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# BER & PAPR Reduction in OFDM System using Wavelet based OFDM Analysis

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**Abstract:** BER & PAPR reduction in OFDM system using different types of wavelet like as Symlet, Coiflet, Daubechies etc. The Wavelet based OFDM has better spectral efficiency than the OFDM. The wavelet based OFDM does not required any Guard intervals and no pilot tones, but it is necessary in conventional OFDM. The reduction of Bit error rate & Peak to average power ratio is obtained by using complete wavelet based OFDM & distribution of output signal at transmitter respectively. All wavelet based OFDM system are required 3 dB improvement .The Order of wavelet is higher and it contain the large number of coefficients.

**Keywords:** Wavelets; FPGA; Orthogonal Frequency Division multiplication; Bit Error Rate; Peak-to-Average Power Ratio.

## I. INTRODUCTION

The OFDM implemented by using IFFT's and FFT's creating some problems. The OFDM suffer following

• ISI–This is used for by adding a cyclic prefix which is greater than the channel length but this may not be possible. This cause the loss of orthogonality due to channel effects.
• Time and Frequency Synchronization- It requires the time and frequency synchronization which cause low bit error rate.

The modulation technique depends on the flat channel. Validation of assumption does not take place for long channel. Divide and rule policy used in OFDM. It produces the transmission problem for large difficult channel. The bit modulation can take place for different modulation technique.

The subcarrier should be orthogonal for larger spectral efficiency, so that different spectra may overlap. The discrete time and frequency transformation is performed in OFDM. Fourier transform is used for generation of the sub carriers. For generation of carrier we need to look at other type of modulation. For this we used wavelet transform. It requires the loss of orthogonality and higher degree of side lobe suppression. In Wavelet OFDM DWT and IDWT used in place of FFT and IFFT respectively. Time-frequency gives lesser flexibility than the wavelet packet transform. In wavelet packet transform we can construct an algorithm for the decomposition.

For high speed communication we need broadband communication. The flat frequency response is obtained from small channel width. As the channel width grows then channel divided into sub-channels. Advanced signal processing techniques is used for data transmission for difficult channel. Field-Programmable Gate Array (FPGA) used as a hardware that can be programmable and actual design implementation is control by designer without the need of IC fabrication facility.

## II. BACKGROUND INFORMATION

**Wavelet transform**

Amplitude of wave generally start from the zero then wave increase and decrease also .Wavelet has specific properties and used for signal processing It perform the various type of operation like as multiplication ,shifting operation and it also give the information about the unknown signal.

Wavelet transform breaks the feeding signal into a series of local basis functions namely wavelet. The set of basis function are decomposed by wavelet transform …..V < V < V < V <…… (1) -2 -1 0 1

The decomposition is done by using a basis function and wavelet function and there translation and dilation. i.e. {ø (t)} forms a basis for V. The wavelet functions forms a subspace which is orthogonal to the scaling function. The scaling and the wavelet function both satisfy some dilation equation.

$$ø(t) = \Sigma\, ø(2t-n)h(n).$$

Wavelet Packet: The wavelet transform is actually a subset of versatile transform. In the wavelet transform linear combination of wavelet known as Wavelet packets. It gives the different types of parent wavelet like as orthogonality. Recursive algorithm is used for computation of coefficient of linear combinations.
Nowadays, wavelet transformation is time-frequency-transformations. Discrete wavelet transform is the wavelet transform which is used for sampled the wavelets. Fourier transform is used for resolution.

Wavelet based OFDM
In the wavelet packet transform we can construct an algorithm to do the decomposition such that the effect due to the noise In wavelet-based OFDM system, the wavelet transform blocks which are IDWT and DWT ,which are replace the IFFT and FFT blocks respectively in OFDM system. The advantages of wavelet transform are the overlapping nature of wavelet properties and preserve the orthogonality of output IDWT signal.


