PARR reduction techniques OFDM technology-A comprehensive review

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Abstract: **Nowadays, Signals, which were initially sent in the analog domain, are being sent more and more in the digital domain. For better transmission, even single – carrier waves are being replaced by multi – carriers. Multi – carrier systems like CDMA and OFDM are now – a – days being implemented commonly. In the OFDM system, orthogonally placed sub – carriers are used to carry the data from the transmitter end to the receiver end. Presence of guard band in this system deals with the problem of ISI and noise is minimized by larger number of sub – carriers. But the large Peak – to – Average Power Ratio of these signal have some undesirable effects on the system.**

Keywords: **Cyclic Prefix, CCDF, Amplitude Clipping & Filtering, SLM, PTS.**

I. INTRODUCTION

A simple communication system consists of a transmitter end which send the data and a receiver end at which the data is received. Usually there received data is not the same as the data sent. Because of the noise present in the medium the signal gets affected and distortion is observed in the signal. Various modulation techniques are under taken in order to ensure that the signal sent is safely available at the receiver end. Orthogonal Frequency Division Multiplexing is a special form of multicarrier modulation which is particularly suited for transmission over a dispersive channel. Here the different carriers are orthogonal to each other, that is, they are totally independent of one another. This is achieved by placing the carrier exactly at the nulls in the modulation spectra of each other. in the OFDM system ,Due to increase in symbol duration, there is a reduction in delay spread. Addition of guard band almost removes the ISI and ICI in the system. Conversion of the channel into many narrowly spaced orthogonal sub – carriers render it immune to frequency selective fading. As it is evident from the spectral pattern of an OFDM system, orthogonally placing the sub – carriers lead to high spectral efficiency.

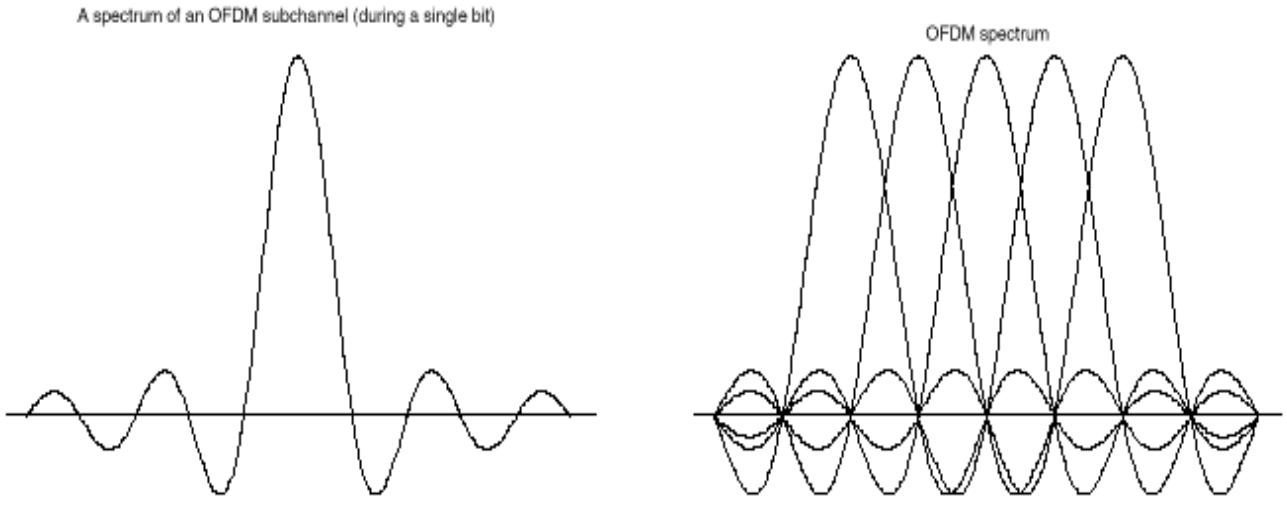

Fig. 1 OFDM Spectrum

The development of OFDM systems can be divided into three parts. This comprises of Frequency Division Multiplexing,

Multicarrier Communication and Orthogonal Frequency Division Multiplexing.

Frequency Division Multiplexing

Frequency Division Multiplexing is a form of signal multiplexing which involves assigning non – overlapping frequency ranges or channels to different signals or to each "user" of a medium. A gap or guard band is left between each of these channels to ensure that the signal of one channel does not overlap with the signal from an adjacent one. Due to lack of digital filters it was difficult to filter closely packed adjacent channels.

Multicarrier Communication

As it is ineffective to transfer a high rate data stream through a channel, the signal is split to give a number of signals over that frequency range. Each of these signals are individually modulated and transmitted over the channel. At the receiver end, these signals are fed to a de – multiplexer where it is demodulated and re – combined to obtain the original signal.

OFDM

OFDM system Can be efficiently implemented using IFFT. but OFDM systems are highly sensitive to Doppler shifts which affect the carrier frequency offsets, resulting in ICI. in these system Presence of a large number of sub – carriers with varying amplitude results in a high Peak – to – Average Power Ratio (PAPR) of the system, which in turn hampers the efficiency of the RF amplifier.

