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Mitigation Techniques of Peak-to-Average Power Ratio in Orthogonal Frequency Division Multiplexing

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Abstract: Orthogonal Frequency Division Multiplexing (OFDM) is a multicarrier transport technology for high data rate headset call system. The OFDM is based on allocation of high speed data to be transmitted over a large number of low swiftness carriers. Those carriers are orthogonal to each other. It creates orthogonal ghostlike professional low speed carriers in order to transmit high-rate signals. OFDM utilizes non-varying prefix in the attendant period in order to guarantee no ISI and ICI. It's a automatic-seeking to time build up for but alert to frequency offset and phase racket. It is second-hand in IEEE 802.16 Broadband wireless access (BWA) a term referring to a range of fixed radio systems, used largely to advocate broadband services between users' premises and central piece networks. It is used in IEEE 802.20 mobile broadband wireless access a specification for an efficient packet based air interface that is optimized for the transport of IP based services.

There are many techniques that will reduce the PAPR up to a certain level out of which PTS Scheme is most convenient for the multicarrier transmit. In this skill the input data flow is divided into sub-blocks that are associated with the phase vectors that will search for minimum PAPR order. However in at once PTS, there was also a drawback that these are no. of sub-blocks increases the come back with cost for the phase vectors also goes on increasing. Also this technique required side information for recovering the signal at the receiver that also put a limit on the no of sub-blocks in the immediately PTS method.

Keywords: OFDM, BWA, PAPR ,CCDF, PTS, Mapper, Orthogonal Sub carriers.

I. INTRODUCTION

OFDM is an acronym that means for Orthogonal Frequency Division Multiplexing. Orthogonal Frequency Division Multiplexing (OFDM) is a multicarrier transport technology of high data rate communication system. The OFDM concept is based on spreading higher speed data to transmit over a large number of low rate carriers. The carriers are orthogonal to all and frequency spaces between those are created by using the Fast Fourier transform (FFT).

OFDM begin from Frequency Division Multiplexing (FDM), from there more than one low rate signal is carried over separate carrier frequencies (Table 1.1). In FDM, separation of signal at the receiver is achieved by placing the channels sufficiently far apart so that signal spectrum are not overlapped. Of course, the resulting spectral efficiency is very low in comparison to OFDM, where a comparison is depicted in Fig. 1.1

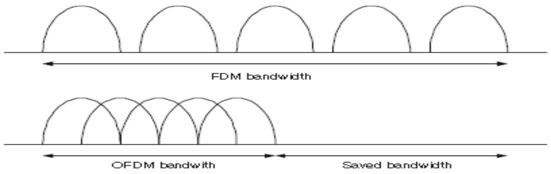

Fig 1.1 Comparison of OFDM with FDM

FDM is first utilized to carry high-rate signals by converting the serial high rate signal into parallel low bit streams. Such a parallel communication method when compared with high-rate single carrier scheme is costly to build. On the other hand, high-rate single carrier scheme is more susceptible to inter symbol interference (ISI). This is due to the short duration of the signal and higher deformation by its wider frequency band as compared with the long duration signal and narrow bandwidth sub channels in the parallel system. Fig. 1.2 shows an analogy of OFDM against single carrier and FDM in terms of spectral efficiency.

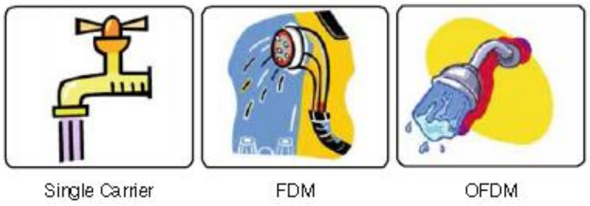

Fig 1.2 Comparison Of OFDM Over FDM And Single-Carrier Systems.

OFDM and FDM are resilient to interference, since flow of water can be easily stopped in single-carrier systems. OFDM is more spectral efficient than FDM, since it utilizes the surface successfully with adjacent tiny streams.

The technique involved assembling the input information into blocks of N complex numbers, one for each sub-channel. An inverse FFT is performed on each block, and the resultant transmitted one after the other. At the receiver, the information is recovered by performing an

FFT on the established block of signal samples. The range of the signal on the line is identical to that of N separate QAM signals as seen in Fig. 1.3, where N frequencies separated by the the signaling rate. Each QAM signal carries one of the original input complex numbers.

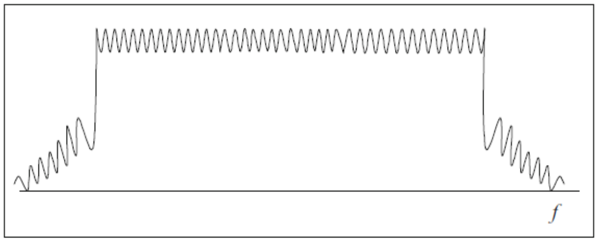

Fig.1.3 Spectrum of OFDM signal

The spectrum of each QAM signal is of the form **sin(Kf)/f** with nulls at the midpoint of the other subcarriers as seen in Fig1.3 this ensures orthogonality of subcarriers.

