# ANALYSIS OF PAPR REDUCTION IN OFDM SYSTEM BY USING CLIPING TECHNIQUES

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**Abstract-** Orthogonal frequency division multiplexing (OFDM) is mostly considered because of its highly efficient bandwidth capability, its high data rate and ability to prevent multipath fading. Communication is one of the imperative parts of life. With the progression in age and its developing requests, there has been fast development in the field of communications. Signals, which were at first sent in the analog form, are being sent increasingly in the digital domain now a day. For better transmission, even single-carrier waves are being supplanted by multi-carriers. Multi-carrier frameworks like CDMA and OFDM are presently a-days being executed usually. In the OFDM framework, orthogonally set sub-carriers are utilized to convey the information from the transmitter end to the receiver end. Presence of guard band in this framework manages the issue of ISI and noise is minimized by bigger number of sub-carriers. In any case, the vast Peak-to-Average Power Ratio of these signal have some undesirable impacts on the framework.

We have concentrated on taking in the rudiments of an OFDM System and have attempted different techniques to diminish the PAPR in the framework so that this framework can be utilized more normally and successfully. Here Clipping, Selective mapping and Companding reduction techniques with different transform like DCT, DST, DWT etc. to get the good result for PAPR and BER which are the major issues in a system which reduces the efficiency of a system. Sometimes recution technique alone do not produce required outcome which it can do with the combination of transform. In case of Clipping PAPR is good for OFDM signal but BER is very high but when we are using this technique with transforms BER decreases at a very appropriate level. Also by making the use of both blocks i.e. Transforms and IFFT block which is called Precoding technique we get high PAPR with Precoding but with reduced BER in case of Clipping technique. Same analysis is done for SLM and Companding. With hybrid combination of SLM with transform and Precoding PAPR and BER both factors are reduced. So the problem which is associative in case of clipping i.e. tradeoff between PAPR and BER is solved in SLM technique. SLM used side band information which increase the complexity is decrease by using Companding technique with transform s and precoding, we get the lower values of PAPR and BER.

## 1 INTRODUCTION

High information rate is attractive in numerous current remote media applications [1]. Conventional single transporter balance systems can accomplish just constrained information rates because of the confinements forced by the multipath impact of remote channel and the beneficiary multifaceted nature. In single carriers system, as the information rate in correspondence framework expands, the image term gets diminished. In this way, the correspondence frameworks utilizing single bearer regulation experience the ill effects of Inter symbol interference image impedance (ISI) brought about by dispersive-channel drive reaction, and subsequently require an unpredictable balance plot. Orthogonal Frequency Division Multiplexing (OFDM) is a potential contender to satisfy the prerequisites of present and cutting edge remote correspondence frameworks.

By Chang [3], in 1996, initially presented the idea of multicarrier correspondence. Along with this, he recommended a multicarrier plot using the parallel transmitted information by methods for 10 recurrence division multiplexing (FDM) by covering all subcarriers. It is also said that it is a productive plan for data transfer capacity use and to alleviate the impact of multipath engendering. Also, it likewise disposed of the prerequisite of fast leveling strategy. KINEPLEX, ANDEFT and KATHRYN and so forth belongs to OFDM derived frameworks used by US military

frameworks which is meant for high frequency applications. Framework of KINEPLEX was produced by Collins Radio Company for transmitting the information at high frequency over multipath blurring medium. In this framework, 20 tones are adjusted by DQPSK without shifting, which brought about covering channels.

Numerous models have been proposed for remote neighborhood (WLANs) that works on ISM band that depend on spread-range innovation. First OFDM which is based on WLAN standard, in 1997, was discharged and belongs to IEEE 802.11 standard. IEEE 802.11 can bolster an information rate up to 2Mbps. In 1999, confirmation to OFDM based standard 802.11a was affirmed by IEEE, which supports rate of information up to 54 Mbps [2]. Amid all these and moving further, ETSI has likewise institutionalized Hiper LAN/2 standard that has embraced OFDM regarding its PHY principles [1]. 2001 was the year in which FCC accompanied few current guidelines for balances plot working for the value of 2.4 Ghz, that permits IEEE to stretch out 802.11b to 802.11g standard. Presently today, it is utilized similarly as a part of WiMAX (IEEE 802.16), and versatile remote area to get (MBWA) IEEE 802.10. Additionally, it is used by 4G remote correspondence frameworks, for example, IMT-A.

Also, it is taken similar contents for 3FPP long term evolution under organization.

