PAPR REDUCTION AND BIT ERROR RATE EVALUATION IN OFDM SYSTEM USING HYBRID TECHNIQUES

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ABSTRACT

Orthogonal frequency division multiplexing (OFDM) has become an important component of waveform generation in wideband transmission. it's a superior technology for the high-speed rate of wired and wireless communication systems. Currently, multiple-input multiple-output orthogonal frequency division multiplexing (MIMO OFDM) systems are crucial wireless communication systems like 4G and 5G networks & tactical communication. The OFDM has many advantages over other techniques like its high capacity and immunity against multipath fading channels. However, one amongst the foremost drawbacks of the OFDM system is that the high-peak-to-average power ratio (PAPR) that leads the system to provide in-band distortion and out-of-band radiation and reduces its efficiency. This problem increases with a rise within the number of transmit antennas. Therefore, it's highly desirable to cut back the PAPR of an OFDM signal. For this, numerous techniques are proposed to beat the PAPR problem like i) Selective mapping (SLM) ii) Partial transmit sequence (PTS), iii) Clipping, iv) Clipping and filtering. All of those are reduced the PAPR by generating alternative subcarrier vector that are statistically independent OFDM symbols for a given data frame and transmitting the symbol with rock bottom peak power. During this paper we also proposed, some hybrid techniques. The hybrid techniques are the technique of clipping is employed in conjunction with SLM and PTS to cut back computational complexity. And also the combination of SLM-PTS to scale back PAPR. Simulations are acquainted with analyze the efficiency of the techniques used which signifies OFDM to be providing much better PAPR reduction and a way better Bit Error Rate (BER). it's shown in simulation results that the proposed scheme performs well reducing PAPR. But the proposed scheme is more complex than the prevailing techniques.

KEYWORDS

OFDM, PAPR, SLM, PTS, MIMO, 5G, 4G, HYBRID, BER.

1. INTRODUCTION

In data communications and networking, orthogonal frequency-division multiplexing (OFDM) could be a method of digital data modulation, whereby one stream of information is split into several separate sub-streams for transmission via multiple channels. Orthogonal Frequency Division Multiplexing may well be a Multicarrier transmission technique supported orthogonal carriers which became one in every of the foremost cheering developments of up thus far broadband wireless networks and wire line transmission systems due to its high speed data transmission, great spectral efficiency, fine quality service, robustness to the selective fading problem and narrow band interference [1].

OFDM uses the principle of frequency division multiplexing (FDM), where the available bandwidth is split into a group of sub-streams having separate frequency bands .The downlink of

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the LTE system is OFDM-based and this might be often so permanent reason. OFDM is principally utilized in digital audio broad-casting (DAB), digital video broad-casting-terrestrial (DVB-T), mobile Multimedia access communication (MMAC), IEEE802.11a, IEEE802.16 and IEEE 802.20[2][3].

OFDM possesses a remarkable characteristic of getting the pliability to be adapted in an exceedingly very straightforward manner to work in numerous channel bandwidths per spectrum availability. Another advantage of OFDM is that the low complexity within the planning of the receiver. Orthogonal frequency division multiplexing (OFDM) underlies all 4G wireless communication Systems; for example, it's included within the IEEE 802.16 Worldwide Interoperability for Microwave Access (WiMAX) and future Evolution (LTE) standards. LTE is currently the chosen standard for interoperable Public Safety communications within the US and in other countries.[4]

Furthermore, the OFDM system is healthier than other multicarrier techniques because it's unique features like efficient bandwidth utilization, less vulnerability, and fewer non-linear distortion .Although OFDM has many distinctive features, the high peak-to-average power ratio(PAPR) is taken into account because the foremost drawback in OFDM that causes the OFDM system suffer from in-band distortion and out-of-band radiation [5]. This can be attributed to the non-linearity nature of the high power amplifier (HPA) within the transmitter. Also, the high PAPR value increases the complexity when using some devices like analog to digital converter (ADC) and digital to analog converter (DAC). Hence, the OFDM system requires HPA with large input back- off power (IBO), and long word length to follow the high PAPR value [6]. These constraints undoubtedly represent relevant issues that caught the eye of the many researchers.

1.1. Working Principle of OFDM

OFDM could be a specialized FDM having the constraint that the sub-streams within which the most signal is split, are orthogonal to every other. Orthogonal signals are signals that are perpendicular to every other. A main property of orthogonal signals is that they are doing not interfere with one another. When any signal is modulated by the sender, its sidebands detached either side. A receiver can successfully demodulate the information on condition that it receives the entire signal. just in case of FDM, guard bands are inserted so interference between the signals, leading to cross-talks, doesn't occur. However, since orthogonal signals are employed in OFDM, no interference occurs between the signals whether or not their sidebands overlap. So, guard bands are often removed, thus saving bandwidth. the standards that must be maintained is that the carrier spacing should be adequate the reciprocal of the symbol period.

In order that OFDM works, there should be very accurate synchronization between the communicating nodes. If frequency deviation occurs within the sub-streams, they'll not be orthogonal from now on, thanks to which interference between the signals will occur.

