ABSTRACT
Multi-carrier modulation is an attractive technique for fourth generation wireless communication. Orthogonal Frequency Division Multiplexing (OFDM) is an efficient method of data transmission for high speed communication systems. However, the main drawback of OFDM system is that, it exhibits high Peak to Average Power Ratio (PAPR) of the transmitted signals. OFDM consist of large number of independent subcarriers, as a result of which, the amplitude of such a signal can have high peak values. The Selected Mapping (SLM) and turbo coding is one of the promising PAPR reduction techniques for OFDM. In this paper, the issue of PAPR in OFDM is discussed. Two new methods are proposed to reduce the PAPR. First method is carried out by selecting mapping, the input sequence properly using a Hamming code and second method is turbo code using interleavers encoder. These two methods provide better result.

KEYWORDS: OFDM, PAPR, Turbo Codes, Error Correcting Codes.

1.0. INTRODUCTION
A well known problem of the Orthogonal Frequency Division Multiplexing (OFDM) system is the possible occurrence of high Peak to Average Power Ratio (PAPR) [1]. Many techniques have been proposed to mitigate the PAPR problem. Except for the signal distortion techniques such as clipping, peak windowing and companding, redundancy is needed to control PAPR [2-4]. The redundancy based PAPR reduction techniques include selective mapping, partial transmit sequence, tone reservation, tone injection and coding, etc information. The undesired effects occurring to the distortion techniques can be alleviated with the penalty of the reduced transmission rates due to introduction of redundancy. The basic idea of selective-mapping (SLM) technique is to generate several OFDM symbols as candidates and then select the one with the lowest PAPR for actual transmission [5-9]. Conventionally, the transmission of side information is needed so that the receiver can use the side information to tell which candidate is selected in the transmission and then recover the information a selective-mapping scheme for turbo coded OFDM which does not need information was proposed [8], which employ the discriminating characteristic of the interleaver of the turbo coded system. Several distinct interleavers are used as candidates for the selection operations in the transmitter. The receiver uses the MAP decoder for the turbo code to calculate the reliability of each candidate. Although side information is not available, the reliability of the decoded results will be high and the receiver can recover the correct codeword in case that the interleaver chosen by the receiver is correct. In case that the interleaver is not the right one, the reliability of the decoded results will be very low and the receiver needs to try another interleaver. The price to pay is the increased decoding complexity. Moreover, there is room for improving the capability of PAPR reduction [10]. The reason is that we note that varying interleavers of turbo encoder will only vary the parity bits of the second component convolutional code of the turbo codes. With this observation, in this thesis, we present two modified side-information-free selective mapping turbo coded OFDM schemes for which all the code bits of a whole turbo codeword may be varied so that the PAPR can be substantially reduced. Simulation results show that better PAPR reduction can be achieved for the modified schemes [11-12].

2.0. THE PAPR OF OFDM SYSTEM
The PAPR of OFDM is defined as the ratio between maximum the power and the average power, The PAPR of the OFDM signal $X(t)$ is defined by the following equation (1).

$$PAPR = \frac{P_{peak}}{P_{average}} = \frac{\text{MAX}[|X_n|^2]}{E[|x_n|^2]}$$

Where $x = \text{An OFDM signal after IFFT (Inverse Fast Fourier transform)}$, $E[\cdot] = \text{Expectation operator}$, it is an average power. The complex base band OFDM signal for N subcarriers represented as equation (2) -

$$X(t) = 1/\sqrt{N}\sum_{n=0}^{N-1} x_n e^{j2\pi nt/NT} \quad 0 \leq t \leq NT$$

3.0. BACKGROUND
3.1. SLM TECHNIQUE

![Fig:3.1 Block Diagram of OFDM transmitter with the SLM Technique](image-url)

In selective mapping (SLM) technique the actual transmit signal lowest PAPR is selected from a set of sufficiently different signals which all represents the same information [8-10]. SLM Technique is very
flexible as they do not impose any restriction on modulation applied in the subcarriers or on their number. Block diagram of SLM Technique is shown in figure 3.1. Let us define data stream after serial to parallel conversion as equation (3):
\[ X = [X_n, X_{n-1}, \ldots, X_1] \]

\[ X_n^{(u)} = X_n b_n^{(u)} \]

\[ n = 0, 1, 2, \ldots, N-1, \text{ and } u = 0, 1, 2, \ldots, U \] (4)

\[ b_n^{(u)} = \text{is written as equation (5)} \]

\[ X_n^{(u)} = [X_0, X_1, X_2, \ldots, X_{N-1}]^T \] (4)

Where \( n = 0, 1, 2, \ldots, N-1 \), and \( u = 0, 1, 2, \ldots, U \) to make the U phase rotated OFDM data blocks. All U phase rotated OFDM data blocks represented the same information as the unmodified OFDM data block provided that the phase sequence is known.