### 1.1 OFDM and Multicarrier Modulation

OFDM is an uncommon type of multicarrier balance conspire, which separates the full frequency selective channel fading components to numerous narrowband orthogonal level sub channels for flat fading, which includes transmission of high-piece rate information stream in parallel using various information subcarriers rate which gets lower consequently and significantly decreases inter symbol interference because of bigger image length [4]. As probably aware of OFDM framework is a multicarrier balance framework in which through serial-to-parallel port, input information stream changes over into N parallel information stream. Because of the closeness of subcarriers they can sees level blurred channel. The procedure of regulation and demodulation in OFDM is finished by quick DSP applications (FFT/IFFT) [2]. After the era of parallel image, balance is done on each stream and they conveyed at remarkable focal frequencies and they should be orthogonal to each other. This undertaking which is most capable elements of OFDM i.e. orthogonality is finished by utilizing IFFT. To expel impedance between the progressive OFDM images watch groups are embedded.

Frequency division multiplexing (FDM) develops an idea about using bearer regulation alone through utilizing numerous sub-channels inside provided bands of frequency for the corresponding channel. Aggregate channel transfer speed yet separated among various sub-channels [5-6]. One of the real focal points of FDM framework is that diverse sub- channels in the band can use distinctive tweak conspire and transmit different information. Yet, FDM needs shielded frequency bands between neighboring sub-channels to permit their partition with minimal effort channels at the collector. Monitor groups debase the data transfer capacity effectiveness of the FDM framework in contrast with single transporter framework without need of doing multiplexing.

Multicarrier modulation is a propelled type of Frequency Division Multiplexing (FDM), where various recurrence sub-groups called subcarriers are designated to a client [7-8]. An improved piece outline of MCM modulator is appeared in Fig. 1.1. Information stream of serial is gone to through a serial-to-parallel converter, which parts the information stream into various parallel sub- channels. On connecting sub-channel information to modulator, with the end goal which requires N sub-channels for N modulators whose bearer frequencies starts from fo, f1……fk……fN-1 . These N adjusted subcarriers are then joined to give a multicarrier regulated signal.

The essential multicarrier demodulator comprising of a bank of correlators, one for each of the sub-channel or subcarrier. Under perfect conditions, the neighborhood oscillators used to produce the subcarrier frequencies are thought to be synchronized with comparing nearby

oscillators utilized at the transmitter; along these lines subcarriers don't make any impedance each other at the collector.

Of late, the need of mixed media remote information administrations has developed indulgently which get the correspondence the time of fourth era remote correspondence framework. In this time where number of clients are more with confined transfer speed , the need of present day computerized remote correspondence is embraced in light of the fact that it furnishes better otherworldly productivity with effective data transmission and furthermore powerful to multipath channel condition which is known as multi-carrier modulation framework [9]. This kind of correspondence framework gives simplicity of rapid information rate at shoddy cost for some clients with high dependability. The fundamental distinction between single carrier framework and multi carrier framework is that in single carrier framework, single carrier possesses whole correspondence data transmission yet in multicarrier accessible transfer speed is conveyed among many sub-carriers so that each subcarrier conveys the helpful measure of transmission capacity as indicated by its need as contrast with the entire data transmission as if there should arise an occurance of single carrier framwork.The interest for fast remote applications and constrained RF signals data transmission is expanding step by step. New applications are developing in the wired frameworks, as well as in the remote portable frameworks. At present, just low rate information administrations are accessible for portable applications. Be that as it may, there is an interest for high information rates for interactive media applications. In single bearer framework, the image term decreases with an expansion in information rate and along these lines the impact of Inter symbol Interference (ISI) turns out to be more extreme. ISI, in remote correspondence frameworks, is delivered because of the memory of dispersive remote channels [41]. When in doubt, the impact of ISI on blunder execution of the framework is insignificant; the length of the delay spread is altogether shorter than the term of one transmitted signal. This infers the symbol rate bolstered by the correspondence framework is for all intents and purposes restricted by ISI. On the off chance that the information rate surpasses the maximum furthest reaches of information transmission over the channel, a component must be actualized to battle the impacts of ISI. Channel equalization methods can be utilized to smother the echoes brought on by the channel. In any case, such equalizers posture challenges progressively frameworks working at a few Mbps speed with minimized, ease equipment. Multicarrier modulation methods act the hero in such circumstances.

