IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 08, Issue 5 (May. 2018), ||V (IV) || PP 50-53

Effectiveness of using Huffman coding in High data rates and reducing PAPR in OFDM systems

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Abstract: This paper reviews the use of Huffman coding to reduce the high PAPR which is one of the deleterious problems of OFDM system. It is elucidated that the use of encoding eliminates the probability of repeating the same symbol and thus prevents the coherent addition of the multicarrier signals that cause the undesired very high peak. Huffman coding employs the saving in the total bit rate by sending the encoding table for accurate decoding at the receiver without reducing the operative throughput.

Keywords: PAPR, OFDM,QAM,OFDM,IFFD

Date of Submission: 27-05-2018 Date of acceptance: 10-06-2018

I. INTRODUCTION

Orthogonal Frequency Division Multiplexing (OFDM) has been distinguished between other types of data transmission and reception schemes, for its excellent tolerance towards multipath fading and for supporting higher data rates. In OFDM the significant feature is to split of data in various orthogonal information carriers along with the fact of introducing a guard band called cyclic prefix to avoid inter symbol interference. For these reasons, OFDM has been adopted in many communication applications ,such as wireless local area networks [1] and digital audio and video broadcasting [2]. In spite of many advantages ,a major drawback of OFDM is that it has a high peak-to-average power ratio (PAPR). Since an OFDM signal is composed of a number of independently modulated subcarriers, it results in a high PAPR value when added up coherently. A modulation scheme with high PAPR requires a linear amplifier with a large dynamic range [3]. The high PAPR increases the dynamic range of the analog -to-digital converter and degrades the efficiency ofa linear power amplifier. Therefore, to find ways to control the PAPR of the transmitted signals in OFDM systems has become a very active research area in communication communities.

II. PEAK TO AVERAGE POWER RATIO (PAPR)

When the N sinusoidal signals after modulation by their carriers, adds mostly constructively the peak envelop power is as much as N times the mean power. As a result the amplitude of such a signal can have very large values. When high-peak power signals pass through power amplifiers and Analog to Digital (A/D) and Digital to Analog (D/A) converters, peaks are distorted non-linearly because of amplifier and converters imperfection. Thus, the output signal will suffer from intermodulation distortion resulting in energy being generated at frequencies outside the allocated bandwidth. So, PAPR is defined as the ratio between the instantaneous power of the peaks and the average power of the signal [4].

The transmitted OFDM signal is the real part of the complex signal

$$S(t) = \sum_{i=0}^{n-1} c_i(t) e^{2j\pi f_i t} \qquad (1)$$

Where f_i is the frequency of the *i*thcarrier, $c_i(t)$ is constant over a symbol period of duration T.

To maintain orthogonality, the carrier frequencies are related by

$$f_i = f_0 + i\Delta f \qquad (2)$$

f_0 is the smallest carrier frequency and Δf is the integer multiple of the OFDM symbol rate.

Let (t) in eq.(1) takes the value over a given symbol period, then the corresponding OFDM signal is denoted by $S_c(t)$ and can be expressed as

$$S_c(t) = \sum_{i=0}^{n-1} c_i e^{2j\pi f_i t} \quad (3)$$

Instantaneous envelope power associated with signal is given as

$$P_c(t) = |S_c(t)|^2 = S_c(t).S_c^*(t) \quad (4)$$

Also the average power of C can be expressed as

$$\frac{1}{T}\int_0^T P_c(t)\,dt = \|c\|^2 = \sum_{k=0}^{n-1}|c_k|^2$$

$$\|c\|^2 = \sum_{k=0}^{n-1}|c_k|^2 \quad (5)$$

Where,

$$\mathrm{PAPR}(c) = \frac{\max_{0\le t\le T} P_c(t)}{P_{av}} \quad (6)$$

We would like to design codes C such that $PAPR\ (C) = \max_{C\in c}\ PAPR\ (c)$ are small. So ideally it is usually required that the percentage of code words with high PAPR be an order of magnitude less than the probability of decoding error.

III. HUFFMAN CODING

In 1950s, D.A Huffman developed the method to assign fewer bits to frequently used signal sample and seldom used sample values more bits to make an appropriate compression for the signal to be transmitted [5]. Huffman coding assigns variable length codes to symbols based on their frequency of occurrences in the given message .Low frequency symbols are encoded using many bits, and high frequency symbols are encoded using fewer bits. Therefore the message to be transmitted is first analyzed to find the relative frequencies of its constituent characters. This process of coding generates a binary tree, the Huffman code tree, with branches labeled with bits (0 and 1). The Huffman tree must be sent with the compressed information to enable the receiver decode the message.

