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Analysis of PAPR reduction Techniques for OFDM

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Abstract: **In this paper, a joint solution is proposed with RS coding, OFDM, and PAPR clipping. We implemented the hybrid method which consists of RS coding and adaptive clipping technique over an additive white Gaussian noise (AWGN) channel. Reed Solomon RS (255, 239) coding can correct 8 symbol errors from 239 symbols data. This capability can effectively compensate for the performance degradation resulted by setting PAPR threshold to 5 in case of 256 QAM, and RS (63, 47) and threshold of 4 incase of 64 QAM. The implemented hybrid technique based on RS coding and adaptive clipping technique method to compensate the performance degradation caused by clipping. From the simulation results, by using hybrid technique the clipping distortion can be removed when CR = 5 and SNR = 26.5 dB for 256 QAM, and CR = 4 and SNR = 20.5 dB for 64 QAM. The simulation results show that the hybrid method is an effective technique to mitigate the clipping distortion.**

Introduction

Wireless communications is one of the fastest growing segments of the communications industry. As such, it has captured the attention of the media and the imagination of the public. Wireless communication mainly categorized for media (voice and video), and data. Under media, cellular systems have experienced exponential growth over the last decade and there are currently about two billion users worldwide. Indeed, cellular phones have become a critical business tool and part of everyday life in most developed countries, and they are rapidly supplanting antiquated wire line systems in many developing countries. For data applications, wireless local area networks currently supplement or replace wired networks in many homes, businesses, and campuses. Many new applications – including wireless sensor networks, automated highways and factories, smart homes and appliances, and remote telemedicine – are emerging from research ideas to concrete systems. The explosive growth of wireless systems coupled with the proliferation of laptop and palmtop computers suggests a bright future for wireless networks, both as stand-alone systems and as part of the larger networking infrastructure. However, many technical challenges remain in designing robust wireless networks that deliver the performance necessary to support emerging applications. The gap between current and emerging systems and the vision for future wireless applications indicates that much work remains to be done to make this vision a reality. We describe current wireless systems along with emerging systems and standards.

OFDM with Reed Solomon Encoder and Decoder

The following Figure shows OFDM simulation model used and simulation results are discussed below.

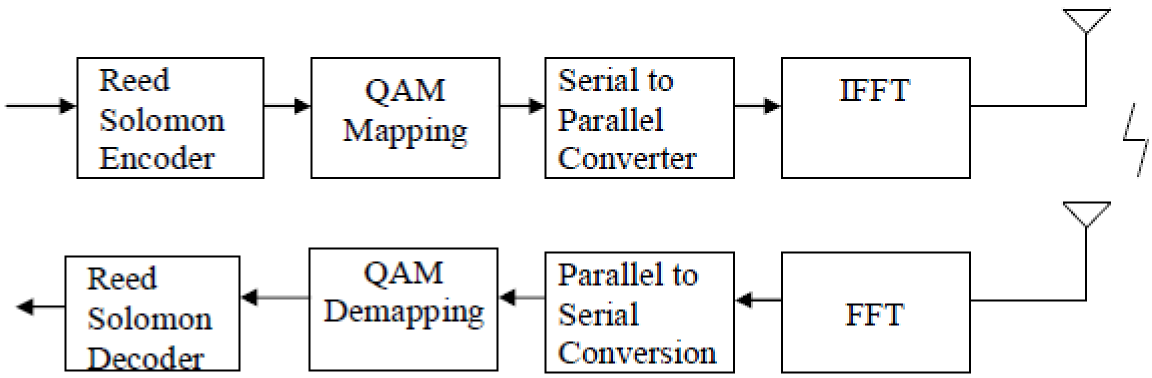

Figure 1: OFDM Simulation model

As shown in the Figure 1, initially the random data is encoded using RS encoder (RS (255,239) for 256 QAM, RS (63, 47) for 64 QAM). The encoded symbols are modulated, goes through serial to parallel conversion and IFFT is performed. IFFT signal is RF up converted and transmitted. In the receiver the received signal is down converted, FFT is performed, after FFT the signal is decoded using QAM constellation. The output of QAM demodulator is divided into 'n' (RS (n, k)) groups. Each group of 'n' symbols are applied to RS decoder to correct the errors.

