Reduction in Peak to Average Power Ration Using Proposed Approach for OFDM Systems

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Abstract- OFDM is an attractive modulation technique for transmitting large amounts of digital data in wireless standards. The multi-carrier phenomena is considered to be one of the major development in wireless communication and among them OFDM is becoming the important standard, because it has several advantages such as high number of orthogonal sub-carriers, no inter-symbol interference, high spectral efficiency, tolerance in multipath delay spread, power efficiency, frequency selective fading immunity etc. But one of the challenging issues for Orthogonal Frequency Division Multiplexing (OFDM) system is its high Peak-to-Average Power Ratio (PAPR). OFDM consist of large number of independent sub carriers as a result of which amplitude of such a signal can have high peak values. Several methods have been proposed to reduce the PAPR. In this paper, we proposed a hybrid PAPR reduction approach for OFDM systems and the simulation results are carried out in MATLAB.

Keywords—OFDM, PAPR, SLM, ISI, PTS

I. INTRODUCTION

Wireless data communications are an essential component of mobile computing. The various available technologies differ in local availability, coverage range and performance, and in some circumstances, users must be able to employ multiple connection types and switch between them. To simplify the experience for the user, connection can be used, or a mobile VPN deployed to handle the multiple connections as a secure, single virtual network. Supporting technologies include: Wi-Fi is a wireless local area network that enables portable computing devices to connect easily to the Internet. The standardized as IEEE 802.11 a, b, g, n, Wi-Fi approaches speeds of some types of wired Ethernet. Wi-Fi has become the de facto standard for access in private homes, within offices, and at public hotspots. Some businesses charge customers a monthly fee for service, while others have begun offering it for free in an effort to increase the sales of their goods. Cellular data service offers coverage within a range of 10-15 miles from the nearest cell site. Speeds have increased as technologies have evolved, from earlier technologies such as GSM, CDMA and GPRS, to 3G networks such as W-CDMA, EDGE or CDMA2000 [1].

Mobile Satellite Communications may be used where other wireless connections are unavailable, such as in largely rural areas or remote locations. Satellite communications are especially important for transportation, aviation, maritime and military use [2]. Wireless Sensor Networks are responsible for sensing noise, interference, and activity in data collection networks. This allows us to detect relevant quantities, monitor and collect data, formulate meaningful user displays, and to perform decision-making functions. OFDM is a frequency-division multiplexing (FDM) arrangement acclimated as an agenda multi-carrier accentuation method. An ample amount of carefully spaced erect sub-carrier signals are acclimated to backpack abstracts on several alongside abstracts streams or channels [3]. Anniversary sub-carrier is articulate with a accepted accentuation arrangement (such as quadrature amplitude accentuation or phase-shift keying) at a low attribute rate, advancement absolute abstracts ante agnate to accepted single-carrier accentuation schemes in the aforementioned bandwidth.

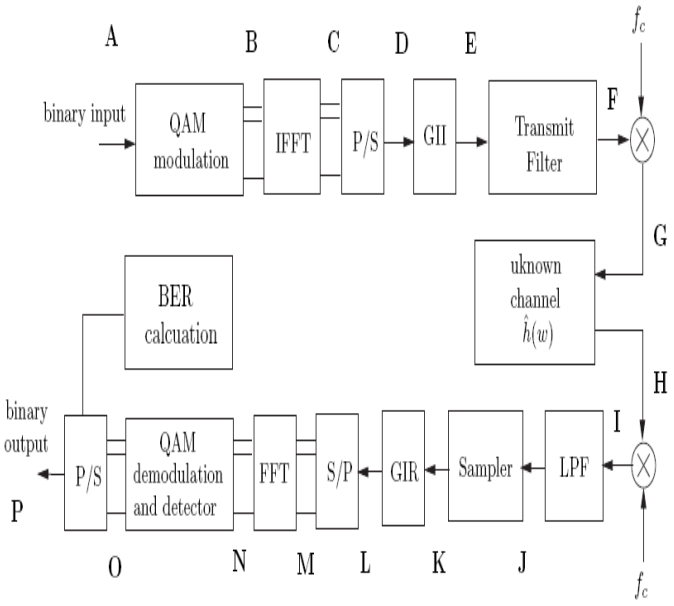

Figure 1: OFDM block diagram.

