iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4 **Issue:** VII **Month of publication:** July 2016

DOI:

Volume 4 Issue VII, July 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Design of BER Measurement for MIMO System on FPGA

G Rashmi[1], Dr.Baswaraj Gadgay[2], Suman B Pujari[3]
[1]*PG student Dept. of VLSI&ES VTU PG Centre Kalaburagi*
[2]*Research Guide & Professor VTU PG Centre Kalaburagi*
[3]*Assistant Professor Dept. of VLSI&ES VTU PG Centre Kalaburagi*

Abstract - The communication systems have become more challenging as difficulty in designing product and cost of product has been increased. In any communication system, bit error rate (BER) plays very important role, if it is high then system performance degrades, so here we are reducing a bit error rate and measure its performance using bit error rate tester (BERT). In this project we are presenting technique called bit error rate performance measurement for MIMO systems to improve performance of data (bit error rate) or data rate of the communication system. In this project we are designing all modules and implemented on the Altera Cyclone IV FPGA.
Keywords- Bit error rate (BER), Bit error rate tester (BERT), Field Programmable Gate Array (FPGA), MIMO (multiple input multiple output) Communication System.

I. INTRODUCTION

In the wireless numeral message due to earlier in the region of improvement, new schemes have to be established in small extent of period. It is needed for communication structure designer and examination tools traders to know a capable and consistent plan even with alterations in the system. Also due to advance in the communiqué methods the product wants bigger number of formations to function suitably. By emerging wireless message organisms we can reach the greater data degrees, field employment becomes more effective and worker facilities can be enriched.

Wireless communiqué skill is the more rapidly raising knowledge and it is the recent communiqué technology. We are having numerous examples of wireless schemes such as cellular handsets, narrow range link. By using local area network reinforced systems that are present in home-based, sites and other locality can be swapped.

A. MIMO for Wireless Systems

We are using one of the present knowledge in order to offer high data rate and to improve productivity of the system that uses several projections at two side's, transmitter and receiver side, it is the Multi Input Multi Output technology. It shows main role in wireless communiqué as it has many input and output. In order to spread information over lengthier range it can be used and it provides ingestion of upper bandwidth.

MIMO can be well-defined as, for a wireless statement organization having conveying ends and acceptance ends we provide linkage between them by using various antenna elements. The key indication in MIMO system is that the signal on the spreading probe and getting projection should be shared in such manner way that it should improve the performance of the data (bit Error rate) or data rate of the communication system.

B. Bit Error Rate

In message organization when we are sending signal from one place to other there may be chances of occurring error if information is not received correctly. The quantity of bit errors is the number of alterations that are present in the expected information of data stream over message network. The reason for variation in expected data is due to sound, interloping, alteration and moment organization mistakes.

Bit fault ratio is defined as percentage of number of moment errors that have been happened for a given period interval to the overall quantity of transferred bits.

Volume 4 Issue VII, July 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

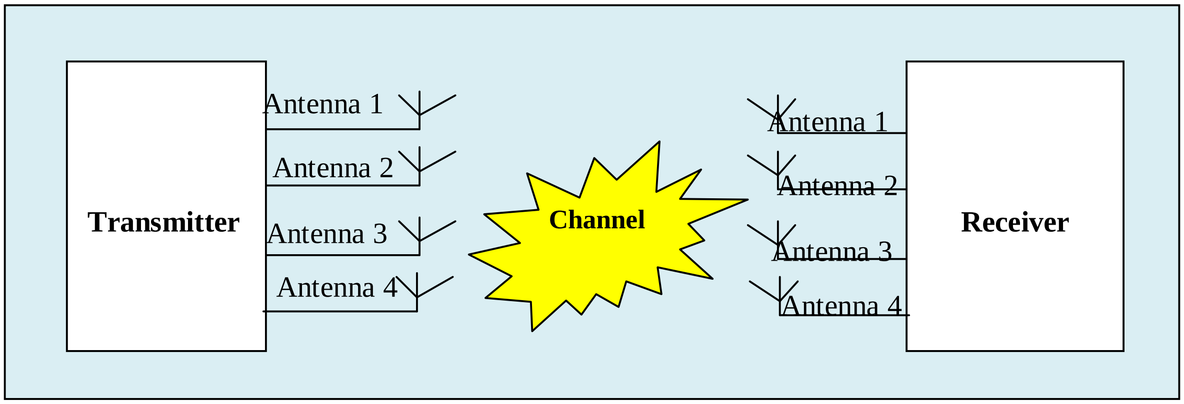


Fig 1: Functionality of MIMO system

C. Bit Error Rate Test

For numerical communiqué system bit fault rate tester is used to measure bit error rate during the data transmission. It is also used to test the quality of signal that is transmitted.