These enormous features of multicarrier system draw our attention to study Orthogonal Frequency Division Multiplexing (OFDM). OFDM is the base for all 4G wireless communication systems because it has large capacity (number of subcarriers), high data rate (excess of 100 Mbps), and efficient use of bandwidth, receiver simplicity, and ubiquitous coverage with high mobility. As we know OFDM system is a multicarrier modulation system in which through serial-to-parallel port, input data stream converts into N parallel data stream. Due to the closeness of subcarriers they can sees flat faded channel. The process of modulation and demodulation in OFDM is done by fast DSP applications (FFT /IFFT) [2]. After the generation of parallel symbol, modulation is done on each stream and they carried at unique central frequencies and they must be orthogonal to each other. This task which is most powerful features of OFDM i.e. orthogonality is done by using IFFT. To remove interference between the successive OFDM symbols guard bands are inserted.

Three methods are there for this purpose which are cycle suffix, cycle prefix and zero padding. Also one more advantage of adding guard band is that OFDM convert wideband frequency selective channel into collection of parallel narrow band flat fading channel in which one channel across each subcarrier is there.

### 1.2 ISI Elimination using Multicarrier Modulation

The dispersive method for remote channel makes the spreading of the modulation symbol in the time space, which is known as delay spread (τm). The effect of the time disseminating is reflected by the ISI phenomenon. A single carrier with high data rate is exceptionally affected by ISI issue. Multicarrier adjustment has surfaced to lighten the effect of ISI made in single carrier structures under the condition τm> T[41]. In this way, the essential believed is to assemble the symbol duration to decrease the effect of ISI. Decreasing the effect of ISI yields a less requesting parity, which in this way infers a less complex reception strategy.

Multicarrier modulation partitions the high rate bit stream into N lower rate sub-streams, each of which has symbol duration (Ts =NT)>> τm, and thus the impact of ISI can be dispensed with as it were. These individual low information rate sub-streams are sent over N parallel subcarriers or sub- channels, keeping up the aggregate coveted data rate of the system. Expecting a single carrier structure with total available transmission capacity (BT) of 1MHz, we transmit the data at symbol length of 1 μs. Consider an average outdoor situation where the most extreme delay spread can be as high as 10μs, so in the most critical result conceivable, no fewer than 10 consecutive symbols will be impacted by the ISI in light of the delay spread. A circumstance for differentiating the single carrier adjustment conspires and multi-carrier modulation is appeared in Table 1. The number of sub- streams is guaranteed that each sub-channel has a bandwidth less than the coherence bandwidth of the channel, and subsequently, the subcarriers encounter generally flat fading. In this manner, the ISI on each subcarrier is little.

The multicarrier modulation plots with N subcarriers requires a bank of N neighborhood oscillators to adjust N data symbols. Along these lines, when the amount of subcarriers is considerable then it is difficult to suit endless oscillators in the system. As saw from Fig. 2, we moreover require a bank of N correlators for demodulating the multicarrier signal. The beforehand specified issues can be avoided by using OFDM as a MCM. The above arrangement can be illuminated by considering the accompanying case:

### 1.3 Advantages of OFDM

- Robustness against multipath proliferation
- Make proficient utilization of the spectrum as the carrier is additionally subdivided into sub carrier by permitting overlap.
- By utilizing cyclic prefix ISI and IFI impacts are expelled
  Using sufficient channel coding and interleaving procedure one can recoup back the lost images because of the frequency selectivity of the channel.
- Computation intricacy lessened utilizing FFT systems for the actualize the balance strategy.

### 1.4 Disadvantages of OFDM system

- OFDM signals with their high peak to-average power ratio (PAPRs) require very straight intensifiers. Something else, execution corruption happens and upgraded out of band power is needed [11].
- More dedication is given to Doppler spread rather than modulation of single carrier frameworks by OFDM.
- Phase commotion created by the defects of the transmitter and beneficiary oscillators corrupts the framework execution. Accurate recurrence and time synchronization is required.
- Because of cyclic-prefix (CP) operation happens in OFDM frameworks causes' loss in spectral efficiency

### 1.5 Applications of OFDM system

- It is utilized as a part of Digital Broadcast Services to handheld administrations.
- It is utilized as a part of LTE and LTE progressed as it gives higher execution, better spectral efficiency, diminished cost, productive administrations, and better nature of administration.
- Mobile Broadband Wireless get to advances additionally incorporate into the use of OFDM.

### 1.6 Major problems in OFDM system

Despite of many advantages and application areas, the major problems in OFDM system is PAPR, BER, and synchronization at the receiver which restrict the OFDM application areas to some extent.