1.2. Block Diagram of the OFDM System.

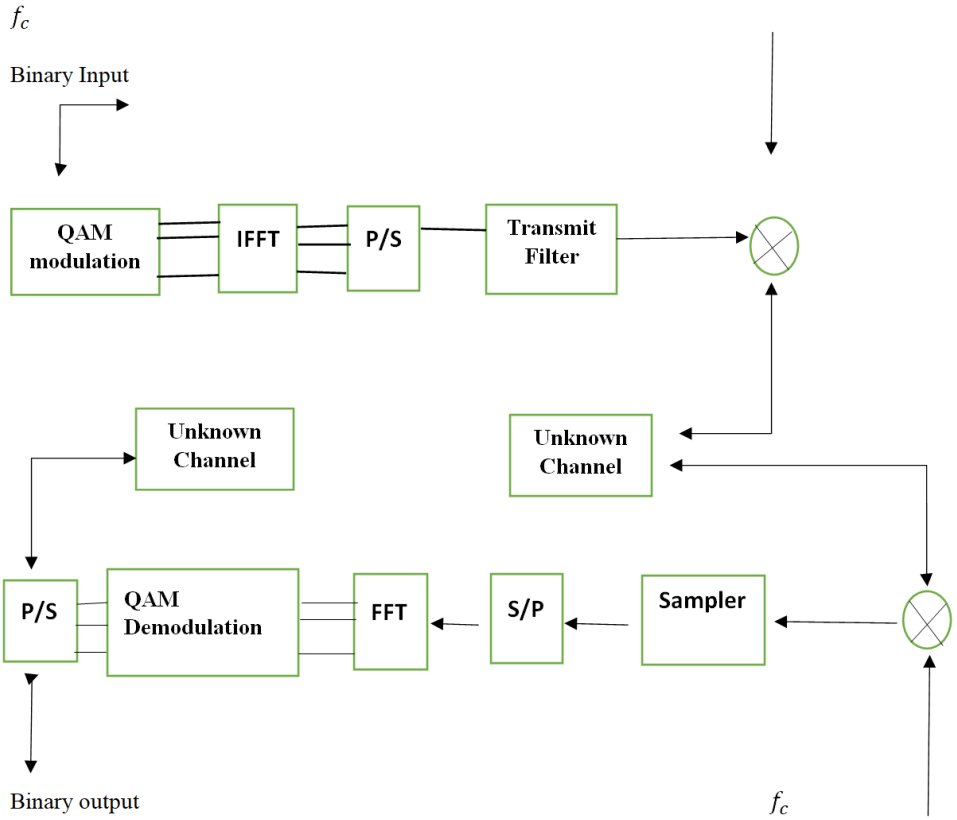

Figure 1. Block diagram of the OFDM system.

The OFDM sequence is generated by adding all N modulated subcarriers when applying IFFT operation, with the consideration; the subcarriers are allowed to be orthogonally one another. to know the concept of OFDM, let X = is that the complex representation of the pc file block symbols after constellation mapping operation, where Xk represents the block data of kth subcarrier, and N is that the quantity of subcarriers. Therefore, the complex baseband OFDM signal is defined as [7]

$$x(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_k \; e^{j2\pi k \Delta f t} \qquad 0 \le t \le T \qquad \text{---------- (1)}$$

where $e^{j2\pi\Delta f t}$ is that the factor of the k th subcarrier, T represents the complete time of symbol, Δf is that the frequency space between subcarriers, and j= $\sqrt{-1}$. The bandwidth of the symbol is B = N. Δf, and Δf is about as 1/T to create sure the orthogonally between the subcarriers of the symbol. Therefore, the baseband OFDM signal is additionally written as

$$x(t) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_k \; e^{j2\pi k t/T} \quad 0 \le t \le T \qquad \text{----------(2)}$$

The baseband OFDM signal is sampled by applying the rate (t = T /N). Therefore, the discrete OFDM signal within the time-domain are visiting be expressed as,[8]

$$x(n) = \frac{1}{\sqrt{N}} \sum_{k=0}^{N-1} X_k \; e^{j2\pi k n /N} \quad 0 \le n \le N-1 \quad \text{----------(3)}$$

where n represents the discrete sampling index, whereas the discrete OFDM signal vector is written as

$$x(n) = [x_0, x_1, x_2, \ldots\ldots\ldots\ldots\ x_{N-1}]^T \qquad \text{---------- (4)}$$

The original OFDM signal is

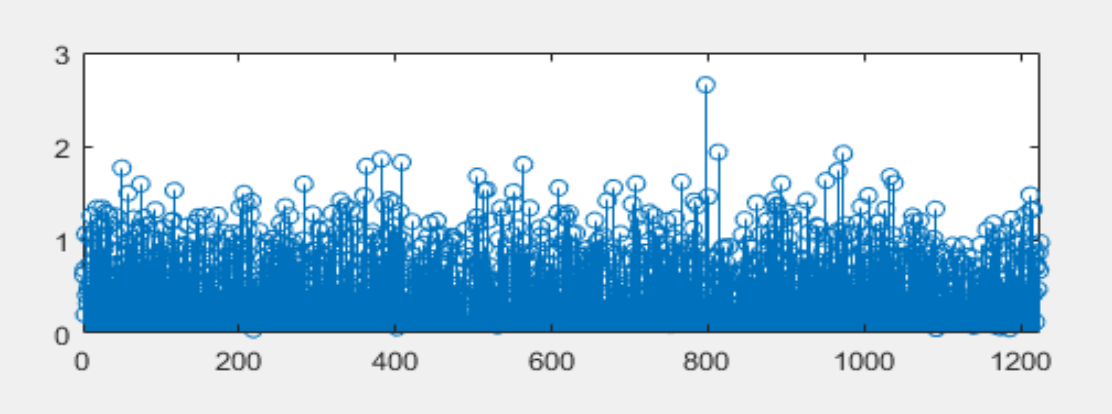

Figure 2. Original OFDM signal.

1.3. Application of OFDM

OFDM is used in the following area –

- Wi-Fi
- DSL internet access
- 4G wireless communications
- digital television
- radio broadcast services

1.4. Objectives

The provided solution is that the reduction of PAPR. additionally, variety of techniques are found within the literature belonging to different categories like clipping, clipping and filtering techniques, SLM & PTS [10]. Probably the simplest technique to combat PAPR in OFDM signal is by using clipping, clipping and filtering [11]. Other techniques are supported multiple signal representation techniques or probabilistic techniques like selected mapping (SLM) technique .These methods act on the phase of the information sub-carriers so as to mitigate the PAPR. However, as clipping could be a non-linear method, it should generate in-band (IB) distortion [12] or out-of-band (OOB) radiation [13], which degrades the BER, breaks the signal down or disturbs the adjacent channel. Nevertheless, such effects are often mitigated when filtering is employed after clipping. Conversely, SLM has disadvantaged because of multiple inverse fast Fourier transform (IFFT) blocks and the computational complexity, which is directly proportional to the scale of the phase vector matrix required to realize the most effective PAPR performance [14].On the opposite hand, Partial Transmit Sequence (PTS) has been the most promising one because of its good PAPR reduction capability without restriction on the amount of subcarriers [15]. In PTS, the data block which is split into disjoint sets called subblocks and also the subblocks are combined followed by multiplication of a phase vector. In PTS, design of the optimal transmit phase selection of the optimum phase vector from a group of known solutions is

most challenging [16]. Furthermore, some ordinary techniques are introduced and discussed in terms of PAPR and Bit error rate (BER).These are the hybrid techniques .In this paper we also discuss hybrid techniques like others technique

