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Analysis of A Weighted OFDM Signal Scheme For Peak-To-Average Power Ratio Reduction of OFDM Signals Using Different Modulation Techniques

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Abstract: *Weighted OFDM signal scheme is widely used in most new broadband communication system which has capability of high spectral efficiency and is resilient against ISI and frequency selective fadingchannels. The major effect to be consideredat receiver is fading effects which must be alleviated at receiverwithout any distortion in removing weight at the receiver side. In this paper we exhibit the BER performance of the OFDM system with different modulation techniques. Proposed OFDM system is demonstrated using various modulation techniques that is BPSK, QPSK, 16-QAM and 64-QAM using multipath fading channels that is AWGN (Additive White Gaussian Noise) and Rayleigh channel. According to result, and comparison with Clipping and Filtering method the PAPR of the weighted OFDM signal is smaller, and the bit-error-rate (BER) performance of the weighted OFDM system is improved and it is simple to implement.*

Keywords: *Bit error rate (BER), convolution, orthogonal frequency division multiplexing (OFDM), peak- to-average- power ratio(PAPR), weighted data.*

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I. Introduction

In wireless communication technology the main objective is to provide high quality of data. Today wireless communication plays vital role and it is become a most popular and successful transmission technique for transmission of multicarrier signal over wireless channel in our day to day life.The weighted OFDM system has advantages like high spectral efficiency, and is resilient against ISI and frequency selective fading channels. but , there is main drawback of OFDM-based systems is the high peak-to-average-power ratio (PAPR) of a transmitted signal, which causes a distortion of a signal at the nonlinear high-power amplifier (HPA) of a transmitter because of this the power efficiency of the HPA is seriously limited to avoid nonlinear distortion.

The most challenging is in OFDM is to reduce PAPR, there are various methods, some of these are summarized in [1].the weighted OFDM signal scheme is influenced by a circular convolution process for reduction of PAPR without any distortion in removing the weight at the receiver side, i.e., we recovered original data at receiver side in same time duration as compared to C&F method.The modulated OFDM signal is convolutedwith a certain kind of signal for smoothing the peak of the OFDM signal before the HPA andhere, we used the signal ϕ to convince that the Fourier transform Ψ of ϕ has no zero on the real line.TheConvoluted signal can be written as a simple weighted OFDM signal[1].but weight Ψ is nonuniform which affect BER performance that can be reduced. To avoid this we amend the weight by addition of suitable positive constant to original weight to improve BER rate.

In the weighted OFDM signal scheme different weighting factors were given such as Rectangular, Half-Sin, Bartlett, Gaussian, Shannon function respectively.

II. Proposed Method

2.1. Weighted OFDM System

The weighted OFDM scheme was introduced in [9], where the Gaussian function, sine function, and some other functions were used as weighted functions. In [9], when the noise is not present, the PAPR of the weighted OFDM system with Gaussian weight is reduced remarkably.

In this paper, we analyzed weighted OFDM system is proposed with different modulation schemes. The simple block diagram of weighted OFDM signal scheme is shown in Fig.1.For discrete data $\{a_k\}_{k=0}^{N-1}$ multicarrier modulated signal $x_N(t)$ on [0, NT] isrepresented as[1].

$$x_N(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} a_k e^{j2\pi f_k t} \qquad (1)$$

Where N is the number of subcarriers, T is the original symbol period,$\Delta f = 1/NT$, and$f_k = k\Delta f$, k = 0, . . . , N − 1. The PAPR of $x_N$over the time interval [0, NT] is defined as[1],

$$PAPR(x_N) = \frac{max_0 \leq t \leq NT|x_N(t)|^2}{E(|x_N(t)|^2)} \qquad (2)$$

Where E(.) denotes the expectation operator.

