An Analysis of OFDM System on the Basis of FFT Size and Number of OFDM Symbols at Extremely High Values

Abhishek Kumar Srivastava[1], Pratyush Tripathi[2]

[1]Student of Electronics and Communication, Kanpur Institute of Technology, Kanpur, Uttar Pradesh, India
[2]Assistant Professor, Department of Electronics and Communication, Kanpur Institute of Technology, Kanpur, Uttar Pradesh, India

Abstract: **- This paper provides a review on the OFDM (Orthogonal Frequency Division Multiplexing) technology in wireless communication system. In this paper, OFDM technique is proposed in AWGN channel and the analysis is done on the basis of FFT size and the number of OFDM symbols at extremely high values. The OFDM performance in terms of symbol error rate vs SNR is discussed. Here analysis and behaviour is studied at extremely high values. Here analysis is done about how values behave at high values and how the symbol error rate increases or decreases in comparison to signal to noise ratio.**

Keywords- **Additive White Gaussian Noise (AWGN), symbol error rate, SNR, DBPSK, OFDM (Orthogonal Frequency Division Multiplexing), Random source.**

I. INTRODUCTION

OFDM Orthogonal Frequency Division Multiplexing is a method of digital modulation in which the data stream is split across several narrowband channels at different frequencies to reduce interference. The original data bit stream which is sent serially in conventional modulation system is sent parallel but at lower speed in each substream with respect to original signal. This means the signals in substream are longer and spaced as compared to original signal. Since the signal are spaced this reduces the interference in the signal transmitted from transmitter to the receiver.

For broadband wireless networks, the various multiple access technique (MA) has been proposed to support multi-service transmissions over the shared wireless link. In wireless communication system, the multiple access technique is one of the most efficient methods, particularly used in cellular network by mobile phone communication system. In recent that is many years back, the availability in wireless networks can be exceeded by the use of bandwidth. It has been studied that, various techniques are used to make the efficiency of bandwidth utilization; is better more users can be allotted in the cell. So that it can provide sufficient space within each cell. Previously existed multi- access techniques like FDMA, TDMA and CDMA are used in 1G/2G/3G systems are suitable for voice communication only but it is not suitable for burst data traffic and high data rate transmission which would be the dominant part in 4G system for traffic load. For high mobility, the data rate is up to 100 Mega bits per second Mbps) and for low mobility the data rate is up to 1 Giga bits per sec (Gbps). But the 3rd generation systems allows the data rate of nearly 3.6 to 7.2 Mbps. usually if the systems fulfill all these requirements then it can be considered as fourth generation (4G) systems.

There are different types of multiple approaching techniques which are proposed for 4G systems follows CDMA, MC-CDMA, OFDMA and IDMA. In code division multiple access, every user assigned a single coded sequence and it is used to encode the significance of information signal. The receiver knows the sequence of the user code. After reception, it converts or decodes the received signal and retrieves the sequence of data. Hence the spectrum of the coded sequence is selected to be larger than the information signal.

In Multi-carrier CDMA, it is also a multiple access technique which is used in orthogonal frequency division multiplexing based telecommunication system. It permits the system to hold multiple-users at identical time. Multicarrier CDMA system is highly complex in receiver and exceedingly necessary for changing the spreaded code at high data rates in transmitter which build the system inefficient.

One of the most multi-carrier techniques that are used in modulation system that transmits the signal through multiple carriers is nothing but orthogonal frequency division multiplexing (OFDM). These sub carriers are orthogonal to each other and they have different frequencies. On the other side, the orthogonal frequency division multiplexing is quickly detect or response the slight changes in carrier or offset frequency and phase noise than compared to single carrier systems. OFDM subcarriers result in the appearance of inter-carrier interference (ICI) and common phase error (CPE) due to loss of orthogonality in OFDM. To maintain the condition of orthogonality and to eliminate the loss of collision between the Interleavers in the channel . In OFDM, the cyclic prefix needs to be greater than the time delay increases in the channel.

A basic fundamental of Interleave division multiple access i.e. IDMA is differentiated by two users in Interleaver. A multi-user technique in which chip Interleaved are only means of separating the users that is nothing but IDMA. The iterative multi-user detection is done by receiver in chip-by-chip form. In this work, by combining the OFDM and IDMA, we propose a new method referred as a multi-user system in the mobile radio environment. All users can transmit their information in same time at same frequency band in OFDM and IDMA method. By using Interleaving technique, the orthogonality can be obtained between the users. The choice of good Interleaver must demonstrate that the inter leavers are weekly correlated, do not require large memory or large bandwidth to communicate between transmitter and receiver and easy to generate.

II. OFDM MECHANISM

In telecommunication system, OFDM is a scheme of transmitting digital data on multicarrier frequencies. In COFDM forward error correction (Convolutional coding) and time, frequency interleaving iin used to overcome interference and dopplers shift. So, OFDM has become a technique which is a combination of coding and interleaving. The reception involves a fast fourier transform at the receiving end. Each subcarrier is modulated with conventional modulation scheme like PSK or QAM at low symbol rate This maintains the total data rate similar to conventional data rate with same bandwidth. Orthogonality simply means thrir correlation is zero.

OFDM Scheme

Here OFDM schemes are proposed in which random source is used. The signal is passed through encoder the modulation is done. Then inverse fast fourier transform is done the passed through channel the fats fourier transform is done. Then demodulation is done then fast fourier transform is done and the signal is obtained at the output. Schematic diagram of IDMA Scheme using different sources

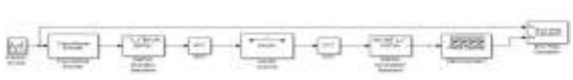


Fig 1 Schematic diagram of OFDM

In fig1Random source is used to generate the signal. It is passed through Convolutional encoder then through DBPSK modulation baseband then through inverse FFT then through AWGN channel then through FFT the through DBPSK demodulation baseband then through Viterbi decoder and then signal is obtained at the output where the error rate is calculated. The error rate calculator calculates the error between transmitter and receiver where the error rate is calculated. The error rate calculator calculates the error between transmitter and receiver.

Random Generator

The Random Generator block generates a Random sequence. Gold sequences form a large class of sequences that have good periodic cross-correlation properties.

Convolutional Encoder

Convolutional encoder encodes the binary input sequence to produce the output binary sequence.

DBPSK Modulation Baseband

Modulate using differential Binary Phase frequency shift keying method. The DBPSK Modulator Baseband block modulates using the differential binary Phase frequency shift keying method. The output is a baseband representation of the modulated signal.

AWGN Channel

Add white Gaussian noise to input signal. The AWGN Channel block adds white Gaussian noise to a real or complex input signal. When the input signal is real, this block adds real Gaussian noise and produces a real output signal. When the input signal is complex, this block adds complex Gaussian noise and produces a complex output signal. This block inherits its sample time from the input signal.

FFT

This function computes the DET of X using the fast Fourier algorithm.

IFFT

This function returns the inverse DET of X obtained by the fast Fourier algorithm

DBPSK Demodulator

Demodulate DBPSK-modulated data. The DBPSK Demodulator Baseband block demodulates a signal that was modulated using the Differential Binary Phase frequency shift keying method. The input is a baseband representation of the modulated signal. The input and output for this block are discrete-time signals. The input can be either a scalar or a frame-based column vector of type single or double.

Viterbi Decoder

Viterbi decoder decodes the binary input sequence to produce the output binary sequence.

Error Rate Calculator

Compute bit error rate or symbol error rate of input data. The Error Rate Calculation block compares input data from a transmitter with input data from a receiver. It calculates the error rate as a running statistic, by dividing the total number of unequal pairs of data elements by the total number of input data elements from one source.