2. OVERVIEW OF PAPR

High PAPR has been cited jointly of the drawbacks of the OFDM modulation format. In RF systems, the most important problem resides within the power amplifiers at the transmitter end, where the amplifier gain will saturate at high input power. a technique to avoid the relatively "peaky" OFDM signal is to work the ability amplifier at the so-called heavy "back off" regime where the signal power is way below the amplifier saturation power. Unfortunately, this needs an excess large saturation power for the facility amplifier, which inevitably ends up in low power efficiency. within the optical systems, the optical power amplifier (predominately erbium-doped amplifiers are currently in use) is ideally linear irrespective of its sign power because of its slow reaction time on the order of milliseconds. Nevertheless, PAPR still presents a challenge for glass fiber communication thanks to the glass fiber nonlinearity. [17]

This ratio of the height to average power value is termed as Peak-to-Average Power Ratio. Coherent addition of N signals of the identical phase produces a peak which is N times the typical signal. [18]

The high PAPR of OFDM implies that if the signal isn't to be distorted, many of the components within the transmitter and receiver must have a good dynamic range. The output amplifier of the transmitter must be very linear over a large range of signal levels. in an exceedingly wireless system, the expense and power consumption of those amplifiers are often the important design constraints. Moreover, the presence of an oversized number of subcarriers with varying amplitudes leads to a high peak-to-average power ratio of the system (OFDM) and has implications within the efficiency of the often ness amplifier. This degrades the bit error rate and increases the price of the system.[19]

To respond to the above-mentioned problems, different methods and techniques were proposed by researchers like coding techniques, tone injection, filtering, oversampling, and multiple signal representation. the most purpose of this study is to propose techniques for the reduction of peak-to-average power ratio in an OFDM system with a stress on the 4G network.[20] PAPR is defined as:

$$\text{PAPR}=\frac{P_{MAX}}{P_{AV}} \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(5)$$

Where, Pmax= Maximam power of the signal. Pav=Average power of the signal.

The major disadvantages of a high PAPR are-

1. Increased complexity within the analog to digital and digital to analog converter.
2. Reduction is an efficiency of RF amplifiers.

2.1. The CCDF of the PAPR

The time domain OFDM signal x(t) could be a number. Assuming that the important and imaginary parts follow a statistical distribution, with 0.5 variance and nil mean, in agreement with the central limit theorem when K is sufficiently large, the amplitude of the OFDM signal

|x(t)| becomes a Rayleigh distribution and also the power distribution is exponential . The cumulative distribution function (CDF) of the amplitude of an indication sample is

$$F(z) = 1-e^{-z} \quad \text{----------(6)}$$

If we assume that the average power of x(t) is equal to one, that is, E|x(t)|2 = 1, the probability distribution function for PAPR less than a certain threshold value is

$$\Pr(\text{PAPR} < z) = (F(z))^k$$
$$= (1-e^{-z})^k \quad \text{---------- (7)}$$

However, the performance of PAPR reduction techniques is evaluated, the CCDF of the PAPR is more frequently used. The probability that PAPR exceeds a threshold value

$$\Pr(\text{PAPR} > z) = 1-\Pr(\text{PAPR} \leq z)$$
$$= 1- (1-e^{-z})^k$$

2.2. PAPR Reduction Techniques

The PAPR reduction includes many techniques, and it's captivated with various factors like Spectral efficiency, Reduction Capacity, increasing of Transmit signal power, loss in rate, Computation Complexity, increase in BER, Peak Reduction Carrier. The PAPR reduction techniques are proposed so as to scale back the PAPR [21] the maximum amount as possible. A number of them are: „amplitude clipping", „clipping and filtering", „coding", „partial transmit sequence (PTS)", „selected mapping (SLM)" and „interleaving". These techniques achieve PAPR reduction at the expense of transmit signal power increase, bit error rate (BER) increase, rate loss, computational complexity increase, and then on .

2.2.1. Clipping

Amplitude clipping is taken into account the only technique which can be undertaken for PAPR reduction in an OFDM system. A threshold value of the amplitude is about during this case to limit the height envelope of the input. [22]A signal having values beyond this pre-determined value is clipped and therefore the rest are allowed to experience undisturbed.

$$B(x) = \begin{cases} X & x \leq A \\ Ae^{j\emptyset(x)}, & X > A \end{cases}$$

where,

B(x) = the amplitude value after clipping.
x = the initial signal value.
A = the edge set by the user for clipping the signal.

2.2.2. Clipping and Filtering

To reduce the out-of-band distortion, the filtering operation is introduced. Clipping and filtering technique for PAPR reduction is employed. the matter, during this case, is that amplitude clipping distortion is observed within the system which may be viewed as another source of the noise. This distortion falls in both in-band and out–of–band. Filtering can not be implemented to cut back the in-band distortion and a blunder performance degradation is observed here. On the

opposite hand, spectral efficiency is hampered by out – of – band radiation. Out – of – band radiation may be reduced by filtering after clipping but this could lead to some peak regrowth. Repeated filtering and clipping operations are often implemented to resolve this problem. the specified grade is just achieved after several iterations of this process.[23]

2.2.3. Coding

In the coding technique, some code words are wont to reduce the PAPR of the signal. It doesn't cause any distortion and no out-of-band radiation production, but it's a drawback of reduced bandwidth efficiency because the rate is reduced. It also suffers from complexity issues, because it requires large memory for locating the most effective codes and to store large lookup tables, especially for an oversized number of subcarriers [24].

2.2.4. Selective Mapping

Selected Mapping (SLM) is an efficient method for peak to-average power ratio reduction in OFDM systems. In SLM technique the info sequence is multiplied with each phase sequences generated. Thus sequences that carry the identical information are formed. From these signals the signal with minimum PAPR is chosen for transmission .In SLM technique the initial data block is multiplied with L phase sequences. Thus L sequences which carry the identical information are generated. And from the generated L sequences the sequence with minimum P APR is chosen for transmission. together with the information the side information is additionally transmitted . Side information indicates the phase sequence which minimized the PAPR.