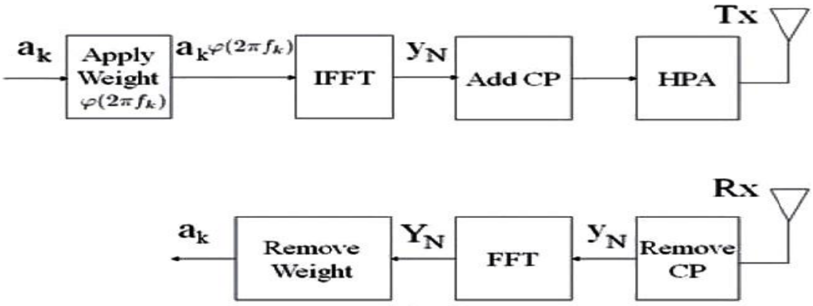

Fig.1. Block diagram of weighted OFDM system [1]

2.2. Analysis using different modulation techniques

The analysis using different modulation techniques for the signification of weighted OFDM system is considered with 64 data subcarriers and 16-QAM constellation. Further we also exhibit system with 128 data subcarriers. To simulate OFDM system Matrix interleaves are used, the cyclic prefix code of length is said to the channel maximum delay, it will prove channel capacity.OFDM system has ability to increases link reliability, channel capacity and high spectral efficiency of multiuser wireless communication system. The spectrum signal will be required to get acceptable and accurate result of simulation is first chosen based on the input data and the different modulation scheme used (such as Differential BPSK, QPSK or 16-QAM) respectively. Using proper scheme of modulation where we choosed Amplitudes and phases of the carrier signals iscalculated. The Transmitting data before transmission is first assigned to each carrier signalwhich can be produced and further modulation takes place. The BER performance evaluation of various modulation system such as DPSK, PSK and 16-QAM modulation schemes for BCH and Convolutionally coded system over AWGN channel is demonstrated in this paper [7]. The performance of different modulation techniques with weighted OFDM system is analyzed in terms of BER and SNR. To achieve error free communication with high security and multiplexing data, guard interval is very essential. It can be inserted in the time domain using cyclic prefix which gives ISI mitigationbetween OFDM symbols. The insertedOFDM guard interval by the cyclic extensions of the OFDM symbol may be cyclic prefix (CP) or cyclic suffix (CS). In this demonstration we used 16-bit cyclic prefix code. System to be practical, we added AWGN noise to channel.AWGN is a noise that affects the transmitted signal when it passes through the communication channel. It contains a uniform continuous frequency spectrum over a particular frequency band.

III. Simulation Results

In this paper, we examine the bit error rate performance of convolutionally and BCH code in AWGN channel using BPSK, QPSK, 16-QAM, 64-QAM as modulation schemes with computer simulations. The BCH encoder block creates a BCH code with constraint length K=5. Here a coded OFDM system with 64 subcarriers (N=64) and the number of constellations for QAM are 16,64 i.e. 16-QAM, 64-QAM is considered. Matrix interleaver is used and cyclic prefix is set at 25 %. There are two transmitter and receiver antennas and Parameter of proposed system is presented in table 1.

Fig.2. shows that BER Vs SNR(signal to noise ratio)of BPSK modulation technique.In this figure it observed that BER Vs SNR is achieved $10^{-2.8}$ at 22dB.

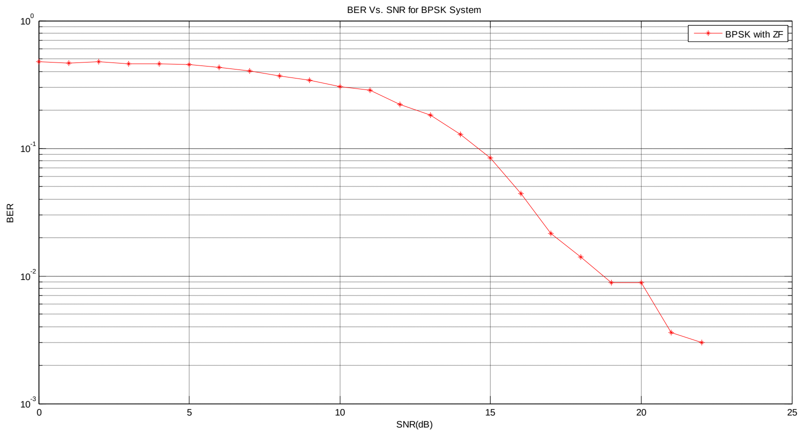

Fig.2.BER vs. SNR for BPSK System

Fig.3. shows that SER(symbol error rate)Vs SNR(signal to noise ratio)for BPSK System.In this figure it observed that SER Vs SNR is reducedto 0 at 23dB.