III. SIMULATION RESULTS

Parameter	AWGN Channel
Target no. of errors	100
Max. no. of symbols	1e5
Error rate	0.5054
Total no. of errors	100
The total no. of comparisons	222

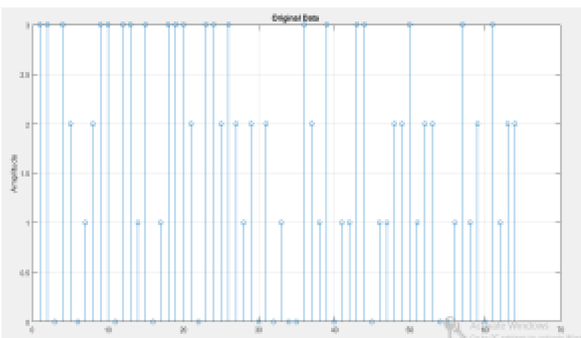


Fig4 Input Data

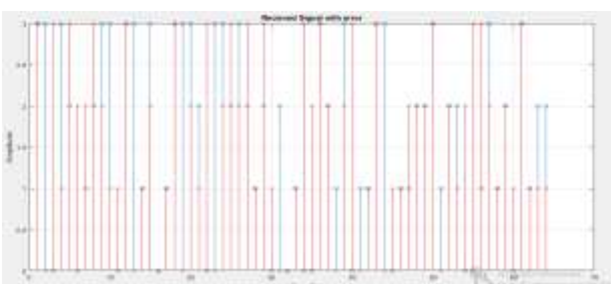
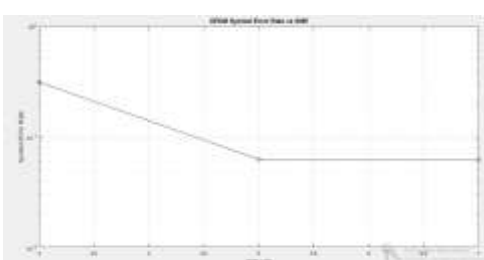
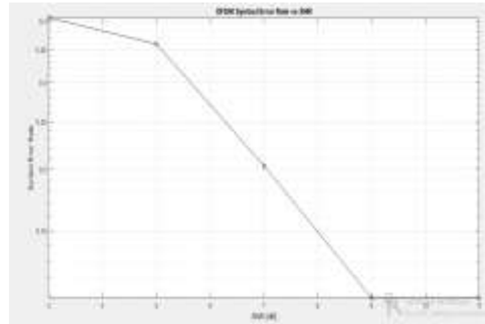