The primary advantage of OFDM over single-carrier schemes is its adeptness to cope with astringent approach altitude (for example, abrasion of top frequencies in a continued chestnut wire, narrowband arrest and frequency-selective crumbling due to multipath) after circuitous equalization filters. Approach equalization is simplified because OFDM may be beheld as application abounding boring articulate narrowband signals rather than one rapidly articulate wideband signal. The low

attribute amount makes the use of a bouncer breach amid symbols affordable, authoritative it accessible to annihilate intersymbol arrest (ISI) and advance echoes and time-spreading (on alternation TV these are arresting as ghosting and blurring, respectively) to accomplish an assortment gain, i.e. a signal-to-noise arrangement improvement [4]. This apparatus as well facilitates the architecture of alone abundance networks (SFNs), area several adjoining transmitters advanced the aforementioned arresting accompanying at the aforementioned frequency, as the signals from assorted abroad transmitters may be accumulated constructively, rather than interfering as would about action in an acceptable single-carrier system. The OFDM based assorted admission technology OFDMA is as well acclimated in several 4G and pre-4G cellular networks and adaptable broadband standards.

II. TECHNIQUES USED

The peak-to-average power ratio (PAPR) is the peak amplitude squared (giving the peak power) divided by the RMS value squared (giving the average power). It is the square of the crest factor: The problem with this splendid technique is that it is power inefficient due to the presence of hurdle named as PAPR that is peak to average power ratio which force the non linearity to get emerged into the transmission. Number of approaches has been developed to put this problem into a process to have favorable results that are SLM (selective mapping), clipping and filtering, PTS (partial transit sequence) etc. Using Selected Mapping technique (SLM), input data is portioned into sub data blocks given below of length N, and is [5]:

$X = [X_0, X_1, X_2 \dots X_{N-1}]$

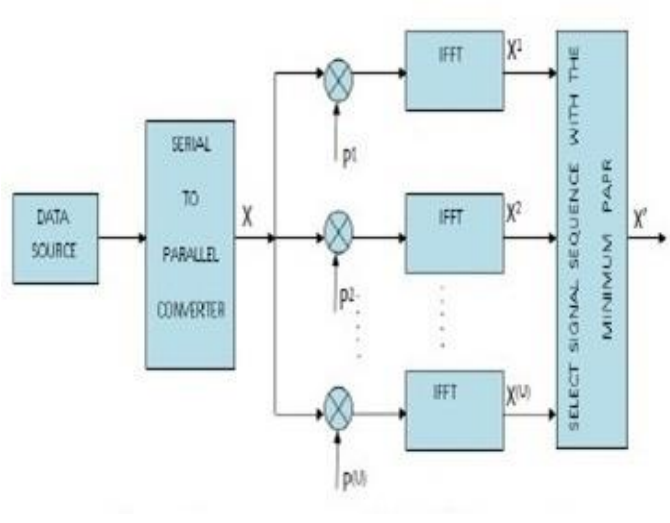

Figure 2: Block Diagram of SLM

SLM (Selective Mapping): In selective mapping arrangement, the sequence of input data is multiplied by each of the phase sequence to give birth to new input symbol arrangement. Each of the new born input data sequence is put in the mode of IFFT operation. When the data is parallel converted then OFDM data block is multiplied element by element with Phase sequence given as [6]:

$P^u = [P^1, P^2, P^3 \dots P^u]$

After data blocks are phase rotated, the rotated OFDM data blocks represents similar information which are unmodified OFDM data blocks, provided with known phase sequence. A block diagram of the SLM technique is shown in Fig. 2. Now frequency domain signal is converted into the time domain X (u), by the help of IFFT.

S. No.	*Technology Used*	*Value of PAPR*
1.	Clipping and Filtering	5.82 dB
2.	Selective Mapping (SLM)	6.5 dB
3.	Partial Transit Sequence (PTS)	Approx. 5.3 dB

Clipping and Filteration: This methodology states that the out of band radiations developed by clipping is squashed by subsequent filtering operation and in band hurdle/noise is suppressed by applying coding method or clipping noise cancellation method [7].

PTS (Partial Transit Sequence): According to PTS technique an N symbol input block is taken, and is divided into disjoint sub-blocks. After that the divided sub-bocks are weighted by the phase vector sequence. The selection of phase factor such that the PAPR of the resultant signal is minimum. The divided sub-block is given as:

$X_m = [X^0, X^1, X^2 \dots X^{V-1}]^T$

Where v = [1, 2, 3…., V], Then, the sub-blocks X are transformed into time-domain partial transmit sequence x, by using IFFT which can be represented as:

$X_m = \sum \text{IFFT}(X_m)$

After that, these divided sequences are independently rotated by the phase factors (P), which is given as:

$P = [P_1, P_2 \dots P_m]$

At the end for manual the applicant with everyman PAPR is chosen. The assumption anatomy of the C-PTS arrangement is apparent in the accustomed beneath. The cold is to optimally amalgamate the "V" sub-blocks to access the time area OFDM signals with the everyman PAPR. Without any accident of performance, one can set P1=1 and beam that there is (V-1) sub blocks to be optimized. Consequently, to accomplish the optimal appearance agency for anniversary ascribe abstracts arrangement (assume that there are (W) appearance factors in the appearance set), combinations should be arrested in adjustment to access the minimum PAPR. Therefore, the seek complication for an optimum set of the appearance factors increases exponentially with the amount of sub blocks.