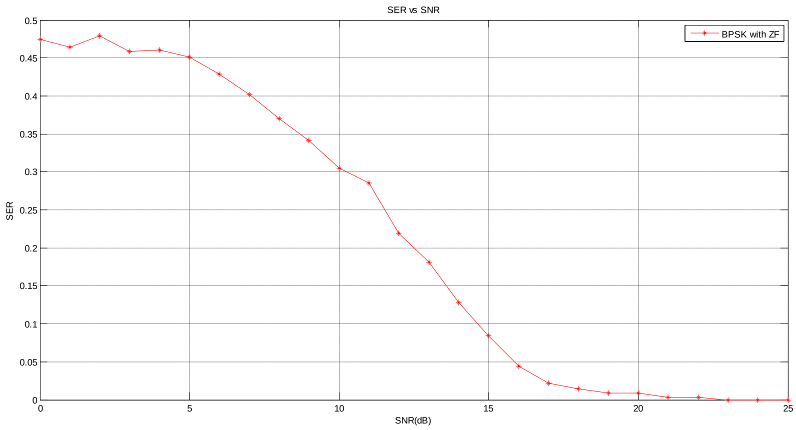

Fig.3.SER Vs SNR for BPSK System

In comparison with figure (2),(3) Shows that BER Vs SNR and SERVsSNR of BPSK modulation technique. In this figure it observed that BER and SER performance of BPSK system decreases when SNR increasedrespectively.

Fig.4. shows that BER Vs SNR of QPSK modulation technique. In this figure it observed that BER Vs SNR is achieved to $10^{-3.7}$ at 22dB.

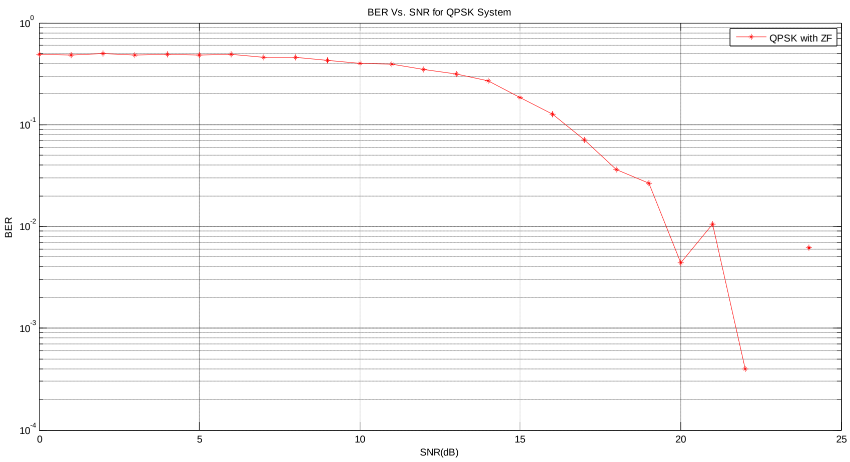

Fig.4.BER vs. SNR for QPSK System

Fig.5.shows that SER Vs SNR of modulation technique. In this figure it observed that SER Vs SNR is reduced to 0 at 22dB.