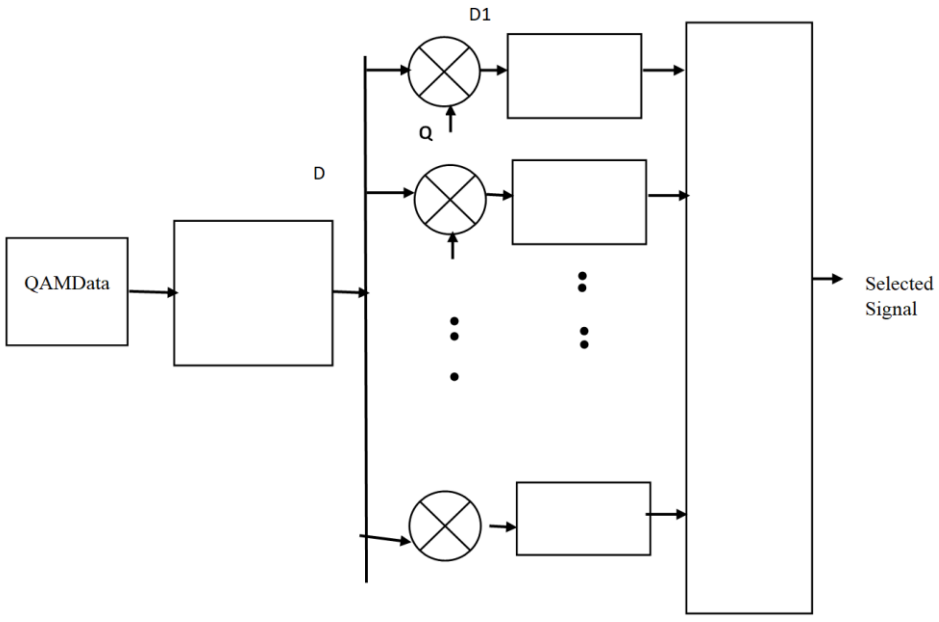

Figure 3. Block diagram of SLM Technique

2.2.5. Partial Transmit Sequence (PTS) Technique

It is the foremost efficient technique to cut back PAPR. during this technique, blocks of information is partitioned into no overlapping sub-blocks. This technique is that the modified technique of selective mapping scheme. There are three partitioning methods for PTS scheme:

Adjacent, interleaved and pseudorandom. Pseudorandom partitioning provide better PAPR performance among of these schemes. [25]

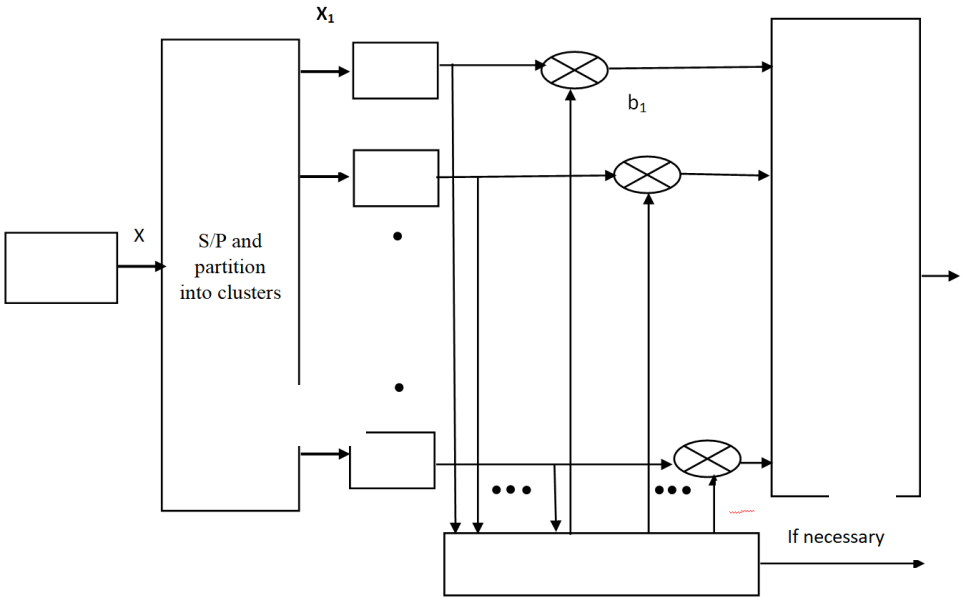

Figure 4. Block diagram of PTS scheme.

Partial Transmit Sequences (PTS) generates a proof with a coffee PAPR through the addition of appropriately phase rotated signal parts. The below figure shows the diagram of the partial transmit sequence (PTS) technique. The signal to be transmitted is partitioned into disjoint sub-blocks X v, of length which is represented by the vector as

$$x=\sum_{v=1}^{v} x^{v} \quad \text{.....(7)}$$

Where, is that the number of subcarriers and V is that the number of sub-blocks. Complex phase factors,

$$b^{v}=e^{i\varphi v}, \varphi_{v}\epsilon[0,2\pi] and\ v=1,2,\ldots..,V \quad \text{.....} \quad (8)$$

are introduced to mix the PTS's within the diagram. All subcarriers positions which are occupied in another sub-block are set to zero. An IFFT is performed on each sub-block, which are then all summed together to make a possible transmit symbol as:

$$X=\text{IFFT}\ \{\sum_{v=1}^{v} b^{v}x^{v}\}=\sum_{v=1}^{v} b^{v}\text{IFFT}[x^{v}] \quad \text{.....(9)}$$

The phase vector is chosen in order that the PAPR are often minimized, which is shown as:

$$[b^{1}\ldots..,b^{v}]=\underset{\{b1,\ldots..,bv\}}{\arg\min}[\underset{n=0,1,\ldots,Nc-1}{\max}\sum_{v=1}^{v} b^{v}x^{v}(n)] \quad \text{.....} \quad (10)$$

Then, the corresponding time-domain signal with all-time low PAPR vector may be expressed as:

$$x=\sum_{v=1}^{v} b^{v}\,x_{v} \quad \text{.....} \quad (11)$$

The receiver must have knowledge about the generation process of the transmitted OFDM to recover the received data for PTS approach. The phase factors must then be transmitted as side-information that the data is decoded.[26] noted that the quantity of angles should be kept low to stay the side information to a minimum. If each phase rotation is chosen from a collection of admissible angles, then the desired number of bits for side information is bits per OFDM symbol. The computational complexity of PTS method depends on the amount of phase rotation factors allowed. the choice of the phase factors is restricted to set of elements number to scale back the search complexity[27]. The sets of phase factors should be searched to seek out the optimum set of phase vectors. Furthermore, the search complexity increases exponentially with the amount of sub-blocks and also depends on the sub-block partitioning.

The concept of the PTS technique is to partition the computer file symbols into the disjoint subsets and these subsets are rotated with different rotation factors. After that, the modified partitioned subsets are combined again to come up with set of the candidate signals named partial transmit sequences (pts). Finally, one among candidate sequence which has the minimum PAPR value is chosen for transmission. within the PTS technique, the amount of the inverse fast Fourier transform (IFFT) blocks is that the same because the number of subsets. The PTS technique can do better PAPR reduction performance than the opposite probabilistic techniques like selective mapping (SLM) and interleaving techniques [28].

