A Novel Ber Analysis Approach For Different Modulation Schemes For Conventional And Wavelet Based Ofdm System

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Abstract

Orthogonal Frequency Division Multiplexing is considered as an advanced communication model which has wide range of applications such as 3G, 4G, and Wi-Fi etc. Comparing with Frequency Division Multiplexing (FDM), we are providing a higher level of spectral efficiency by using the OFDM Multiple Carriers. To overcome the problems of the Inter carrier interference (ICI) and inter symbol interference (ISI), using of the cyclic prefix which uses the available bandwidth of 20% for the loss of the Orthogonality between the sub carriers in OFDM. Providing of better Orthogonality which is based on the wavelet of OFDM and improving of BER (Bit Error Rate) is also used in it. Increasing of the spectral efficiency we doesn't require the cyclic prefix which is based on the wavelet system. In the upcoming of the 4th generation LTE, using of wavelets in place of Discrete Fourier Transform (DFT) based OFDM is proposed. Using of the wavelets and DFT based OFDM Systems we have compared the performance of the BER.

KEY WORDS: Inter carrier interference (ICI) and inter symbol interference (ISI), cyclic prefix

I. INTRODUCTION

LTE-Advanced also known as 4G wireless networks and it is an evolution of LTE Rel-8. IMT-Advanced (International Mobile Telecommunication-Advanced) refer to a family of mobile wireless technologies, which is also known as 4G. In 2010, LTE-Advanced/4G is ratified as IMT-Advanced technology. It will allow the cellular provider to complement their 3G services by offering higher data rates, lower latency and packet –based network. The standard for LTE was first published in 2005 as Rel-6 by 3GPP (third generation partnership project) since then LTE-Advanced standard been in development and finally in March 2009 it was finalized by 3GPP. Table 1 provides an overview of LTE-Advanced items and its requirements. There are significant amount of improvement that were made to be qualified as LTE Advanced.

To improve the user experience 3GPP is considering various aspects which include higher order MIMO, carrier aggregation, and a deployment strategy called heterogeneous network. Het Net combines macro-cell, microcell, relays, Pico-cell, and Femto-cell deployment in a single cell to increase spectral efficiency per unit area. It will also provide better broadband experience in a cost effective manner to users .

The 4G technology can also significantly increase the spectral efficiency by adapting carrier aggregation that supports the bandwidth from 1.4MHz to 20MHz. In carrier aggregation multiple component carriers can be jointly used for transmission to/from user equipment. It is done such a way that it will be compatible with the previous releases of LTE.

The fourth generation (4G) of wireless cellular systems has been a topic of interest for quite a long time, probably since the formal definition of third generation (3G) systems was officially completed by the International Telecommunications Union Radio communication Sector (ITU-R) in 1997. A set of requirements was specified by the ITU-R regarding minimum peak user data rates in different environments through what is known as the International Mobile Telecommunications 2000 project (IMT-2000). The requirements included 2048 kbps for an indoor office, 384 kbps for outdoor to indoor pedestrian environments, 144 kbps for vehicular connections, and 9.6 kbps for satellite connections.

With the target of creating a collaboration entity among different telecommunications associations, the 3rd Generation Partnership Project (3GPP) was established in 1998. It started working on the radio, core network, and service architecture of a globally applicable 3G technology specification. Even though 3G data rates were already real in theory, initial systems like Universal Mobile Telecommunications System (UMTS) did not immediately meet the IMT- 2000 requirements in

their practical deployments. The combination of High Speed Downlink Packet Access (HSDPA) and the subsequent addition of an Enhanced Dedicated Channel, also known as High Speed Uplink Packet Access (HSUPA), led to the development of the technology referred to as High Speed Packet Access (HSPA) or, more informally, 3.5G.

