Review On OFDM Transreceiver

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Abstract— Currently an OFDM (Orthogonal Frequency Division Multiplexing) modulation technique has become eminent in telecommunication domain because of its high data rate capability. It is boosting the signal strength by eliminating Inter Carrier Interference and Inter Symbol Interference defects. In OFDM orthogonal subcarriers carries transmission data on multiple channels. Crucial concept of OFDM is to split the bandwidth into orthogonal adjacent so that they can transmit the data through multiple parallel channels. Here in this paper we will discuss the role of OFDM in telecommunication domain its performance, its profit as well as losses and few of its utility. This system is prototyped based on the IEEE 802.11a standard. According to July 1988 rule, OFDM is the basis for 5Ghz frequency and the new objective of IEEE standard is to make it mandatory for data 6 to 54 Mbps data rate. This system has been accepted by both wired and wireless technologies.

Keywords— OFDM, CDMA, FDM, ICI, ISI, QPSK, BPSK, QAM, DFT, IDFT, FFT, IFFT

I. INTRODUCTION

An OFDM is a fusion of modulation and multiplexing technique. It was firstly introduced in 1960s as a parallel data transmitting technique. In 1971 complexity of this system limited the development of OFDM. In 1990 due to internet it is became possible that this system used in digital communication, high density recording and high speed modem. Recently FPGA has captured the most attention because of its superior performance and high flexibility. Later it evolved due to the increasing need of communication. In OFDM existing bandwidth is divided into number of carriers then these carriers are arranged in orthogonal manner finally this signal is transmitted. This system contains multi carriers having some benefits over a single carrier that are it is less immune to frequency attenuation, narrow band interference and frequency selective fading.

A. Concept of OFDM

The spectral bandwidth is divided in orthogonal adjacent frequency carriers so that channel can access it.

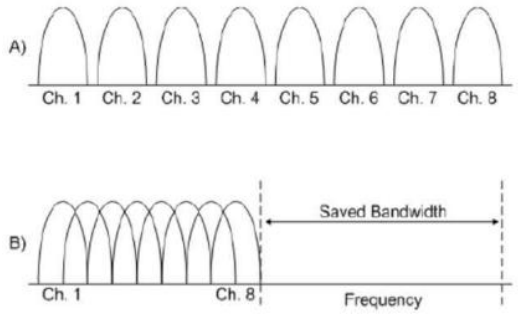

Fig.1 Channel Division

Guard bands are present between two adjacent channels in fig. A (containing 8 channels). Frequency spectrum of OFDM is shown in fig. B where bandwidth utilization is reduced by 50%.In short OFDM is an enhanced version of FDM. Let us take an example of these two BPSK system with their power spectral density. Data originate from one rate R and bandwidth is W.

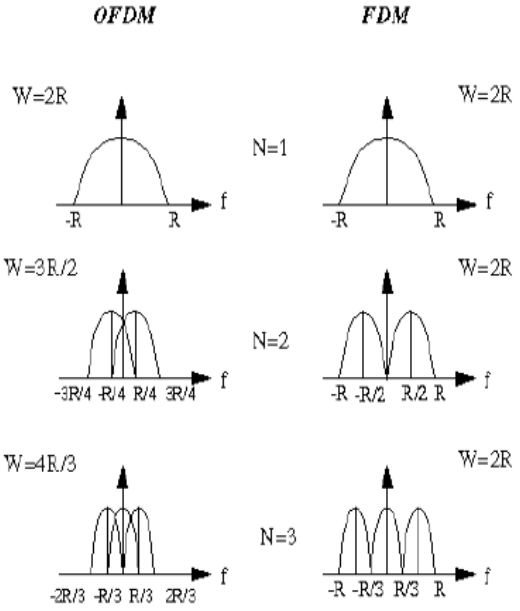

Fig.2 Difference between OFDM and FDM

This graph shows how throughput efficiency is increase of OFDM [7].

B. Orthogonality

If multiplication output of a two signals is zero for specific duration, then they are orthogonal to each other. It simply means these two signals are perpendicular to each other's.

