PAPR REDUCTION USING CLIPPING AND FILTERING, SLM AND PTS TECHNIQUES

VASIM KHAN
Research Scholar
Electronics and Communication Engineering
Lakshmi Narain College Of Technology
Indore(M.P.),India
vasimkhan87@yahoo.co.in

Prof. VIJAY CHAUHAN
Electronics and Communication Engineering
Lakshmi Narain College Of Technology
Indore(M.P.),India
Vijay_38697@yahoo.co.in

***Abstract*— Orthogonal Frequency-division multiplexing or multicarrier transmission scheme is an attractive technique for high-bit-rate communication systems. It has been widely used in modern wireless communication because of its high data rate, immunity to delay spread and frequency spectral efficiency and other advantages. Besides these advantages, one of the major drawbacks of OFDM is the high Peak-to-average-power ratio (PAPR) of the Transmitter's output signal, as it restricts the system performance. Clipping method is the simplest method to reduce the PAPR of the OFDM system, here we are using the Clipping and Filtering method as it provides better results compared to clipping method. Selective Mapping (SLM) method is another approach which provides good performance for reduction of PAPR, where the actual transmit signal is selected from a set of signals to construct the transmitted signal. A comprehensive analysis and comparison are conducted in terms of all possible influencing factors and PAPR reduction performance, respectively. Some research findings are obtained based on the simulation results. The results verify that PTS method provides a better PAPR reduction performance compared to SLM method and the probability of high PAPR with increasing the number of sub-blocks in PTS technique decreases obviously, compared to the original OFDM signal. In addition, SLM algorithm is more suitable if the system can tolerate more redundant information; otherwise, PTS algorithm is more acceptable when complexity becomes the first considering factor. In this paper, Clipping and filtering, SLM and PTS method are compared.**

***Keywords*— Orthogonal Frequency-division multiplexing (OFDM), Peak-to-average-power ratio (PAPR), Selective Mapping (SLM), Inverse Fast Fourier Transform (IFFT), Partial Transmit Sequence (PTS).**

I. INTRODUCTION

The technology of Orthogonal Frequency Division Multiplexing (OFDM) is a multi-carrier digital communication modulation technique which makes use of multiple sub-carriers and the frequency of overlapping technology. OFDM is mainly used in digital audio broadcasting (DAB), digital video broadcasting-terrestrial (DVB-T), mobile multimedia access communication (MMAC), IEEE802.11a, IEEE802.16 and IEEE 802.20. However, as the OFDM symbol is modulated by the sum of a number of independent sub-carrier signal, and the subcarriers are statistically independent, when the number of subcarriers comes to a certain extent, the peak to average power is much larger than the single-carrier system, which requires the system power amplifier, A/D and D/A converter with a larger linear dynamic range. So that the OFDM system can easily lead to interference between adjacent channels, and the orthogonal is destroyed. It is therefore important to minimize the PAPR. The high PAPR feature will cause poor efficiency of power consumption, in band distortion, and spectral spreading when an OFDM signal is passed through a nonlinear power amplifier.

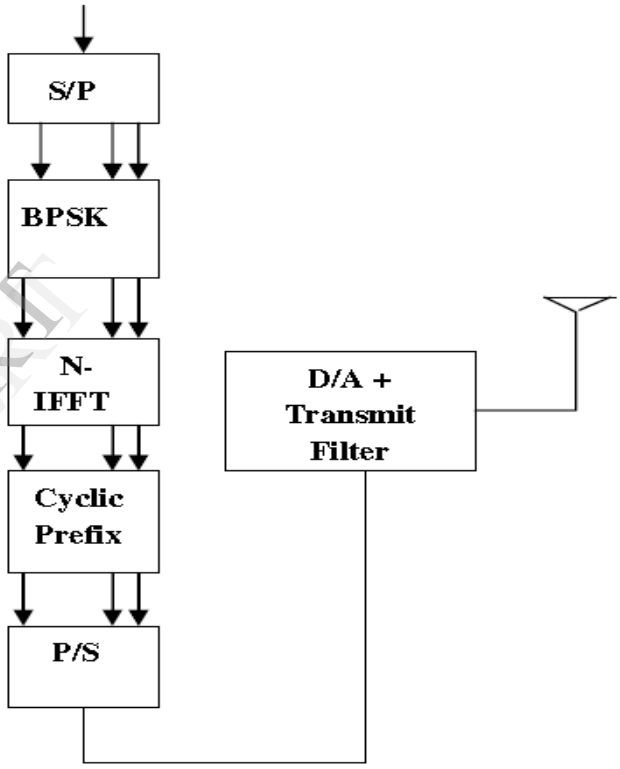

Fig 1.Basic Ofdm Transmitter Structure

II. REDUCTION TECHNIQUES

(A) CLIPPING AND FILTERING

The simplest approach to reducing the PAPR of OFDM signals is to clip the high amplitude peaks. In the OFDM signal at or near the peak amplitude use non-linear operation, you can make the peak signal is lower than the expected maximum level of value, thereby reducing the PAPR value of the signal. Clipping can be applied to any number of sub-carriers constitute the system. In OFDM system, although the PAPR is very large, signal peak probability is very small, PAPR can be reduced by reducing the probability of a small peak to achieve. Therefore, Clipping technology is an effective way to reduce PAPR.