However, the PTS technique holds a high computational complexity when finding the optimum rotation factor and desires to send side information (SI) as index information so as to recover the first data at the receiver side [29]. On the opposite hand, PTS is considered a distortion less method because it relies on the scrambling signal technique to scale back the PAPR value. Hence, PTS considers a probabilistic method to cut back the PAPR of the OFDM signal. Therefore, the PTS method doesn't suffer from the bit error rate (BER) degradation or the facility signal distortion.

3. HYBRID TECHNIQUES FOR REDUCING PAPR

In recent years, some hybrid methods have also been proposed. These schemes combine two or more methods for PAPR reduction, and can be categorized into: Coding plus Multiple Signaling and Probabilistic techniques (C+MSP), Coding plus Signal Distortion techniques (C+SD), Multiple Signaling and Probabilistic plus Signal Distortion techniques (MSP+SD), and a combination of three methods, i.e., Coding plus Multiple Signaling and Probabilistic plus Signal Distortion techniques (C+MSP+SD) .In this paper ,we combine MSP to MSP(PTS & SLM) ,SD signal to MSP (PTS & CLIP ,SLM & CLIP).

3.1. Combination Of Clipping and SLM

SLM achieves good PAPR reduction performance at the value of additional high computational complexity while clipping has moderate complexity but with nonlinear process and in-band distortion. to make an honest balance between performance and complexity, a unique PAPR reduction technique is proposed supported combining SLM and clipping method[30].The diagram of the SLM-clip method is shown in Fig.

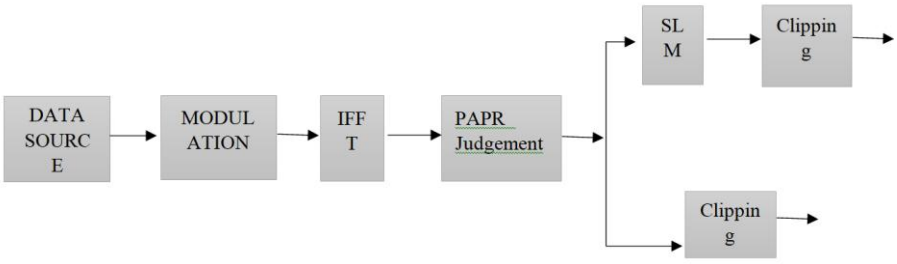

Figure 5. Block diagram of SLM and clipping method

Firstly, the PAPR of input OFDM signals are compared with a preset threshold, so on whether the operation of SLM is required. If the PAPR exceeds the preset threshold, SLM is performed. Then, clipping is performed to the last word signal [31]. The SLM-clip technique is summarized as following.

1) Calculating the PAPR of the input OFDM signal.
2) Compare the PAPR with the preset threshold.
3) If the PAPR is smaller than 1, directly proceed to step 4, else execute the SLM operation.
4) Executing the clipping operation to manage the PAPR of the last word signal.

3.2. Combination of Clipping and PTS

This method works same as SLM-clip technique as discuses above. Instead of SLM, PTS operation has to be performed [32]. The diagram of the PTS-clip method is shown in Fig

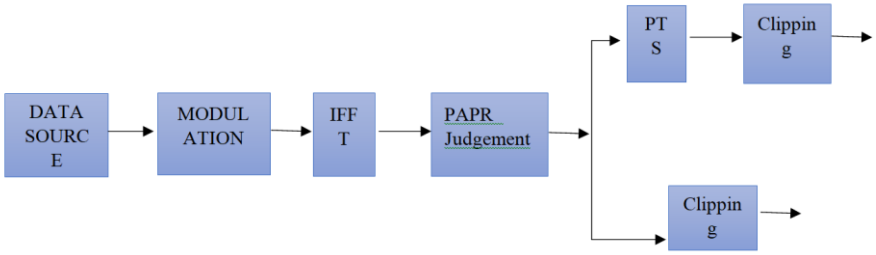

Figure 6. Block diagram of PTS and clipping method

PTS-clip technique is summarized as follows:

1) Calculate the PAPR of the input OFDM signal.
2) Compare the PAPR with the preset threshold.
3) If the PAPR is smaller than 1, directly proceed to step 4; else execute the PTS operation.
4) Executing the clipping operation to control the PAPR of the ultimate signal [33].

3.3. Combination of SLM and PTS

Another hybrid technique which relies on the SLM and PTS schemes, which supply better PAPR reduction performance than all others schemes which is discussed during this paper. The proposed scheme is essentially a mix of SLM and PTS schemes. within the proposed scheme first SLM scheme is applied and that we select the most effective combination of phase sequence and input file which provides minimum PAPR. Now for further reduction of PAPR, we apply this

mixture of phase sequence and input file to PTS scheme which further reduces the PAPR. The proposed scheme may be described by the diagram shown in figure [34]

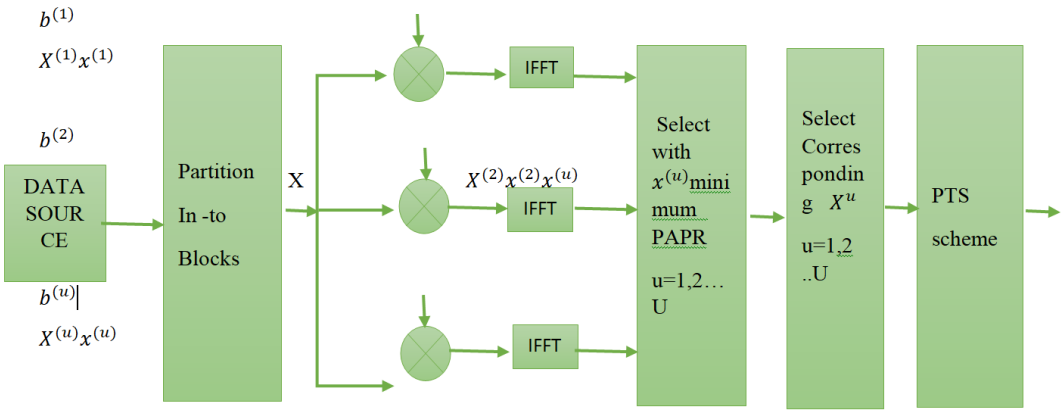

Figure 7. Block diagram of PTS and SLM method

The Proposed method can be described in following steps[35]:
• Multiply the input data signal with U different phase sequences.
• Generate the OFDM signal for each signal (U signals).
• Select the OFDM signal with lowest PAPR i.e. xu .
• Select corresponding combination of phase sequence and input data i.e. X u .
• Apply X u as an input to PTS scheme.
• Obtain signal with reduced PAPR after applying the PTS scheme.