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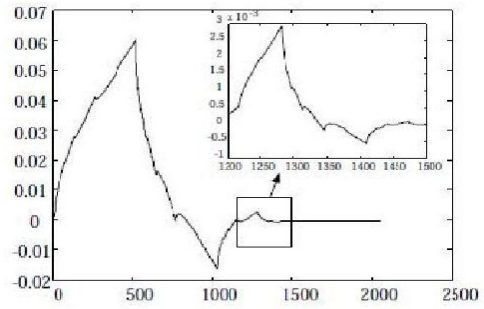

Fig.1 Mother wavelet

WOFDM does not require cyclic prefix to fix the channel delay, thus it improves the bandwidth efficiency.

## III. SYSTEM ARCHITECTURE

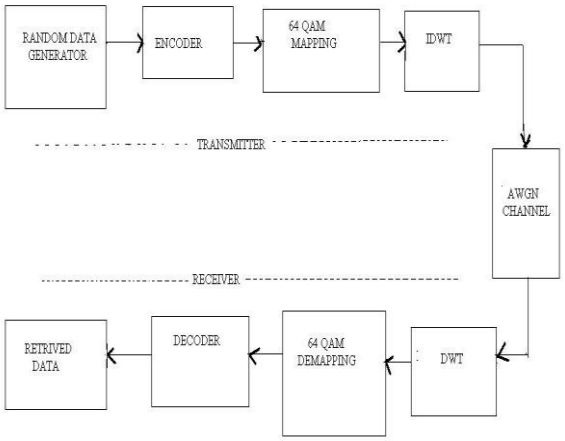


Fig.2 Block diagram of wavelet based OFDM.

A. Convolutional Encoder:
In convolutional encoder the data bits are encoded using a convolutional encoder with Viterbi decoding .Transmitted signal is corrupted mainly by additive white Gaussian noise in FEC technique.

B. Mapper:
According to this data bits are punctured and mapped with QPSK constellations. Puncturing is the process of rejecting the parity bits. Due to removing of parity bits causes encoding of error-correction code with a less redundancy or higher rate. Increases the flexibility of the system without increasing its complexity by using puncturing. Puncturing increases the data rate like rate as 2/3 which indicates transmitting 3 bits and taking 2 at the output. The data thereby is sent to Multiple- Input Multiple-Output (MIMO) parser. The output of encoder/ interleaver module is applied as input to the Mapper. It combines the ROM real & imaginary part and which is located on the real and imaginary axis.

C. AWGN Channel:
For an AWGN channel the parameters used are 4 subcarriers, BPSK modulation and bi-orthogonal wavelets. In it is shown that some of the wavelets perform worse than the single carrier case Basis function is not orthogonal to each other. AWGN is correlated within a subcarrier .Thus an AWGN doesn't remain an AWGN channel. Thus the non orthogonality create problem, but some wavelets are useful. Haar wavelet case the performance of a DWT is much better than the DFT OFDM, and then frequency synchronization is done.

D. DWT&IDWT:
For the transmission section we used the IDWT i.e. Inverse Discrete Wavelet transforms. For the Receiver section we used the DWT i.e. Discrete Wavelet Transform. It preserves the nature of overlapping of OFDM. In wavelet decomposition the details and the approximations can be split into second level details. Convolution can be obtained in between the input signals and coefficients wavelet filter.

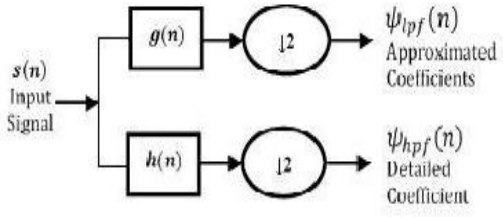


Fig.3DWT &IDWT process

Series of High pass and low pass filter is used for the decomposition process .sequence of wavelets that are orthogonal in nature, when performing the reverse operation of this decomposition the original signal is then reconstructed.