The following example bases on a data source using a set of five different symbols. The symbol's frequencies are:

Symbol	Frequency
A	24
B	12
C	10
D	8
E	8

The two rarest symbols 'E' and 'D' are connected first, followed by 'C' and 'D'. The new parent nodes have the frequency 16 and 22 respectively and are brought together in the next step. The resulting node and the remaining symbol 'A' are subordinated to the root node that is created in a final step.

IV. CODE TREE ACCORDING TO HUFFMAN

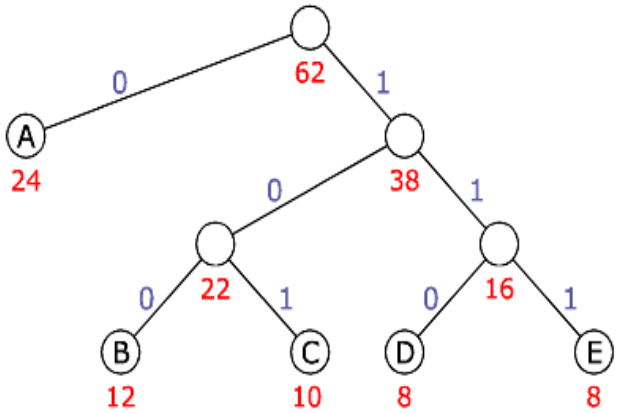

Fig.1 . Huffman Code Tree

Symbol	Frequency	Code	Code Length
A	24	0	1
B	12	100	3
C	10	101	3
D	8	110	3
E	8	111	3

$$\alpha + \beta = \chi. \qquad (1)$$

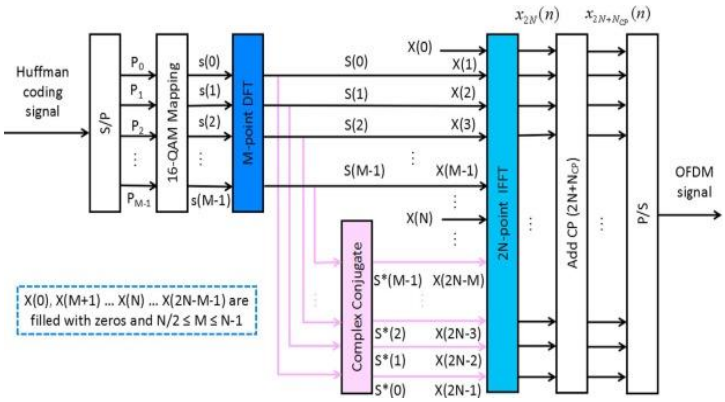

Fig.2. Block diagram for Huffman Coding in OFDM

Huffman coding can be used in the OFDM system as shown in figure 2. The input data stream is converted from serial to parallel among M symbols , while $M=^{2n}$, which is Huffman encoded yielding a serial bit stream, that is again converted to parallel among M symbols. It is then mapped using 16-QAM modulation and finally the OFDM composite time signal is produced through the IFFT stage. When applied to the OFDM signal, the Huffman encoding will cause the PAPR to be reduced, because of its nature that the encoding causes the frequently occurring symbols is assigned a lower number of bits rather than the less probable to occur symbols, and thus when rearranging the stream of bits among symbols with fixed number of bits , the probability of repeating the same symbol will be eliminated, preventing the coherent addition of the multicarrier signals that cause the undesired very high peak [6]

V. CONCLUSION

This paper Highlighted the use of Huffman Coding in Transmitting the data at high rates due to its lossless data Compression Technique and reducing high peak to average power ratio which occurs in OFDM systems.

VI. REFERENCES

[1]. Nee, R. V. anwdd R. Prasad, "OFDM for Wireless Multimedia Communications, Artech House Publishers, Norwood", MA ,January 2000
[2]. Liu, P., "A new peak to average power ratio reduction schemes for OFDM system," Master dissertation, 2004
[3]. Min, K.-S., M.-S. Kim, C.-K. Park, and M. D. Vu, "Design for PCS antenna based on Wi Bro-MIMO," Progress In Electromagnetic Research Letters, Vol 83, 2008
[4]. Simon Litsyn, "Peak Power Control in Multicarrier Communications", Cambridge University Press, New York, 2007
[5]. Ashraf A. Eltholth, Adel R. Mikhail, "Peak-to-Average Power Ratio Reduction in OFDM Systems using Huffman Coding", World Academy of Science, Engineering and Technology International Journal of Electrical, Computer, Energetic, Electronic and Communication Engineering Vol:2, No:7, 2008
[6]. Steven W. Smith, "The Scientist and Engineer's Guide to Digital Signal Processing", Second Edition, copyright © 1999 California Technical Publishing

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