### 1.7 PAPR

One new problem that comes in OFDM systems is PAPR. The main reason of occurring of PAPR is that there is uniform power spectrum at the input symbol stream of IFFT but at the output side non uniform spectrum is there.

PAPR is defined as the peak signal power versus the average signal power. The PAPR of a signal is expressed by the following formula:

$$PAPR_{dB} = 10\log\left(\frac{\max[x(t)x^*(t)]}{E[x(t)x^*(t)]}\right) \quad [1]$$

OFDM fundamental issue is high PAPR on the grounds that when OFDM signal transmits over an optical fiber channel, because of high PAPR contortions is there brought about by nonlinear gadgets, for example, analog to digital converter, transmission fiber and so forth [12-13].

Vast PAPR brings about band mutilation and in addition out of band radiation which the real issue is endured by transmitted OFDM signal. Likewise it builds the trouble for analog -to- digital converter and digital- to-analog converter. It additionally diminishes the efficiency of radio power enhancer. Primary reason of happening the PAPR is that In Multicarrier framework diverse subcarriers are out of phase with each other [14]. At each moment they show distinctive phase with each other. At the point when focuses accomplish most extreme esteem at the same time then this will come about that the yield envelope abruptly to shoot up and becomes the reason of causing peak in the output envelope. In multicarrier framework many modulated subcarriers are there so more peak value will be there when contrasted with the average of the entire framework. This proportion is called PAPR. Because of expansive PAPR control speaker ought to be worked with extensive power back-offs brings about costly transmitters and wasteful amplification will bring about.

### 1.8 BER

BER is the proportion of mistaken bits to the aggregate number of bits that have been transmitted over a given time period [15]. It is communicated as 10 to the negative power. It is the major problem in OFDM system because as we reduced the PAPR, BER further goes on increasing at a drastic rate. Consequences of BER are interference, increase transmitted power, lower order modulation, reduce bandwidth.

### 1.9 PAPR Reduction Techniques

Numerous PAPR decrease strategies are proposed in the Literature [16]. The PAPR lessening plans are significantly isolated into two classifications

**a) Distortion Based Techniques:** The plans that belong to spectral re-development have a place with this class. Distortion based techniques are the most clear PAPR decrease techniques [17]. Besides, these techniques misshape the range, this range distortion or “spectral re-development” can be rectified to a specific degree by utilizing filtering operation.

**b) Non-Distortion Techniques:** These sorts of PAPR diminishment plans don't bend the state of the OFDM signal and in this way no spectral re-development happen.

### 1.10 Objectives

- **Efficient PAPR reduction:** By using different reduction techniques i.e. Clipping, Selective Mapping and Companding PAPR of a system is reduced to a very great extent. To remove the in- band distortion due to clipping SLM technique is used and to remove the complexity factor companding is used to get the good result of PAPR parameter of an OFDM system.
- **Reduction of Probability error:** BER is reduced by using the various combination of reduction technique with transforms as well as with precoding technique. BER of OFDM signal with DWT transform is getting lowered down but when reduction technique is implemented i.e. clipping it again increased.
- **Complexity Reduction:** Clipping technique having lower complexity among all the techniques but

performance of PAPR and BER is not up to good level. SLM is the best technique but it require side information to be sent with the transmitted signal which increases the complexity so Companding is used because here no side information is need to be sent with the transmitted signal.

- **Hybrid system design:** It contains the combination of three techniques i.e. Transform, Precoding and Reduction. With the combination of the hybrid technique trade off between PAPR and BER is reduced up to certain level.

## 2 RESEARCH METHEDOLOGY

Numerous PAPR lessening systems are proposed in the literature [23-39]. In this section, such systems are elaborate and talk about their focal points and shortcoming as far as PAPR lessening capacity and BER degradation. The PAPR diminishment schemes are significantly separated into two classes:
(a) Distortion Based techniques
(b) Non- Distortion techniques

### 2.1 Distortion Based techniques

The plans that acquaint unearthly re-development have a place with this class. Contortion based frameworks are the most direct PAPR decreasing procedures. In addition, these techniques contort the range, this range twisting or “spectral re-development” can be helped to a specific degree by using separating operation.

#### 2.1.1 Clipping and Filtering

Clipping is one of the minimum complex techniques to decrease the PAPR of OFDM signal. It decreases the peak of the OFDM motion by cut-out the signal to the coveted level. This operation can be executed on discrete time tests before the DAC or by delineating the power enhancers with immersion level lesser than the OFDM signal dynamic range [45]. The BW effectiveness of the OFDM system decreases because of ghastly re-development. The computational many-sided quality of the section plan is seen to be the base conversely with other twisting PAPR diminishes contrives yet meanwhile its BER execution is amazingly poor. Separating can likewise bring about same i.e. range development yet it lessen the out of band radiation in the wake of cut-out however may bring about some peak regrowth, which the signal of peak surpasses in the clasp level.

The combination of clipping and filtering reduces the PAPR without any expansion in spectrum but computation complexity is there in OFDM transmitter. Also we have to perform interpolation before clipping to prevent out of band radiation. But it causes peak re- growth. So iterative clipping and frequent domain filtering is used to remove or prevent the peak re-growth. In this technique it clips the level to those signal components that exceed some unvarying amplitude called clip level. It is very effective as well as very simple technique. But the main problem suffered in this is that due to clipping distortion power is there which is known as clipping noise and it also expands the spectrum of transmitted signal which results in interference. It is nonlinear process so it cause in band noise distortion and also degrades the performance of BER. It also reduces the spectral efficiency because of out of band noise.

#### 2.1.2 Companding

Companding is another conspicuous PAPR diminish plot. Companding is a composite word encircled by merging compacting and augmenting. In this arrangement, at the transmitter a signal with high element range is associated with a compander and at the collector side a decompanding capacity (the invert of companding capacity) is used to recover the first signal. At to begin with, it was used as a piece of computerized correspondence framework to construct the dynamic scope of advanced to simple converters (DACs) [17-18]. The μ-law and A-law are the two most understood compacting capacities used far and wide.

### 2.2 Non Distortion Techniques

These sorts of PAPR decrease plans don't contort the state of the OFDM signal and Therefore no spectrum re-development occur.

#### 2.2.1 Coding Techniques

The basic idea behind this technique is that it uses set of codes to reduce the PAPR. The code words are used before the application of IFFT. “When N signal are

added with same phase they produce peak power which is N times greater than the average power". This doesn't do out band radiations and creates Do distortion signal but due the reason it uses set of code words. The bandwidth efficiency is lesser when code rate is reduced [16]. Complexity with this type of technique is that it needs to find best and suitable code words for reduction of OFDM and need to maintain the look up tables for coding and decoding.

### 2.2.2 Precoding Technique

In this technique we are using the transform before the IFFT block at the transmitter side and after the FFT inverse of that transform is used at the receiver side. Discrete-Cosine transform matrix (DCTM) precoding method is good for improving PAPR as well as BER. In this technique constellation symbols are precoded with linear independent precoder, which diminish the autocorrelation relationship of the IFFT input sequence and disperse the information among subcarriers. Other method Hadamard precoding, Zad-off chu precoding method is used but as compared to DCTM precoding they are more complex. We used different transform like DHT(discrete Hartley transform), DWT(discrete wavelet transform), DFT(discrete Fourier transform), DST(discrete sine transform), DCT(discrete cosine transform) and other transform in combination of IFFT OFDM block which produces precoded scheme and we check the PAPR and BER in each case and check which precoding technique is best.

### 2.2.3 Selective Mapping

SLM is a promising technique which is helpful to reduce the PAPR in an OFDM system. The basic idea behind this technique is that it firstly divides the incoming or transmitted sequence into sub parts and checks the PAPR of each sub sequence and transmits only that sequence which is having lower PAPR [50]. Thus it is helpful to overcome the major problem of OFDM system but on the other hand complexity increases as side band information is also required in this reduction technique.

The SLM plan is a standout amongst the best PAPR lessening plans in OFDM frameworks. It was demonstrated that the SLM plan can accomplish a few decibels of PAPR diminishment and henceforth fundamentally enhances the transmission control productivity. The real impediments of this plan, nonetheless, are as per the following. To start with, the transmission of side data bits so as to empower the beneficiary to recuperate the transmitted information pieces. These repetitive bits diminish the framework transfer speed effectiveness. The second impediment is that it requires a bank of IFFTs to create an arrangement of applicant transmission signals, and this necessity for the most part results in high computational unpredictability. We can overcome this by using this technique with some other technique so that its disadvantages can be removed and make the system efficient. The selected signals sent to the receiver along with selected signal as information (SSI) in order to decode information at the receiver. Even though SLM method uses codes it's been limited for only PAPR reduction but not any error correction codes.

### 2.2.4 Partial transmits sequence (PTS)

The PTS is most popularly used method in reduction of PAPR. The idea behind the PTS scheme is that original sequences of OFDM divided into diverse sequences and multiplies each sequence by distinct weights. The weights which offer better improvement in OFDM signal with less PAPR is the best results. In the other words adding the phase rotated sub-blocks to produce number of candidate signals and pick the one which has smallest PAPR for transmission. Here we only multiply different phase sequence with original OFDM signal.

### 2.2.5 Interleaved OFDM

The method is like alternate of SLM technique, just the difference is that it uses an interleaver instead of using the sequences of phases. Interleaver is a computational device which has specific manner permutation and operates on N symbol block. The interleaved OFDM's block diagram Inter-leavers and de-inter-leavers are usually denoted by the symbol π and π-1. At the receiver side to detect the original signal receiver has to know which type of interleaver is used at the transmitter side so that detection

becomes easy. So side band information is also required and PAPR reduced level depends upon which type of interleaver is used at the transmitter as well as receiver side and memory is there on both transmitter and receiver to store the permutation indices.

### 2.3 Hybrid Techniques

#### 2.3.1 Reduction with transform

In this technique we are using different transforms instead of IFFT and similar the inverse of transform which we are using at the transmitter side is used at the collector side. Transform reduces the PAPR and BER appropriate but it has complexity for implementing it like DCT (Discrete Cosine Transform) has leakage effect. We are using different transform to check the PAPR factor after the modulation block like DST, DHT, and DWT etc.

**DTC**

Progression data f (x) of OFDM is changed with DCT and we will get progression data F(u), which changes the estimations of the segments of progression data. In any case, the progression structure won't be changed [5]. In the meantime, many zero parts will appear in the changed progression. That suggests, the energy of the signal focuses on some sub-subcarriers, and PAPR is generally impacted by them.

#### 2.3.2 Reduction with Precoding

The combination of DCT precoding with clipping can lowered the PAPR in very efficient manner. Firstly, by DCT data is transformed into new modified form. Secondly, the proposed scheme utilizes the reduction method. In this scheme first the transmitted data are transformed with the help of DCT precoding matrix before IFFT operation, which reduces the PAPR. After that reduction technique is done. In place of DCT transform we can use different transforms like DWT, DST, Hadamard transform etc. Also in the place of reduction many techniques like SLM, PTS, Companding, Clipping and Filtering techniques can be used and analyzed which hybrid system is compatible for remote communication with lesser PAPR and BER.

Both blocks are utilized here i.e. FFT block and transform block to see how these blocks are effective to lessen out the PAPR factor from the signal.

## 3 RESULT AND DISCUSSION

In this chapter different Reduction techniques, Precoding techniques and Hybrid techniques are implemented and finding the PAPR and BER of these systems and finding out the best system with different schemes. Reduction techniques used in this chapter are Clipping , SLM and Companding. With them various combination of transforms are used and also utilized the IFFT block i.e. Precoding method to get the desired level of PAPR and BER.

### 3.1 Analysis with Clipping Reduction Technique

#### 3.1.1 Analysis of OFDM system

The PAPR and BER of conventional OFDM signal which is 11.2dB and 45dB respectively which is quite high. These results are for simple OFDM signal i.e. without the use of any reduction technique and precoding technique. Also no transforms are applied here. From these graph one can analyze that no worthful PAPR and BER is achieved for making a reliable wireless communication system. To improve these factors in next section reduction techniques and various combination of transforms and precoding techniques are implemented so as to get the lesser value of these major issues as much as possible.

### 3.2 Analysis of OFDM system with Clipping reduction technique

The PAPR and BER of OFDM signal with reduction technique clipping is used and comparison
analysis made between the OFDM signal and Clipped signal. PAPR of the OFDM system is 14dB approximately and that of Clipped signal it is 2dB which is quite less. This same analysis is made in case of SNR verses BER analysis in which BER of OFDM signal and Clipped signal are approximately same. In this technique certain threshold level is selected for clipping purpose. But the main limitation is the loss of data.

But BER is not sufficiently reduced whether PAPR is reduced at a great level. Both factors are necessary to be reduced to get an efficient system for better communication ahead. So in next

scenario clipping is done with combination of some transforms to get a better result of these two parameters.

**3.3 Analysis of OFDM system with DCT (Discrete Cosine Transform)**

the PAPR and BER- of OFDM signal with Transform technique DCT is used and comparison analysis made between the OFDM signal and Transformed signal. PAPR of the OFDM system is 11.5dB approximately and that of Transformed signal it is 12.5dB which is more. This same analysis is made in case of SNR verses BER analysis in which BER of OFDM signal is 42dB approximately and that of Transformed signal it is 10dB approximately which is very less.

**3.4 Analysis of OFDM system with DWT (Discrete Wavelet Transform)**

The PAPR and BER of OFDM signal with Transform technique DWT is used and comparison analysis made between the OFDM signal and Transformed signal. PAPR of the OFDM system is 11.5dB approximately and that of Transformed signal it is 7.5dB which is less. This same analysis is made in case of SNR verses BER analysis in which BER of OFDM signal is 42dB approximately and that of Transformed signal it is 12dB approximately which is very less.

**3.5 Analysis of OFDM system with**

Precoding DCT (Discrete Cosine Transform) the PAPR and BER of OFDM signal with Precoding technique in which DCT Transform is used and comparison analysis made between the OFDM signal and Precoded signal. PAPR of the OFDM system is 11.2dB approximately and that of Transformed signal it is 12.5dB which is more. This same analysis is made in case of SNR verses BER analysis in which BER of OFDM signal is 42dB approximately and that of Precoded signal it is 42dB approximately which is almost same.

**3.6 Analysis of OFDM system with Precoding DST (Discrete Sine Transform)**

The PAPR and BER of OFDM signal with Precoding technique in which DST Transform is used and comparison analysis made between the OFDM signal and Precoded signal PAPR of the OFDM system is 11.2dB approximately and that of Precoded signal it is 13dB which is more. This same analysis is made in case of SNR verses BER analysis in which BER of OFDM signal is 42dB approximately and that of Precoded signal it is 16dB approximately which is quite less.

**3.7 Analysis of OFDM system with**

Precoded DWT (Discrete Wavelet Transform) the PAPR and BER of OFDM signal with Precoding

technique in which DWT Transform is used and comparison analysis made between the OFDM signal and Precoded signal. PAPR of the OFDM system and that of Precoded signal is almost same. This same analysis is made in case of SNR verses BER analysis in which BER of OFDM signal is 45dB approximately and that of Precoded signal it is 42dB approximately which is less.Here, calculating the PAPR of Hybrid technique which is the combination of DCT Precoding and Clipped signal and its comparison is made with OFDM signal. Same process is done for calculating the SNR verses BER analysis. For PAPR, OFDM signal has 11dB value, Clipped has 4dB approximately and DCT Precoding has 19dB value. For BER, OFDM signal has 45dB value, Clipped has 45dB approximately and DCT Precoding has 49dB value.

In preoding IFFT block is not removed so transmitted data is generated by IFFT and after that transform block i.e. DCT transform is performed on the transmitted OFDM signal. PAPR is increased but BER gets lowered down when precoding technique applied on the transmitted signal. So there is always tradeoff between PAPR and BER. To make an efficient system both parameters should have reduced value so no information is lost during the transmission and easily detectable process is carried out for a received signal.

**3.8 Analysis of OFDM system with Precoded**

DST with Reduction technique Clipping Here, calculating the PAPR of Hybrid technique which is the combination of DST Precoding and Clipped signal and its comparison is made with OFDM signal. Same process is done for calculating the

SNR verses BER analysis. For PAPR, OFDM signal has 12dB value, Clipped has 1dB approximately and DST Precoding has 12dB value. For BER, OFDM signal has 42dB value, Clipped has 49dB approximately and DST Precoding has 15dB value. calculating the PAPR of Hybrid technique which is the combination of DWT Precoding and Clipped signal and its comparison is made with OFDM signal. Same process is done for calculating the SNR verses BER analysis. For PAPR, OFDM signal has 11dB value, Clipped has 5dB approximately and DWT Precoding has 17dB value. For BER, OFDM signal has 42dB value, Clipped has 49dB approximately and DWT Precoding has 44dB value.

Here, calculating the PAPR of Hybrid technique which is the combination of DCT transform and Clipped signal and its comparison is made with OFDM signal. Same process is done for calculating the SNR verses BER analysis. For PAPR, OFDM signal has 4dB value, Clipped has 2dB approximately and DCT Transform has 15dB value. For BER, OFDM signal has 42dB value, Clipped has 49dB approximately and DCT Transform has 10dB value.