## IV. PAPR & BER IN OFDM

Table1.The parameter used in performance analysis of BER & PAPR reduction is as follow.

| Parameter | value |
|---|---|
| Modulation type | 64 QAM |
| No.of subcarrier | 128 |
| DWT point | 128 |
| Channel model | AWGN |

This also applies to wavelet families like as Symlets and Coieflet wavelets which can be denoted by symN and coifN respectively. Meyer wavelet is the discrete approximation version of wavelet. Since the OFDM require different characteristic from WOFDM. The performance of BER under 128 subcarriers under AWGN channel. AWGN is the reference profile which is widely used in AWGN channel. PAPR is generally used for characterize the envelope fluctuation of the OFDM signal.
Effect of High PAPR:
In wavelet based OFDM system large number of subcarrier are used. It produces large dynamic range of transmitted signal. It also produce the radiation of out of band and distortion in band when signal passing in power amplifier. This problem can be avoided by using linear region.

BER Rate:
Probability of reduced bit error rate (increased performance) is another key issue in wireless communication. The noise robustness of DWT-OFDM

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communication scheme are used. The BER as a function of SNR performance for different levels of noise. This is the relationship of BER & SNR .Then wavelet family that results in high performance gains is selected for optimum performance of wavelet OFDM. Various parameters is affected by receiver side of BER like as channel noise, interference, distortion, etc. The strong signal strength is improved by choosing a strong signal strength the error correction code is used for bit error rate.

FPGA

Field-programmable gate array can be configured by a designer. Hence for FPGA implementation hardware description language can be used. Similarly FPGA meets the time constrients in resource reallocation when the floor plan is enable .various logical function can be implemented. FPGA update the performance. For implementation of complex digital computations required logic gates and RAM blocks available in FPGA. It gives the very high speed of input and outputs and data bus this is too much challenging for setting and holding time requirement.

## V. IMPLEMENTATION

Matlab is used for verification of each step. The Matlab is multi-purpose software which is used in the engineering field for mathematical computation. First algorithm is verified, and then constructing block diagram in Simulink from this hardware implementation will be obtained. Then a VHDL code will be Simulink via Xilinx system generator from this bit and cycle accurate hardware model will be implemented.

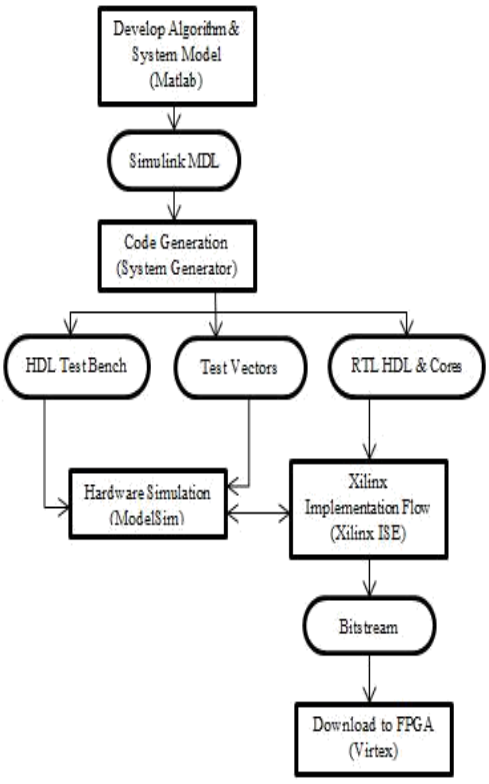


Fig.4 Hardware model

## VI. CONCLUSION

The dynamic range of composite signal is increased in reconstruction process. BER & PAPR Reduction can performed under the A white Gaussian Noise Channel .The Performance of wavelet based OFDM can be obtained by using 3 dB improvement for BER. For PAPR profile reduction the order of wavelet is increased then the z of CCDF function also increased. The higher no of coefficient required higher no of wavelet hence it. Reduce the PAPR profile & also reduce the CCDF at z power.

## VII. FUTURE WORK

We are interested to build a system which produces the lowest CCDF function at the z power. We select the best optimum power consumption for the operation of the system; from this we should investigate the error occurrence from the selected power level. The technique is that wavelets produce the flexibility in the system's design and they are depends on the transmission environment. Then we achieve reconfigurable multicarrier modulation.

High data rate of wireless communication has been increasing more drastically. Since the coherence bandwidth of the channel is much greater than the transmission bandwidth for recovering the transmitted information. Then receiver is used highly complex equalizers Multi-carrier techniques can be used to solve the problem significantly.

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