OFDM with adaptive clipping

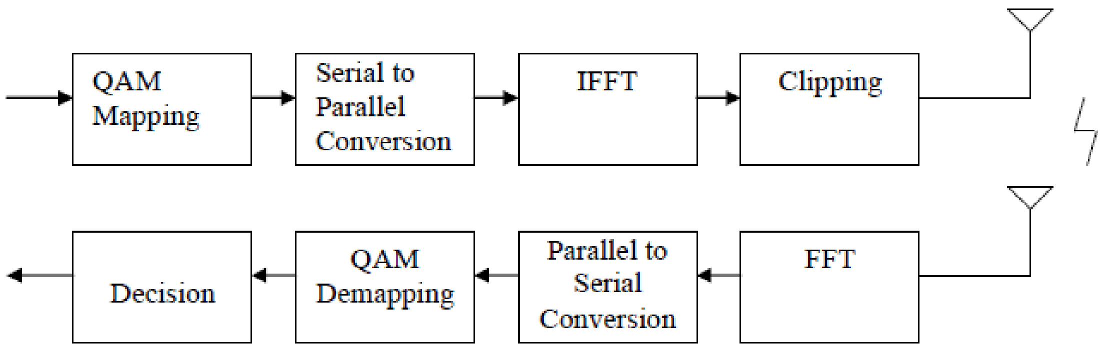

Figure 2: OFDM Simulation model

Simplified baseband transmitter and receiver block diagram of OFDM systems, described at Figure 2 are considered for analyzing a PAPR characteristics of OFDM signals. First, transmitted binary source data is randomly generated. This random data is '1' or '0' and it happens equally likely. Next, this random data is mapped through QAM constellation. QAM mapped signal is complex value. Then, QAM mapped signal is loaded on each subcarrier, and goes through serial to parallel conversion. And IFFT is performed. IFFT output signal is operated with clipping for reducing PAPR, and then this signal is transmitted. The receiver structure has reciprocal architecture to the transmitter.

Simulation and Analysis

Simulation Results

Figure 3 is shown for 256 QAM normal OFDM. For a BER of 10-3, it is required to maintain SNR of 30dB. By applying RS coding, it can be observed that significant decrease in BER after 26dB. Similarly, as shown in Figure 4 , for 64 QAM with RS coded OFDM, there is significant drop in BER after 17dB. RS coding improves the performance. Reed Solomon Encoder QAM Mapping Serial to Parallel Converter IFFT FFT Parallel to Serial Conversion QAM Demapping Reed Solomon Decoder.

