Fourier transform (FT) because its ability to describe any type of signals both in time and frequency domain simultaneously while for FT, it describes a

signal from time domain to frequency domain.

II. LITERATURE SURVEY

[1] In this paper the describe the Orthogonal Frequency Division Multiplexing (OFDM) and Multiple Input and Multiple Output (MIMO).Both method are main techniques employed in 4th Generation Long Term Evolution (LTE). In OFDM multiple carriers are used and it provides higher level of spectral efficiency as compared to Frequency Division Multiplexing (FDM). In OFDM because of loss of orthogonality between the subcarriers there is inter carrier interference (ICI) and inter symbol interference (ISI) and to overcome this problem use of cyclic prefixing (CP) is required, which uses 20% of available bandwidth. Wavelet based OFDM provides good orthogonality and with its use Bit Error Rate (BER) is improved. Wavelet based system does not require cyclic prefix, so spectrum efficiency is increased.

They proposed to use wavelet based OFDM at the place of Discrete Fourier Transform (DFT) based OFDM in LTE. They have compared the BER performance of wavelets and DFT based OFDM.[2] "Multi carrier modulation for data transmission: a long-awaited concept." In this paper, Discrete Fourier Transform - OFDM is put back with Multi-wavelets OFDM DMWT-OFDM in order to minimize interference and correct the spectral efficiency to much more. The proposed multi-wavelet planning achieves much lower BER and improves the signal to noise power ratio, according to the findings (SNR), It can be utilized as a substitution for original OFDM. The suggested Orthogonal Frequency Division Multiplexing system was modelled and checked, and its output under various channel conditions was discovered.

[5] "Multi way blurring channels with Altamonte coded wavelet-based OFDM." We estimated the presentation of old style DFT based OFDM and wavelet based OFDM with and without Altamonte coding on multi-way Rayleigh blurring channels with remarkable force defer profiles. In terms of bit error rate, the findings show that WOFDM outperforms conventional OFDM with and with-out Altamonte code. Because of its higher bandwidth availability, WOFDM could be a feasible alternative to conventional OFDM in addition to offering better performance. [6] "A output comparison of conventional and wavelet-based OFDM systems." They compared a DFT-based OFDM system's output bit error rate (BER) and power spectral density to a wavelet-based OFDM system in this paper. When comparing the BER efficiency of DFT and wavelet-based OFDM systems in AWGN and Rayleigh fading networks, wavelet-based OFDM systems outperform DFT. [7] "Wavelets in Digital Wireless Communication: A Review." The aim of this paper was to provide an overview of wavelet applications in wireless communications, highlighting the many potentials and possibilities that wavelets can provide to wireless communications.

[8] "Orthogonally multiplexed communication using wavelet packet modulation." They compare different trans-multiplexer structures in terms of the ISI/ICI that occurs for standard time-invariant channels in this paper. They look at wavelet-type, Gabor-type (which includes OFDM and DMT), and Wilson-type (offset-QAM/OFDM) trans-multiplexers in particular. We publish both theory based outputs (on the basis of a recently introduced perturbation theory of coherent Riesz bases) and numerical simulations.

[9] This paper represents performance evaluation of Bit Error Rate (BER) for conventional (DFT) and wavelet (DWT) based orthogonal frequency division multiplexing (OFDM) with various modulation techniques. There are different modulation schemes such as Binary Phase Shit Keying (BPSK) and Quadrature Phase Shift Keying (QPSK). The performance in between these modulation techniques is evaluated and analyzed to obtain lowest possible Bit Error Rate (BER) to be transmitted. Simulation is performed on the software named MATLAB.

[10] In recent year the orthogonal frequency division multiplexing widely used in wireless communication system, the conventional structure of OFDM used Inverse Fast Fourier Transform for modulation and multiplexing the data at the transmitter side and used Fast Fourier Transform at the receiver to demodulation and demultiplexing the data. In this paper, Inverse Wavelet Transform IWT used in transmitter instead of IFFT and Wavelet Transform WT in receiver side instead of FFT and compared between two methods with different noise in the AWGN channel. The performance found by bit error rate BER. Also different modulation scheme have been used (16-QAM, 32-QAM, 64-QAM and 128-

QAM) and different types of wavelet filters Daubechies (Db-3, Db-5, Db-8, Db-10) and Haar filter. [11]In OFDM multiple carriers are used and it provides higher level of spectral efficiency as compared to Frequency Division Multiplexing (FDM). In OFDM because of loss of orthogonality between the subcarriers there is inter carrier interference (ICI) and inter symbol interference (ISI) and to overcome this problem use of cyclic prefixing (CP) is required, which uses 20% of available bandwidth. Comparison between the conventional FFT based OFDM systems with DW T based OFDM system have been made according to some conventional and non-conventional modulation methods over AW GN. The wavelet families have been used and compared with FFT based OFDM system and found that DWT based OFDM system is better than FFT based OFDM system with regards to the bit error rate (BER) performance.

