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# CLIPPING BASED PAPR REDUCTION METHOD FOR LTE OFDMA SYSTEMS

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**Abstract :** This thesis work carries out a study of the 3GPP LTE standards and mainly concentrates on the LTE 8 OFDM PHY layer. A MATLAB model based on LTE 8 PHY baseband is built for simulation and performance evaluation. All mandatory blocks in the 802.11a OFDM-PHY specification are included: Randomization, FEC, adaptive modulation, and IFFT/FFT. An additive random Gaussian channel is implemented and Peak to Average Power ratio is reduced using clipping and filtering and Companding model at the transmitter end and it is quantified using CCDF analysis. It is also mentioned that once the system is put under test using MATLAB there is some assumption being taken to represent the results. A random signal of different M-ary value is considered as the digital baseband signal which has to be recovered at the receiver side. It is about evaluating the Complementary cumulative distribution function for performance evaluation which is taken at the transmitter side. The graphs are taken for techniques like clipping, clipping & filtering & non linear Companding techniques. The results so obtained are compared and then a final conclusion is made regarding the Peak to average power ratio reduction.

## INTRODUCTION

This chapter gives a brief introduction on the motivation of this thesis work and the objectives on the work as well. At last the structure of the final report is listed.

### 1.1 Background

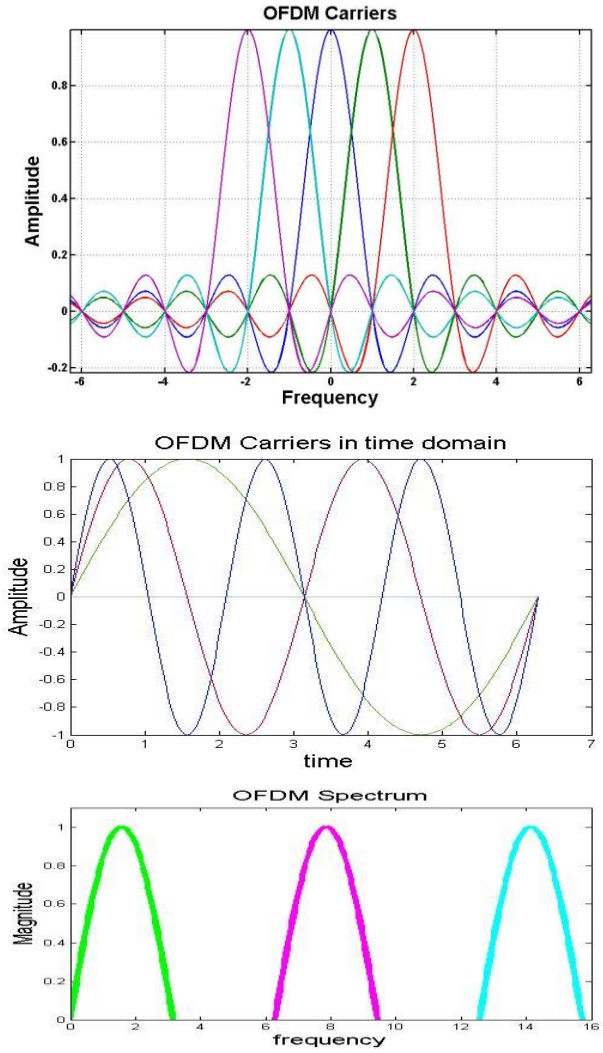
The ever increasing demand for very high rate wireless data transmission calls for technologies which make use of the available electromagnetic resource spectrum in the most intelligent way. Key objectives are spectrum efficiency (B/S/Hz), robustness against multipath propagation, range, power consumption, and implementation complexity. These objectives are often conflicting, so techniques and implementations are sought which offer the best possible tradeoffs between them. The Internet revolution has created the need for wireless technologies that can deliver data at high speeds in a spectrally efficient manner. However, supporting such high data rates with sufficient robustness to radio channel impairments requires careful selection of modulation techniques. Currently, the most suitable choice appears to be OFDM (Orthogonal Frequency Division Multiplexing). Orthogonal frequency division multiplexing (OFDM) is becoming the chosen modulation technique for wireless communications. OFDM can provide large data rates with sufficient robustness to radio channel impairments. Orthogonal Frequency Division Multiplexing (OFDM) has grown to be the most popular communications systems in high speed communications. OFDM technology is the future of wireless communications. Orthogonal Frequency Division Multiplexing (OFDM) is a multicarrier transmission technique, which divides the bandwidth into many carriers; each one.

