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Implementation of ASK, PSK and FSK on FPGA

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ABSTRACT

This paper present the review on an implementation of ASK, PSK and FSK modulators and demodulators on FPGA using Quartus II software. The ASK,PSK and FSK modulators and demodulators system is simulated using MATLAB/SIMULINK environment ,DSP Builder and Quartus II. **The DSP builder Signal Compiler block reads Simulink Model Files (.mdl) and writes out VHDL files and Tcl scripts for hardware implementation and simulation.** Quartus II**,** a tool from altera used to implement the design on two Cyclone II Starter kit board. The first board behaves as a modulator and second as a demodulator. The modulated signal was achieved in the first Cyclone II board, passed through a channel and transmitted to the second board, which behaves as a demodulator. At the end of the demodulator, the modulating signal was obtained.

I. INTRODUCTION

In the recent year, all the areas of Communication like satellite communication system, Cellular system and wireless system use digital modulation over analog modulation, due to the fact that, digital communication system is more reliable than the analog. The major advantage of using digital modulation technique is that the use of digital signals reduces hardware, noise and interference problems as compared to the analogue signal where large number of waveforms will be required resulting in a larger bandwidth for the symbol to be transmitted .

Digital modulation is nothing but varying the parameter of continuous carrier signal according to the digital modulating signal. There are three basic techniques of digital modulation which can be achieved by varying the different parameters like amplitude, phase and frequency.

II.DIGITAL MODULATION

As the communication system is application oriented, Design of communication system depends upon type of signal to be transmitted. The transmission of video, audio and data over a computer network or mobile telephony network required large bandwidth. Digital modulation provides large immunity to noise and it provides large bandwidth.

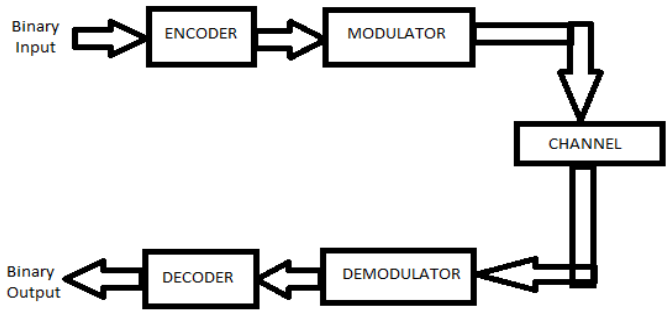

Fig. 1. Digital modulation system.

Block diagram above shows the digital modulation system, where the digital data i.e. binary input is first encoded on any of the parameter and then fed with high frequency carrier i.e. modulation for efficient transmission of the signal. The modulated signal is transferred through the channel of any type. At the receiver end, the signal is first demodulated to remove the high frequency carrier and then decoded to get the original binary data.

The digital modulation has three basic type

1. Amplitude Shift Keying.
2. Phase Shift Keying .
3. Frequency Shift Keying.

III.FPGA IMPLEMENTATION

For the implementation of large logic circuit the chip should have a large logic capacity. Field Programmable Gate Array is the programmable logic device which supports the implementation of large logic circuits.
Implementation of the proposed system is carried out in three major parts.

1. Designing of matlab simulink model of each modulator and demodulator system.
2. Convert the matlab simulink (.HDL) file in the VHDL code using DSP builder software.
3. Implementation of that VHDL code in FPGA using Quartus software.

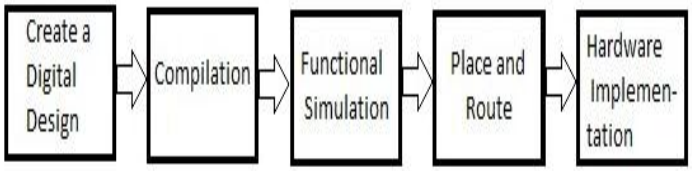

Fig. 2. FPGA Design Flow

FPGA design flow start with the digital design that can be build using VHDL or Verilog HDL language which is further compile, simulate and then implement on FPGA.
The DSP builder is a set of building blocks that shortens DSP design cycles by helping you create the hardware representation of a DSP design in an algorithm-friendly development environment. DSP builder links system-level design and DSP algorithm development; therefore, algorithm and system designers can share a common development platform. The DSP builder Signal Compiler block reads Simulink Model Files (.mdl) and writes out VHDL files and Tcl scripts for hardware implementation and simulation.

IV.PAST WORK ON DIGITAL MODULATION

Faruque Ahamed, and Frank A. Scarpino [1], have discussed design simulation and FPGA implementation of BPSK Demodulator system using altera design tool. The entire system was designed using the Verilog hardware description language and implemented on an Altera 10-k FPGA device.