BERT consist of test array producer, it generates order of logical zeros and ones. In order to measure BER performance of any message system we use the bit error rate tester.

II. RELATED WORK

It is critical to verify the design characteristics at the earliest possible stage of design (e.g., at the baseband level) to minimize costly design iterations. At the physical (PHY) layer, the bit error rate (BER) performance metric is widely used to measure the reliability of the communication systems. Because BER properties are not in general amenable to analysis, Monte Carlo (MC) simulation techniques have been widely used to generate BER versus a range of expected signal-to-noise ratio (SNR) conditions. However, the execution times of software-based MC simulations of the baseband layer on workstations can be extremely long, especially for increasingly complex communication systems.

This is mainly because:

A. Many modern techniques, such as multiple-input–multiple-output (MIMO) systems, rely on computationally intensive signal processing at the receiver. Therefore, bit-true software-based simulation of these algorithms on workstations is becoming prohibitively time consuming. In addition, for a communication system specification with a set of target system requirements such as data throughput, received power, available bandwidth, noise statistics, and a target error performance, there are typically various potential solutions .Each solution can use a different combination of subsystem designs with different sets of input parameters. Exploring the design space to achieve an optimized overall system solution that meets the target specifications can involve a large number of options.

B. To estimate the BER performance of a communication system with the MC simulation method, we have to measure the BER over a large number of independent problem instances. While simulation of digital communication systems under additive white Gaussian noise (AWGN) channels is straightforward as the system performance is averaged over a large number of independent instances of noise and data, BER performance measurement of wireless systems over time-varying fading channels requires significantly longer simulation times because of the dependence between the channel instances. To accurately estimate the BER performance of a communication system over a time-varying fading channel, the error performance needs to be averaged not only on independent instances of noise and data, but also on the fading channel samples over a long period. Such a performance evaluation can require several weeks or months of software simulations.

Hardware simulators can accelerate the performance evaluation of communication systems compared with software simulators by several orders of magnitude. This makes hardware-accelerated prototyping and validation of the PHY layer as an increasingly attractive. While using system level tools can eliminate the need for extensive hardware knowledge and will usually shorten the design time, a simulation library may include only a set of basic digital communication components and might not include modules, such as new coding algorithms, for emerging technologies. Thus, designers will still need to implement various communication modules with compatible interfaces with other components.

Volume 4 Issue VII, July 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

III. PROPOSED WORK

This paper presents the design and implementation of a parameterizable baseband MIMO BER measurement system on an FPGA. Below fig shows the basic block diagram of BERT System, which includes the Transmitter block system, Bit Control & Bit Measurement Block, and Receiver block system. We used Full Duplex communication and it's divided into three main parts there as follows:

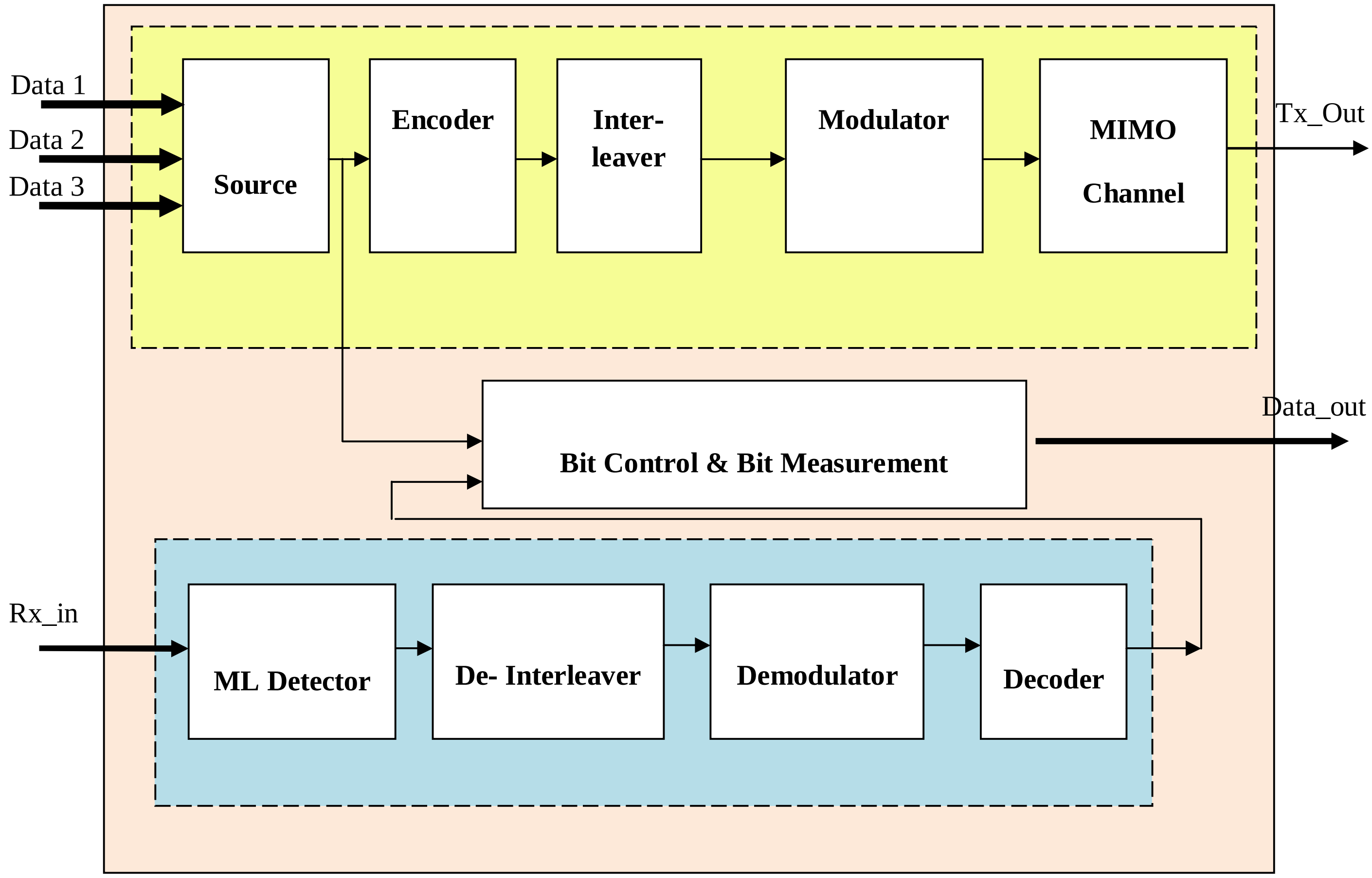


Fig 2: Proposed Block Diagram of BERT System

A. *Transmitter Section*

The Transmitter System includes Source, Encoder, Inter-leaver, Modulator and MIMO Channel.

1) *Source:* Source is used for processing the information or data and here input to the source is multiple data inputs of 8 bit. After processing individual data it will send these inputs to encoder as well as bit control and measurement block.
2) *Encoder:* In any system encoder is used to convert information from one form to another form. It is used to keep the information safely during data transmission, for improving the accuracy of system it is used. If we want to reduce the size of data then encoder can be used, it transform data from one format to other. The main advantage of encoder is it increases the usability of data and the space required to store information can be reduced. It is called as data compression technique because it helps in reconstructing original data at the output.
3) *Interleaver:* Interleaving is the reordering of data that is to be transmitted over a larger sequence of data to reduce the effect of burst errors. The use of interleaving greatly increases the ability of error protection codes to correct for burst errors. Many of the error protection coding processes can correct for small numbers of errors, but cannot correct errors that occur in groups.

Interleaving is normally used in digital communication and storage systems to improve the performance of forward error correcting codes. Many communication channels are not memory less: errors typically occur in bursts (groups) rather than independently. If the number of errors within a code word exceeds the error-correcting code's capability, it fails to recover the original code word. Interleaving eliminates this problem by shuffling source symbols across several code words, thereby creating a more uniform distribution of errors. Therefore, interleaving is widely used for burst error-correction.

4) *Modulator:* Modulation is a process in which some of the characteristics of carrier wave are varied according to modulated wave. Carrier wave is represented by sine wave and modulated wave is represented by binary values. So modulation is the process of varying one or more properties of a periodic waveform, called the carrier signal, with a modulating signal that typically contains information to be transmitted.