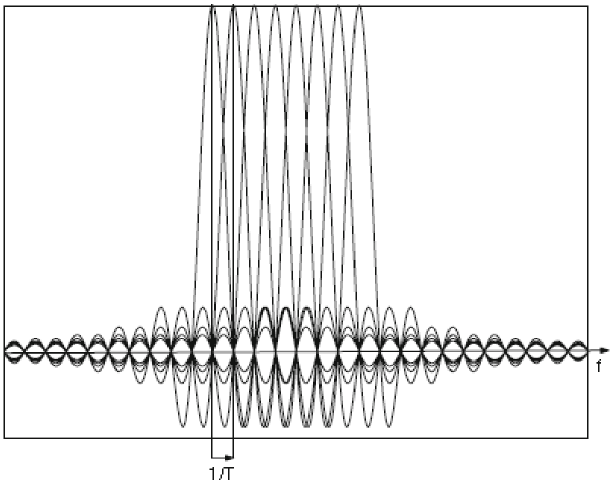

Fig 1.4 OFDM spectrum for each QAM Signal

Threats to Orthogonality: Orthogonality is threatened by inter symbol interference(ISI), which is caused by leakage of symbols into other due to multipath interference. To combat for ISI, a guard time is introduce previous to the OFDM sign. Guard time is to select longer than impulse response or multipath delay so as not to cause interference of multipath components of single symbol with next symbol.

Orthogonality is also threatened by inter carrier interference (ICI), which is crosstalk stuck between subcarriers, since at the moment the multipath component of one subcarrier can disturb the one. ICI in OFDM is prevented by regularly increasing the guard interval to ensure integer number of cycles in the symbol time as long as the delay is smaller than the watch time.

Simple OFDM System: Let us consider a simple OFDM system to understand the Let us consider a simple OFDM system to understand the mechanics behind it. The inward data is transformed from serial to parallel and grouped into bits each to form a compound number *x* after PSK or QAM modulation in order to be transmitted over *N* low-rate data streams. Each low-rate data stream is linked with a subcarrier to the form.

$$\emptyset_k(t) = e_k^{j2\pi kt}$$

Where f_k is the frequency of the kth subcarrier. Consequently, one baseband OFDM symbol with N subcarrier,

$$s(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} x_k \emptyset_k(t) \, for \; 0 < t < T$$

Where x_k is the kth complex data symbol and T is is the length of the OFDM symbol.

When signal is transmitted over a channel, channel dispersion destroys the orthogonality between subcarries and causes ICI, and delay reach causes ISI between successive OFDM symbols. As we mentioned before, cyclic prefix (CP) is used to preserve the orthogonality and avoid ISI. The CP is utilized in the guard period between successive blocks and construct by the cyclic expansion of the OFDM symbol over a period τ.

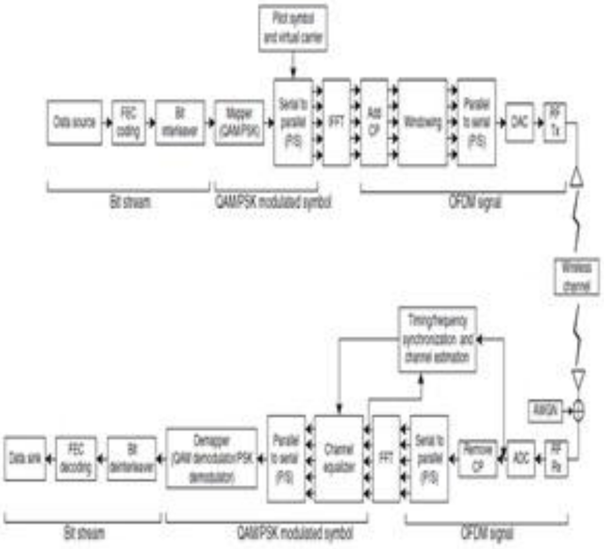

Fig 1.5 Simplified Block Diagram of OFDM system

The spectrum of OFDM decays slowly. This causes spectrum leakage to neighboring bands. Pulse shaping is used to change the spectral shape by either commonly used raised cosine time window or passing through a filter. Here shown below the spectrum for OFDM with real and imaginary components with their resp. PDFs in Fig 1.6 and Fig1.7.