[12] In this paper, an efficient technique for the OFDM system using wavelet transform is proposed. This system shows a superior performance when compared with traditional OFDM-FFT systems through an Additive White Gaussian Noise (AWGN) channel. The system performance is described in Bit Error Rate (BER) as a function of Signal to Noise Ratio (SNR) and the peak-to-average ratio (PAR). Furthermore, the proposed system gives nearly a perfect reconstruction for the input signal in the presence of Gaussian noise.

[13]In this paper they proposed to use singular wavelet transform (SWT) in OFDM based LTE because the SWT based system does not require a cyclic prefix, so spectrum efficiency is increased. SWT is used to analyze signals by the coefficients of SWT in both time and frequency domain. In order to investigate the bit error rate performance a practical channel model is required. Many channel models are proposed to mimic a real world scenario. Out of which Stanford university interim (SUI) channel provides best results so we replaced AWGN channel with SUI channel.

We investigated the performance of bit error rates of SWT based OFDM in LTE for different modulation techniques such as QPSK, 64 QAM, 128 QAM under SUI 3 Channel model using SWT based haar and db2 transform. BER is reduced by 2 times when compared to the existing system. [15] In this paper, the Fast Discrete Curvelet Transform (FDCT) is proposed for OFDM in order to reduce the PAPR. In terms of PAPR, the results show that both transforms used in this work gives better PAPR results, FDCT via USFFT and FDCT via Wrapping are given approximately about 7.7 dB reduction compared to traditional OFDM. Moreover, the results show that the BER performance of the considered system nearly matches the theoretical BPSK BER performance in an Additive White Gaussian Noise (AWGN) channel.

[16] Other than the conventional fast Fourier transform (FFT) for multicarrier modulation, a new approach for multicarrier modulation (MCM) has been known. Meanwhile, multicarrier modulation involves dividing the broadband channel into many orthogonal but overlapping narrowband carriers. In an OFDM modulation based multicarrier system using the FFT, a cyclic prefix (CP) is inserted after each symbol frame to combat the effects of inter symbol interference (ISI). By inserting the CP, which results in spectral inefficiency OFDM schemes trades up to 25% of the transmit bandwidth. A new MCM approach that is void of the expense is the wavelet transform-based systems.

These systems also have very suppressed side-lobes and exhibit improved BER performance. In wavelet based systems, the latest challenge in its implementation is in the channel estimation. In this work we have studied the performance of the FFT based OFDM system against wavelet transform (WT) based multicarrier system using a simple zero forcing (ZF) equalization in time domain. The studied system shows some improved BER performance.

[19] "Compressed Sensing Algorithms for SISO-OFDM Channel Estimation", The BER performance of the SISOOFDM system channel estimation is analyzed. OFDM is a multicarrier technology with high data rate and low interference, used in many 4th generations (4G) and 5th generation (5G) wireless systems like LTE, LTEA, WiMAX and several Wi-Fi and WLAN standards. OFDM is mainly used for reducing the inter symbol interference (ISI) effect in a wideband channel. By increasing the symbol time, the effect of the delay spread reduces which helps in reducing the ISI. Compressive sensing techniques are used to retrieve the transmitted information bits using the optimization technique of Orthogonal Matching Pursuit (OMP) and norm minimization.

[20] Estimation of Underwater Acoustic MIMO-OFDM Channel Based on Compressed Sensing,

Underwater acoustic (UWA) channel estimation is crucial for underwater acoustic communications. In this paper MIMO-OFDM system is applied in shallow water acoustic communication. The channel estimation is based on compressed sensing (CS) theory due to the sparse characteristic of UA channel.

[21] Time domain synchronous OFDM system for optical fiber communications A spectrum efficient OFDM scheme named Time Domain Synchronous-OFDM (TDS-OFDM) is introduced into coherent optical transmission system, in which the pseudo noise (PN) sequence is exploited as guard interval to realize frame synchronization, compensate the carrier frequency offset (CFO), and estimate and equalize channel simultaneously. Since there is no pilot signals or training symbols in TDS-OFDM, the proposed scheme can achieve higher spectral efficiency (SE) above 10% improvement comparing with CP-OFDM.

The proposed method is implemented and verified in a 28GBaud QPSK OFDM system and a 28GBaud 16QAM OFDM system. It is demonstrated that the proposed scheme shows high CFO estimation accuracy and synchronous accuracy. Under CFO and line width of laser source set as 100MHz and 100kHz respectively, BER of QPSK OFDM system is below 3.8e-3 at the optical signal-to-noise ratio (OSNR) of 13dB, and BER of 16QAM OFDM system is below 3.8e-3 at the OSNR of 20dB.

[22] Multirate 5G Downlink Performance Comparison for f-OFDM and wOFDM Schemes with Different Numerologies ,One of the main open problems for next generation wireless networks, is to find the new OFDM-based waveform to be used in 5G. The new modulation scheme must primarily be able to achieve higher spectral efficiency than its predecessor. In this paper they compare classic OFDM signals using Cyclic Prefix (CP-OFDM) with f-OFDM and w-OFDM, each one with multiple parametric options and numerologies. A multirate transmitter simultaneously operating with multiple numerologies is considered, where the transmitted sub-bands must be up sampled and interpolated in order to generate the composite numerical signal fed to the Digital to Analog Converter (DAC). Finally, we discuss advantages and disadvantages of the various schemes.