C. Why OFDM?

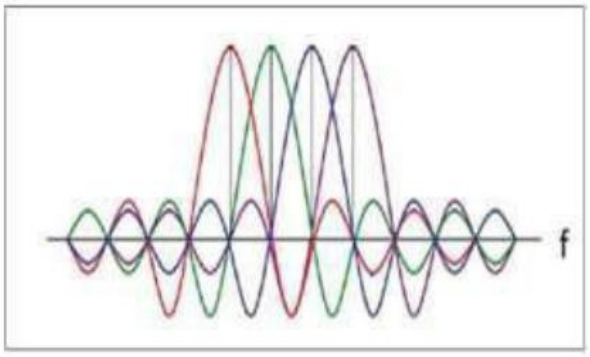

Fig.3 Orthogonality

The spectral overlapping is accepted in OFDM and the orthogonality ensures the separation of subcarriers at demodulator, providing better spectral efficiency.

Table. I DIFFERENCE BETWEEN MULTIPLEXING TECHNIQUES

Parameter	OFDM	FDM	CDMA
Concept	It is a multicarrier transmission sing discrete subcarrier frequency for modulation	It is assigned the frequency band into disjoint sub band	It spread the signal with the orthogona l code
Spectral efficiency	Better	Low	High
SNR	Better	Low	High
Multi cellular application	0.7 TO 4 TIMES MORE	--	0.7 TO 4 TIMES LESS
Communicati on	Secured due to encryption & in cooperating scrambler module	Less secure	Secure due to p-n codes
Tolerant	Better	Less	Good
Peak POWER	Better	Less	Good
Frequency	Less	More	More
Bit RATE	Low	High	High
Application	Digital broadcasting terrestrial digital broadcasting, lifi, Wi-Fi, WiMAX	Radio, pt., analog cellular	2G/2.5G/3 G digital cellular system

A.QAM

MODULATION AND DEMODULATION

And it is given by the formula [8].

Analog QAM (Quadrature amplitude modulation) faces the problem such as Single sideband modulation techniques which is used for demodulation of carrier. Even if the demodulation is small then it results in crosstalk in the modulation signals. The received signal is in phase with the coherent demodulator obtained by the transmitting burst signal. As we know the concept of QAM transmitter. We state that the input to the QAM is analog signal which is given to the product multiplier block and other input to the product modulator is carrier signal. Multiplication output is nothing but the digital signal of modulator. The modulator output is given to the filter which filters the signal & then given the input to the analog to digital converter because the output of the QAM transreceiver is analog signal.

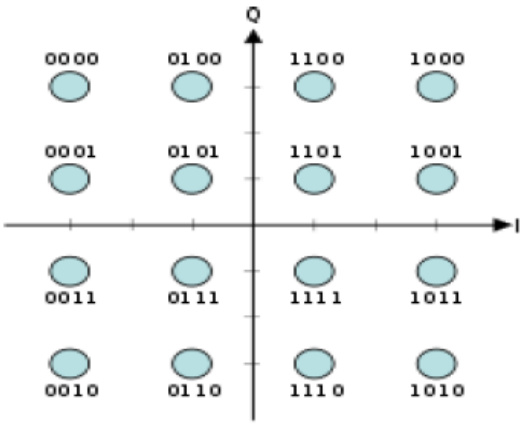

Fig.4Constellation diagram of QAM

B. QPSK

In this system the input bit stream is converted into the NRZ Encoder with the help of serial to parallel converter. With the help of product modulator we can convert it into the NRZ Encoder. Then combination of the two signals to the product modulator is finally added through adder & acts as an output of QPSK modulator which is digital output. The QPSK modulator output is given to the product modulator with carrier. The output of product modulator is given to the integrator. The output integrator is given to the threshold detector and finally acts as QPSK Receiver i.e. analog in nature [5].

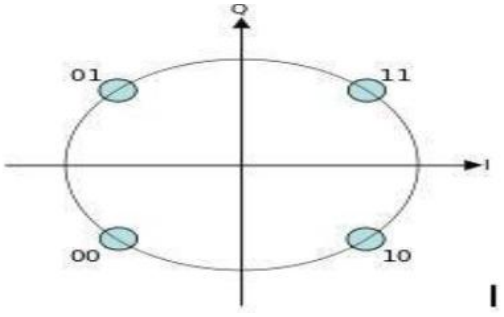

Fig. 5 Constellation diagram of QPSK

In QPSK each adjacent symbol can be changed by only one It is also known as QPSK, 4-PSK, or 4QAM. It uses 4-point constellation diagram which is as shown in the figure. It encodes 2 bit per symbol to minimize the Bit Error Rate. In comparing with BPSK, QPSK has double data rate, same bandwidth and same Break Error Rate. The modulation carrier endures the phase. Radio

Communication channel can be selected by the firm such as Federal. Hence as comparing with the modern world the cost is less.

C. BPSK

BPSK Trans receiver has low signal to noise ratio (SNR), Break Even Rate (BER). The input signal is given to modulator the other input to the balance modulator is carrier that is cos (wt). The output of the balance modulator is given to the channel. The channel output is given to the square law detector as well as synchronous demodulator. The output of the square law detector is given to the frequency divider through band pass filter (BPF). The output of the frequency divider is given to the synchronous demodulator and finally gets the output.

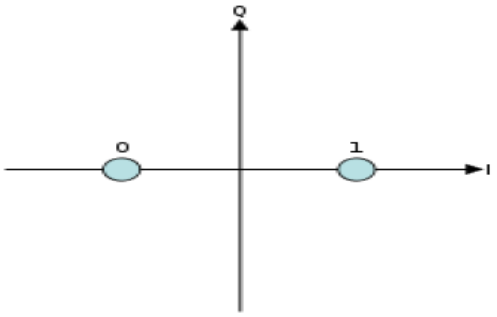

Fig. 6 Constellation diagram of BPSK

BPSK (Binary phase shift keying) is also known as phase reversal keying. It consists of two phases that are separated by 180o.In BPSK the constellation points are placed at 0o and 180o. This modulation is robust as compared to all PSK as it takes the greatest level of noise. It is used to modulate the data rate by using 1Mbps & high data rate application. Following table shows that BPSK is better modulation techniques as compared to the QPSK & QAM.BPSK uses only one signal which avoids the congestion in the link. Even the breakeven rate is less as compared to other modulation technique.

Table. II COMPARISON OF THE MODULATION TECHNIQUES

Parameter	BPSK	QPSK	QAM
Phase	2 i.e. +180, & - 180	4 i.e. 45, 135, -45, -135	16
Basics function	Single	Double	--
Bit/symbol	1	2	4
Data rate	Single (high)	Double data rate	Very high
BER	Low	High	Very high
Functionally equal to	2QAM	4QAM	--
SNR	Low	High	Very high

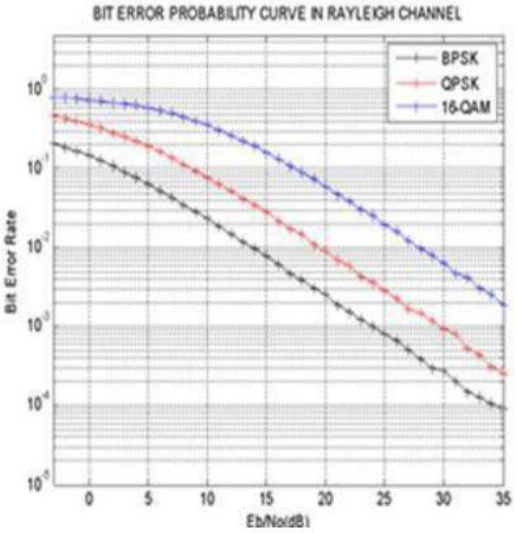

Fig. 7 Plot of SNR value in DB to BER

As modulation increases the BER value increases. If we consider only BER value into account & not the throughout is the best modulation technique since number of error in even we consider only BER value into account & not the throughout then BPSK is the best modulation techniques since number of error in even small SNR values are minimal as compared other modulation techniques. Figure clearly denotes BPSK gives more efficient BER hence it is comparatively good as compared to other modulation techniques.

