ADVANCE FBMC BASED MIMO DESIGN FOR 4G LTE SYSTEM

Mr. Rajesh Gadhvi,Prof. Bhavin Sedani

Students,Professor

Electronics & Communication Department,

L.D College of Engineering, Ahmedabad, Gujarat,India

Abstract:This paper introduces filter bank multicarrier (FBMC) as a potential candidate in the application of massive MIMO communication. It also points out the advantages of FBMC over OFDM (orthogonal frequency division multiplexing) in the application of massive MIMO. The absence of cyclic prefix in FBMC increases the bandwidth efficiency.In this modern generation of 4G, Orthogonal Frequency Division Multiplexing (OFDM) is the latest modulation technique which is used to achieve high data rate and it is also used to transmit data without Inter-Symbol Interference (ISI) and Inter-Carrier Interference (ICI). The concept of OFDM is difficult to understand as it is a modern 4G wireless technique and various problems such as Peak-to-Average Power Ratio (PAPR) also takes place. We have use Field-Programmable Gate Array.FPGA is a coordinated circuit that can be altered for a particular application. In contrast to conventional CPUs, FGPAs are "field-programmable," which means they can be arranged by the client in the wake of assembling. The FPGA on the Nexys2 board must be designed (or modified) by the user before it can play out any capacities. Amid arrangement, a "bit" document is moved into memory cells inside the FPGA to characterize the consistent capacities and circuit interconnects. The free ISE/WebPack CAD programming from Xilinx can be utilized to make bit documents from VHDL, Verilog, or schematic-based source records.

***IndexTerms*–FBMC, MIMO, OFDM, FPGA**

I. INTRODUCTION

In recent past, massive MIMO has gained significant momentumas a potential candidate to increase the capacity ofmultiuser networks.High speed data rate transmission is needed in order to meet the requirements of the tremendous growth in the communications. Apart from the high data rate, future communication system will also support the high rate of voice, video as well as wireless communication links. Orthogonal Frequency Division Multiplexing (OFDM) has considerably achieved a success in providing high data rate transmission. OFDM modulation techniques include multicarrier modulation techniques and high capacity transmission. As OFDM is having high bit rate as well as multicarrier modulation technique[2]. FBMC are purelybased on simulations, we perform real-world testbed measurementsat a carrier frequency of 2.5GHz (outdoor-to-indoor,150m link distance) and 60GHz (indoor-to-indoor, 5m linkdistance). FBMC andOFDM signals are pre-generated off-line in MATLAB and thesamples are saved on a hard disk. Then, a Digital-to-Analog-Converter (DAC) together with a radio frequency hardware upconvertsthe signal to 2.5GHz, respectively 60GHz. DifferentSignal-to-Noise Ratio (SNR) values are obtained by a stepwise attenuator at the transmitter.

II. Orthogonal Frequency Division Multiplexing (OFDM) SYSTEM

OFDM modulation technique is to split the high data stream into several lower rate data streams. These data streams are transmitted over several subcarriers. But whenever high data rate is there, there is always a problem of noise and other interferences. Peak-to-Average Power Ratio (PAPR) is also one of it.PAPR is the ratio of instantaneous maximum power to the average power given by a signal. The transmission rate can be increased by overlapping sub channels in frequency domain. Different modulation techniques such as Fast Fourier Transform (FFT) and Inverse Fast Fourier Transform(IFFT) are used to for modulation as well as demodulation of filters at the transmitter and receivers.OFDM has been widely used in today's high speed digital communication such as 4G,5G and LTE systems.OFDM combines a large number of low data rate carriers to construct a composite high data rate communication system.Orthogonality is used to give the carrier a valid reason to a closely spaced, even overlapped without inter-carrier interference. The high data is modulated over a single carrier frequency and bandwidth is occupied by each signal. Thus in these case of frequency selection, Inter-symbol Interference (ISI) and Inter Carrier Interference (ICI) occurs. Flat fading occurs in OFDM because the total bandwidth is divided into number of subcarriers and the channel spectrum into number of orthogonal sub channels. Several modulation techniques such as FDMA, CDMA, TDMA are used over several years, the problem such as multipath fading, less spectral efficiency, Bit-Error Rate (BER) etc. still occurs[2].