In digital communication system we are having three different modulation techniques:

a) *Amplitude shift keying (ASK):* In this the amplitude of carrier signal is varied as per the information signal. It uses tone on and off conditions as digital binary states.
b) *Frequency shift keying (FSK):* Here change in the carrier frequency occurs as per the information signal. It uses two frequencies as binaryA1 and 0.
c) *Phase shift keying (PSK):* In this the carrier phase changes according to the information signal. It uses phases of a signal to represent binary states.

5) *Amplitude-Shift Keying (ASK):* The functional block of ASK consist of clock distribution, bit split and actual signal. The functional block of Clock Distribution which includes the blocks like up counter, comparators and D- flip flops. The clock distribution is main functional unit which is specially help in the selecting and processing the single bit in particular time slot.

The bit Split is also called as 'Bit Extract or Bit Splitter' Separating indusial Bits given digital data by Parallel to Serial Conversion Normally called Bit Splitter. This block produces separate bits with select line from the clock distribution. It consists of mux and D-Flip Flop. The actual signal block will generate carrier sine wave signal, the sine wave signal is generated with the help of VHDL code.

6) *Design of MIMO Channel:* In communication system we have to send information from sender to receiver hence to perform this function we are using channel. It provides connection between transmitter and receiver by using a wire or it can be logical connection over the medium such as radio channel. By using channel we can convey the information from one location to other location. Capacity of channel can be measured by bandwidth in HZ or data rate in bits per second. MIMO channel consist of fading variate generator and additive white Gaussian noise generator (AWGN).The output of modulator is sent as input to the channel. If the modulated signal experiences distortion than it is called fading. Fading is a phenomenon that occurs when the amplitude and phase of a radio signal change rapidly over a short period of time or travel distance. Fading is caused by interference between two or more versions of the transmitted signal which arrive at the receiver at slightly different times. These waves, called multipath waves, combine at the receiver antenna to give a resultant signal which can vary widely in amplitude and phase. If the delays of the multipath signals are longer than a symbol period, these multipath signals must be considered as different signals.

B. Receiver Section

The Receiver System includes Decoder, De-Inter-leaver, and Demodulator.

1) *Ml (Maximum Like Hood) Detector:* It is used to estimate the transmitted symbols. Since we want to recover the original data hence it tries to estimate the transmitted symbols from received data.
2) *De-Interleaver:* De-interleavers reconstruct the code words when it processes the data stream. The deinterleaver performs the reverse operation, where the received bits are written randomly into a memory using the same pseudorandom sequence.

Interleavers and Deinterleavers are designed and used in the context of characteristics of the errors that might occur when the message bits are transmitted through a noisy channel.

3) *Demodulator:* Demodulation is the process of filtering out the actual transferred information from the received signal. Demodulation is the process of extracting information signal from the carrier signal. All the modulation methods, such as AM, FM, PM etc. have their own demodulation methods to recover the original signal at the destination end. It consist of clock divider, sampling unit and SIPO. Both modulation and demodulation processes are equally important to transfer an information signal in a given channel using a carrier signal. Therefore, the modulation method we use at the transmitter must be exactly compatible with the demodulation method at the receiver end to achieve proper transfer of information from one location to another.
4) *Decoder:* A decoder is a component in the system which converts the received information back to the previous or original form. A decoder performs the opposite functions of the encoder, reversing the encoding process and converting the information to its previous format or other accessible format.

Volume 4 Issue VII, July 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

C. Bit Control & Bit Measurement

It takes two inputs one from transmitter and other from receiver, it checks both inputs for presence of errors if there are no errors then it will produce the output same as that of original input, otherwise it requires retransmission of data. We have to send data inputs again, by comparing these inputs it will produce output.