II. MOTIVATION

Motivated by the increasing demand for mobile broadband services with higher data rates and Quality of Service (QoS), 3GPP started working on two parallel projects, Long Term Evolution (LTE) and System Architecture Evolution (SAE), which are intended to define both the radio access network (RAN) and the network core of the system, and are included in 3GPP Release 8. LTE/SAE, also known as the Evolved Packet System (EPS), represents a radical step forward for the wireless industry that aims to provide a highly efficient, low-latency, packet-optimized, and more secure service. The main radio access design parameters of this new system include OFDM (Orthogonal Frequency Division Multiplexing) waveforms in order to avoid the inter-symbol interference that typically limits the performance of high-speed systems, and MIMO (Multiple-Input Multiple-Output) techniques to boost the data rates. At the network layer, an all-IP flat architecture supporting QoS has been defined.

III. PROPOSED METHOD

In this paper we have compared the performance of wavelets based OFDM system with performance of conventional OFDM system

for different LTE modulation techniques. For wavelet based system we have used daubechies2 and haar wavelets. Additive White Gaussian Noise (AWGN) channel is used for transmission. The paper is organized as first of all the conventional OFDM system and wavelet based OFDM system. The proposed wavelet based OFDM design is presented and then the performance evaluation and the results obtained from the simulation are discussed and Conclusion is summarized.
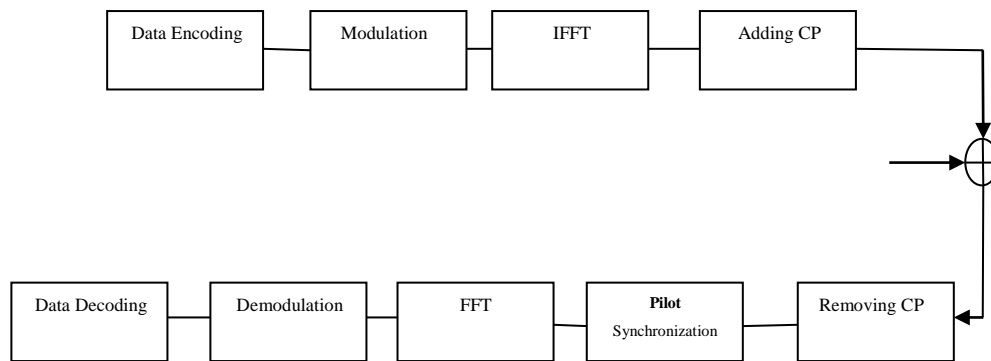

Figure 1: DFT based OFDM transmitter and receiver

A) Conventional Ofdm System

For typical OFDM system sinusoids of DFT type associate orthogonal basis perform set. In DFT the remodel correlates its signaling with every of curving basis perform , here orthogonal basis functions are the subcarriers utilized in OFDM. At the receiver the signals are combined to get the information transmitted. much, quick Fourier remodel (FFT) and Inverse quick Fourier remodel (IFFT) are used for the implementation of the OFDM system as a result of less range of computations needed in FFT and IFFT. Multiple replicas of the signal are received at the receiver finish attributable to the time dispersive nature of the channel, thus frequency selective fading results and to scale back this interference guard interval is used that is termed cyclic prefix. Cyclic prefix is copy of the some fraction of image finish. As long because the channels delay unfold remains among the limit of the cyclic prefix there would not be any loss in Orthogonality.

For LTE, in the downlink information of various users is multiplexed in frequency domain and access technique is termed Orthogonal Frequency Division Multiple Access (OFDMA) . within the transmission of the LTE access technique used is Single Carrier-Frequency Division Multiple Access (SC-FDMA). High Peak Average Power quantitative relation (PAPR) happens because of random constructive addition of subcarriers and leads to spectrum spreading of signal resulting in adjacent channel interference. So power linearization techniques and compression purpose electronic equipment got to be wont to overcome this downside. These strategies are often implemented at base station (BS), however ar high-priced to implement at user instrumentality (UE).

Thus LTE uses SCFDMA with cyclic prefix on transmission, which is able to end in reduction of PAPR attributable to the presence of

single carrier. Due to single carrier modulation impact of Inter-Services Intelligence are high in uplink and to beat from its impact low complexness equalizer are needed however SC-FDMA isn't sensitive to frequency offset and propagation.