III. Filter bank multicarrier (FBMC) technique

Filter bank multicarrier (FBMC) is an evolution with many advantages over the widespread OFDM multicarrier scheme. Filter banks are an evolved form of subband processing based on Fast Fourier Transforms and addressing some of its shortcomings, at the price of a somewhat increased implementation complexity. FBMC a viable choice for future mobile systems due to the following reasons: Firstly, FBMC can be designed to have good localization in both, time and frequency, allowing an efficient allocation of the available time-frequency resources. Secondly, the low delay spread guarantees that simple one-tap equalizers are enough to achieve close to optimal performance.

IV. Multiple-Input Multiple-Output (MIMO)

Multiple-Input Multiple-Output (MIMO) innovation is a remote innovation that utilizes various transmitters and recipients to exchange more information in the meantime. MIMO innovation exploits a radio-wave wonder called multipath where transmitted data bobs off dividers, roofs, and different items, achieving the getting recieving wire on numerous occasions by means of various points and at Slightly extraordinary occasions. MIMO innovation influences multipath conduct by utilizing different, "keen" transmitters and collectors with an additional "spatial" measurement to drastically expand execution and range. MIMO enables various radio wires to send and get different spatial streams in the meantime. MIMO makes recieving wires work more brilliant by empowering them to consolidate information streams touching base from various ways and at various occasions to viably build beneficiary flag catching force. Shrewd recieving wires utilize spatial decent variety innovation, which puts surplus radio wires to great use. On the off chance that there are a larger number of radio wires than spatial streams, the extra reception apparatuses can include beneficiary decent variety and increment range.