## PROBLEM IDENTIFICATION & ISSUES

### 2.1 ORTHOGONALITY

OFDM is simply defined as a form of multi-carrier modulation where the carrier spacing is carefully selected so that each sub carrier is orthogonal to the other sub carriers. Two signals are orthogonal if their dot product is zero. That is, if you take two signals multiply them together and if their integral over an interval is zero, then two signals are orthogonal in that interval. Orthogonality can be achieved by carefully selecting

carrier spacing, such as letting the carrier spacing be equal to the reciprocal of the useful symbol period.




## PROPOSED WORK

### 3GPP LONG-TERM EVOLUTION

The Third-Generation Partnership Project (3GPP) is an international standardization body working on the specification of the 3G Universal Terrestrial Radio Access Network (UTRAN) and on the Global System for Mobile communications (GSM). The latest specification that is being studied and developed in 3GPP is an evolved 3G radio access, widely known as the Long-Term Evolution (LTE) or Evolved UTRAN (E-UTRAN), as well as an evolved packet access core network in the System Architecture Evolution (SAE). The initial requirements for LTE were set out in early 2005. The initial objective of 3GPP [29] was to produce global specifications for a 3G mobile system evolving from the existing GSM core network. This includes the Wideband CDMA (WCDMA) based UTRA Frequency Division Duplex (FDD) mode and the Time Division Code Division Multiple Access (TD-CDMA) based UTRA Time Division Duplex (TDD) mode. There are some key features of LTE release 8 that has been mentioned in an explicit way so that we can understand that our current LTE has been utilising it because of so many features that makes it distinct from others.

## SIMULATION AND RESULT

This chapter is divided into two sections. The first section calculates analytical peak-to-average power ratio (PAPR) reduction and bit error rate (BER) for various modulation techniques. The second section calculates PAPR for the technique implemented. The work is on the following specification techniques mentioned in the below table 6.1.In the system, the following specifications have been used for the PAPR reduction of single user OFDM:

- Three types of modulation schemes QAM4, QAM8, QAM16 used in simulations.
- There is one channel model AWGN used in the simulations.
- The different outputs of the simulation are: reduction of PAPR for different modulation scheme.

| Parameter | Work done by J Armstrong[20] | Work done by SH Han JH Lee [28] | Thesis work |
|---|---|---|---|
| FFT/IFFT Block size | 128 | 256,1024 | 128,256 |
| Clipping ratio | 6 dB | 6dB | 1.5(4dB) |
| Modulation Scheme | 4 QAM | 4 QAM | 16 QAM |
| Channel | AWGN | AWGN | AWGN |
| Cyclic Prefix | NA | NA | 16 Samples |
| PAPR Technique 1 | Clipping and filtering | - | Clipping and filtering |
| PAPR Technique 2 | NA | SLM | Companding Technique A law and μlaw |
| Oversampling | NA | 1-4 | 1-4 |
| CCDF in dBs at $10^{-1}$ clip and filter | 7dB | 7.6dB | 7.9dB |
| CCDF in dBs at $10^{-1.5}$ | 7.5 dB | 7.8 dB | 8.1dB |
| CCDF in dBs for Companding Technique at $10^{-2}$ | NA | NA | 6.5dB and 6.9dB |
| CCDF in dBs for iterative clipping and filtering at $10^{-1.5}$ clip 4 | 6 dB | NA | 4.9Db |



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## CONCLUSION AND FUTURE WORK

This chapter discusses the overall scenario of the thesis and presents the future work which can be taken in the near future for further developments. OFDM is a promising technique for wireless communication systems although it has some drawbacks which are given below:

1. High PAPR
2. Frequency offset

High PAPR is one of the major problems of OFDM system. There are several techniques to reduce the PAPR in OFDM transmission system. All PAPR reduction techniques have some advantages and disadvantages. These PAPR reduction techniques should be chosen carefully for getting the desirable minimum PAPR. All PAPR reduction techniques are based on particular situation of system. This section describes and summarizes several techniques of PAPR and proposes repeated clipping and frequency domain filtering technique which is the best solution for PAPR.

As discussed that proposed results are better from the traditional systems which provides a performance improvement of 2-3dBs using clipping and filtering, while our efforts shows a improvement of 3.2dBs which is quite comparable. The work has to make certain that the PAPR of the system is minimum for any modulation technique which is used. In the present model, modulation used 16 QAM for 20 MHz sampling frequency alongwith the cyclic prefix. This can be used for multi user environment where the same technology can be used for the system. In future it will be suggested to further reduce the PAPR using better approach for multi user systems.

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