The receiver has to know which sequence and phase factor was used to generate the signal, so that it can recover the original data, and the used sequence and phase factor can be transmitted as side information.[36]

4. RESULTS & DISCUSSION

The result represents the bit error rate with respect to the signal to noise ratio (SNR) Which is simulated in MATLAB. In figure -8 ,it describe the bit error rate for normal OFDM signal .Figure 9,10,11,12,13 that all represent also the bit error rate for SLM modified signal ,Clipped signal ,Clipped & Filtered signal and Partial Transmit Sequence (PTS) signal and also represents the BER of all techniques. Figure -14, which represents the CCDF of all techniques. Figure -15 denotes PAPR for Clip, PTS, SLM .Figure -16 express PAPR for Hybrid Techniques. Finally Figure -17: Comparing PAPR for all Techniques. Figure 18,19,20,21 sequentially represents the BER of hybrid techniques as well.

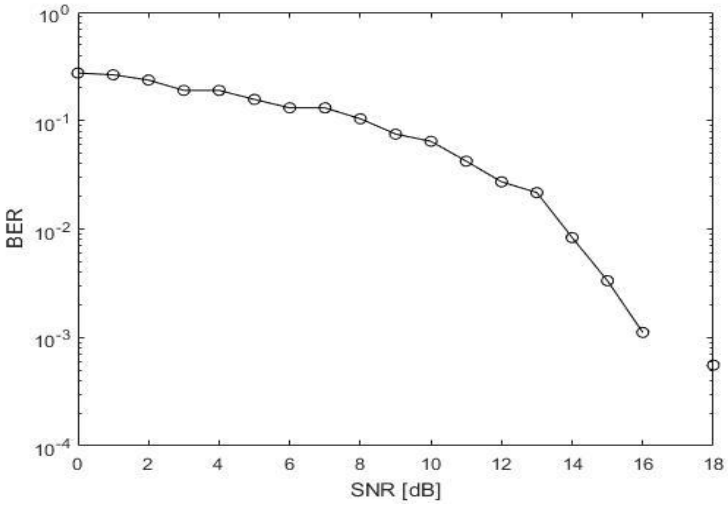

Figure 8. Bit error rate of OFDM signal.

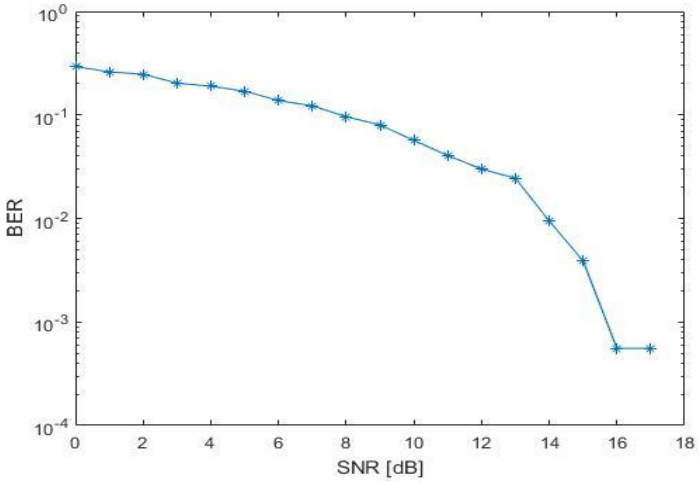

Figure 9. Bit error rate of SLM modified signal.

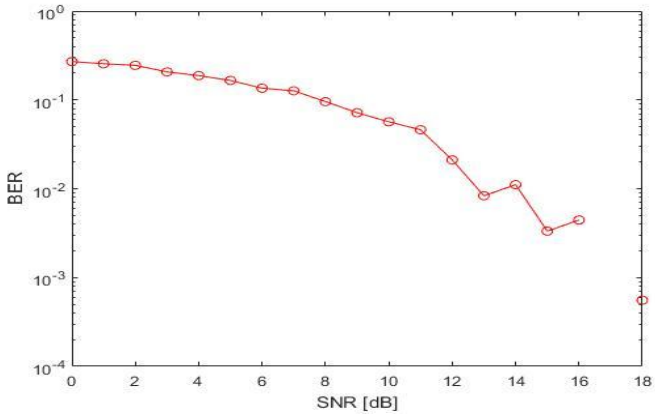

Figure 10. Bit error rate of clipped OFDM signal.

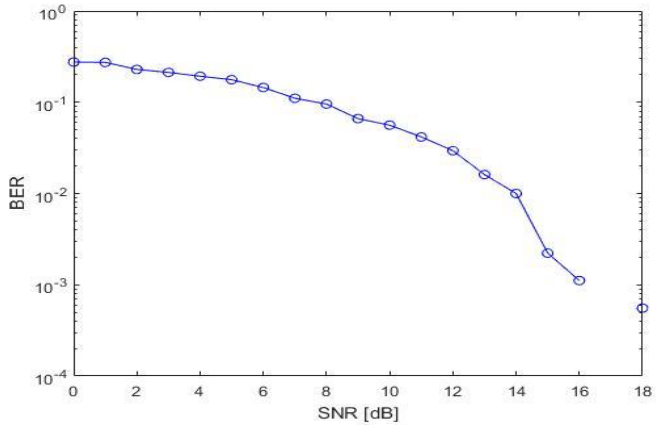

Figure 11. Bit error rate of clipped & filtered OFDM signal.