B) Wavelet Based Ofdm System

Wavelet rework could be a tool for analysis of the signal in time and frequency domain together. it's a multi resolution analysis mechanism wherever signal is rotten into completely different frequency elements for the analysis with explicit resolution matching to scale . Using any explicit sort of ripple filter the system will be designed in line with the necessity and additionally the multi resolution signal will be generated by the utilization of wavelets. By the utilization of varying ripple filter, one will style waveforms with selectable time/frequency partitioning for multi user application .

Wavelets possess higher Orthogonality and have localization each in time and frequency domain. Because of good Orthogonality wavelets area unit capable of reducing the power of the international intelligence agency and ICI, which ends from loss of Orthogonality. To cut back international intelligence agency and ICI in typical OFDM system use of cyclic prefix is there, that uses 2 hundredth of available information measure, therefore leads to information measure unskillfulness however this cyclic prefix isn't needed in ripple primarily based OFDM system. quality also can be reduced by victimization ripple transform as compared with the Fourier rework as a result of in wavelet quality is $O[N]$ as compared

with quality of Fourier rework of $O[N \log 2 N]$. Ripple primarily based OFDM is simple and also the DFT primarily based OFDM is complicated. Wavelet based OFDM is versatile further and since higher Orthogonality is provided by it, there's no a need of cyclic prefixing in ripple primarily based OFDM that is needed in DFT based OFDM to take care of Orthogonality therefore ripple based system is a lot of information measure economical as compared with the DFT based OFDM.

In distinct ripple rework (DWT), signal presented can experience many completely different filters and can be decomposed into low pass and high pass bands through the filters. throughout decomposition the high pass filter can take away the frequencies below 1/2 the best frequency and low pass filter can take away frequencies that area unit on top of 1/2 the highest frequency. The decomposition halves the time resolution as a result of 1/2 the samples area unit accustomed characterize the signal equally frequency resolution are doubled and this decomposition method are perennial once more for getting the ripple coefficients of needed level. 2 forms of coefficients area unit obtained through process, 1st ones area unit called elaborated coefficients obtained through high pass filter and second ones area unit referred to as coarse approximations obtained through low pass filter connected with scaling method. After passing the info through filters the destruction method are performed. the entire procedure can continue till the required level is obtained.

C. PROPOSED WAVELET BASED OFDM DESIGN

In this proposed model we are using IDWT and DWT at the place of IDFT and DFT. AWGN channel is used for transmission and cyclic prefixing is not used. Here first of all conventional encoding is done followed by interleaving then data is converted to decimal form and modulation is done next. After modulation the pilot insertion and sub carrier mapping is done then comes the IDWT of the data, which provides the orthogonality to the subcarriers. IDWT will convert time domain signal to the frequency domain. After passing through the channel on the signal DWT will be performed and then pilot synchronization where the inserted pilots at the transmitter are removed then the demodulation is done.

Demodulated data is converted to binary form and the de-interleaved and decoded to obtain the original data transmitted.
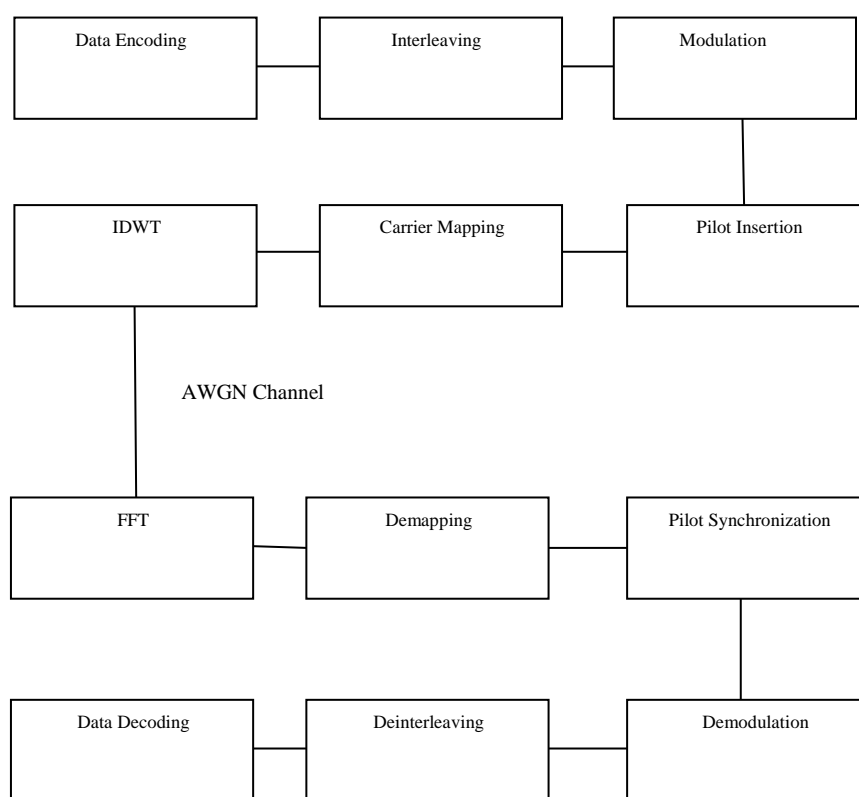