Here, calculating the PAPR of Hybrid technique which is the combination of DWT transform and Clipped signal and its comparison is made with OFDM signal. Same process is done for calculating the SNR verses BER analysis. For PAPR, OFDM signal has 12dB value, Clipped has 4dB approximately and DWT Transform has 14dB value. For BER, OFDM signal has 42dB value, Clipped has 49dB approximately and DWT Transform has 12dB value. So with DWT transform PAPR value of a signal is reduced which is the requirement of an efficient OFDM system but with clipped reduction technique BER value is not degrade which lower down the efficiency of a system.

### 3.2 Analysis with SLM Reduction Technique

#### 3.2.1 Analysis of OFDM system with SLM reduction technique

The SLM strategy for PAPR and BER. On examination of OFDM signal with SLM flag PAPR is 10.3 dB and 8.7dB roughly which is lesser than the OFDM signal. So by applying the SLM lessening method on the OFDM signal, we improve execution of a signal by dropping down the PAPR of a transmitted signal and BER for SLM is 55dB around which is not exactly helpful for the framework whether PAPR is useful for SLM-based OFDM framework.

#### 3.2.2 Analysis of OFDM with hybrid

Combination of SLM and diverse transforms reenacts the proposed system i.e. Hybrid half SLM
with Transform (DCT, DST, Hadamard Transform, Natural Hadamard Transform) which speaks to the PAPR and BER investigation. In this procedure distinctive changes are performed on the SLM information and the collector information backwards operation of the change is performed. No IFFT operation is performed here. PAPR for Hybrid SLM with DST, DCT, Hadamard and natural Hadamard are 9dB, 8.7dB, 8.9dB, 8.8dB individually which is are around same and BER examination for the same are 60dB, 20dB, 30dB, 9dB separately.35.2.3 Analysis of OFDM with hybrid combination of SLM and precoding technique reproduce the proposed method for PAPR and BER examination for the Hybrid procedure which is the mix of decrease strategy SLM with Precoded DCT, DST, Hadamard and natural Hadamard transform. IFFT operation is performed here. PAPR for Hybrid SLM with DST, DCT, Hadamard and natural Hadamard are 6.5dB, 6.8dB, 8dB, 8dB separately and BER investigation for the same are 60dB, 50dB, 38dB, 30dB individually. By applying the precoding, PAPR gets let down on the off chance that we contrast these outcomes with hybrid transorms, yet in the meantime, poor BER results are there.

## 5 CONCLUSION

OFDM is very much attractive scheme for multicarrier transmission as it is known as MCM and has better spectral efficiency, simple deployment of receiver section and high speed data transmission up to 100mbps over a communication channel. Every scheme has pros and cons so its main disadvantage is a very high PAPR. In this project different techniques are elaborated to overcome this problem but as in some techniques we get reduced PAPR then at the same time high BER is

there which is not a useful for conventional system.

Clipping scheme is the most straightforward approach to lessen the PAPR however huge
number of iterations is required to restrict out-of- band radiation and to accomplish wanted PAPR level. Clipping technique is easiest for implementation but tradeoff between PAPR and BER is there. For clipping alone PAPR is 2dB but at the same time 49dB BER is there. To maintain the balance between the PAPR and BER with clipping Transforms are used . Among DCT, DWT transforms both are having low PAPR values when used with the reduction technique clipping i.e. 2dB and 3dB respectively but BER for this combination is 49dB for both the transforms which is not acceptable. Further Precoding techniques with the combination of Clipping technique is used which is known s hybrid system and DWT is the best among DCT and DST which give PAPR 7.2dB and BER is 12dB in a hybrid system. Next SLM is done for this same analysis and natural Hadamard transform is good when combined with SLM technique as it gives the PAPR and BER values 8.7dB and 10dB respectively. For Hybrid precoding system with SLM again tradeoff is there between PAPR and BER. To reduce the complexity in SLM next analysis is done with companding. With the combination of A-law companding with different transforms (DCT, DST, DWT) DWT give the best .is the best value of PAPR i.e. 6.2 but worst value of BER i.e. 52dB. With Mu-law same thing is happened there. DWT is also best here but in PAPR only. Next comes for Hybrid Precoding with A- law DST give the best PAPR value of 10.2dB but worst value of BER of 70dB and for Mu-law same thing is happened in this case also DCT is having best PAPR but poor BER value. In future filteration, tone rejection, block coding, interleaving reduction techniques can be used with different precoding as well as transforms to counterbalance between BER and PAPR.

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