V. RESULTS
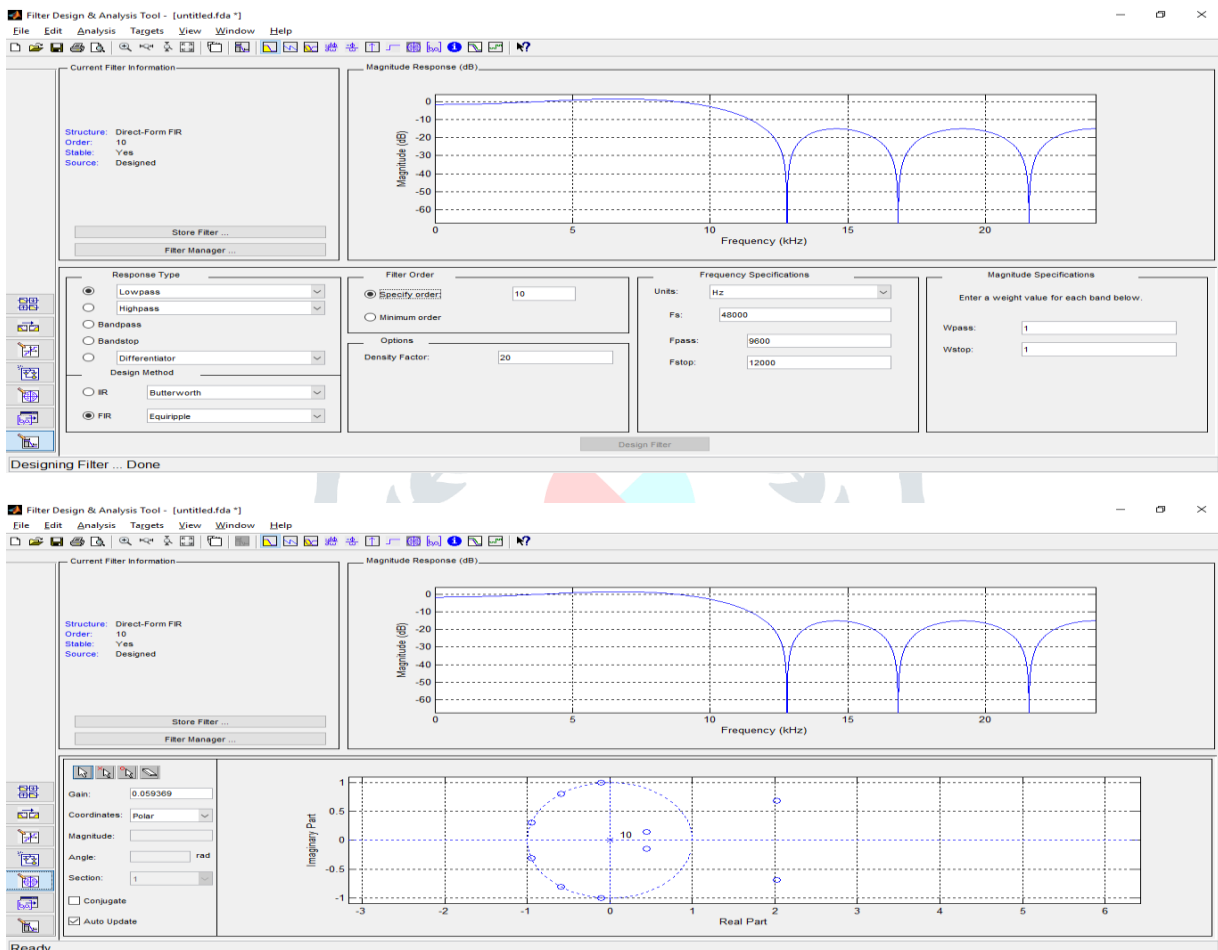
Noisy is an undesirable aggravation in an electrical signal. Commotion created by electronic gadgets fluctuates extraordinarily as it is delivered by a few unique impacts. In correspondence frameworks, clamor is a mistake or undesired irregular aggravation of a helpful data signal.
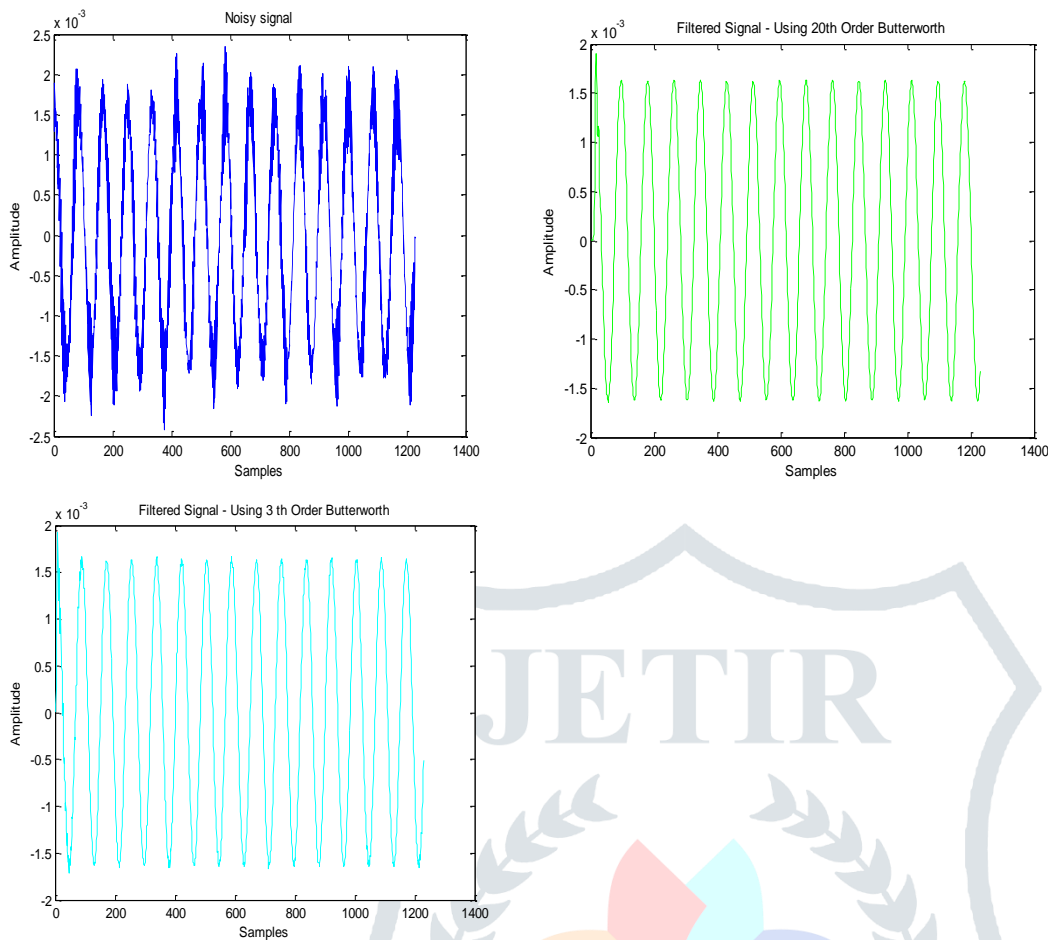
The Butterworth Filter is a kind of signal preparing channel intended to have a frequency response as level as conceivable in the passband. It is additionally alluded to as a maximally level greatness channel and Chebyshev filters are nothing but analog or digital filters, Then Elliptic filter is a signal processing filter with equalized ripple behavior in both the passband and the stopband.
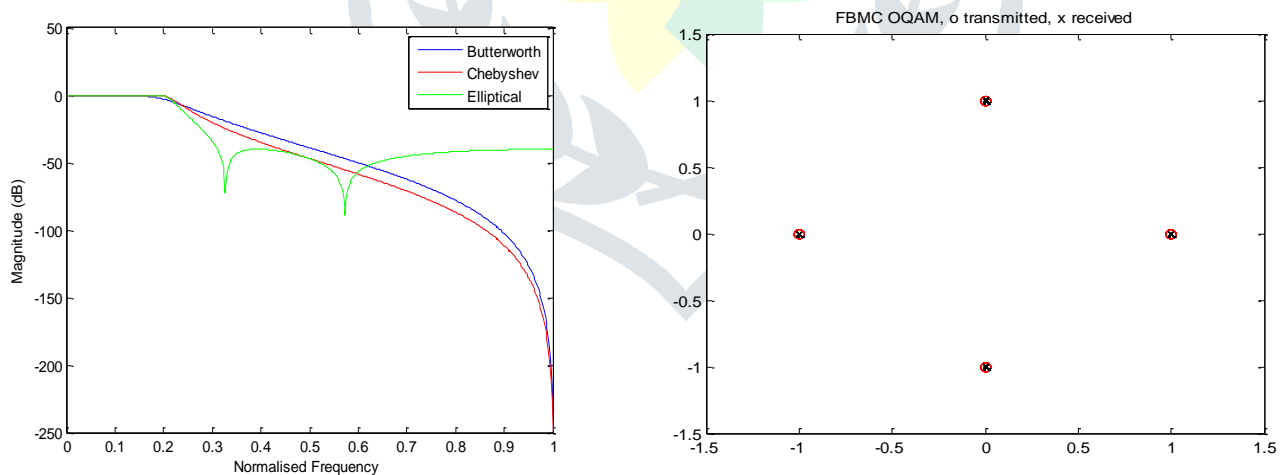