Since Clipping and filtering approach is the simplest PAPR reduction scheme, which limits the transmit signal to a prespecified level. As Clipping causes out-of-band radiation, which imposes out-of-band interference to adjacent channels , it can be reduced by filtering at the cost of peak regrowth, it may affect high-frequency components of in-band signal (aliasing) when clipping is performed with the Nyquist sampling rate in the discrete-time domain (DT). However, if clipping is performed for the sufficiently-oversampled OFDM signals (e.g. L=4) in the DT domain before a low-pass filter (LPF) and the signal passes through a band-pass filter (BPF), the performance of BER will be less degraded.

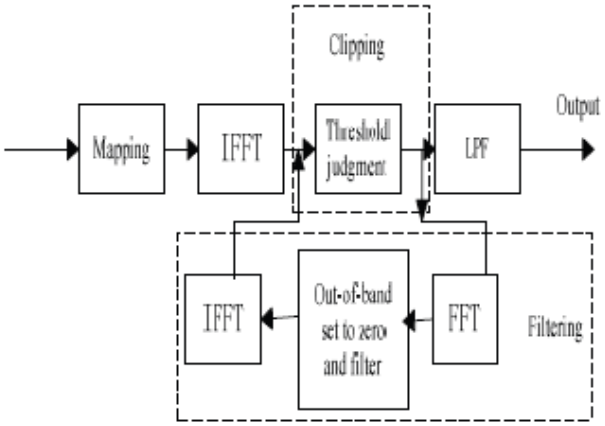

Fig 2.Clipping And Filtering Algorithm For Ofdm Transmitter Block Diagram

Because clipping process on the OFDM time domain signal, which use non-linear operation, so Clipping will cause peak re growth . To avoid the problem of peak regrowth, the signal can be clipped after interpolation. However, this cause very significant out-of-band power. To avoid the out-of-band power, we can use filtering the signal after clipping, through this filtering process; it will effectively eliminate the out-of-band power and prevent peak re growth. Clipping and filtering

Algorithm for OFDM transmitter block diagram as shown in figure 2. The main idea of Clipping and Filtering algorithm is to limit distortion of the frequency domain to approximate estimate and processing. The processing steps are as follows:

a) The frequency domain signal through the IFFT transform, received oversampling time-domain signal.

b) Clipping in the time domain, and then clipping distortion to the frequency domain by FFT transform.

c) Out-of-band signal is set to zero, artificially.

d) Using IFFT converted to time domain signal, and output.

(B) SELECTIVE MAPPING

SLM (Selected Mapping) is an effective algorithm to reduce Peak to Average Power Ratio in OFDM (orthogonal frequency division multiplexing) signal without distortion. However the SLM scheme needs to dispose U paths of IFFT(Inverse Fourier Transform), which increases the computational burden and reduces the signal transmission rate. This article offers an improved algorithm that based on SLM, which is named Random Screening SLM (RS-SLM). The proposed algorithm executes the selection before the IFFT module. and only selects one sequence with the highest randomness to be transmitted according to the offset. Because only one path of signal is transmitted in IFFT modules, the proposed algorithm has lower complexity compares with SLM. Moreover, it has advantages in enhancing the signal transmission rate and decreasing the PAPR of OFDM signals.

