Performance Analysis of Wavelet Based OFDM in LTE

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ABSTRACT

Long term Evolution (LTE) is a noteworthy undertaking of third Generation Partnership Project, as a move from the third generation (3G) to the fourth generation(4G), has accomplished incredible limit and fast of cellular phone systems without uncertainty. Orthogonal Frequency Division Multiplexing (OFDM) is principal procedure utilized in fourth Generation Long Term Evolution (LTE). Inter Carrier Interference (ICI) and Inter Symbol Interference (ISI) are both problems occur in OFDM due to the loss of subcarrier orthogonality and to defeat this issue utilization of Cyclic Prefixing (CP) is required, which utilizes 20% of available data. usually, OFDM is executed utilizing FFT, then again OFDM can be implemented utilizing orthogonal wavelets. Regardless of the way that are execution of the OFDM structure absolutely a couple inconvenience. One of the genuine drawbacks is the high Peak to Average Power Ratio (PAPR) which realize broad measure of sub-transporters that make controls for possible applications. Partial Transmit Sequence and clipping are some PAPR diminish techniques that have been proposed to defeat this issue.

Keywords— Bit Error Rate (BER); Long Term Evolution (LTE); Orthogonal Frequency Division Multiplexing; Peak to Average Power Ratio ; Partial Transmit Sequence.

I. INTRODUCTION

An arrangement of prerequisites is indicated for fourth generation of cell frameworks by International Telecommunication Union Radio correspondence Sector (ITU-R). The prerequisite of information rate was indicated in International Mobile Information Transfers Advanced task (IMT-Advanced). Third generation Partnership Project (3GPP) was built up in1998 [1] and dealing with the LTE task to characterize the Radio Access Network (RAN) and center system. 3GPP's possibility for 4G was LTE-Advanced. OFDM is one of the fundamental methods utilized in LTE to improve the information rate. The primary LTE prerequisites exhibitions are: Peak information rate for 20MHz range uplink is 50Mbps and downlink is 100Mbps. Mobility boost up to 500kmph yet streamlined for low speeds from 0 to 15 kmph. Control plane inactivity which is under 100ms for unmoving to dynamic. User plane inactivity which is under 5ms. Control plane limit is more noteworthy than 200 clients for every cell for 5MHz range. Coverage (cell size) is 5 to 100 km with slight debasement of 30km.Spectrum adaptability 1.25, 2.5, 5, 10, 15 and 20MHz individually.

II. LITERATURE REVIEW

Holma et al [2] presented about LTE that LTE is the successor advancement of UMTS and also of CDMA 2000. The rule goal of LTE is to give a high data rate, low absence of movement and bundle enhanced radio access advancement supporting versatile exchange speed courses of action. Same time its framework building has been laid out with the goal to support group traded development with reliable flexibility and unprecedented nature of organization. LTE is basic since it will raise to 50 times execution change and much better unearthly capability to cell systems

Kanupriya Singh et al [3] provides information about evolution of various generations of wireless mobile communications. LTE is familiar with get higher data rates, 300 Mbps top downlink and 75 Mbps top uplink. In a 20 MHz transporter, data rates past 300Mbps can be expert under awesome sign conditions.

H.G. Myung et al [4] presented about Future cellular systems employ single carrier frequency division multiple access (SC FDMA), a modified version of orthogonal FDMA (OFDMA), for high data rate uplink communications. Similar throughput performance and general complexity exist between SC-FDMA and

OFDMA. One of the main benefits of SC-FDMA is that its peak-to-average power ratio (PARR) is lower than that of OFDMA.

Reference [5] presents the demands for a high peak transmission rate, spectrum competency, and numerous channel bandwidths strongly influence how the LTE physical layer (PHY) is designed (1.25-20 MHz). Orthogonal frequency division multiplex (OFDM), as the foundation for the PHY layer, was chosen to meet these requirements.

These conditions are refined by multi-transporter change and among them Orthogonal Frequency Division Multiplexing (OFDM) is generally able. So, LTE has clutched this multicarrier OFDM as its downlink range framework. This is the prima block of OFDM transmission.