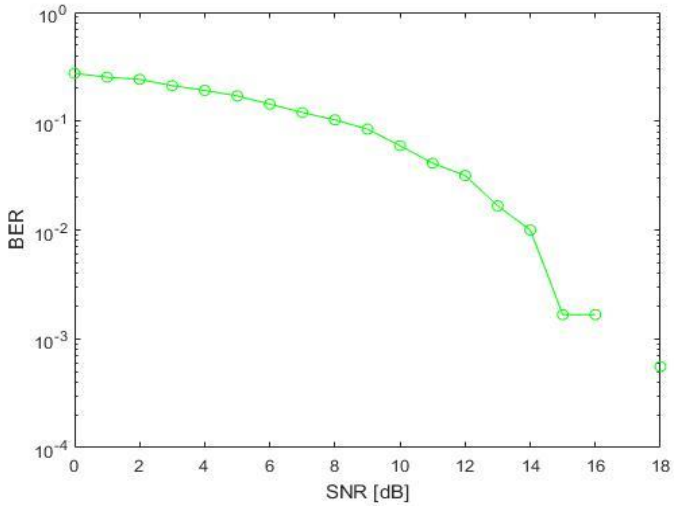

Figure 12. Bit error rate of PTS signal.

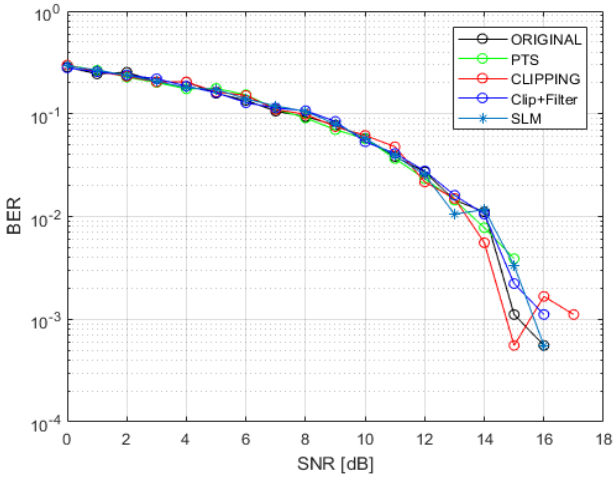

Figure 13. Comparing Bit error rate of all techniques.

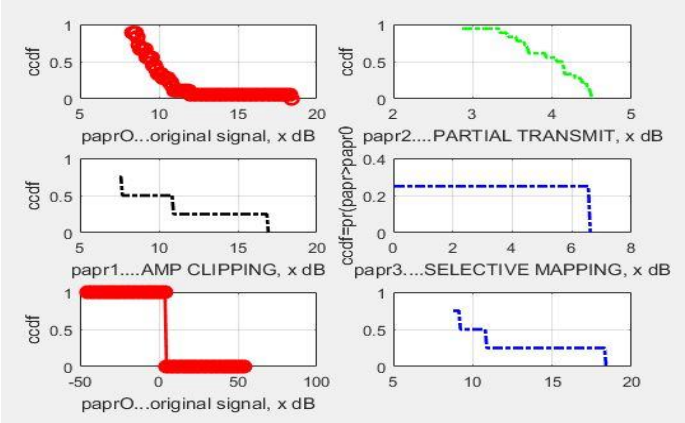

Figure 14. CCDF for Calculating PAPR.

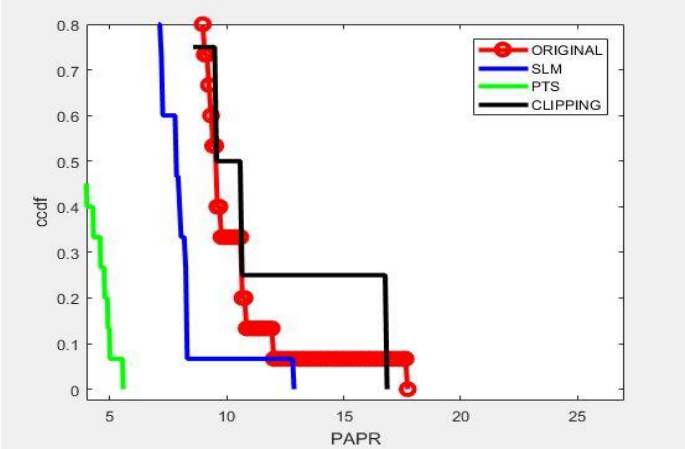

Figure 15. PAPR for Clip, PTS, SLM .

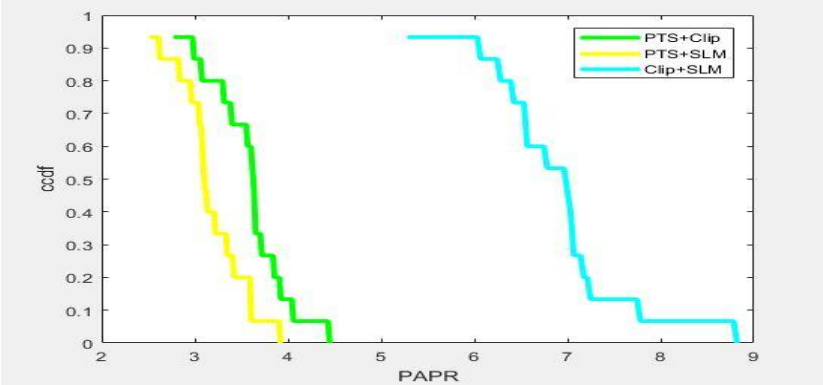

Figure 16. PAPR for Hybrid Techniques.

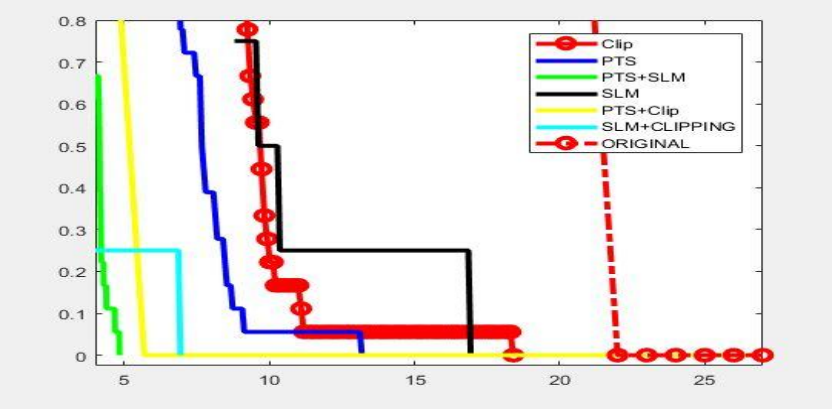

Figure 17. Comparing PAPR for all Techniques.