The quantity of bit error is the quantity of gotten bits of an information stream over a correspondence channel that have been changed because of commotion, obstruction, twisting or bit synchronization mistakes. The bit error rate is the quantity of bit error per unit time.
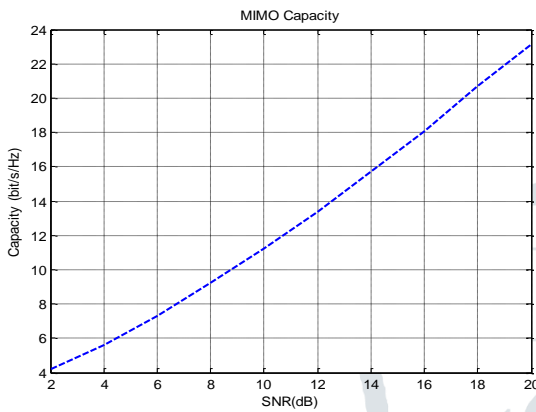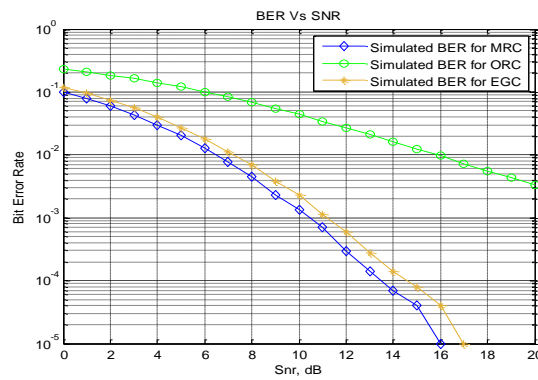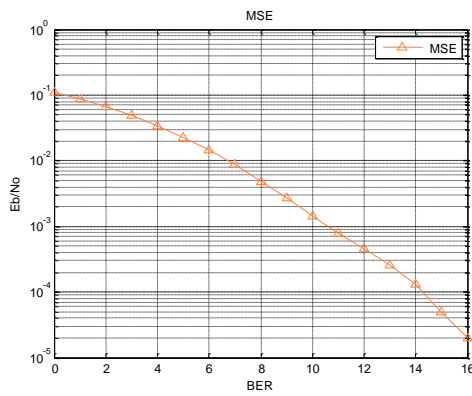
Hardware