A. MODULATION AND DEMODULATION OF OFDM SYSTEMS

Modulation

it is the technique by which the signal wave is transformed in order to send it over the communication channel in order to minimize the effect of noise. This is done in order to ensure that the received data can be demodulated to give back the original data. In an OFDM system, the high data rate information is divided into small packets of data which are placed orthogonal to each other. This is achieved by modulating the data by a desirable modulation technique (QPSK). After this, IFFT is performed on the modulated signal which is further processed by passing through a parallel – to – serial converter. In order to avoid ISI we provide a cyclic prefix to the signal.

Demodulation

It is the technique by which the original data (or a part of it) is recovered from the modulated signal which is received at the receiver end. In this case, the received data is first made to pass through a low pass filter and the cyclic prefix is removed. FFT of the signal is done after it is made to pass through a serial – to – parallel converter. A demodulator is used, to get back the original signal. The bit error rate and the signal – to – noise ratio is calculated by taking into consideration the un – modulated signal data and the data at the receiving end.

II. RELATED WORK

J. Armstrong [1**]** proposed Power Reduction technique for OFDM. The signal may be decreased without any increase in power. Frequency domain filter has been developed to eliminate the discrete component from the signal and this is done by filtering technique which is based on the FFT.

S. H. Han [2] this work explains some essential PAPR reduction methods for multicarrier transmission. Moreover, in this paper, some explanation are made on the principle for PAPR reduction method selection and explain shortly the issue of PAPR reduction in OFDMA and MIMO-OFDM

S. Y. L. Goff [3] presented a novel SLM method. In this method,no information required to be transferred. This method is utilized to minimize the PAPR in OFDM system. In this work, example of an OFDM system using 16-QAM modulation has been taken to explain the proposed method. It is indicated that the presented approach operates well in terms of PAPR reduction and bit error rate at the receiver output.

S. H. Muller [4] in this paper, comparison has been done between two distortionless peak power reduction schemes for OFDM. One technique is used to send the signal chosen from the group of signal. And the second scheme uses the PTS method to build the transmitted signal. these two techniques are flexible and do not require any limitation on modulation applied in the subcarriers.

S. Mohapatra [5] A novel technique has been presented for Improvement of OFDM System using Pulse Shaping. Orthogonal Frequency Division Multiplexing (OFDM) is a multi-carrier modulation technique, in which a single high rate data-stream is divided into multiple low rate data-streams and is modulated using sub-carriers, which are orthogonal to each other. The signals must maintain a specified average energy level in the channel to obtain the desired Bit-error-rate. The peak signal level relative to that average

defines the maximum dynamic range that must be accommodated by the components in the signal flow path to support the desired average.

X. Li, L. J. Cimini [6] discussed the Effect of Clipping and Filtering on the Performance of OFDM. Orthogonal frequency division multiplexing (OFDM) is an attractive technique for wireless communication applications. Our results show that clipping and filtering is a promising technique for the transmission of OFDM signals using realistic linear amplifiers

S. Y. L. Goff, S. S. Al [7] in this paper, Selected Mapping Without Side Information for PAPR Reduction has been discussed. Mapping approach is utilized to minimize the PAPR in OFDM system.in this work no data required to transfer. It is demonstrated that the presented method operates well in terms of PAPR reduction and bit error rate at the receiver output.

R. O"Neil [8] in this paper, Spectral splatter in clipped multicarrier signals has been proposed. This work indicates that there will be reduction in the variation of amplitude of signal is possible due to the spectral distortion and noise emission.

III. ADVANTAGES OF OFDM

- Multipath delay spread tolerance
- High transmission bitrates
- Chance to cancel any cannel if is affected by fading
- Flexibility: each transceiver has access to all subcarriers within a cell layer.
- Easy equalization: OFDM symbols are longer than the maximum delay spread resulting in flat fading channel which can be easily equalized.
- High spectral efficiency.
- Resiliency to RF interference.
- Lower multi-path distortion.

IV. DISADVANTAGES OF OFDM

- High synchronism accuracy.
- Multipath propagation must be avoided in other orthogonallity not be affected
- Large peak-to-mean power ratio due to the superposition of all subcarrier signals, this can become a distortion problem.
- More complex than single-carrier Modulation.
- Requires a more linear power amplifier.
- The OFDM signal has a noise like amplitude with a very large dynamic range, therefore it requires RF power amplifiers with a high peak to average power ratio.
- It is more sensitive to carrier frequency offset and drift than single carrier systems are due to leakage of the DFT.
- Peak to average power ratio (PAPR) is high.
- High power transmitter amplifiers need linearization.
- Low noise receiver amplifiers need large dynamic range.
- Capacity and power loss due to guard interval.
- Bandwidth and power loss due to the guard interval can be significant.

V. OFDM APPLICATIONS

OFDM technique is the most prominent technique of this era .Some of its applications is given
Below:

- HDTV
- Wireless LAN Networks
- 5.3.1 HIPERLAN/2
- IEEE 802.11g
- IEEE 802.16 Broadband Wireless Access System.
- Wireless ATM transmission
- IEEE 802.11a

VI. CONCLUSION

OFDM is a very attractive technique for multicarrier transmission and has become one of the standard choices for high – speed data transmission over a communication channel. It has various advantages; but also has one major drawback: it has a very high PAPR. In

this paper, the different properties of an OFDM System are analyzed and the advantages and disadvantages of this system are understood. The bit – error – rate is also plotted against the signal – to – noise ratio to understand the performance of the OFDM system.

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