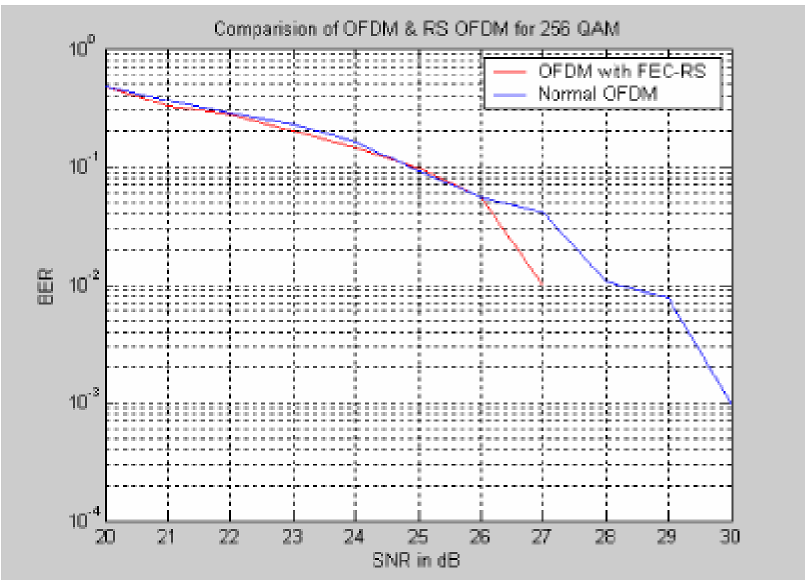

Figure 3: Comparison of OFDM and RS OFDM for 256 QAM

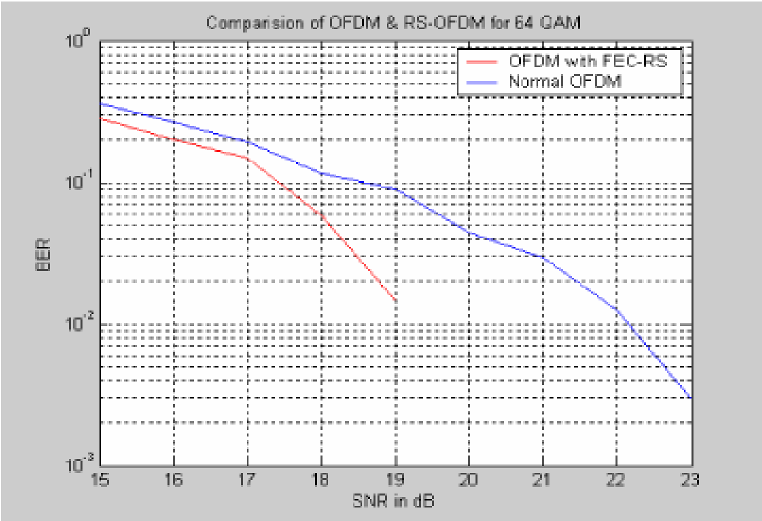

Figure 4: Comparison of OFDM and RS OFDM for 64 QAM

FEC schemes are used along with modulation schemes like OFDM. RS is one of the popular scheme. The RS codes are able to correct a corrupted symbol with a single bit error as it can be symbol with all b Figure 5 & 6 show BER performance with Modulation scheme and CR. In these figures 64-QAM and 256-QAM show an error flow phenomenon at CR. When we use the 64 QAM modulations, required SNRs when CR is 3 and 4 are shown, so we can use CR 4 when 64 QAM is used. Similarly for 256 QAM, required SNRs when CR is 4 and 5 are shown, so we can use CR 5 when 256 QAM is used. its in error. RS used with OFDM improves the on BER that will result in able to operate with lower SNR. This also helps in increase range. There are many other error correction codes like Turbo codes that provide more gain than RS. From complexity and easy VLSI implementation, RS is adapted popularly in base band processing.