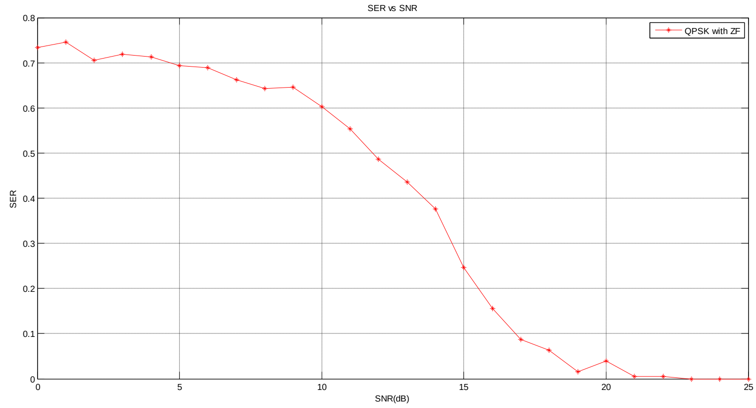

Fig.5. SER Vs SNR for QPSK System

In comparison with figure (4),(5) Shows that BER Vs SNRand SERVs SNR for QPSK modulation technique. In this figure it observed that BER and SER performance of QPSK system decreases when SNR increased respectively.

Fig.6. shows that BER VsSNR of 16-QAM modulation technique.In this figure it observed that BER Vs SNR is achieved at $10^{-2.4}$ at 18dB.

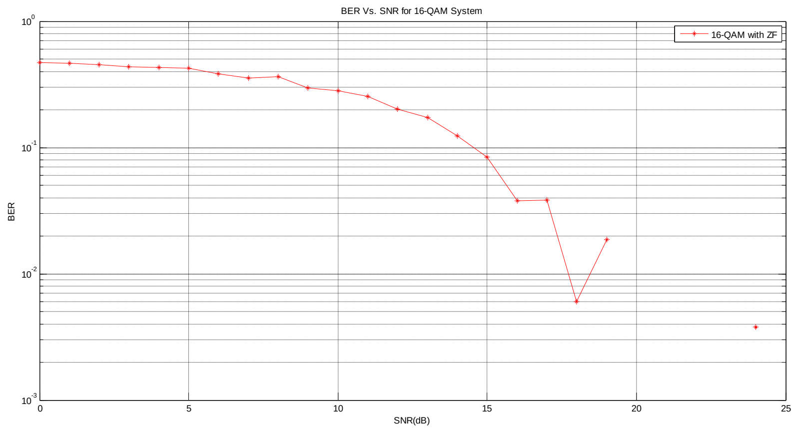

Fig.6.BER vs. SNR for 16-QAM system

Fig.7. shows that SER Vs SNR curve for 16-QAM modulation technique. In this figure it observed that SER Vs SNR is reduced to 0 at 20dB.

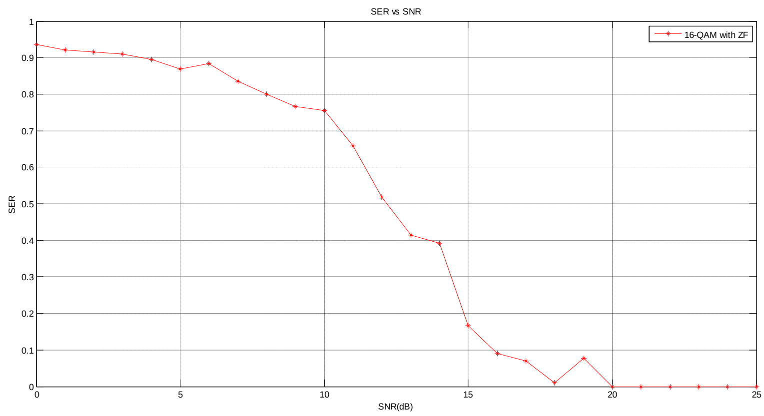

Fig.7.SER Vs SNR for 16-QAM system

In comparison with figure (6), (7) Shows that BER Vs SNR and SERVs SNR of 16-QAMmodulation technique. In this figure it observed that BER and SER performance of 16 QAM system decreases when SNR increased respectively.

Fig.8. shows that BER Vs SNR of 64-QAM system. In this figure it observed that BER Vs SNR is achieved at $10^{-2.8}$ at 18dB.