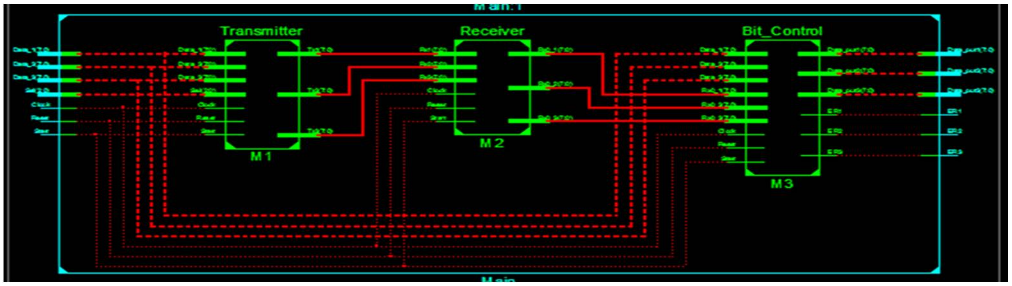


Fig 3: RTL schematic of BERT block

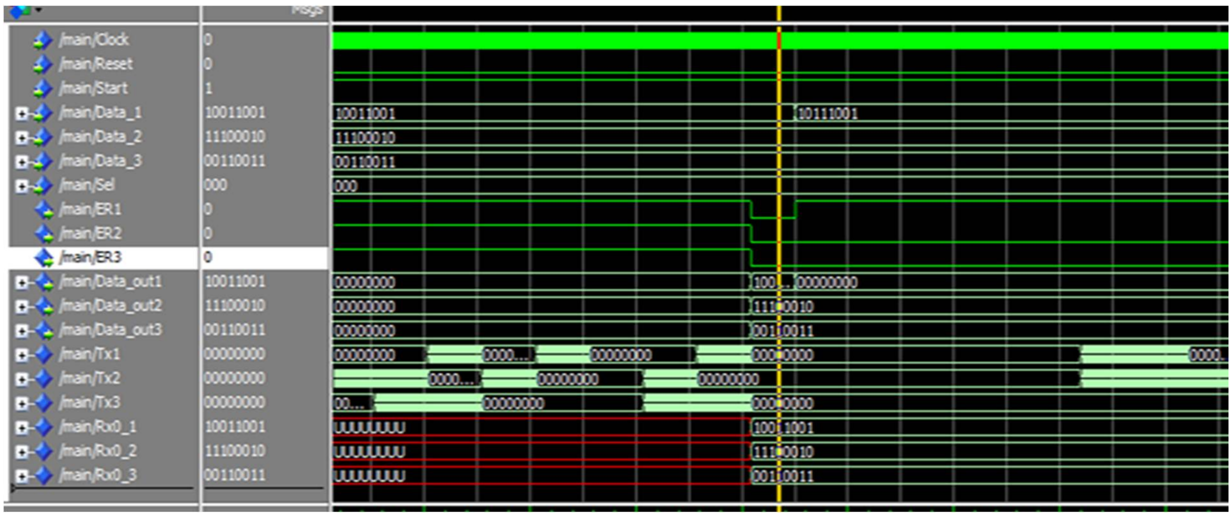


Fig 4: Simulation of complete BERT system

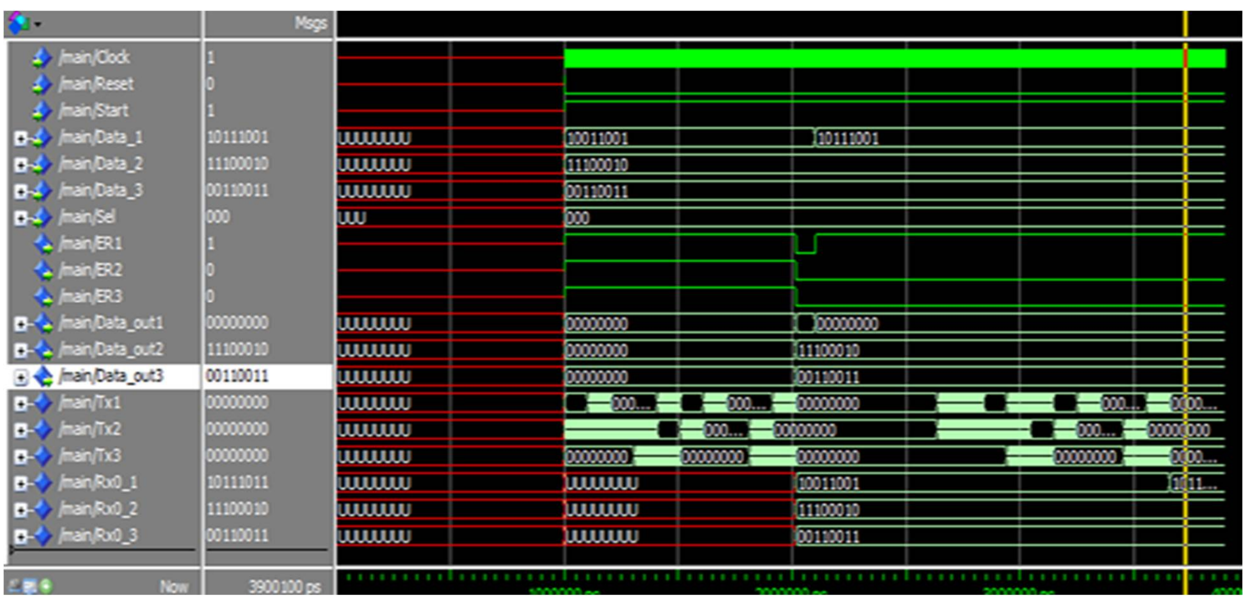


Fig5: Simulation of BERT with error

Volume 4 Issue VII, July 2016
ISSN: 2321-9653

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

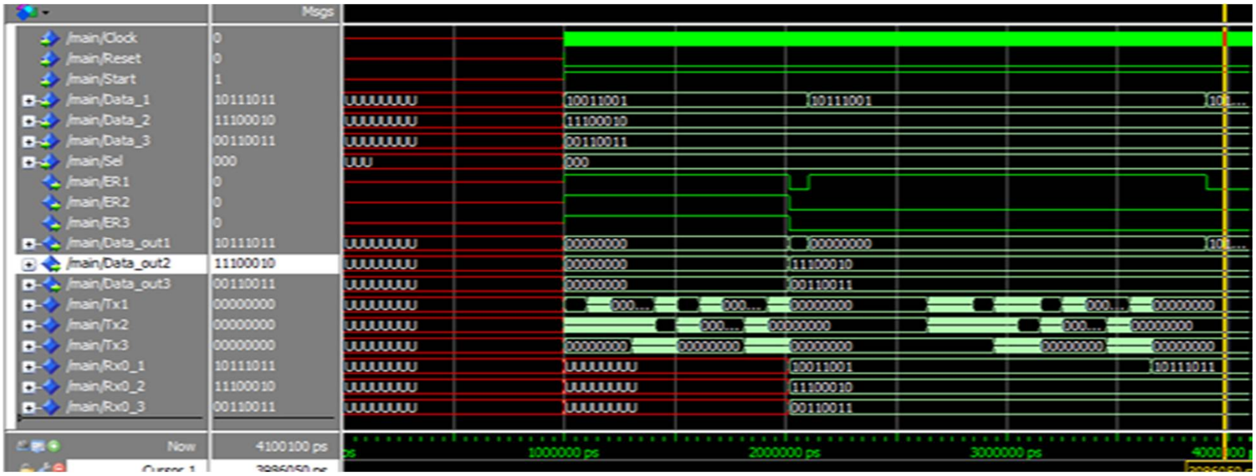


Fig 6: Simulation of system after retransmission

V. CONCLUSION

In the proposed design we have successfully implemented MIMO transceiver communication with transmitter as well as receiver with inside block likes, First design begins with transmitter section, here we have to design encoder, modulator and MIMO channel. The design of modulator contains clock distribution, bit split and actual signal generator. Second part of the design is receiver section; it contains design of demodulator and decoder block. The design of demodulator consists of clock divider, demodulation, sampling and serial in parallel out (SIPO) block. Third part of design contains bit control and bit measurement. At last functionality will be verified using ModelSim also we synthesized on Altera Cyclone IV FPGA.

REFERENCES

[1] V. Singh A. Root, E Hemphill, N. Shirazi, and J Hwang, "Accelerating bit error rate testing using a system level design tool," in Pro. 11th Annu. IEEE Symp. FCCM, Apr. 2003, pp. 62–68.