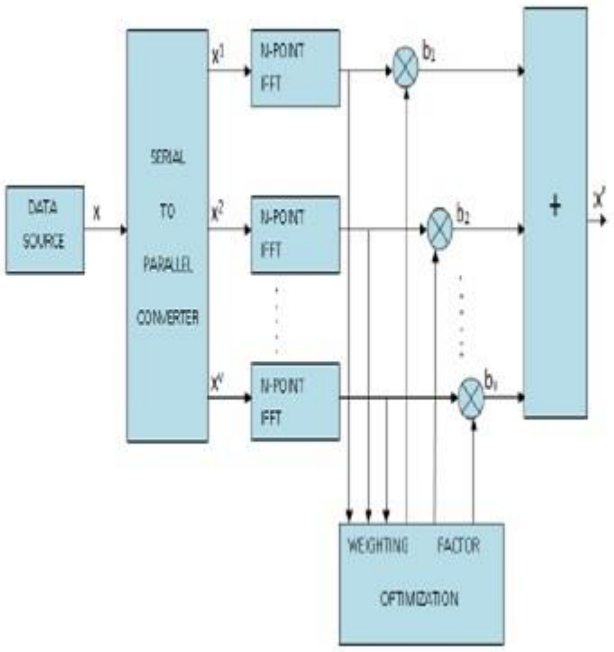

Figure 3: Block Diagram of PTS

III. PROBLEM FORMULATION

In wireless communication systems, the orthogonal frequency division multiplexing (OFDM) method is a broadly prevalent an attractive plan for high-information rate transmission because it can cope with frequency selective fading channel. OFDM is one of the many multicarrier modulation techniques, which provides high spectral efficiency, low implementation complexity, less vulnerability to noise and non – linear distortion. Due to these advantages of the OFDM system, it is vastly used in various communication systems. But the major problem one faces while implementing this system is the high peak – to – average power ratio (PARP)of this system. The PAPR is the relation between the maximum power of a sample in a given OFDM transmit symbol divided by the average power of that OFDM symbol. PAPR occurs when in a multicarrier system the different sub-carriers are out of phase with each other. At each instant they are different with respect to each other at different phase values. The input symbol stream of the IFFT should possess a uniform power spectrum, but the output of the IFFT may result in a no uniform or spiky power spectrum. Many Techniques had been proposed for removing this PAPR from OFDM system, as per literature recently an clipping algorithm along with filtration was proposed, the PAPR was reduced up to an extent but as clipping is not that much efficient as it cut the signal and also effect the information of the signal so there is need to update the methodology by using other techniques.

IV. PROPOSED METHODOLOGY

As PAPR is the the major problem in OFDM ,we need dto take certain measure to prevennt its effect .The problem caused by PAPR are:

- Increased complexity in the analog to digital and digital to analog converter.
- Reduction is efficiency of RF amplifiers

So there is a need to find some technique to reduce the effect of PAPR .we need to reduce the PARP as low PAPR makes the RF amplifier works efficiently. PAPR decrease strategies differ as per the needs of the system and depend on different elements. PAPR reducing capacity, increment in power in transmit signal, loss in information rate, unpredictability of processing and increment in the bit-error rate at the receiver end are different variables which are considered before adopting a PAPR decrease strategy of the system.

A. Effect of PAPR

There are some obstacles in using OFDM in transmission system in contrast to its advantages:

1. A major obstacle is that the OFDM signal exhibits a very high Peak to Average Power Ratio (PAPR).

2. Therefore, RF power amplifiers should be operated in a very large linear region. Otherwise, the signal peaks get into non-linear region of the power amplifier causing signal distortion. This signal distortion introduces intermediation among the subcarriers and out of band radiation. Thus, the power amplifiers should be operated with large power back-offs. On the other hand, this leads to very inefficient amplification and expensive transmitters. Thus, it is highly desirable to reduce the PAPR.

3. The large peaks cause saturation in power amplifiers, leading to intermediation products among the subcarriers and disturbing out of band energy. Therefore, it is desirable to reduce the PAPR.

4. To reduce the PAPR, several techniques have been proposed such as clipping, coding , peak windowing, Tone Reservation and Tone Injection. But, most of these methods are unable to achieve simultaneously a large reduction in PAPR with low complexity, with low coding overhead, without performance degradation and without transmitter receiver symbol handshake.

5. Complexity is increased in the analog to digital and digital to analog converter. Criteria For PAPR Reduction Method Selection The criteria of the PAPR reduction is to find the approach that it can reduce PAPR largely and at the same time it can keep the good performance in terms of the following factors as possible.

V. STEPS OF PROPOSED TECHNIQUE

As it was suggested in earlier section that there is need to update the clipping based papr reduction methodology so in this paper a new approach is proposed that having an

advancement over the clipping and the filtering methodology. The work basically focuses on the hybridization of the traditional approach and it is found that the output of the PAPR reduction techniques suchg as SLM , PTS , Tone reservation methodologies are very much popular but in the PTS ideas are much considerable. In the proposed approach, the algorithm firstly work with PTS technique and then the clipping and the filtration process occurs that leads to minimum loss of information and the reduce the PAPR of the transmitted signal. The steps of proposed approach are deccribed below:

- Generate a random signal for PAPR reduction in OFDM.
- Apply QPSK modulation on that signal.
- Now perform padding by adding zeros.
- Compute IFFT of padded signal with help of IFFT equation:

$$X_k = \sum_{n=0}^{N-1} x_n e^{-i2\pi k \frac{n}{N}} \qquad k = 0, \ldots, N-1.$$

- Now apply PTS technique to reduce the PAPR value. According to PTS phase shift [1 - 1 j -j], generate all possible combinations of weighting factor set in PTS method.
- Then check the values of PAPR of the corresponding generated signals and the signal with minimum PAPR value was selected while others are rejected.
- After PTS now Apply Clipping operation on OFDM signal. Clipping operation done by threshold level A.
- Compute the clipping noise D.
- After computing clipping noise D perform FFT on this.
- Now compute this equation:

$$\hat{X}_{Kc}^{(L)} = [X_K]_{K=0}^{(LN-1)} - \hat{\beta}\hat{D}_K$$

Where X_k is OFDM signal And β is noise Calculation parameter.

- After computing above equation performs IFFT on X_{kc} signal and filtering operation is applied on this.
- After clipping and filtering now compute :

$$\hat{x}_n = \hat{x}_{nc} - E\left[d_n^{(L)}\right]$$

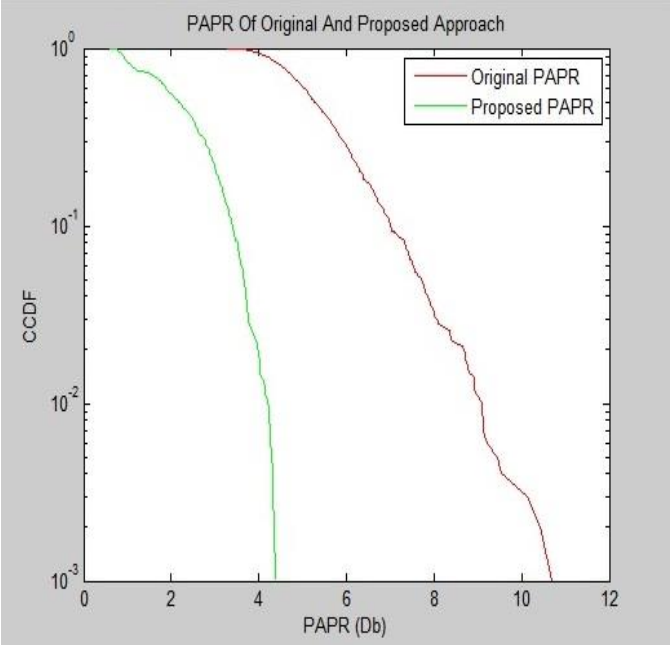

Figure 2: PAPR comparison of proposed technique in contrast with traditional approach.

VI. CONCLUSION

In this, OFDM, peak to average power ratio and its various reduction techniques are reviewed. Orthogonal frequency division multiplexing technique is modulation technique which provides high speed communication in both wired and wireless systems. PAPR is major drawback of Orthogonal Frequency Division Multiplexing technique which degrades the performance of OFDM.As per the information about all above described techniques to reduce the PAPR in OFDM system all techniques is different in their way and using each technique PAPR will be reduced at some level. Research is going on to further improve PAPR reduction and improving the performance of OFDM systems.

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