

# Overview of PAPR Reduction Techniques of OFDM System

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**Abstract** - Orthogonal Frequency Division Multiplexing (OFDM) is one of the efficient multicarrier modulation scheme used in mobile Communications. The advantages of OFDM includes the removal of and Inter Symbol Interference (ISI) and Inter Carrier Interference (ICI) in the signal [1]. However transmission of OFDM signals using power amplifiers are unavoidably loss free due to high Peak to Average Power Ratio (PAPR). There are couples of techniques used to eradicate the issue discussed here within.

**Key Words:** PAPR; PTS; OFDM; SLM; ICI; ISI; TR; HPA (High Power Amplifier)

## 1. INTRODUCTION

OFDM is a frequency division multiplexing (FDM) and it is used by the American National Defense Department for military communications. In this subcarriers are orthogonal with each other that increase the spectral efficiency of the system. This technique was proposed by RW Chang in 1965, and it was patented at the USPD and then after it was used in military communication systems

## 2. OFDM System and PAPR

### OFDM system

Orthogonal frequency division multiplexing (OFDM) most widely used for 4G and 5G telecommunications standards modulation technology that includes digital radio broadcasting, digital terrestrial television (DTT), wireless local area networks (LANs), etc. It consists of transmitter side and the receiver side [2].

### OFDM transceiver

The basic principle of OFDM is to divide the existing bandwidth into several sub-carriers. With the number of sub-carriers, it gets more resistant to frequency selective fading, as a result data rates also increasing. But, number of sub-carriers cannot be increased arbitrarily beyond a certain level because it makes make transmission more sensitive to the time incoherence of the channel.

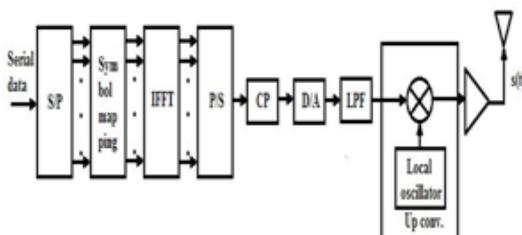


Figure 1: OFDM system transmitter.

### OFDM system transmitter

The received data is the information to be transmitted using OFDM through the channel. This data is transformed into N-parallel data streams with the help of serial to parallel converter. Further, it can be modulated and given to the IFFT block as an input [3]. The parallel data is changed into serial data with the help of parallel to serial converter. To cancel the impact of ISI, cyclic prefix is introduced between two symbols. The available baseband signal is up converted to an RF pass band signal with the use of a mixer or modulators.

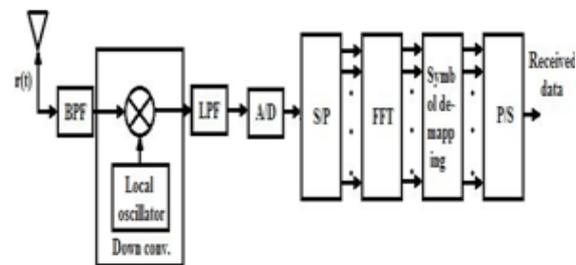


Figure 2: OFDM System receiver.

### PAPR

The OFDM signal has a high peak power when added in the same phase at IFFT, it causes out-of-band radiation, it further distorts the signals in adjacent bands. This reduces the efficiency of power amplifiers and degrades the overall performance of the OFDM system. PAPR increase the complexity in the ADC and DAC, and it reduces the efficiency of RF (radio frequency) amplifiers [4].

## 3. PAPR Reduction Techniques

The PAPR reduction includes coding, Active constellation extension (ACE), Tone reservation (TR), Selected mapping (SLM), Partial transmit sequences (PTS), Companding, Tone injection (TI)

### 3.1 Active constellation extension (ACE)

In ACE, constellation points in some outer signal are extended in each block outside of the constellation [5].

#### Advantages:

- A. Less loss of data rate.
- B. No extra information is required.
- C. Less distortion of the original signal.

#### Drawbacks:

Require addition operations after FFT operation in receiver.

### 3.2 Tone reservation (TR)

It reserves few tones and assign them suitable values [6].

**Advantages:**

- A. No distortion is introduced to the data bearing tones
- B. No side information is required.

**Drawbacks:**

- A. Improves the average energy per bit.
- B. Loss of spectral efficiency.
- C.

### 3.3 Selected mapping (SLM)

In this, some candidate data blocks are created and the one with lowest PAPR is transmitted. [7].

**Advantage:**

- A. No distortion is introduced.
- B. Independent of number of carriers.

**Drawback:**

- A. Extra information is required.
- B. Corrupt BER performance.

### 3.4 Partial transmit sequences (PTS)

The subcarriers in each of the sub blocks are rotated by phase factor, so the PAPR of the combination is minimized [8].

**Advantage:**

- A. Less distortion is introduced.
- B. Less complex.

**Drawbacks:**

- A. Side information is required

### 3.5 Companding

In this technique, the small signals are enlarged while compressing the large signals. The compression is done out at the transmitter end. The Compression of the signal decreases the high peaks, as a result PAPR is reduced [9].

**Advantage:** Less distortion is introduced.

**Drawback:** Loss of data rate.

### Tone injection (TI)

The TI technique, basic idea is to increase the constellation size so each point present in the original constellation could be mapped into various equivalent points. In an original constellation point, the equivalent constellation points are added so PAPR reduced. The calculation of the sub-carrier time domain signals also gives lowered PAPR [9].

**Advantage:** No data rate loss.

**Drawback:** Require modulo-D addition, after an FFT operation in the receiver.

### 4. CONCLUSIONS

In this paper, it is compared and analyses different PAPR reduction techniques. However, no technique solely eradicate PAPR problem. Before implementing the technique various other factors like maintaining data rate, computational complexity, BER, signal power should also be taken into acknowledgement.

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