International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 1 Issue 7, September - 2012

Modified Slm Technique For The Reduction Of Papr

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ABSTRACT

High peak to average power ratio (PAPR) in OFDM can be reduced by scrambling techniques like SLM and PTS.SLM technique is commonly used to reduce PAPR but it require large number of complex multiplications. In this paper we propose the algorithm to reduce the complexity of SLM technique. This is obtained by linearly combining the original signal with multiple cyclic shift equivalents. The proposed technique has a lower computational complexity but is some what poorer in the PAPR reduction.

Keywords – **OFDM, PAPR, PTS, SLM.**

Paper submitted: Date, Revised: Date (only if applicable), Accepted: Date

I. INTRODUCTION

ORTHOGONAL frequency division multiple access (OFDMA) systems have emerged as the architecture of choice for broadband wireless networks such as the IEEE 802.16 series of WiMAX (worldwide inter-operability for microwave access) networks [1]. In OFDMA systems, the sub-carriers are assigned to different users for simultaneous transmission subject to the constraint that no sub-carrier is occupied by more than one user at the same time. OFDMA systems retain all the advantages of orthogonal frequency division multiplexing (OFDM) systems, including a high spectral efficiency and immunity to interference caused by the multi-path channels. An important disadvantage of OFDM systems is their high peak-to-average power ratio (PAPR). When the OFDM signal is transformed to time domain, the resulting signal is the sum of all the subcarriers, and when all the subcarriers add up in phase the result is a peak N times higher than the average power.

High PAPR degrades performance of OFDM signals by forcing the analog amplifier to work in the nonlinear region, distorting this way the signal and making the amplifier to consume more power. However, OFDMA systems also inherit the principal disadvantage of traditional OFDM systems, namely a high peak-to-average power ratio (PAPR). Various PAPR reduction schemes have been proposed for OFDM systems in recent years, including clipping [2], [3], coding [4], selected mapping (SLM) [5]-[14], partial transmit sequence (PTS) [15]-[17], active constellation extension (ACE) [18]-[19], and tone reservation [20]-[21].While widely used, SLM methods require a bank of inverse fast Fourier transforms (IFFTs) to generate the candidate signals. Several
methods have been proposed for reducing the computational complexity [10]-[14].

Both PAPR and computational complexity are critical challenges in OFDMA systems, especially for the mobile terminals. Therefore, this paper proposes a low-complexity scheme for PAPR reduction in OFDMA uplink systems, where only one IFFT is required. The PAPR reduction performance of the proposed scheme is only marginally poorer than that of the traditional SLM scheme. However, the proposed scheme has a significantly lower computational complexity.

II. SYSTEM MODELS

In the case of the interleaved OFDMA uplink system, we first assume that the N sub-carriers are partitioned into four interleaved groups denoted as $T\psi$, $\psi = 1, 2, 3, 4$, each sub-carrier is allocated to at most one user. A single user can occupy an entire group of subcarriers or several users can share the same group. all the sub-carriers assigned to a given user should belong to the same group.

In other words, $\Gamma u \subseteq T\psi$, $\psi = 1, 2, \ldots, \Psi$. Therefore, each user can occupy a maximum of one part in Ψ equal parts of the total available sub-carriers. In the discrete-time case, the PAPR of the transmitted signal is defined as

$$PAPR = \frac{\max_{0 \le n < NL-1} |x[n]|^2}{E[|x[n]|^2]} \qquad (1)$$

The cumulative distribution function (CDF) of the PAPR is one of the most frequently used performance measures for PAPR reduction techniques. In the literature, the

$$X_{u,m}[k] = \left(1 + N_1 e^{\theta_1} . e^{-\frac{j2\pi k s_{m,1}}{LN}} + \cdots \ldots\ldots\ldots\ldots \right) . X_u[k] \qquad (6)$$

complementary CDF (CCDF) is commonly used instead of the CDF itself. The CCDF of the PAPR denotes the probability that the PAPR of a data block exceeds a given threshold.The performance of PAPR-reduction schemes is generally evaluated using the complementary cumulative distribution function (CCDF), defined as the probability that the PAPR of $\mathbf{x}_u$ exceeds some clip level $PAPR_0$.

$$CCDF_{PAPR}(\mathbf{x}_u) = \Pr(PAPR(\mathbf{x}_u) > PAPR_0) \qquad (2)$$

III MODIFIED SLM TECHNIQUE

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In contrast to traditional SLM schemes, in which multiple IFFTs are required, the proposed scheme requires just one IFFT. The architecture of the investigated PAPR reduction scheme is depicted in Fig. 2. It can be seen that following the OFDMA modulation and IFFT operations, the time-domain signal is processed by $M - 1$ Candidate Signal Generating Blocks (CSGBs) to obtain a total of M candidate signals, of which one signal is the original time-domain transmitted signal. It is noted that a total of $\lceil \log 2M \rceil$ side information bits are required for decoding proposes at the receiver end. Figure 3 delineates the structure of each CSGB and shows that each candidate signal is obtained as a linear combination of a number of different signals, namely the