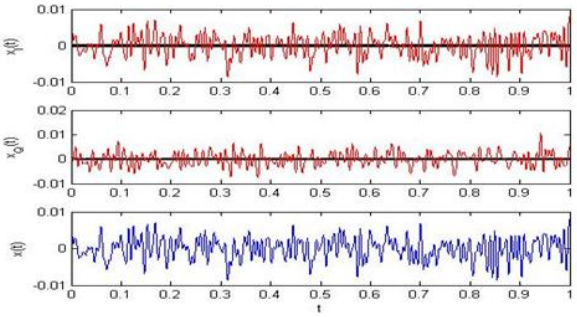

Fig 1.6 OFDM Signal with N=256 with The Imaginary and Real Components

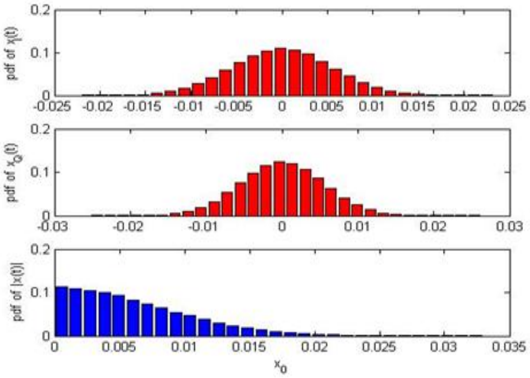

Fig 1.7 PDFso of the OFDM Signal with N=64 with Real and Imaginary Components

II. OFDM TECHNIQUE

Peak Average Power Ratio (PAPR): In case of OFDM system there is a prospect to experience large peaks since the signal shows a random variable characteristic since it is sum of *N* independent composite random variables. *These different carriers may all line up in phase at some second and accordingly produce a high peak, which is quantified by peak-to-average-power ratio (PAPR).* This distorts the transmitted signal if the source contains nonlinear components such as power amplifiers (PAs). Since PA is forced to operate in the nonlinear region. The nonlinear personal property may cause in-band or out-of-band distortion to signals such as spectral distribution, inter-modulation, or change the signal constellation. The high PAPR is one of the most detrimental aspects in the OFDM system, as it decreases the SQNR (Signal-to-Quantization Noise Ratio) of ADC (Analog-to-Digital Converter) and DAC (Digital-to-Analog Converter) while corrupting the competence of the power amplifier in the transmitter. The PAPR problem is more important in the uplink since the competence of amplifier is decisive due to the limited battery power in a mobile terminal.

It is desired to operate the PA in the linear area as shown in fig 2.1. To avoid the high peaks, average input control may be decreased. Operating area of the PA is called input back-off and the resultant signal is definite to be in output back-off range. High input back off reduces the power efficiency and would mandate the cost of the PA higher, since input back off is usually greater than or equal to the PAPR of the signal. Ideally, the average and peak values should be as close as can be in order to maximize the efficiency of the PA. PAPR mitigation relaxes the PA back off requirements as well as the high resolution requirements on ADC and DAC.

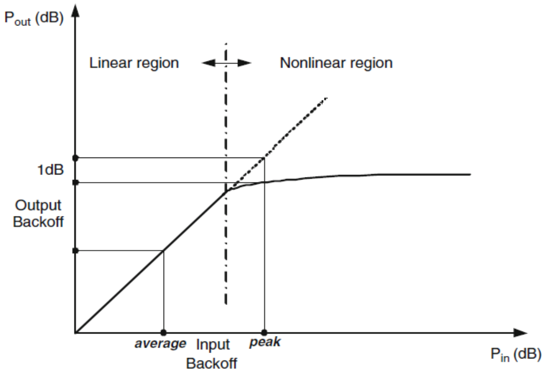

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Fig 2.1 Input Output Characteristics of a HPA

Consider one baseband OFDM symbol with *N* subcarrier,

$$s(t) = \frac{1}{\sqrt{N}}\sum_{k=0}^{N-1} x_k \emptyset_k(t)\, for\; 0 \; < t \; < T$$

Where x_k the k^{th} complex data symbol and T is the length of the OFDM symbol where $\emptyset_k(t) = e_k^{j2\pi kt}$ low-rate data stream is is associated with a subcarrier of the form

where f_k the frequency of the kth subcarrier. *PAPR is the ratio between the maximum power and the average power of the complex pass band signal.*

$$PAPR[s(t)] = \frac{max|s(t)|^2}{E\{|s(t)|^2\}}$$

Where E (.) is the average signal power of s (t).

Complementary Cumulative Distribution Function (CCDF): In the OFDM system with N subcarriers, the maximum power occurs when all of the N subcarrier workings happen to be added with impossible to tell apart phases. We first consider the distribution of output signals for IFFT in the OFDM system. While the contribution signals of N-point IFFT have the independent and finite magnitudes which are uniformly distributed for QAM, we can assume that the real and imaginary parts of the time-domain. Complex OFDM signal s (t) (after IFFT at the transmitter) has asymptotically Gaussian distributions for a sufficiently large number of subcarriers by the central limit theorem. Then the amplitude of the OFDM signal s (t) follows a Rayleigh distribution. Let $\{Z_n\}$ be the magnitudes of complex samples $\{|s\ (nT_s/N)|\}^{N}_{n=0}$. Assuming that the average power of s(t) is equal to one, that is, $E\{|s(t)|^2\}=1$, then $\{Z_n\}$ are the Rayleigh random variables normalized with its own average power, which has the following probability density function:

$$f_{z_n}(z) = \frac{z}{\sigma^2} e^{\frac{z^2}{2\sigma^2}} = 2ze^{-z^2} \; for \; n = \; 0, 1, 2 \ldots.. \; N-1$$