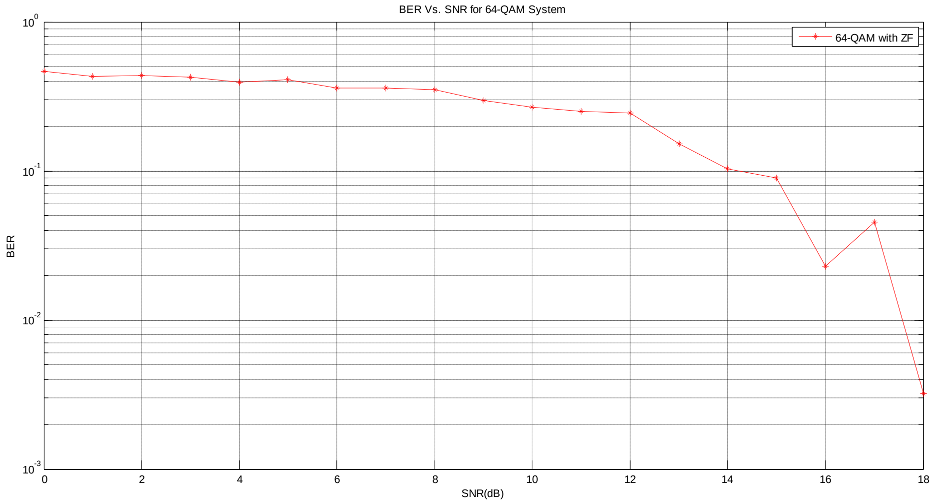

Fig.8.BER VsSNR for 64-QAM System

Fig.9. shows that SER VsSNR 64 modulation technique.In this figure it observed that SER Vs SNR is reduced to 0 at 19dB.

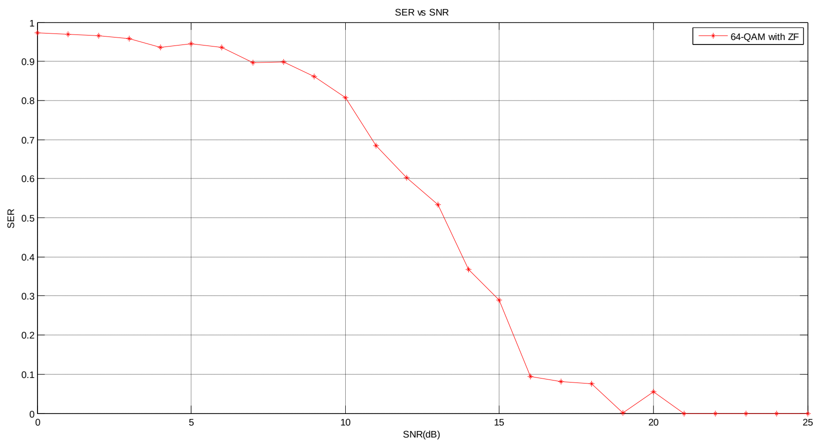

Fig.9. SER VsSNRfor 64-QAM System

In comparison with figure (8), (9) Shows that BER Vs SNR and SERVsSNRof 64-QAMmodulation technique. In this figure we observed that BER and SER performance of 64 QAM system decreases when SNR increased respectively.

In comparison with different modulation techniques,BER Vs SNR for 16-QAM and 64-QAM modulation. It observes that, BER Vs SNR of$10^{-2.4}$and$10^{-2.8}$ isachieved at 18 dB for 16-QAM and 64-QAM respectively, under AWGN channel. So from this graph it is observed that 16 QAM is better than 64-QAM. This is because for the same value of SNR, BER is reduced in 16-QAM.

Table 1. Parameters of proposed system

Parameters	**Values**
Modulation Techniques	BPSK, QPSK, 16-QAM, 64-QA M
Coding	BCH
Interleaver	Matrix
Data Subcarriers	128
Cyclic Prefix	16
System	OFDM
IFFT Points	128
No. of Samples	5000

IV. Conclusion

In this paper, we analyzed the proposed system results show that, the comparison analysis of BPSK, QPSK, 16-QAM, 64-QAM schemes over AWGN channel. According to computer simulation results it is concluded that by using 16-QAM scheme provide much better SNR performance for same value of BER is obtained as Compared to the BPSK and QPSK. Through simulationitcan be shown that PAPR will be smaller and the BER performance of the system and the minimum required SNR to satisfy both high quality and low quality of data services is obtained.

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