S.O. Popescu, A.S.Gontean and G.Budura [2] have suggested a BPSK system design. The BPSK system was simulated using Matlab/Simulink environment and System Generator, a tool from Xilinx for FPGA design. The design was implemented on two Spartan 3E Starter Kit boards one for the modulator other for the demodulator.

Kangshun Li 1,2,3, Xiaoqiao Lu1, Wensheng Zhang3, Feng Wang [3], proposed the design model Using direct digital synthesizer (DDS) for digital modulator. The model is designed using Matlab/DSP Builder environment. DDS technology helps in improving the shortcomings of the old method and also helps in reducing lots of error and hardware. The model was further simulated and implemented on FPGA and verified the correctness.
S.O. Popescu, A.S.Gontean and G.Budura [4], have suggested three methods for BPSK modulator implementation using the Matlab/Simulink environment, In the first method simple blocks which consist of externally generated modulated signal using the carrier, the modulating signal, In second method , the block which consist of matlab code along with the internally generated modulating signal with LFSR and externally generated carrier signal.In third method, System generator tool from Xilinx is used and all the signals are generated internally.

Faiza Quadri, ArunaD.Tete [5], have reviewed three digital modulation schemes ASK,PSK and FSK which are designed using Matlab/Simulink environment and then simulated using xilinx13.1 and implementation on FPGA.
They also reviewed the different factors that affect the choice of particular modulation technique.

V.METHODOLOGY

The three digital modulation techniques on a single chip provide the ease in communication and reduce the extra hardware. According to the need of system any of the modulation can be chosen.

Most easy approach for the designing these modulation techniques are by MATLAB/SIMULINK environment and convert it into VHDL. Simulate code and implement on FPGA.

The ASK system with input binary signal, Modulated signal and Demodulated signal is shown in fig. below

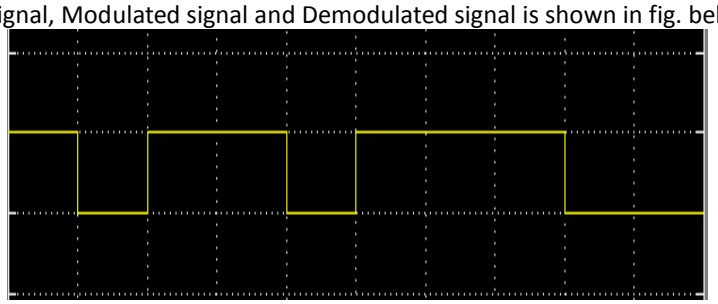

Fig. 3. Input binary sequence to modulator.

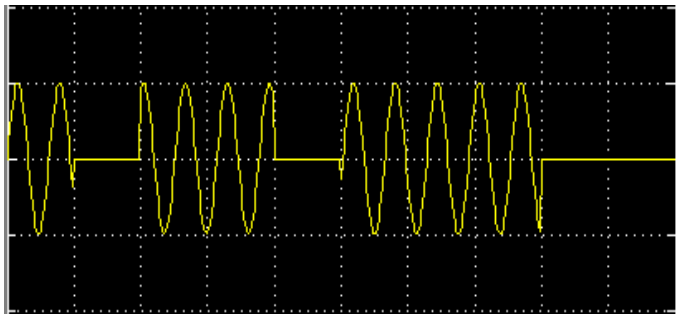

Fig. 4. ASK modulated signal.

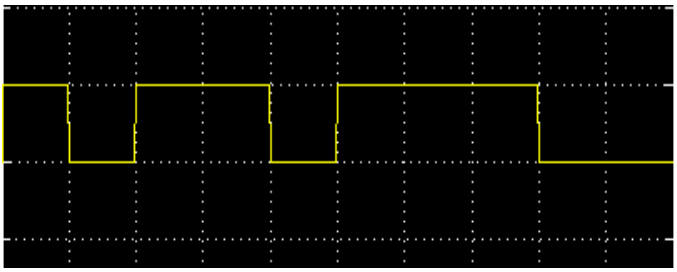

Fig. 5. Output binary sequence of demodulator.

VI. CONCLUSION

Digital modulation is more reliable than analogue modulation in many terms. The FPGA implementation of three digital modulation technique using Quartus II and DSP builder software from altera are proposed .All the three modulation techniques are implemented on the two Cyclone-II FPGA kit and external binary sequence is provided using pulse generator. Out of two kits one is acting as a modulator which modulates the signal from pulse generator and transmit over a channel and second kit is acting as a demodulator which convert the modulated signal into modulating signal.

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