III. TRANSFORMATION METHOD

The FFT and IFFT algorithms are used to convert the signals from one domain to other. The Fourier transform is a powerful tool to analyse the signal in frequency domain and find the frequency components present in the signal. DFT converts the discrete time signal which is sampled signal into discrete frequency form DFT. IFFT and IDFT performs inverse operation of that of FFT and DFT respectively. The IFFT is fast implementation of IDFT. The complex calculations in IDFT and DFT are reduced when IFFT and FFT are used.

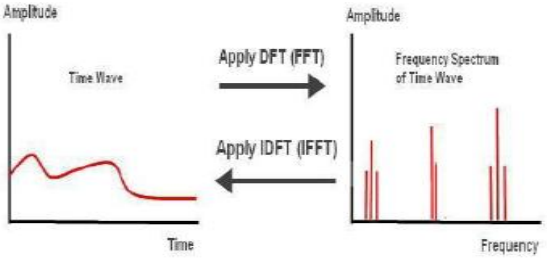

Fig. 8 Conversion of time domain to frequency domain and vice versa

$DFT(FFT)$:

$$X(k)=\sum_{n=0}^{N-1}x(n)\cdot e^{-j\left(\frac{2\pi}{N}\right)nk}\ (k=0,1,\ldots,N-1)$$

$IDFT(IFFT)$:

$$x(n)=\frac{1}{N}\sum_{k=0}^{N-1}X(k)\cdot e^{j\left(\frac{2\pi}{N}\right)nk}\ (n=0,1,\ldots,N-1)$$

IV. ADVANTAGES, DISADVANTAGES AND ITS APPLICATIONS

A. Advantages

1. OFDM overcomes the effect of ISI.

2. Frequency selective fading and burst error is minimized.

3. Using IFFT the bits can be mapped to specific carriers so the cost is minimized.

4. OFDM can be used in broadcast applications because single frequency networks can be used. OFDM can be used to integrate smart antennas. The MIMO systems can be implemented using OFDM along with its all the advantages.

5. Delay spread is tolerated using multipath technique.

6. Easy equalization

7. Bandwidth Efficiency.

B. Disadvantages

1. Peak-to-Mean Power Ratio

The amplitude of OFDM signal is changing. This changing amplitude should be kept constant as they contain the information of signal. If the amplitude changes then the original information may get lost. The FFT of the signal generated does not produces the information required of the original signal.

2.Synchronization

As there is difference in the changes of frequencies of the signal the errors are caused.

3. It has high noise in the amplification process so RF power amplifiers are used to compensate the effect.

C. Applications

1. OFDM is used in Digital audio and video broadcasting.

2. It is used in wireless applications like IEEE 802.11g, IEEE

802.16 broadcast applications, LANs, in ATMs, etc.

3. It is used in HDTV.

4. It is used in multicarrier transmission systems.

V. FUTURE SCOPE

1. The channel estimation is an area which required a lot of attention and inaccurate channel estimation decreases the working of system hence one can evaluate the performance of proposed work with different channel estimation method.

2. The algorithm of timing offset estimation can be extended for channel estimation in OFDM system.

3. The proposed PAPR reduction method can be used with MIMO OFDM system.

VI. CONCLUSION

The importance of multi-carrier communication system has been increased in the present year. The advantages and disadvantages of OFDM system along with its implication are discussed in this paper. Here we have adopted OFDM technique using FFT and IFFT algorithm. OFDM and FDM techniques were studied. OFDM has better spectral efficiency than FDM. The wireless communication has been implemented widely. OFDM technique can be used to efficiently transfer the data using in wireless communication. OFDM is implemented using single carrier system. Using multicarrier system in OFDM can reduce the aliasing effect and coherence bandwidth effect at the receiver.

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