256QAM

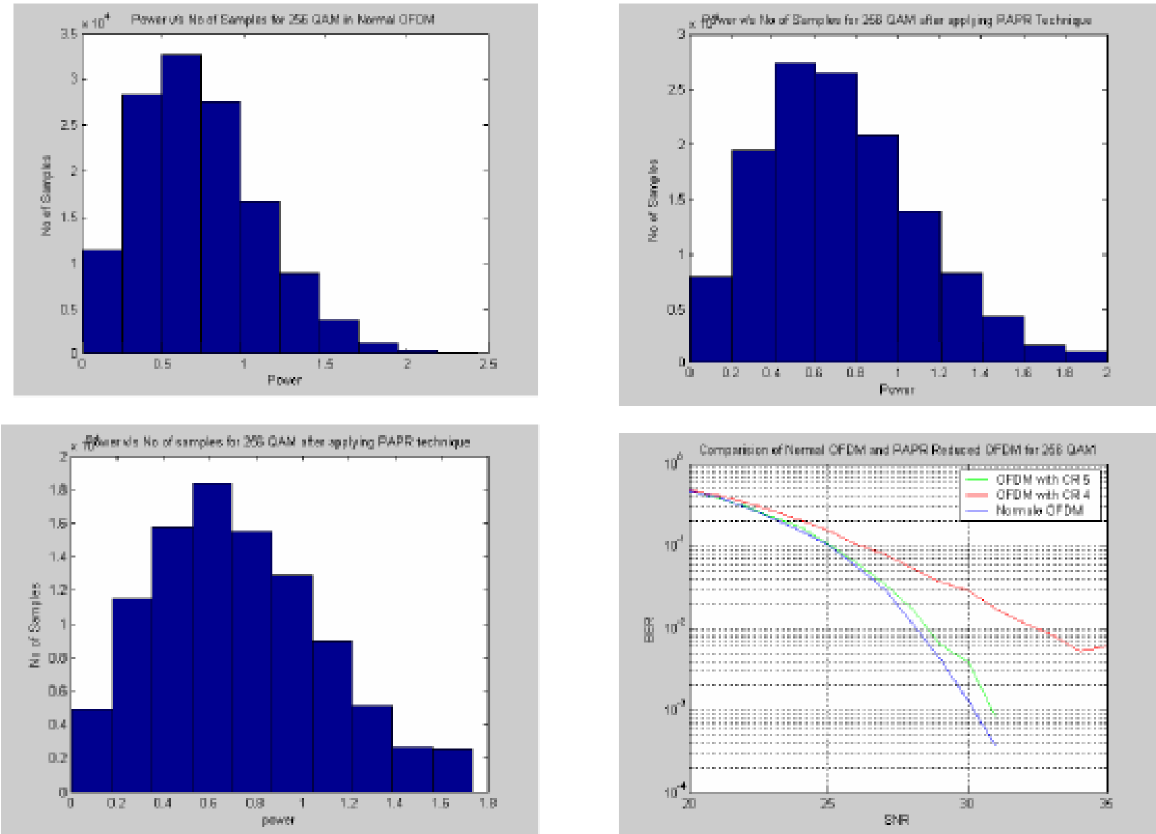

Figure 5: SNR v/s BER plots for Adaptive clipped OFDM system for 256 QAM at CR-4and CR-5

64QAM

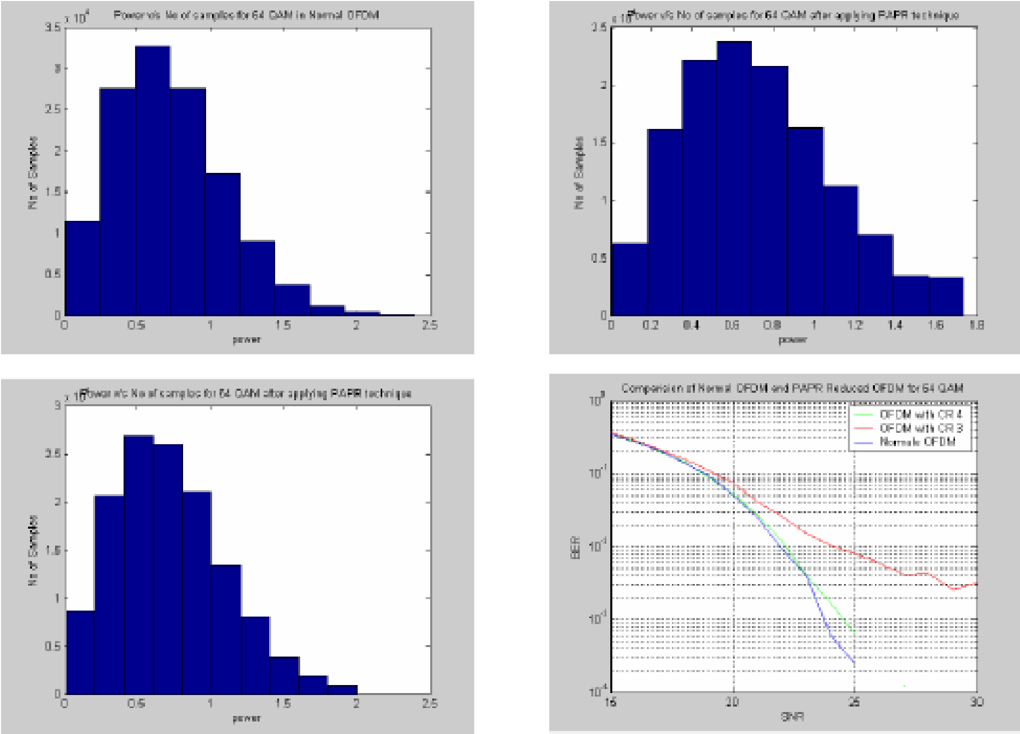

Figure 6: SNR v/s BER plots for Adaptive clipped OFDM system for 64 QAM at CR-3 and CR-4

The major drawback of OFDM system is when all the subcarriers are of same phase then the instantaneous power is very high, this leads to nonlinear characteristics in amplifier. To overcome this earlier techniques are First, clipping technique is used, but it has BER degradation, second, peak power avoidance precoding technique, it will decreases the data rate. This proposed technique will be similar to clipping technique but it is adaptive to modulation order. It is simple and combined advantages of both the clipping technique and peak power precoding technique.

Conclusions

various WLAN standards and the system aspects are presented at first level. We then analyzed on multi carrier modulation scheme OFDM. Next, we have considered some of the parameters which effect the wireless transmission of data through OFDM. We have proposed a new system which is robust in terms of channel coding, peak power reduction, and complexity. The main disadvantage of peak power of OFDM based systems can be improved with PAPR techniques. This creates additional BER to the overall performance. Error correction schemes like Reed-Solomon coding helps in both PAPR BER degradations and also overall system performance.

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