Where $E(Z_n^2) = 2\sigma^2 = 1$. The maximum of Z_n is equivalent to the crest factor (CF) defined as:

$$CF = \sqrt{PAPR} = Pass\ Band$$

Let Z_{max} denote the crest factor (i.e., $Z_{max} = \max_{n=0, 1, 2, .N-1} Z_n$). The Complementary Cumulative Distribution Function (CCDF) of Z_{max} is given as

$$\tilde{F}_{Z_{max}}(z) = P(Z_{max} > z)$$

$$(z) = 1 - P(Z_{max} > z)$$

$$F_{Zmax}(z) = 1 - (1 - e^{-z^2})^N$$

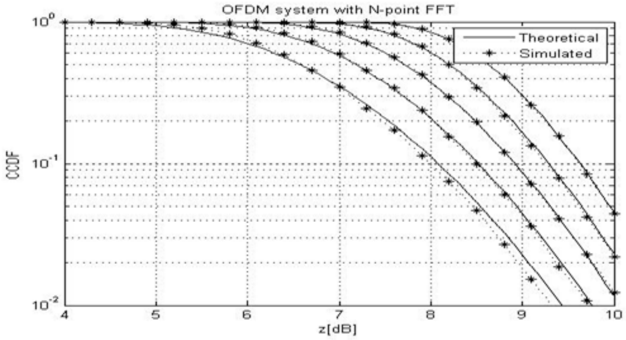


Figure 3.2 Theoretical and Simulated CCDFs of OFDM Signals With N = 64, 128, 256,512, 1024

Oversampling and PAPR: The PAPR defined as the CF deals with the pass band signal with a carrier frequency of f_c in the continuous time domain. Since f_c in general is much higher than $1/T_s$, a continuous time baseband OFDM signal x (t) with the symbol period Ts and the corresponding pass band signal with the carrier frequency fc have almost the same PAPR. However, the PAPR for the discrete-time baseband signal x[n] may not be the same as that for the continuous-time baseband signal x (t). In fact, the PAPR for x[n] is lower than that for x (t), simply because x[n] may not have all the peaks of x (t). In practice, the PAPR for the continuous-time baseband signal can be measured only after implementing the actual hardware, including digital-to-analog convertor (DAC). In other words, measurement of the PAPR for the continuous-time baseband signal is not straightforward. Therefore, there must be some means of estimating the PAPR from the discrete-time signal x[n]. Fortunately, it is known that x[n] can show almost the same PAPR as x(t) if it is L-times interpolated (oversampled) where L≥4.

The values of PAPR oversampling will increase than without sampling showing a significant difference in the PAPR by the sampling rate. The values of PAPR with oversampling are just about 0.4dB greater than those without oversampling. Therefore, an oversampling process may be required to make a precise measurement of PAPR in the baseband.

*PAPR Reduction Techniques***:** PAPR reduction techniques are classified into the singular approaches: clipping method, coding technique, probabilistic (scrambling) technique, adaptive pre deformation technique, and DFT-spreading technique. The brief description of these techniques is given below:

- The clipping technique employs clipping or nonlinear dispersion around the peaks to condense the PAPR. It is simple to put into service, but it may cause in-band and out-of-band interferences while destroy the orthogonality surrounded by the subcarriers. This exacting come near includes block-scaling technique, clipping and filter technique, crest windowing technique, peak termination technique, Fourier projection technique, and decision-aided reconstruction technique.

- The coding technique is to decide on such codewords that minimize or diminish the PAPR. It causes no deformation and creates no out-of-band energy, but it suffers from bandwidth good organization as the code rate is cheap. It also suffer from complication to find the best codes and to store large call on tables for encoding and decoding, especially for a large amount of subcarriers. Golay complementary sequence, Reed Muller code, M-sequence, or Hadamard code can be second-hand in this approach.

- The probabilistic (scrambling) technique is to rush an input data block of the OFDM symbols and transmit one of them with the minimum PAPR so that the prospect of incurring high PAPR can be reduced. While it does not go through from the out-of-band power, the shadowlike efficiency decreases and the density increase as the number of subcarriers increases. Furthermore, it cannot guarantee the PAPR below a specified level. This advance include SLM (SeLective Mapping), PTS (Partial Transmit Sequence), TR (Tone Reservation), and TI (Tone Injection) techniques.

- The adaptive pre distortion technique can pay damages the nonlinear effect of a high power amplifier (HPA) in OFDM systems. It can cope with time variations of nonlinear HPA by repeatedly modifying the input assemblage with the least hardware requirement (RAM and memory lookup encoder). The union time and MSE of the adaptive pre distorter can be reduced by using a broadcasting technique and by designing appropriate training signals.

- The DFT-spreading technique is to spread the input signal with DFT, which can be afterward taken into IFFT. This can trim down the PAPR of OFDM signal to the level of single-carrier transmission. This technique is for the most part useful for mobile terminals in uplink transmission. It is known as the Single Carrier-FDMA (SC-FDMA), which is adopted for uplink conduction in the 3GPP LTE standard.