[23] A comprehensive study of universal time-domain windowed OFDM-based LTE downlink system , For the 5G system and beyond, several new-waveforms with low out-of-band emission (OOBE) have been proposed to improve spectral efficiency. The universal time domain windowed OFDM (UTW-OFDM) have been proposed as a waveform that has the low OOBE characteristics and high compatibility with the conventional cyclic prefix OFDM (CP-OFDM)-based systems. To indicate the feasibility of the UTW-OFDM-based system in the 5G and beyond, the comprehensive evaluation of the UTW-OFDM-based LTE system is important, however, the evaluation of the UTW-OFDM-based

LTE system complexity has been not reported. Furthermore, the communication quality of the UTW-OFDM-based LTE system was evaluated by using BER characteristics on the short delay multipath propagation channel in the previous studies. In this paper, to show the feasibility of the UTW-OFDM for the 5G and beyond, the complexity of the UTW-OFDM-based LTE downlink (DL) system is evaluated and compared with one of the LTE-DL system with the conventional CPOFDM and the filtering-based waveform (UF-OFDM).

The complexity of the conventional CP-OFDM-based system and the UTW-OFDM-based system is about 0.45 % of the complexity of the UF-OFDM-based system. Furthermore, the communication quality of the UTW-OFDM-based LTE-DL system is evaluated by using BLER on the 3GPP Extended Typical Urban (ETU) channel model with the 70 Hz Doppler shift. The UTW-OFDM-based LTE-DL system can improve the OOBE of the conventional CP-OFDM-based LTE-DL system by 45 dB with only 2.0 dB deterioration of EN 0 to achieve BLER = 10 -1 even if the 64QAM is applied with a half coding rate.

[24] Channel estimation for sparse channel OFDM systems using least square and minimum mean square error techniques Published in: 2017 International Conference on Engineering and Technology (ICET)

Orthogonal Frequency Division Multiplexing (OFDM), is a kind of signal modulation that divides a high data rate modulating stream and locates them onto several modulated narrowband channels called sub-carriers. Therefore, signal will be less sensitive to frequency selective fading. Channel estimation is used for increasing the capacity of orthogonal

frequency division multiple access (OFDMA) systems by improving the system performance in terms of bit error rate. OFDM pilot-based channel estimation is applied in this paper. Channel tracking and channel estimation techniques must be employed at the receiver side of the OFDM system. Channel estimations require channel state information in order to decode the data. In this paper, a proposed Least square (LS) method is considered for sparse channels. Channel coefficients for OFDM are estimated by applying this method and Minimum Mean Square Error (MMSE) method. Results show that the performance of MMSE technique is better than LS method. It is found that the LS method for sparse channel gives lower bit error rate than the general LS method.

[25] Performance analysis of direct detection Flip-OFDM for VLC system Published in: 2016 International Conference on Emerging Trends in Engineering, Technology and Science (ICETETS)

In recent years researchers have shown that Orthogonal frequency division multiplexing (OFDM) is also a promising technology for optical wireless communications (OWC). In this paper we evaluate the performance of direct detection Flip-OFDM with different mapping schemes in indoor OWC, visible light communication (VLC). Three OFDM techniques, namely, DC-clipped optical OFDM (DCO-OFDM), asymmetrically clipped optical OFDM (ACO-OFDM) and flip OFDM are discussed. The performance of M-QAM and M-PSK mapping schemes in Flip-OFDM are studied using simulation results.

III. CONCLUSION

In a wireless communication system, the signal is conveyed by countless with various qualities and deferrals. Such multipath scattering of the signal is normally alluded as channel-prompted bury image obstruction (ISI).truth be told, the multipath scattering prompts to an upper impediment of the transmission rate keeping in mind the end goal to dodge the frequency selectivity of the channel or the need of a complex versatile evening out in the receiver. Keeping in mind the end goal to alleviate the time dispersive nature of the channel, single-carrier serial transmission at a high data rate is succeeded with various slower parallel data streams. As per the Convectional orthogonal frequency division Multiplexing is concerned we were facing issue in the accuracy of the output but with help of Wavelet Based multiplexing the issue is resolved and the accuracy as efficiency is increased. By studying different paper we can say that by using wavelet transform rather than convectional FFT modulation using OFDM techniques enhance the performance of system. Wavelet transform (WT) are very powerful compared to Fourier transform (FT) because its ability to describe any type of signals both in time and frequency domain simultaneously while for FT, it describes a signal from time domain to frequency domain. The discrete wavelet transform has a huge number of applications in science, engineering, and mathematics and computer science. Most notably, it is used for signal coding, to represent a discrete signal in a more redundant form, often as a preconditioning for data compression.

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