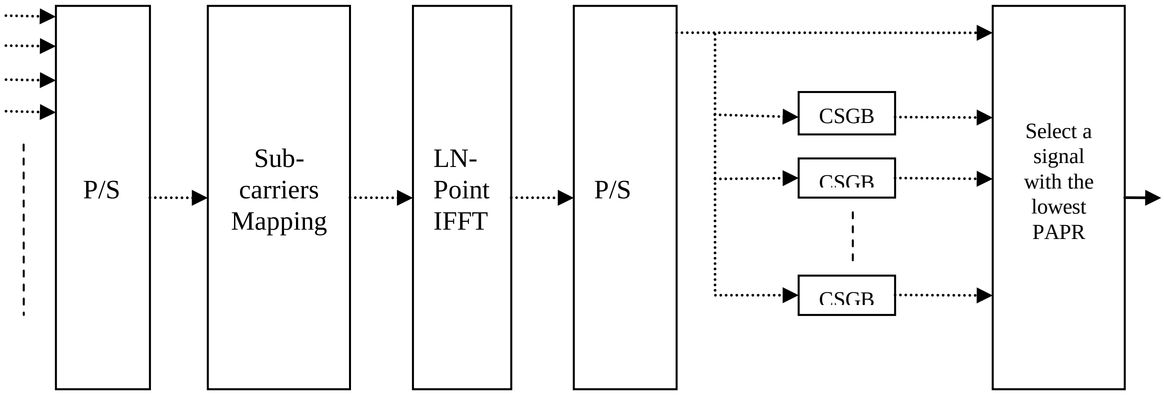

Fig1. PAPR reduction technique

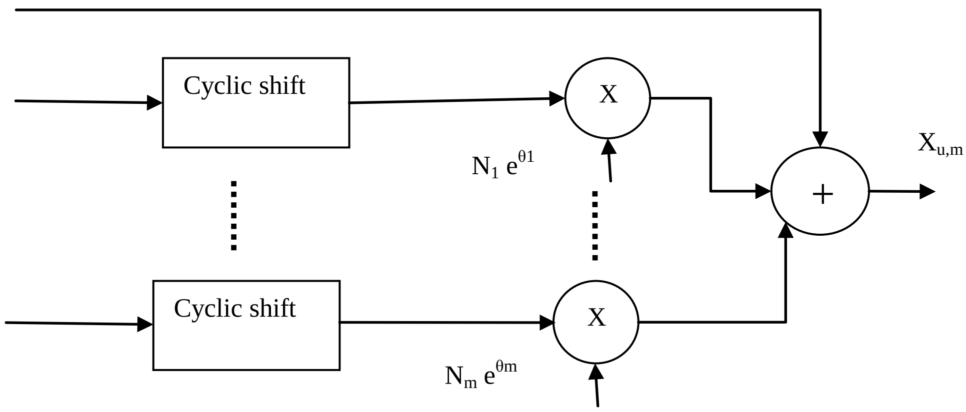

Fig.2. Architecture of the candidate signal generating block (CGSB)

original time domain transmitted signal and multiple cyclic shift equivalents of the original signal multiplied by various complex numbers. Note that to constrain the computational complexity of the investigated architecture; this study limits the number of combined signals within each CSGB to just four. As a result, the m^{th} candidate signal of the u^{th} user has the general form:

To enhance the PAPR performance, the proposed scheme can be integrated with the traditional SLM scheme by increasing the number of IFFT operations. For example, Fig. 3 illustrates the modified Proposed Scheme for the case in which two IFFT operations are performed, where R is a random phase rotation vector whose elements belong to the set$\{\pm 1, \pm j\}$.

IV. ANALYSIS OF COMPLEXITY

The traditional SLM scheme requires a total of M IFFT operations to generate M candidate signals, where each operation requires $(LN/2) \cdot \log_2(LN)$ complex multiplications and $(LN) \cdot \log_2(LN)$ complex additions. the modified Proposed Scheme requires a total of $(QLN/2) \cdot \log 2(LN)$ complex multiplications and $(QLN) \cdot \log 2(LN)$ complex additions for the Q IFFTs.