Zadoff-Chu Precoding Based OFDM System: Zadoff-Chu sequences are class of poly phase sequences having optimum correspondence property. Zadoff- Chu sequences have an ultimate periodic autocorrelation and constant degree. The Zadoff-Chu sequences of length L can be defined as:

$$Z(k) = \begin{cases} e^{\frac{j2\pi r}{L}\left(\frac{k^2}{2}+qk\right)} & for\ L\ even \\ e^{\frac{j2\pi r}{L}\left(\frac{k(k+1)}{2}+qk\right)} & for\ L\ odd \end{cases}$$

Where k = 0, 1, 2… L-1, q is any integer, r is any integer relatively prime to L and $j = \sqrt{-1}$.

Fig.3.1. shows the block diagram of ZCT precoding based OFDM system. In the ZCT precoding based OFDM system baseband modulate data is passed from end to end S/P convertor which generates a complex vector of size N that can be written as

$$X = [X0\ , X1, X2 \ldots\ldots\ldots\ldots\ldots\ldots\ldots . X_{N-1}]^T$$

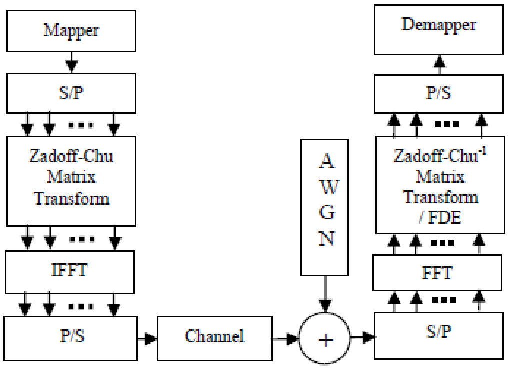


Fig 2.5 Block Diagram of Zad-off Chu Sequence

Then ZCT precoding is applied to this multifaceted vector which transforms this multifaceted vector into new vector of length N that can be written as

$$Y = RX = \left[Y_0, Y_1, Y_2, \ldots, Y_{N-1}\right]^T$$

Where R is a ZCT based row-wise precoding matrix of size L = N*N With the use of reorder as given in equation

$$k = mN + l$$

Matrix R with row wise reshaping can be written as

$$R = \begin{bmatrix} r_{00} & \cdots & r_{0(N-1)} \\ \vdots & \ddots & \vdots \\ r_{(N-1)0} & \cdots & r_{(N-1)(n-1)} \end{bmatrix}$$

In other words, the N^2 point long Zadoff-Chu sequence fills the precoding matrix row wise. R is N x N, ZCT complex orthogonal matrix with length $L^2 = N * N$ by letting, q = 1 and r = 1, the ZCT for Even L can be written as r^k = exp [(j*pi*k2) / L2]. consequently, precoding X gives rise to Y as follows:

$$Y_m = \sum_{l=0}^{N-1} r_{m,l} . X_l$$

$r_{m,l}$ means m^{th} row and l^{th} column of precoder matrix. The complex baseband OFDM signal with N subcarriers without precoding is given by

$$Y_m = \sum_{l=0}^{N-1} r_{m,l} X_l \qquad \text{Where m=0, 1, 2, N-1}$$

However, expanding while using q = 1 and r = 1 gives complex baseband ZCT precoding based OFDM signal with N subcarriers as

$$x_N = \frac{1}{\sqrt{N}} \sum_{m=0}^{N-1} \left\{ e^{\left(\frac{j2\pi mn}{N}\right)} \left[e^{j\pi m^2} \sum_{l=0}^{L-1} \left(Y_l . e^{\frac{j\pi l^2}{L^2}} \right) e^{j\frac{2\pi ml}{L}} \right] \right\}$$

This expression suggests that x_n are IFFT of constellation data Xl premultiplied with quadratic phase and IFFT precoded, and then alternate with ±1.

III. EXPERIMENTAL AND COMPUTATIONAL

First we will define the Partial transmit Sequence (PTS) method and then we will focus on our proposed scheme. The PTS method is an efficient method but calculation cost of its phase rotation vectors is high. So a novel approach is used to minimize the calculation cost.

With the help of simulation performance of the new algorithm compared to traditional algorithm in terms of PAPR reduction and system throughout put is being studied to deduce important conclusions.

Partial Transmit Sequence: In PTS approach, the input data block is partitioned into put out of joint sub-blocks. The sub carriers in each sub block are weighted by a phase rotations. The phase rotations are special such that the PAPR is minimized. At the receiver, the original data are recovered by applying opposite phase rotations.

Consider we have an input data block { $X_{n,n=0,\ 1,2,\ldots\ldots\ldots,N}$ } is defined as a vector.

The vector X is Partitioned into V put out of joint sets. It is represented by vectors $\{X^v, v=1,2,3,\ldots\ldots\ldots,V\}$ where

$X^0 = [X^1,\ldots X^{(N/V)}, ..0\ldots0\ldots0 \quad 0\ldots0]^T$

$X^v = \ [0\ldots.0\ldots.X^{((v-1)(N/V)+1)},\ldots\ldots..,X^{(v.(N/V))} \quad 0,\ldots0]^T$

$$X = \sum_{v=1}^{V} X^v$$

Where X^v are the sub-blocks that are consecutively located and are of equal size. In case of PAPR the scrambling is applied to each sub-block.

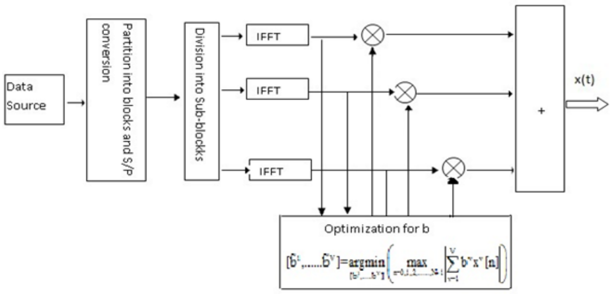


Fig 3.1 A General PTS Sequence

Each partitioned sub-block is multiplied by a corresponding complex phase factor, $b^v = e^{j\emptyset v}, v = 0,1,2\ldots\ldots V$ subsequently taking its IFFT to yield.

$$x = IFFT\{\sum_{v=1}^{V} b^v X^v\} = \sum_{v=1}^{V} b^v IFFT\{X^v\} = \sum_{v=1}^{V} b^v x^v$$

Where $\{x^v\}$ is referred to as a partial transmit sequence (PTS). The phase vector is chosen so that the PAPR can be minimized which is shown as

$$[\tilde{b}^1,\ldots\ldots\tilde{b}^V] = \arg\min_{[b^1,\ldots\ldots b^V]}\left(\max_{n=0,1,2,\ldots\ldots,N-1}\left|\sum_{v=1}^{V} b^v x^v[n]\right|\right)$$

Then, the corresponding time-domain signal with the lowest PAPR vector can be expressed as

$$\tilde{x} = \sum_{v=1}^{V} \widetilde{b^v} x^v$$

The selection of the phase factors $\{b^v\}_{v-1}^{V}$ is limited to a set of elements to reduce the search complexity. As the set of allowed phase factors is

$$b = \{e^{j2\pi iW}|_{i=0,1,2\ldots\ldots W-1}\}, W^{v-1}$$

sets of phase factors should be searched to find the optimum set of phase vectors. Therefore, the search difficulty increases exponentially with the number of sub-blocks.

The PTS technique requires V IFFT operations for each data block and $[\log_2 W^v]$ bits of side information. The PAPR performance of the PTS technique is affected by not only the number of sub-blocks, V, and the number of the allowed phase factors, W, but also the sub-block partitioning.

Proposed Optimized Reduction Scheme: Choosing $b^v \uparrow\in \{\pm1, \pm i\}\{W = 4\}$ is widely used in conventional systems. We can set $b_1 = 1$ without loss of performance. Accordingly, in order to determine other weights, we need an far-reaching search for (M-1) phase rotations. In this search, W^{v-1} sets of candidate vectors on period rotations are prepared and one of them is selected as the optimum set of phase rotations. So from the case of unadventurous PTS schemes we have to calculate 4^{W-1} no. of calculations for finding the phase rotation vectors. The upcoming scheme provides a better solution for adding up of the phase vectors. The proposed scheme is detailed below:

Assume N_{sb} define the no. of sub-blocks into which the input data is to be partitioned.

Define the size of the sub-carriers (N) and the Oversampling Factor for the OFDM signal.

Define 'r', where2^r becomes the no of times the value of v is to be calculated for finding the minimum PAPR.

Assume $b^v = 1 \, for \; v = 1{:}N_{sb}$.

Find PAPR for equation and set it as PAPR_min. percentage increase v by 1, and then again find the PAPR for equation with the value of $b^v = -1$.

If PAPR>PAPR_min then set the value of $b^v = 1$..

Now update the value of PAPR_min by PAPR.

If PAPR<PAPR_min then set the value of $b^v = 1$.

Now continue the process until $v < 2^r$by incrementing the value of v by one every times and going back for calculating the value of PAPR from step(7)

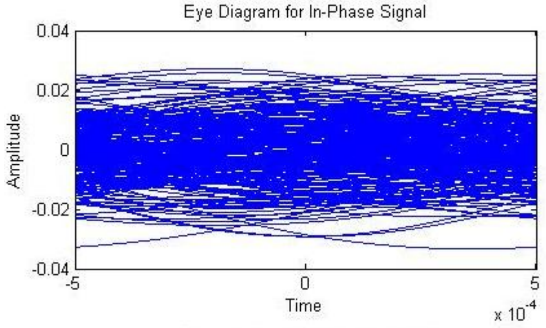
When v becomes equal to 2^r, then exit the process with the set of optimal phase vectors.

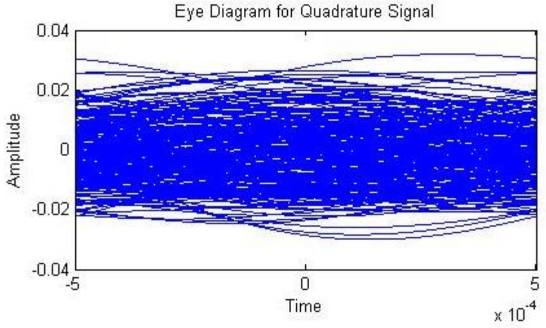
Here from the algorithm we can see that the no. of period rotation vectors depends upon the value of 2^r where r = 3, 4, 5, 6, 7, 8…. However we cannot beat the value of r after r=8 as this will not give a more change in the value of PAPR. From the PTS scheme where the no of calculation were 4^{Nsb-1} we come to a result with computation equals to $2^r, r = 3,4,5,6,7,8$. So the presentation of this algorithm increases as the no of sub-blocks, $N_{sb} = 4,8,16,64,128\ldots\ldots increases$ and we will see in the next chapter that this will reduce the PAPR up to a confident limit and that value of 'r' becomes prominent value for this algorithm. As we know that every PTS scheme require side information has to be sent over feed to correctly recover the pointer at the receiver . So in the purposed method the no of bits compulsory for the side information reduces to ‘r' which was ‘Nsb' in case of the conventional PTS scheme.

IV. RESULTS AND DISCUSSIONS

To perform the simulation MATLAB is installed on Windows XP Operating System using Mathworks. Mathworks provides a very good simulation platform for calculation under Windows. MATLAB Communication toolbox is also installed which is a software used for plotting various graphs and doing calculations also. It implements all the filters, source generators ,coding algorithms, modulation functions , scattering plot platforms, BER calculators, Eye Diagram plotter etc. It also supports coding algorithms for various filters design , modulation and demodulation, coders ,decoders etc. The proposed algorithm is being implemented here using the Communication Toolbox. Here we will show the simulation scenario, CCDF for the purposed scheme beneath various factors, the eye figure for various OFDM signal with the purposed scheme. So at the end we will compare the conventional PTS scheme with the Purposed Scheme.

Simulation Details & Scenario: The simulation information are taken for the OFDM signal with 256 no of subcarriers and the no of the sub-blocks in the deliberate scheme are different to change the PAPR of the signal . As they go on increasing the no . Of sub-blocks [16,64,128] the value of PAPR goes on decreasing with the coupled value of factor ‘r' . We have considered the results onto CCDF platform.





Scenario Parameters & Results:

Table 1 The Simulation Parameters

Parameter Name	Value
No. of Sub-Carriers, N	256
No. of Sub-blocks, Nsb	16,64,128
Sampling Frequency,fs	4 MHz
Carrier Frequency,fc	2MHz
Oversampling Factor, Nos	4
Type of Modulation	16 QAM
Decision Frequency,fd	1KHz
No. of FFT blocks for iteration	3000

The same scenario parameters are applied to study both the conventional OFDM scheme and the optimized scheme. The routine of both the schemes is distinction in terms of PAPR by computing their CCDF plots. With the variation in the parameter ‘r'and the no of sub-blocks the best situation for PAPR of the OFDM signals has been evaluated. With the help of CCDF plots, the PAPR of signal is plot beside the possibility for minimum PAPR in a Two Dimensional graph. The CCDF plot put side by side PAPRo [dB] against Pr [PAPR>PAPRo] with PAPRo [dB] on X-axis and Pr [PAPR>PAPRo] on Y-axis.

We are showing the comparison between conventional PTS scheme and the Optimized PTS for three different scenarios to better justify the results.

1. Results First Scenario: In the first scenario, we are taking the OFDM signal with No. of Sub-blocks=16 with subcarriers N=256, and fig 4.1.1 is plotted with the value of ‘r=3, then we can see from figure that PAPR reduces from the conventional OFDM scheme but from fig 4.1.2 we can see that there is a major change in the PAPR when r becomes equal to 4 so giving an efficient PAPR value for r=4.

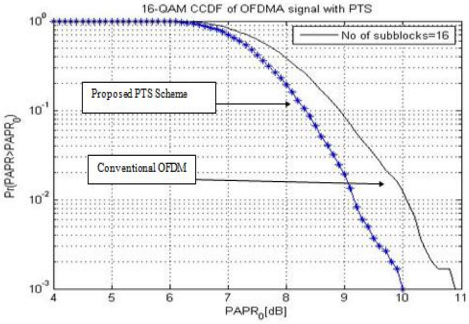


Fig 4.1 CCDF for Sub-Blocks =16, With The Value Of R = 3.

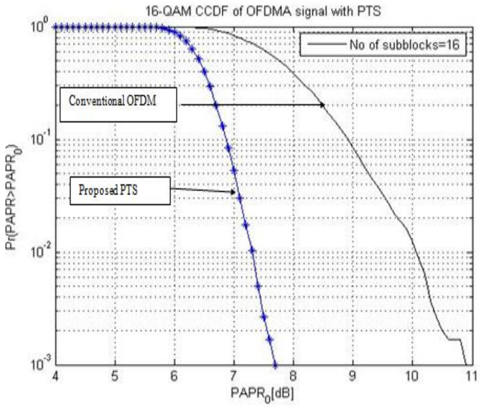


Fig 4.2 CCDF for Sub-Blocks =16, With The Value of R = 4.

2. *Results Second Scenario:* In second scenario, we have measured the OFDM signal With 256 Subcarriers, and the no of sub-blocks has been improved in this case. So the value of r also has to be increased. We have Plotted the CCDF for the value of r=5 in fig 4.1.3 which shows a change in the PAPR of the Optimized Scheme w.r.t conventional PTS scheme. This change goes on increasing as we further increase the value of r and this can be seen from fig 4.1.4 where we get a better PAPR value. Although if we further increased the value of 'r' this will does not recover the PAPR so value of 'r' has to be confined to r=7.

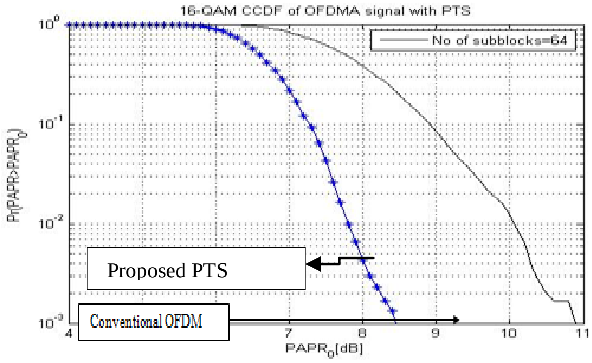


Fig 4.3 CCDF for Sub-Blocks =64, With the Value of R = 5.

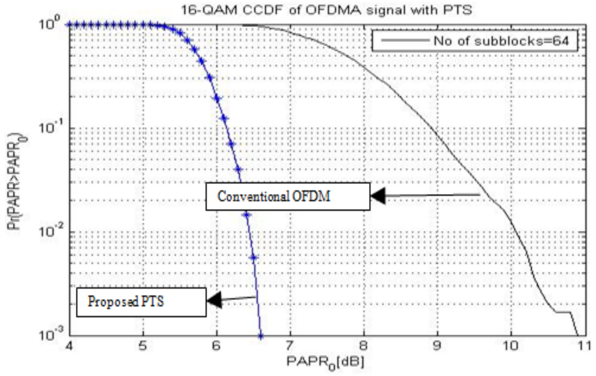


Fig 4.4 CCDF for Sub-Blocks =64, With the Value of R=6

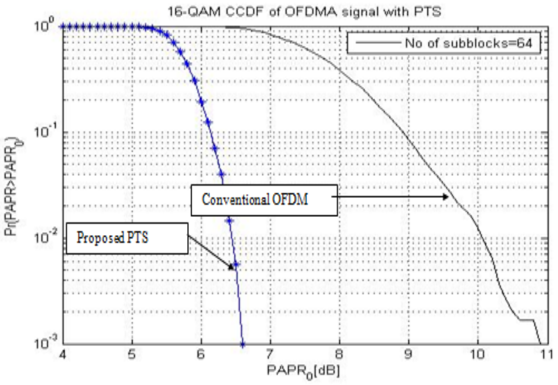


Fig 4.5 CCDF for Sub-Blocks =64, , With yhe Value Of R = 7

V. CONCLUSION AND FUTURE WORK

Since PAPR is a most extensive reason in the proper sending and receiving of the OFDM as it depend ahead the range of HPA that will construct the signal less or more noisy .So this becomes an important factor for comparison of various schemes for their intelligent working. In this dissertation, several PAPR reduction schemes proposed by various researchers for OFDM Signals are analyzed and a new PAPR reduction scheme called the Optimized PTS scheme is being planned. This layout depends ahead a factor 'r' that defines the no of times the phase vectors get attached to the modulate and oversampled signal. As well the no bits required for the side information that are to be transmitted with the signal over the direct has also been concentrated. With the help of simulations we have proven that the Optimized PTS method is more well-organized and send less no of area information bits with the channel. In other words this scheme reduces the misuse of wireless resources and improves the show of Orthogonal Frequency Division Multiplexing.

There is lot of more scope in the same direction to work with. New fast and efficient PAPR reduction schemes can be suggested and analyzed by simulating against the conventional PAPR reduction schemes. Performance of other proposed efficient PAPR reduction schemes are also issues to further investigate. Their actual network environment implementation is also worth for further study. Also, the current work is restricted to PAPR reduction only. Possibilities of extending this work to OFDMA with the less no of transmitted symbols can be worthy of an investigation. Other QoS issues can be taken to improve or compare the PAPR reduction performance.

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