III. EXISTING METHOD

The implementation and assessment of different revising codes utilizing Quadrature Phase Shift Keying (QPSK) and Quadrature amplitude modulation (QAM) regulation plan [6-7] and the BER execution was measured for an Additive White Gaussian Noise (AWGN) channel. MIMO correspondence (different information diverse yield) frameworks utilized different radio wires at either the transmitter or beneficiary (gathering of receiving wires) in remote correspondence structures and the DFT-based OFDM implementation used haar, db2, and coif2 wavelets to operate in a variety of channel conditions. [8-9].

In remote correspondence frameworks recommendation, the wavelets require basic appropriateness, by methodology for channel portrayal, deterrent change, heading then multiplexing, diverse access correspondence, Ultra-Wide-band (UWB) correspondence, subjective radio and teaming up in a similar manner. The Discrete Wavelet Transform (DWT) is discarded in a strategy for sign handling offers, such as by method for video weight, Internet exchanges weight, despite location attestation as well as numerical study [10]. To enhance the channel farthest reaches of remote correspondence framework by the execution of Multiple-Input and Multiple-Output of the OFDM game plan.

IV. PROPOSED METHOD

A. LTE SCHEME

Long term evolution (LTE) is the last stroll toward the fourth time frame (4G) of radio advances proposed to create the cutoff and rate of telephone systems. For the downlink transmission, LTE has evolved into Orthogonal Frequency Division Multiplexing. A section-based PAPR lowering algorithm for LTE OFDMA frameworks is shown in Figure 1. The discrete wavelet Transform (DWT) converts signal into rehash territory signal.

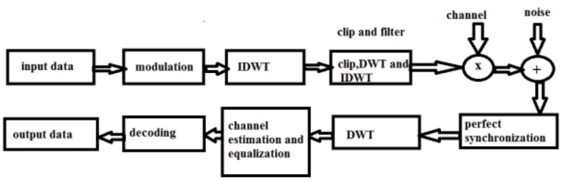

Figure 1: Block Diagram of a LTE OFDM System

The in-band rehash zone signs are gone to the second rearrange DWT (IDWT) while out of band sign parts are invalid. Along these lines it doesn't makes check /the in-band OFDM signal. Duplication results display that the ampleness cutting method is decreased PAPR in a general sense which diminishes as the measure of catch and disengaging level is amplified. As an outcome, develop the mean transmit control, and re design the power enhancer ability. This goes to the disadvantage of multifaceted nature, capacity furthermore cost.

B. PAPR REDUCTION TECHNIQUE

The PAPR definition imparts that the quick yield of an OFDM structure routinely has tremendous changes stood out from common single-transport frameworks. For example power speakers, A/D converters and D/A converters, must have enormous direct part extends. In the unlikely event that this is not done, the top sign enters the transmitter's non-direct area, causing strong out-of-band radiation and causing distortion between the events[11-13]. Theoretically, clearing peaks in OFDM structure can be granted as PAPR. It is depicted as:

$$PAPR = P_{peak} \div P_{average}$$
$$= 10\log_{10} [Max[[X_n]^2] \div E[X_n]^2] \qquad (1)$$

Where P_{peak} is the maximum output power
$P_{average}$ stands for average output power

The transmitted OFDM signals are represented by X_n.

$$X_n = 1/\sqrt{N} \sum_{K=0}^{-1} X_K W_N^{nk} \quad (2)$$

The essential rational issue including OFDM change is high PAPR. High PAPR results from the method for the modification itself where various sub-carriers are incorporated to outline the sign to be transmitted. Peak power requirements need the use of power intensifier devices and high-power, low-productivity (A/D) converters, ranging from the simple to the sophisticated.

This PAPR is declines as the quantity of clasp and separating is expanded from one to four levels. Since the clipping is trailed by separating to lessen out of band power [14-16]. The DWT change the cut sign into frequency area signal. While out-of-band sign components are invalid, the in-band frequency space signs are transferred to the second IDWT. Along these lines it doesn't causes obstruction to the in-band OFDM signal. The plentiful ness clipping is straightforward technique with negligible figuring multifaceted nature.