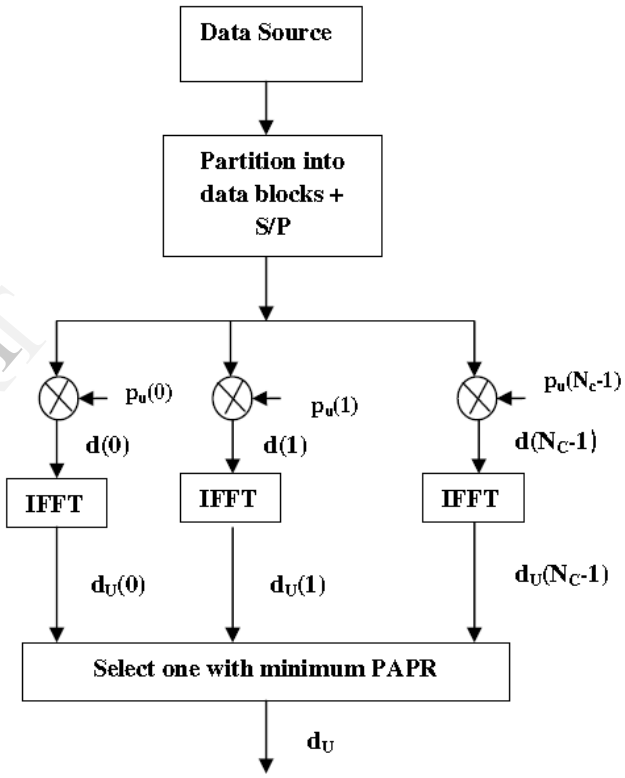

Fig 3.Block Diagram Of Slm Technique

(C) PARTIAL TRANSMIT SEQUENCE-PTS

The data stream is partitioned into non-overlapping sub blocks of equal size. Each sub block is multiplied by a weight. The weight is chosen as per convenience and a hit and trial method is used to obtain the weights to optimize the algorithm. The side information must be provided at the receiver. The performance of BER will be less degraded.

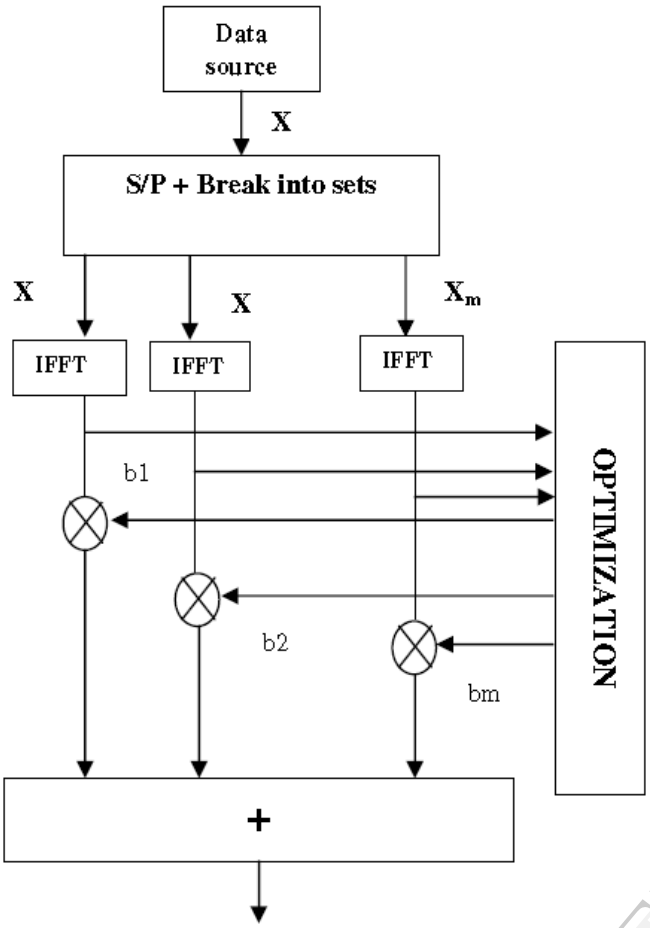

Fig 4. Block Diagram For Pts

III.CONCLUSION

In this paper, the comparison of the method of clipping and filtering , selected mapping and partial transmit sequence is drawn on the basis of extensive reading and studying of associated papers and literature in this research area. Clipping and Filtering algorithm are used to optimize the system performance of PAPR and out-of-band power performance. Simulation results show that the clipping rate (CR) more lower, the effect of PAPR reduces more significant. When the clipping rate (CR) is under the same conditions, Clipping and Filtering method than direct Clipping method is more effective reduces the PAPR of OFDM system. The algorithm also has disadvantage, Clipping and Filtering algorithm use filter to improve clipping distortion, the filtering process needs a pair of FFT/IFFT operation, increased complexity of equipment and computing.

Also the advantages and disadvantages of two algorithms i.e., SLM and PTS were summed up and the occasions of their respective adaptation were pointed out. A series of detailed comparison results show that SLM and PTS are similar techniques with similar characteristics. SLM also offers an efficient and distortion-less scheme by increasing complexity in the transmitter and receiver and reducing the data rate. Both techniques scramble an input data block of the OFDM symbols and transmit one of them with the minimum PAPR so that the probability of incurring high PAPR can be reduced. The main differences between them are: SLM is better than PTS in terms of reduction capability vs. redundancy, but PTS is considerably better with respect to reduction capability vs. additional complexity in the systems as it is capable of provide more reduction. Obviously, complexity is the main factor if practical OFDM systems are considered and so PTS could be a strong candidate. PTS and SLM are near optimum when PAR reduction capability vs. redundancy is considered. Thus, they seem to be the most powerful methods known to reduce OFDM peak power without non-linear distortion.

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