Overcoming The Drawbacks of OFDM

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Abstract- *This undertaking proposes Generalized Frequency Division Multiplexing (GFDM) is a new 5G multicarrier waveform technique. The main feature of GFDM is the lower out-of-band (OOB) emissions which can be achieved by flexible pulse shaping of subcarriers individually. The thesis work proposed the use of better pulse shaping filters so that symbol error rate (SER) performance can be improved.*

Keywords- GFDM, OOB, SER, 5G, Genralized Frequency Division Multiplexing.

I. INTRODUCTION

Now-a-days, there is a rapid growth of wireless communication in telecommunication industry. The number of mobile users are increasing exponentially. This rapid growth in total number of mobile users has concluded that the wireless communication is a robust mechanism for data transmission. The increase in success of mobile phones has led to the development of new wireless systems and standards which has different applications in Massive Machine Communications (MMC), Tactile Internet, Internet of Things and Health care and mission critical application. Orthogonal Frequency Division Multiplexing (OFDM). It is a method by which we can encode data which is in digital form on various carrier frequencies Sub- carriers used are orthogonal which are closely spaced. They carry data on parallel streams of data. Every sub-carrier is then modulated with the help of modulation scheme whose symbol rate is so that net data rate is same as that of modulation schemes which are of single carrier in the same region of bandwidth. 4G is used in video conferencing, gaming, high-definition mobile TV, IP telephony, cloud computing, etc. The invention of smart phones having large storage space and better computational capabilities are equipped with high definition cameras and screen turning users into content providers which pushed this system even towards more throughput. LTE and LTE-A are the practical 4G systems.

II. DESIGN AND IMPLEMENTATIONOF PROPOSED SYSTEM

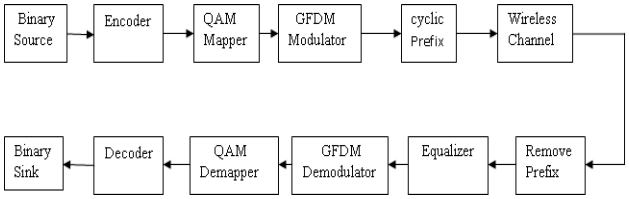

Fig.1.Block Diagram representation of design and implementation of proposed system

The GFDM block diagram is shown in Figure .1. There are three main parts in GFDM: transmitter, channel and receiver which are divided into various blocks. Let's study each block in detail

A. GFDM TRANSMITTER

In the transmitter part of GFDM, various operations are performed: data generation, encoding, mapping, modulation, adding CP which are explained below.

B. Binary Source

The binary source generates the data in the binary form (i.e. '1' and '0'). This binary data is represented by vector **b** and give as an input to the encoder.

C. Encoder

The binary data is given as an input to the encoder which splits the higher bit rate stream into lower bit rate streams. The encoded output, **be** is then given as an input to the QAM mapper.

D. QAM Mapper

The encoded output is applied as an input to the QAM mapper which takes its values from 2μ complex constellation where μ is the order of modulation. The mapped data vector, d having $N \times 1$ elements is given as an input to the GFDM modulator.

E. GFDM Modulator

The block diagram of GFDM modulator is as shown in the figure 1. Different operations are performed on the data stream**s** which are discussed in the subsequent sections.

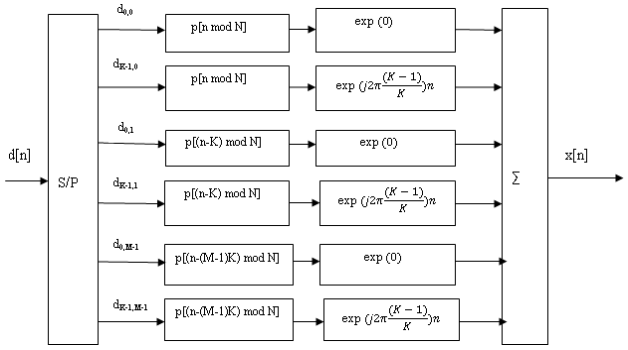

Fig.2. GFDM Modulator

F. Serial-to-Parallel Conversion

The serial-to-parallel converter splits the single data stream in to multiple sub streams. These multiple data streams will modulate different sub carriers

G. Pulse Shaping

Pulse shaping is a process in which changing the transmitted pulse waveform. Its main goal is to make the waveform to better suited the to its communication purpose

H. Cyclic Prefix

In the final stage of modulation, cyclic prefix is appended to each block of data. The length of cyclic is very small compare to that of data it serves as. Guard band to avoid interference between adjacent blocks

I. CHANNEL

It is the physical medium through which the signals are transmitted. It is the communication link between transmitter and receive

J. GFDM RECEIVER

The signal is received at the user equipment after undergoing through the channel. The expression for received signal is given by the fallowing.

$$y = Hxcp + w$$

where H denotes the channel matrix which represents The channel characteristics this expression is applicable only in case of Additive White Gaussian Noise For a channel having Additive White Gaussian noise where H is equals to 1

$$ycp = xcp + w$$

If the channel is distributed according to Rayleigh distribution, then the channel impulse response is convolved with data and added with noiseas shown in the equation.

$$ycp = h\Theta xcp + w$$

where Θ denotes the circular convolution.

The signal after the addition of AWGN noise is received at the receiver side.

There are various operations performed at the receiver end of the GFDM system model which are explained below.

K. Remove Prefix

In the received signal, the cyclic prefix is discarded

$$y = yc(Ncp: Ncp + N - 1)$$

L. Equalizer

Due to inter symbol interference, the received signal will not be exact replicate of the transmitted data. In order to remove channel effects, equalizers are employed.

$$z = H{-}1Hx + H{-}1w = x + wn$$

M. GFDM Demodulator

Is a two dimensional cubic (block) designed technology which is used in extraction of original data through a prototype filter which is fit in the electronic circuit .

N. Zero Forcing Receivers

It is special type of receiver which removes self interference (SI) at the receiver which is transmitted through transmitter at the receiver end but there is a chance of noise increment which has an effect on symbol error rate (SER) performance. The term zero forcing means bringing down the zero intersymbol interference. This requires a proper shaping of pulse.

In this receiver, evaluate a matrix BZF such that $BZF = I$ in which I is the identity matrix and matrix BZF is given as

$$BZF = (BHB)-1BH$$

where BH is the Hermitian transpose of matrix, B.

O. Matched Filter Receiver

If the output of the filter is such athat if it produces the maxmal ratio of the output peak power to the noise power in its frequency result then ot is called matched filter. It is usually used in receiver purpose.

$$BMF = BH$$

where B^H is the hermitian transpose of matrix,B.

P. QAM De-mapper

The demodulated output,r is given as an input to the QAM de-mapper which reverse the process of QAM mapper. Its function is to converts the output received data symbols into fallowing data bits.

Q. Decoder

The QAM de-mapper output is given as an input to the decoder which converts the different lower bit rate streams into single higher bit rate stream.

R. Binary Sink

The decoded output is then taken as the final received data which is same as the input data if there are no errors occur in the process.

This above model is used to find PSD and SER of GFDM while using improved pulse shaping filters for different values of reel-off factor. The channels used in the model are of two types: AWGN and Rayleigh channel.

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