Figure 2: **Wavelet based proposed OFDM system design**
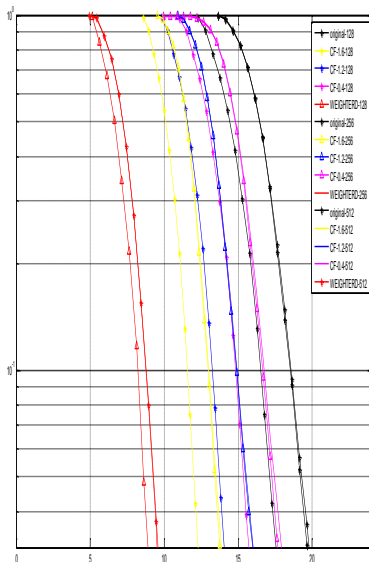
IV. SIMULATION RESULTS

Figure 1: BER performance of wavelets and DFT based OFDM system using QPSK modulation.
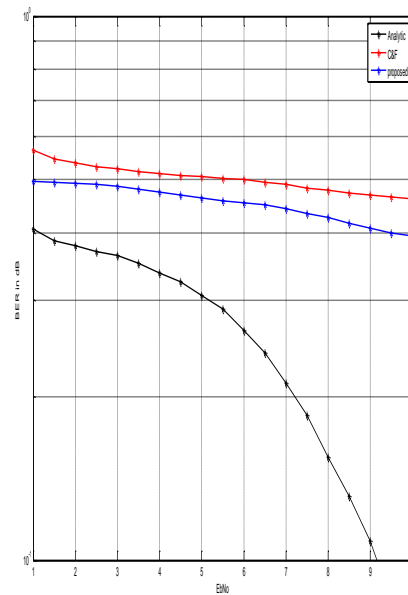

Figure 2: BER performance of wavelets and DFT based OFDM system using 16-QAM modulation.
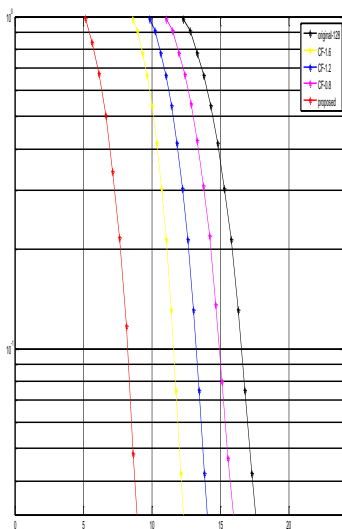

Figure 3: BER performance of wavelets and DFT based OFDM system using 64-QAM modulation.

V. CONCLUSION

In this paper we have a tendency to analyzed the performance of rippling primarily {based} OFDM system and compared it with the performance of DFT based OFDM system. From the performance curve we've determined that the BER curves obtained from rippling primarily {based} OFDM area unit higher than that of DFT based OFDM. we have a tendency to used 3 modulation techniques for implementation that area unit QPSK, 16QAM and 64QAM, that area unit utilized in LTE. In rippling based mostly OFDM differing kinds of filters are often used with the assistance of various wavelets offered. we've used daubechies2 and haar wavelets, each offer their best performances at totally different intervals of SNR.

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