C. PARTIAL TRANSMIT SEQUENCE

Orthogonal frequency division multiplexing (OFDM) systems commonly use Partial Transmit Sequence (PTS) to lower the Peak-to-Average Power Ratio (PAPR).

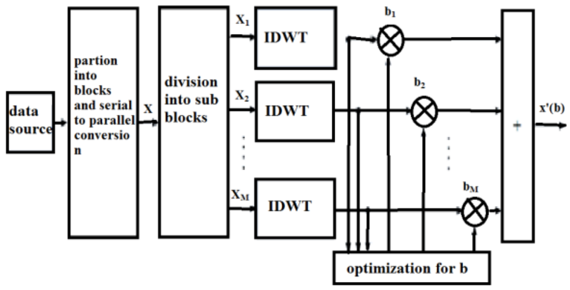

Figure 2: Partial Transmit Sequence

Before communicating the signal, The PTS approach divides an input data block of N symbols into disjoint subblocks. Technique involves partition of data block of N symbols $X=[X_0,X_1....X_{N-1},]$ into disjoint subsets M and then taking individual IDWTs as $x_m=[x_m,0,x_m,1.....,x_m,N-1]$ $T_m=1,2,3.....m$. The first step is to split the original OFDM signal into a number of subblocks. The second step is to multiply each subblock by a phase factor, and the phase-rotated subblocks are added in the third stage to provide a number of potential signals. The lowest PAPR signal among these candidates is then chosen for transmission. The above-generated disjoint subsets are multiplied with the phase rotation vectors b1, b2, b3, ..., b_M. At this point, phase optimization methods can be used to reduce the signal's PAPR. There are many different techniques outlined. Subblock partitioning can be done in three different ways: neighboring, interleaved, and pseudo-random. After multiplying with various phase rotation vectors, the disjoint sub blocks are then added prior to the transmission. Thus, the candidate signal is given by

$$x^c = \sum_{m=1}^{M} b_m^c \, x_{m,} = [x_0^c x_1^c x_2^c \ldots\ldots\ldots\ldots\ldots, x_{N-1}^c]^T \quad (3)$$

where c=1,2,3…………C

V. RESULTS

It is shown from figure 3, figure 4, and figure 5 that BER vs SNR for DWT and DFT for different modulations namely QPSK, 16-QAM and 64- QAM is performed in which DWT performs better compared to DFT. Figure 6 shows BER and SNR performance between DWT and FFT in LTE system for multipath channel using Partial Transmit Scheme where DWT shows better performance than FFT. PAPR performance between DWT and FFT is obtained for multipath channel in LTE using PAPR reduction scheme namely Partial Transmit Sequence depicts in Figure 7. By using Partial Transmit Sequence for multipath channels in LTE system, the Peak to Average Power Ratio is decreased in DWT compared to FFT. From Figure 7 PAPR for DWT is 8.78dB and for FFT it is 12.45dB.