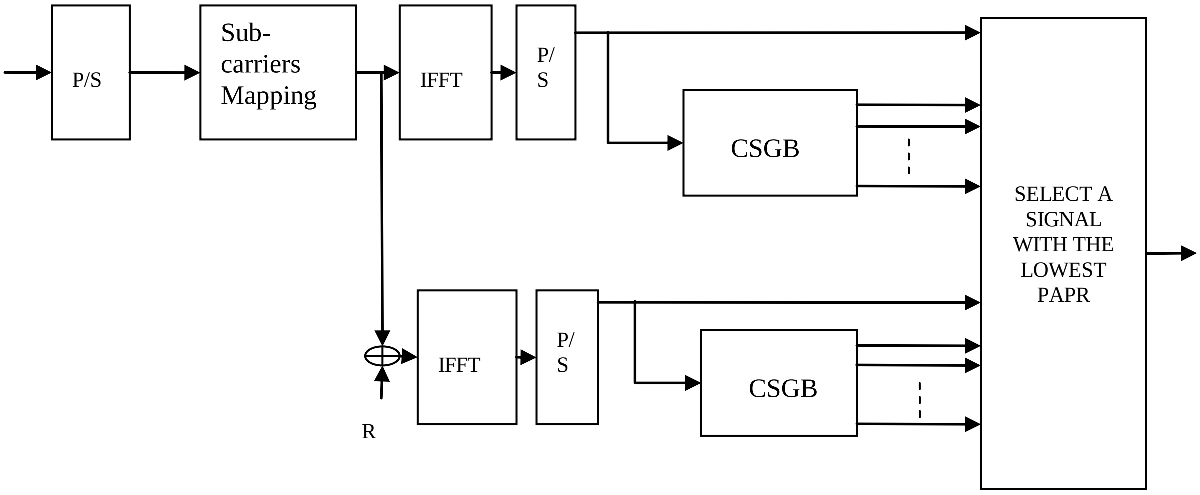

Fig.3. Proposed technique integrated with traditional SLM

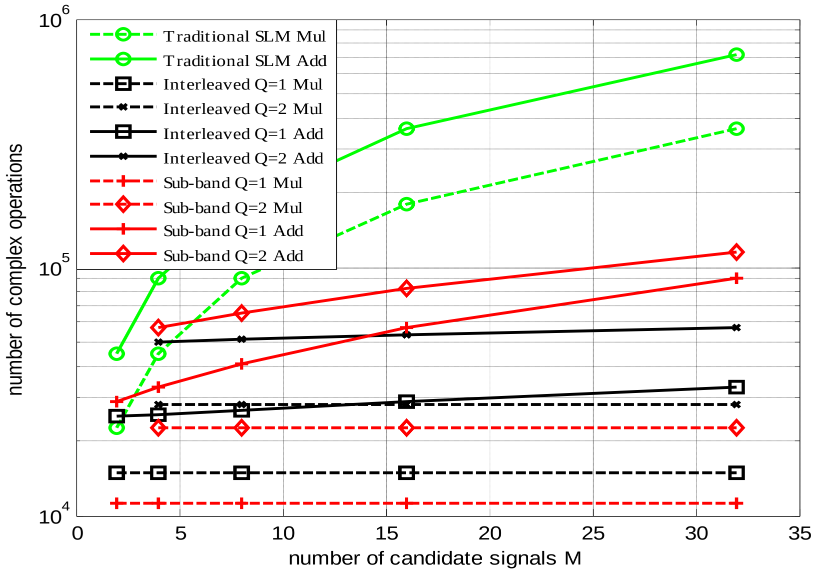

Fig.4 Number of complex operations of the number of candidate signals

V. SIMULATION RESULTS

For comparison purposes, simulation results were obtained for both the traditional SLM scheme and the proposed scheme with $Q = 1$ and $Q = 2$ IFFT operations. The PAPR performance results obtained for the interleaved OFDMA uplink system shows that the maximum performance loss of the proposed scheme with one IFFT relative to the traditional SLM scheme is just 0.62 dB for M = 8 and Prob(PAPR > PAPR0) = 10^{-3}. the relative maximum performance loss of the proposed scheme with two IFFTs is just 0.17 dB under equivalent conditions.

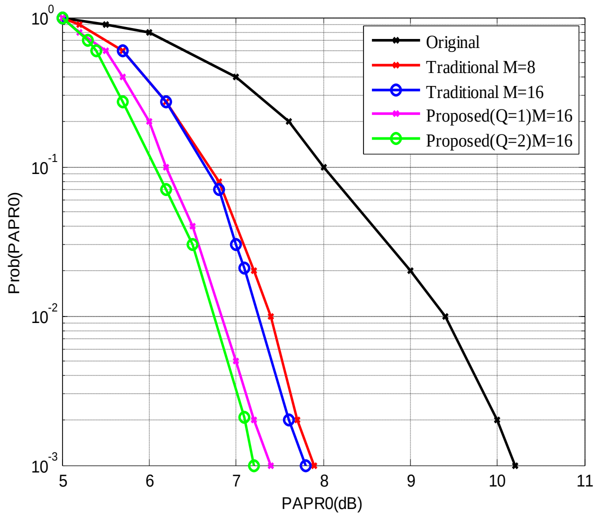

Fig.5 The PAPR reduction performance

VI CONCLUSION

This paper presented a low-complexity scheme for PAPR reduction in OFDMA uplink systems. The PAPR reduction performance of the proposed scheme is marginally poorer but it has a significantly lower computational complexity. the maximum performance loss of the proposed scheme with one IFFT and two IFFT operations is just 0.45 dB and 0.15 dB, respectively.

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