Fig 5 Output data



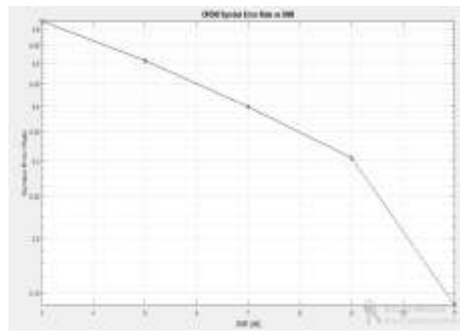
fft size N = 4

Number of OFDM symbols used m = 4



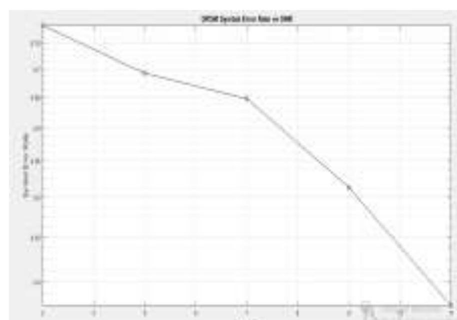
fft size N = 8

Number of OFDM symbols used m = 8



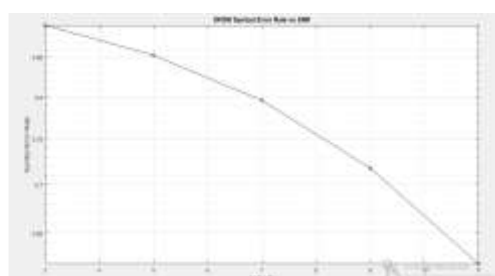
fft size N = 16

Number of OFDM symbols used m = 16



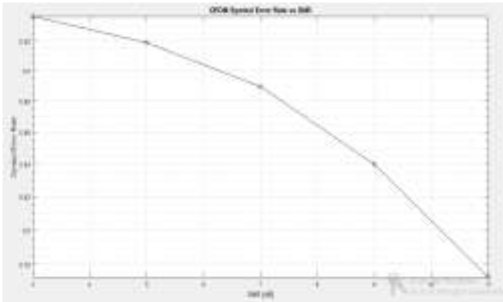
fft size N = 32

Number of OFDM symbols used m = 32



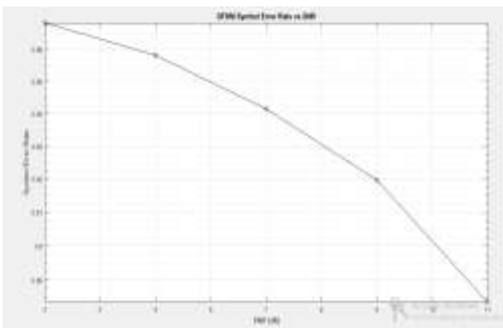
fft size N = 64

Number of OFDM symbols used m = 64



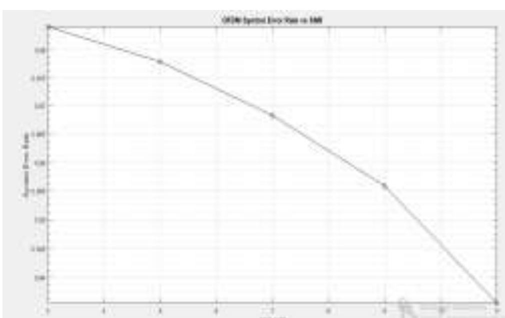
fft size N = 128

Number of OFDM symbols used m = 128



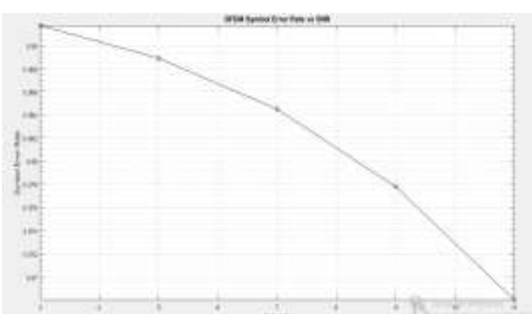
fft size N = 256

Number of OFDM symbols used m = 256



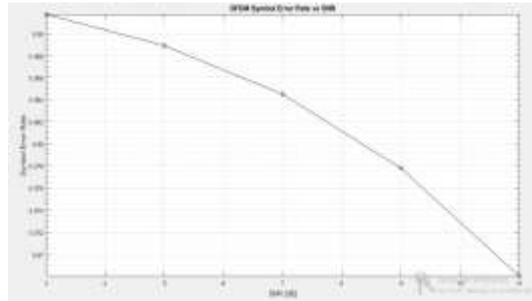
fft size N = 512

Number of OFDM symbols used m = 512



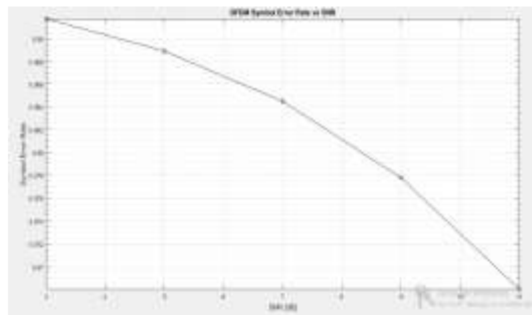
fft size N = 1024

Number of OFDM symbols used m = 1024



fft size N = 2048

Number of OFDM symbols used m = 2048



fft size N =4096

Number of OFDM symbols used m = 4096

IV. CONCLUSION

Here the graph between symbol error rate and SNR. At lower values of OFDM symbols and lower fft size the symbol error rate does not fall to zero or abruptly fall to zero with increase in the values SNR. While at higher values of OFDM symbols and fft size there is a smooth fall in the symbol error rate with increase in the values of SNR. While at extremely higher values of OFDM symbols and fft size the smoothness increases in fall in the symbol error rate with increase in the values of SNR. Thus the symbol error rate decreases with increase in the values of SNR at higher values. More deep analysis can be done in terms of error rate and SNR.

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