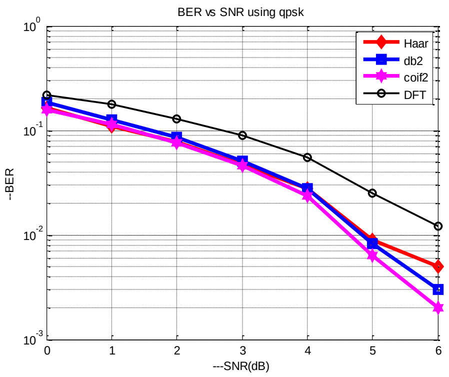

Figure 3: BER vs SNR using QPSK Modulation

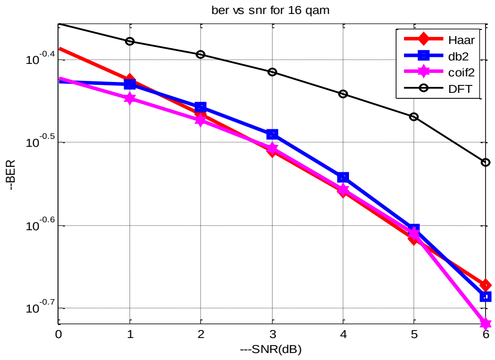

Figure 4: BER vs SNR for 16-QAM Modulation

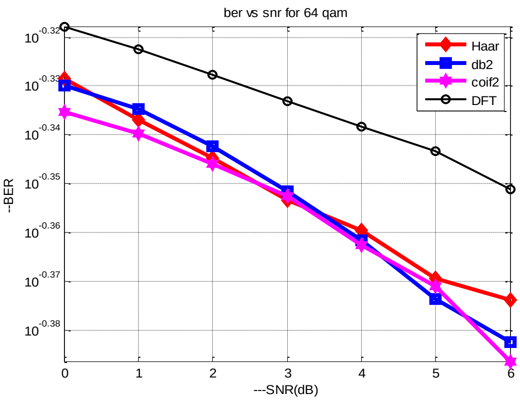

Figure 5: BER vs SNR for 64-QAM Modulation

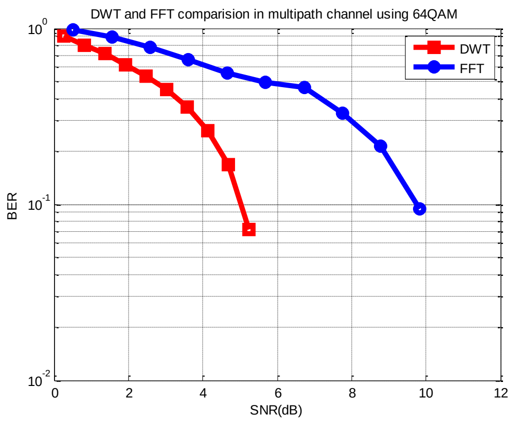

Figure 6: BER vs SNR performance between DWT and FFT in LTE system for multipath channel using PTS scheme

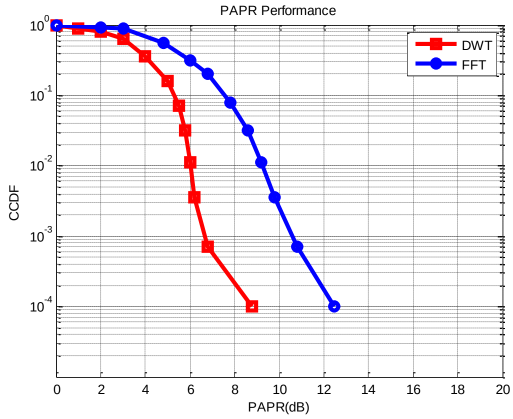

Figure 7: PAPR comparison between DWT and FFT for PTS scheme in LTE system for multipath channel

VI. CONCLUSION & FUTURE SCOPE

The performance of the DFT-based OFDM system was compared to the performance of the wavelet-based OFDM system. It is evident from the performance curve that for the three LTE-compatible modulation schemes, QPSK, 16 QAM, and 64 QAM, wavelet-based OFDM outperforms when compared to DFT-based OFDM. Three wavelet forms, namely coif2, daubechies2, and haar wavelets, are utilized in wavelet-based OFDM. All three offer the best results at various SNR intervals. Successful PAPR diminishment arrangement is one which diminishes the PAPR to least without affecting much to the execution besides with low utilization cost. The Partial Transmit Sequence, which is used to reduce PAPR, exhibits better benefits. Also the DWT utilized as a part of PAPR lessening in LTE demonstrates better results contrasted with DFT. Wavelet-based OFDM is more appealing in LTE systems when all the aforementioned advantages are taken into account.

The cell coverage will decrease as one moves up into the millimeter-wave spectrum, but the loss of coverage will be made up for by increased data speeds and a denser network. So, in the present scenario, implementation of 5G can be possible with the use of OFDMA and/or Digital Fourier Transformation - Spread - OFDMA (DFT-S-OFDMA) for the uplink and orthogonal frequency division multiple access (OFDMA) for the downlink.

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