The FPGA on the Nexys2 board must be designed (or modified) by the user before it can play out any capacities. Amid arrangement, a "bit" document is moved into memory cells inside the FPGA to characterize the consistent capacities and circuit interconnects. The free ISE/WebPack CAD programming from Xilinx can be utilized to make bit documents from VHDL, Verilog, or schematic-based source records.

The FPGA can be modified in two different ways: straightforwardly from a PC utilizing the on-board USB port, and from an on-board Platform Flash ROM (the Flash ROM is additionally client programmable by means of the USB port).
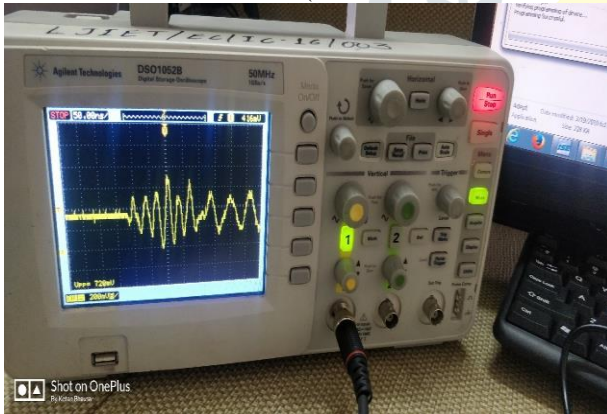
Nexys2 circuit board is a finished, prepared to-utilize circuit advancement stage dependent on a Xilinx Spartan 3E FPGA. Its on-board rapid USB2 port, 16Mbytes of RAM and ROM, and a few I/O gadgets and ports make it a perfect stage for computerized frameworks of different types, including inserted processor frameworks dependent on Xilinx's MicroBlaze.
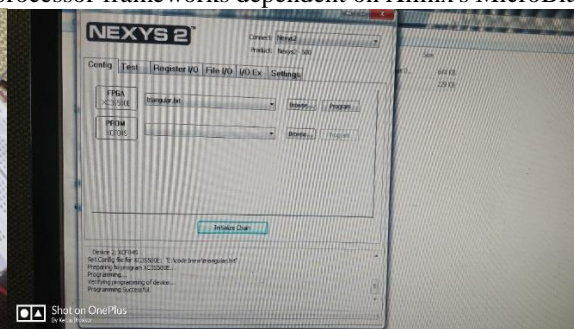
Tools

1) **Matlab**

MATLAB has advanced over a time of years with contribution from numerous clients. In college conditions, it is the standard instructional device for starting and propelled courses in arithmetic, designing, and science. In industry, MATLAB is the device of decision for high-efficiency research, improvement, and examination.

MATLAB highlights a group of use explicit arrangements called tool stash. Important to most clients of MATLAB, tool compartments enable you to learn and apply particular innovation. Tool compartments are exhaustive accumulations of MATLAB capacities (M-records) that stretch out the MATLAB condition to take care of specific classes of issues. Regions in which tool kits are accessible incorporate flag handling, control frameworks, neural systems, fluffy rationale, wavelets, reproduction, and numerous others.

2)   Field-Programmable Gate Array (FPGA)

Means "Field-Programmable Gate Array." A FPGA is a coordinated circuit that can be altered for a particular application. In contrast to conventional CPUs, FGPAs are "field-programmable," which means they can be arranged by the client in the wake of assembling.

