

Implementation of OFDM System

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Abstract—For wideband digital communication OFDM scheme is used. It is used in different applications like digital television and audio broadcasting, Internet access, wireless networks and 4G mobile communications etc. For implementing any type of waveform in software a universal platform SDR is used. While transmission, some data may get lost due to transmission impairments. We can detect loss in signal at the receiver end. OFDM is designed using software to encode the digital data into multicarrier frequencies. Computer was used to generate and processing of the signal with the help of LABVIEW software.

Index Terms— OFDM, SDR, USRP RIO

I. INTRODUCTION

Modulation techniques are used to communicate over long distances and to transmit information. During the transmission of the signal we may confront real-time problems.

OFDM is a multi-carrier modulation technique. It is popular in various applications such as new wireless networks of IEEE standard, digital TV and audio broadcasting and 4G mobile communications. OFDM has the capacity to transmit a high-speed data stream using multiple spectral-overlapped lower-speed subcarriers. Therefore, OFDM is used in many budding broadband wireless and wire-line communication systems. To build and test the digital communication systems the USRP is used which is an SDR RF hardware design.

The USRP can be used as a wireless prototype platform. It can be also used for teaching purpose. LABVIEW is graphical programming software. