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Review paper onPerformance of OFDM system based on PAPR

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Abstract *— Communication is most important requirement of life in these days. There is a tremendous growth in the field of communications. For more effective signal transmission system, single carrier signals are modified as multi-carriers signals. CDMA[1] (Code Division Multiplexing Access) and OFDM are these days being executing repeatedly. Applying of guard band in the signals cover the issue of ISI (Inter symbol interference) and noise signal is reduced by large number of subcarrier signals. But the large number of (PAPR) Peak to Average Power Ratio related to those signals has some unpleasant reactions on the communication system.In this paper we analyzed the PAPR reduction performance of the OFDM system using different techniques like SLM[2], PTS[3], Clipping[4],analysis shows that clipping method shows good PAPR reduction with respect to simplicity to implement. But this comes at the cost of significant amount of BER degradation.*

Keywords*-component; OFDM, Clipping, PAPR (Peak to Power Ratio), BER, CCDF, SLM, PTS*

I. INTRODUCTION

In the future of the Wireless applications demands services heavily rely on Orthogonal Frequency Division Multiplexing (OFDM) technique.In this fourth generation cellular and land mobile radio communication system the OFDM is widely used OFDM.OFDM extends the concept of single carrier modulation by multiple subcarriers within the same channel. One of the major issues over the OFDM system is high value of peak-to- average power ratio (PAPR).PAPR is the one of the most challengeabledrawback of OFDM system. There are several methods to prevail over this problems like SLM[2], PTS[3],Clipping[4]etc.But in each case whenever PAPR is reduced, BER of the system degrades. So we try to overcome this problem to improve the performance.OFDM is a most effective technique for future wireless applications. It is suitable for high data rate transmission in delay dispersive environment. It converts a high data stream in to a number of low data streams that are transmitted over parallel narrow band channels that can be easily equalized. One of the major issues is high peak –to-average power ratio. There are many approaches available to deal with PAPR problem.

II. SYSTEM MODEL

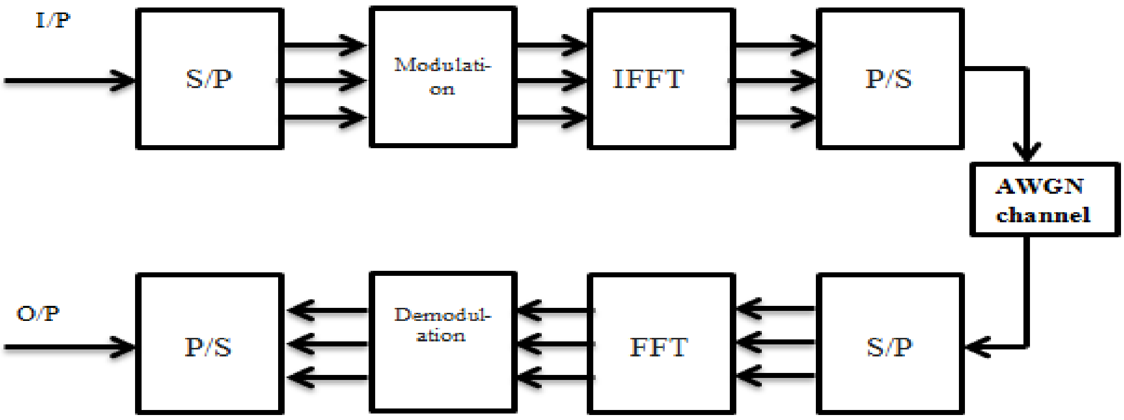

Figure: 1. Basic block Diagram of OFDM Systems

Figure 1 shows the basic diagram of OFDM system. The inputbinary data sequences (X) is givento serial to parallel convertor in which input sequence is converted into parallel complex symbols of size ‘N’.Than all the signals are modulated withrespectivemodulation techniques. The result signals of the modulated block are carried to the IFFT blocks were modulated signals converts into time domain. Parallel to series data convert in to data in one sequence to transmit. Using the AWGN channel to transmit data.At receiver the same process as the transmit is required so data on channel is applied to series to parallel and apply to FFT for transforming signals into frequency domain.We want to require the original data back so demodulation required after FFT operation. Parallel data is not the original data so we want to convert the parallel data into series sequence.

III. PAPR IN OFDM

Themajorproblemwhileimplementing this OFDMsystem isthehighpeaktoaveragepowerratioof thissystem.A large PAPR increasesthecomplexityoftheanalogtodigitalanddigitaltoanalogconverter and reduces the efficiency of the radio frequency (RF) power amplifier. Regulatory and application constraints can be implemented to reduce the peak transmittedpowerwhichinturnreducestherangeofmulticarriertransmission.This leads tothe prevention of spectralgrowthandthetransmitterpoweramplifieris no longerconfinedtolinear region inwhichitshouldoperate.Thishas aharmfuleffecton thebattery lifetime. Peak to average power ratio is calculated by the ratio between maximumpowers divided by average power of signals.PAPR is calculated at the IFFT stage of OFDM system.Here is the mathematical expression for the PAPR (Peak to average Power ratio).

$$\text{PAPR} = \frac{Peak\ \ value}{average\ \ value} = \frac{\max|x(t)^2|}{E[|x(t)^2|]} \quad (1)$$

Where $\max|x(t)^2|$ is peak power of the OFDM system
$E[|x(t)^2|]$ is the average power of the OFDM system

3.1. PAPR reduction techniques

Thereareanumberoftechniquestodealwiththeproblemof PAPR.Someofthemare "clippingandfiltering[4]" ,"coding" ,"partialtransmitsequence(PTS)[3]", Selectedmapping(SLM)[2]"and "interleaving[2]".ThesetechniquesachievePAPRreduction at theresultof transmitssignalpowerincrease,bit error rate (BER)increase, data rate loss, computational complexity increase.Different techniques of PAPR reduction Distortion techniques& distortion less techniquesDistortion techniques: clipping, clipping &filtering Distortion less techniques: PTS, SLM

3.1.1.Clipping& filtering [4]: Clipping is the most affective technique to reduce the high PAPR in the OFDM system. In OFDM peaks values are very high with low probability so clipping is more effective technique. Commonly clipping technique is applying at the transmitter & estimation of clipping signal is needed at the receiver .here is the mathematical expression for the amplitude clipping

$$C(x)=\begin{cases} x, |x| \le A \\ A, |x| > A \end{cases} \quad (2)$$

Here C(x) is the clipping signal & A is the clipping level that we apply to that original signal for PAPR reduction.Existence of the clipping occurs per OFDM symbol, and thusthe receiver has to estimate two parameters: location and size of the level of clip. In this clipping there is major drawback of degrades in the BERbecause information which required to transmit is removed at the clipping stage so there is the big disadvantage of using Clipping technique. Filtering combined with clipping reduce out of band radiation effect due to clipping although it cannot reduce in-band distortion. Clipping and filtering will exceed the clipping level at some points. To reducepeak regrowth, a repeated clipping-and-filtering operationcan be used to obtain a desirable PAPR at a cost of computational complexity increase.

3.2.Distortion less techniques: SLM (Selective Mapping)[2] , PTS [3](Partial Transmit Sequence)
SLM[2]: IN both the techniques the input data sequences are multiplied by each of phase sequences to generate interchanging input symbols sequences. Each sequences is mad e the IFFT operation and the one which has lowest PAPR selected for transmission in the system. For implementing the SLM technique in the OFDM system, the system requires number of the blocks IIFT operations and the number of required bits as side information is for each data block in the transmission system. Therefore the ability of reduction of PAPR depends on the number of phase vector

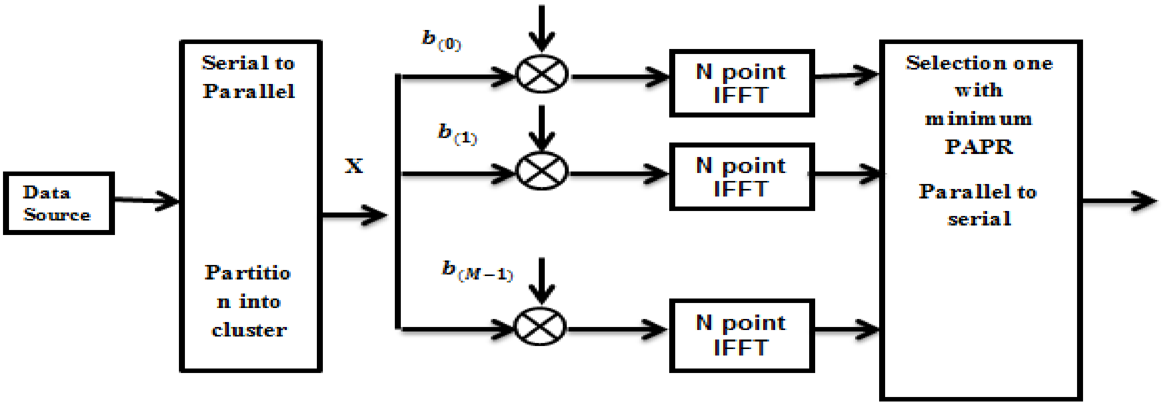

Figure: 2. Block diagram of SLM technique

3.2.1.PTS[3]:PTS scheme is the distortion less technique with computational complexity.in the typical OFDM system when used the PTS technique to reduce the PAPR the input data block is separated into M sub blocks. This is represented using vectors$\{X^{(m)}, m = 0,1,\dots, M-1\}$as shownin the figure. Hence we get

$$X = \sum_{m=0}^{M-1} X^{(m)} \tag{3}$$

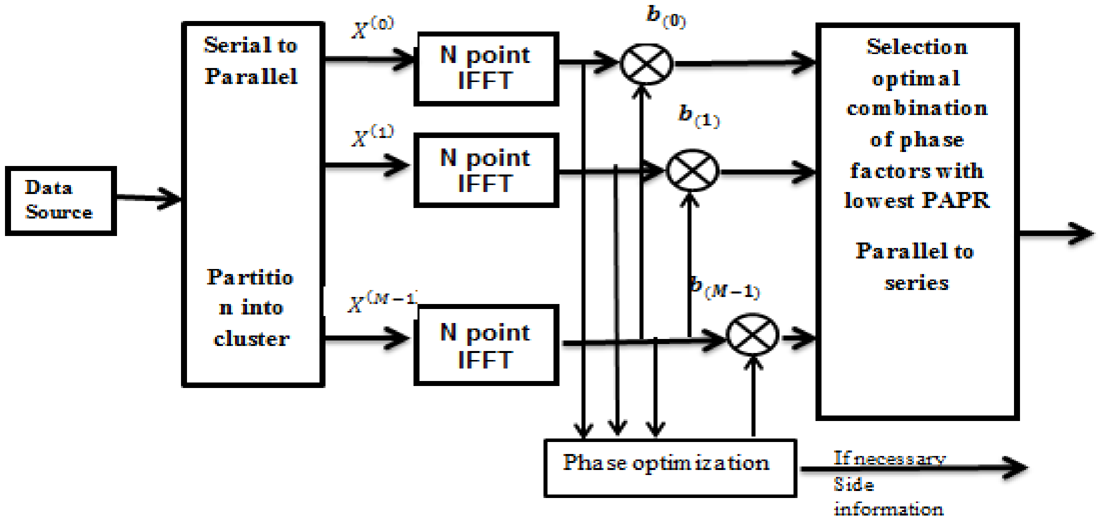

Figure: 2. Block diagram of PTS technique

Where $X^{(m)}$are sub blocks of equal size? Then the subblocks $X^{(m)}$ are transformed into M time domain partial transmit sequences,

$$x^{(m)} = \left[x_0^{(m)} x_1^{(m)} \cdots x_{0LN-1}^{(m)}\right] = IFFT_{LN\times N}[X^{(m)}] \tag{4}$$

These partial sequences are independently rotated by phase vector. So the aim is to ideally combine the sub blocks to obtain the time obtain OFDM signals with lowest PAPR.

$$\tilde{x} = \sum_{m=0}^{M-1} b_m X^{(m)} \tag{5}$$

there are two important problems should be resolved in PTS high computational complexity for discovering the ideal phase factors and the overhead ideal phase factors aside information needed to be transmitted to receiver for the accurate decoding of the transmission bit sequence.

IV. CONCLUSION

OFDM is a very adorable technique for communication system due to its spectrum efficiency and channel robust ness. But in this system it has a very serious drawback that when the input sequences are very high correlated so the PAPR value is very high. In this paper we deliberate few important factors and also provide the mathematical expression for PAPR in the system. Three typical techniques to reduce PAPR have been analyzed .all the techniques have the target to provide substantial reduction in PAPR at the expense of loss in data rate, transmit power increase.These techniques reduce the PAPR at the cost of BER as the amount of PAPR reduction increases BER degrades in the same proportion.

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