After applying the SLM technique, the complex envelope of the transmitted OFDM signal becomes equation (6):

\[ x(t) = \frac{1}{\sqrt{N}} \sum_{n=0}^{N-1} X_n e^{j2\pi n f_s t} \quad 0 \leq t \leq NT \] (6)

Here, \( \Delta f = 1/NT \), NT is the duration of an OFDM data block. Output data of the lowest PAPR is selected to transmit. PAPR reduction effect will be better as the copy block number U is increased. SLM method effectively reduces PAPR without any signal distortion. But it has higher system complexity and computational burden. This complexity can less by reducing the number of IFFT block.

3.2. LINEAR BLOCK CODE (Hamming 7, 4)

What we would really like is to be able to communicate with tiny probability of error AND at a substantial rate. Can we do better than repetition codes? What if we add redundancy to BLOCKS of data instead of encoding one bit at a time? We now study a simple block code that makes use of “parity check bits”.

A BLOCK CODE is a rule for converting a sequence of source bits \( s \), of length \( K \), say, into a transmitted sequence \( t \) of length \( N \) bits, where, in order to add redundancy, \( N \) will of course be greater than \( K \). A neat example of a block code is the (7,4) Hamming code, which transmits \( N=7 \) bits for every \( K=4 \) source bits (Table 3.2).

<table>
<thead>
<tr>
<th>Table 3.2: Matrix of hamming code 7,4.</th>
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<tbody>
<tr>
<td>( s )</td>
</tr>
<tr>
<td>0000</td>
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<tr>
<td>0001</td>
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<tr>
<td>0010</td>
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The (7, 4) Hamming code. The sixteen code words have the elegant property that they all differ from each other in at least three bits. This Hamming code can be written more compactly as follows. It is a LINEAR code, that is, the transmitted codeword \( t \) can be obtained from the source sequence \( s \) by a linear operation, and equation becomes(7):

\[ t = Gs \] (7)

The encoding equation is understood to make use of a modulo 2 arithmetic. Notice that the first four transmitted bits are identical to the four source bits, and the remaining three bits are parity bits: the first is the parity of the first three source bits; the second is the parity of the last three; and the third parity bit is the parity of source bits one, three and four.

3.3 INTERLEAVING:

Interleaver based technique for improving the peak to average power ratio of an OFDM signal. Highly correlated data frames have large OFDM signal. Which thus could be reduced, if long correlation patterns were broken down \[ \text{[14]} \]. The paper proposes a data randomization technique for the reduction of the PAPR of the OFDM system. The paper also proposes an adaptive technique to reduce the complexity of the scheme. The key idea in adaptive interleaving is to establish an early terminating threshold i.e. the search is terminated as soon as the PAPR value reaches below the threshold, rather than searching all the interleaved sequences. The low threshold will force the adaptive interleaving (AIL) to search for all the interleaved sequences, whereas for the large threshold value, AIL will search only a fraction of the interleaved sequences. The most important aspect of this method is that it is less complex than the PTS method but achieves comparable results. The scheme does not provide the guaranteed PAPR reduction and for the worst case PAPR value of N. Therefore, higher order error correction method should be used in addition to this scheme.

4.0. PROPOSED TECHNIQUE

In this paper we combine the selective mapping technique; input sequence is combined using Hamming code and turbo coding using turbo encoder. Data stream generated basically mimic’s the data generator which supplies the randomly generated bit stream for simulation. s/p block used as serial to parallel converter because block coder needs data in parallel. Hamming code is a linear block code. Here we are using hamming Code as a replacement matrix which is used to replace the consecutive ones and zeros with non consecutive ones and zeros sequence. Then turbo coder is used for coding and modulation is IFFT. Receiver side procedure is reversed.

![Fig: 4.1.Bolck Diagram of Transmitter Side](image-url)
5.0. SIMULATIONS AND RESULT
The complete simulation is performed. For 10^3 bits with variation SNR from 0 to 10 dB and noise is considered as AWGN channel, the bit stream is firstly modulated by PSK then the length of IFFT varies according to error correcting code (Hamming and turbo codes) are used (Figure 5.1).

In fig 5.2 shows the BER and signal to noise ratio under AWGN channel, BER is compatibly better above methods. Fig 5.3 show the PAPR performance is 1.7 dB in modified scheme.

6.0. CONCLUSION
A modified selective mapping technique and turbo coding is proposed in this paper to improve the performance of the OFDM system with respective PAPR. This scheme requires only one IFFT block at the transmitter. Results of simulation of modified SLM technique show that the PAPR reduction of OFDM system, which further results in high performance of wireless communication. With the rising demand for efficient frequency spectrum utilization, OFDM proves invaluable to next generation communication system

REFERENCES
6. Yung-Chih Tsai, Student Member, IEEE, Shang-Kang Deng, Student Member, IEEE, Kuan-Cheng Chen, and Mao-Chao Lin, Member, IEEE, Turbo Coded OFDM for Reducing PAPR and Error Rates, IEEE TRANSACTIONS ON WIRELESS COMMUNICATIONS, vol. 7, no. 1, January 2008
11. D. J. G. Mestdagh and P. M. P. Spruyt, “A method to reduce the probability of clipping in DMT-