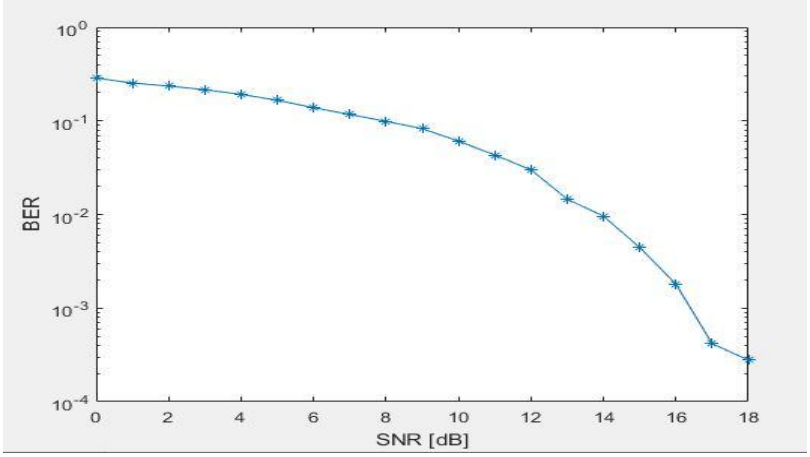

Figure 18. BER of Hybrid Technique CLIP+PTS.

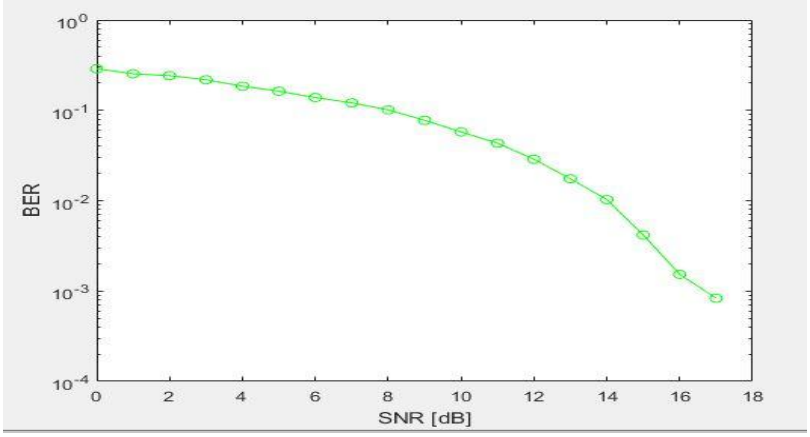

Figure 19. BER of Hybrid Technique PTS+SLM.

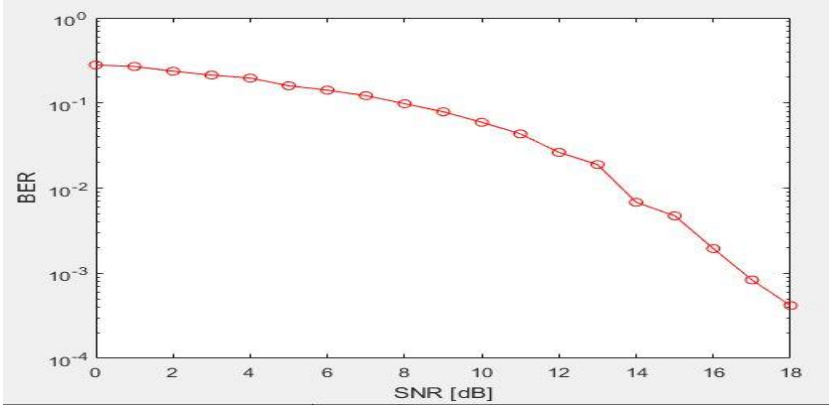

Figure 20. BER of Hybrid Technique CLIP+SLM.

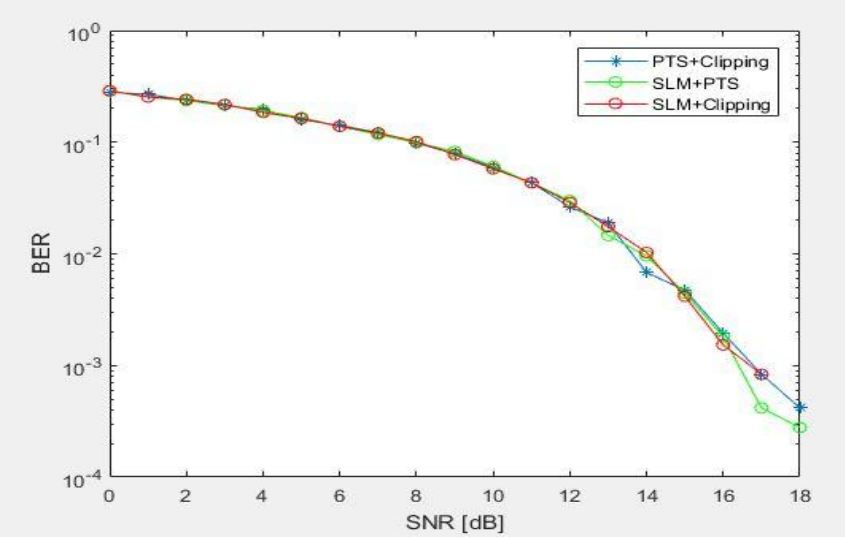

Figure 21. BER of Hybrid Techniques.

5. CONCLUSION

OFDM could even be a very attractive technique for multi-carrier transmission and has become one in every of all the standard choices for top-speed data transmission over-communicating. Its various advantages; but also has one major drawback: it is a very high PAPR. During this project, the varied properties of an OFDM System are analyzed then the benefits, and drawbacks of this method is believed. The bit - error -rate is additionally plotted against the signal/noise ratio to know the performance of the OFDM system. we've also geared toward investigating the planning of the techniques which are in commonly accustomed chop back the high PAPR of the system. Among the three, techniques we revealed that Amplitude Clipping and Filtering finally, find in Data Loss, whereas, Selected Mapping (SLM) and Partial Transmit Sequence (PTS) don, 't affect the data. From the comparison curve of all techniques, we could infer that PTS are often a smaller amount complicated in PAPR reduction.

Some hybrid techniques are also discussed here to reduce PAPR. These techniques are SLP with Clip, PTS with Clip and PTS with SLM. This techniques are more effective to reduce PAPR among other techniques like PTS, SLM and Clipping as well. But These Techniques are more complex and its high cost to installed.

However, no specific PAPR reduction technique is that the foremost effective solution for the OFDM system. Various parameters variety of loss in rate, transmit signal power increase, BER increase, computational complexity increase should be taken into consideration before choosing the acceptable PAPR technique.

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