FPGAs contain programmable rationale hinders that can be wired in various designs. These squares make a physical cluster of rationale doors that can be utilized to perform distinctive activities. Since the entryways are adjustable, FPGAs can be enhanced for any processing errand. This gives FPGAs the possibility to perform tasks a few times quicker than a hard-wired processor.

Performance Parameters

The performance of a MIMO-OFDM framework relies on various elements. There are sure parameters which choose the performance and effectiveness of the remote MIMO-OFDM framework. Probably the most significant parameters are quickly:

1)   Input Power (Pin)

The input power is a essential parameter to choose theperformance of a MIMO-OFDM systemThe range and effectiveness of any framework rely upon its information control.In a MIMO framework, it winds up essential to nourish every one of the recieving wires with the required power as per the kind of regulation method utilized and way of transmission of user information (or signal).

2)   Number of Antennas

In a MIMO system, data is transmitted through a number ofantennas. If number of antennas are used less then we requirelesser power for transmission but there will be more bandwidthtransmitted per antenna in this case. So the symbol durationwill be less and hence inter-symbol interference (ISI) will bemore. In the opposite case i.e. with more number of antennas,the power required will be more but also there will be lessinterference between the symbols and the complexity of thereceiver is reduced.

3)   Bit Error Rate (BER)

This is one of the major parameters for end-to-endperformance measurement. It is basically the fractional relationbetween the number of output bits with errors and the totalnumber of bits transmitted and may be defined as:

$$BER = \frac{No.\,of\,Bits\,with\,Errors}{Total\,No.\,of\,Bits}$$

4)   Channel Capacity

It is the maximum amount of information that can reliably be transmitted over any communication channel at any given instant. It is denoted by 'C' and can be given as:

$$C = Blog_2\left(1 + \frac{S}{N}\right)$$

where B= Bandwidth in Hz; = Signal to Noise Ratio.Channel Capacity of the system increases with increase in SNRas well as with number of antennas in the system. Further,when number of transmitting and receiving antennas areincreased in a MIMO-OFDM systems, rate of increase inchannel capacity also increases.

5)   PAPR (Peak to Average Power Ratio)

The PAPR is defined as the ratio between maximum power and the average power of the complex pass-band signal.

VI.CONCLUSION

If we transmit the data with a single carrier modulation then there will be some intersymbol interference and intercarrier interference. So to reduce that we have implemented an Orthogonal Frequency Division Multiplexing technique. Because of Cyclic Prefix the intersymbol interference is reduced so the speed and data rate is increased.

While in FBMC the OFDM is replaced with the polyphase network. The polyphasenetwork is used as a multirate carrier to increase the spped of data rate. The OFDM system is used for a 4G techniques and its rate is upto 100Mbps. As per the LTE standard the speed is 4-7Mbps with peak approach of 50Mbps. FBMC can be used as a 5G technique and its speed is 10-20Gbps. That major difference in a speed is due to a polyphase network. It has a very low sidelobes so that the intersymbol interference is very much low and its frequency responce is too sharp.

REFERENCES

[1] Arman Farhang Nicola Marchetti∗, Linda E. Doyle,BehrouzFarhang-Boroujeny," Filter Bank Multicarrier for Massive MIMO".

[2] Hardik Modi,Vedang Panchal,Himanshu Patel, Dharmendra Chauhan,"Implementation and Evaluation of OFDM and FBMC Systems", International Journal of Applied Engineering Research ISSN 0973-4562 Volume 13, Number 9 (2018).

[3] Ronald Nissel, Stefan Schwarzand Markus Rupp," Filter Bank Multicarrier Modulation Schemesfor Future Mobile Communications", 2016, IEEE.

[4] Bidyalaxmi Devi Tensubam, Sonika Singh,"

A Review on FBMC: An Efficient Multicarrier Modulation System",International Journal of Computer Applications, Volume 98–No.17, July 2014.

[5] Sandeep Kumar, Deepak Kedia,"Study and Performance Analysis of a General MIMO-OFDM System for Next Generation CommunicationSystems", International Journal of Electronics Communication and Computer Technology (IJECCT)Volume 3 Issue 5, September 2013.