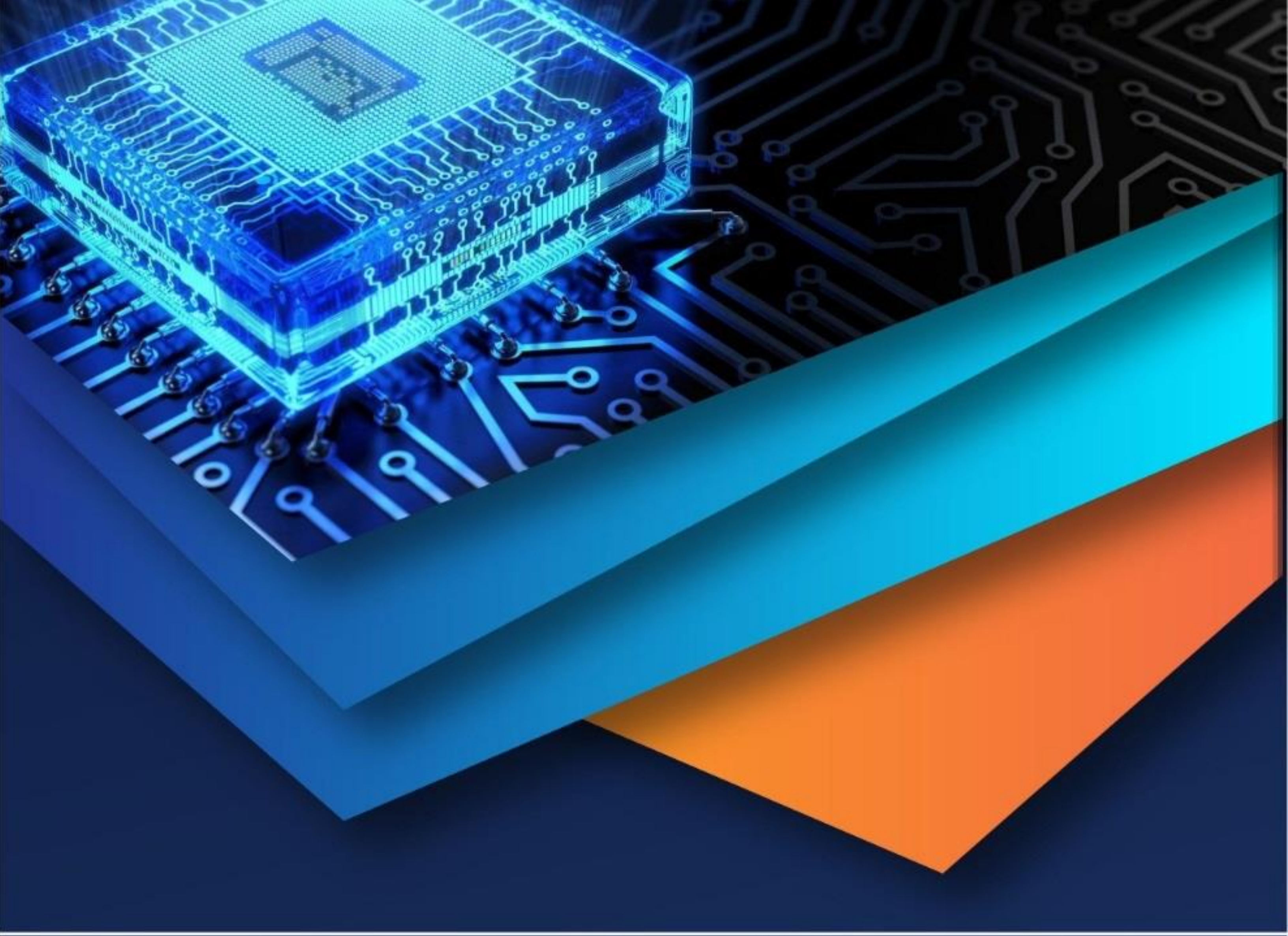
[2] L G. Barbero and J S Thompson, "Rapid prototyping system for the evaluation of MIMO receive algorithms," in Proc. IEEE EUROCON, Nov. 2005, pp. 1779–1782.

[3] D U Lee, J. D Villasenor, W. Luk, and P H. W Leong, "A hardware Gaussian noise generator using the Box Muller method and its error analysis," IEEE Trans. Comput. vol. 55, no 6, pp. 659 671, Jun. 2006.

[4] A Alimohammad, S. F. Fard, and B. F Cockburn, "Hardware based error rate testing of digital baseband communication systems," in Proc.IEEE ITC, Oct. 2008, pp. 1–10.

[5] A Alimohammad, S. F. Fard and B. F. Cockburn, "FPGA-accelerated baseband design and verification of broadband MIMO wireless systems," in Proc IEEE 1st Int. Conf Adv. Syst Testing Validation, Sep. 2009, pp. 135–140.

[6] A Alimohammad, S. F. Fard, and B. F. Cockburn, "FPGA based accelerator for the verification of leading-edge wireless systems," in Proc IEEE Int. DAC, Jul 2009, pp 844–847.



10.22214/IJRASET

INDEX COPERNICUS
45.98

IMPACT FACTOR:
7.129

TOGETHER WE REACH THE GOAL
IMPACT FACTOR:
7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY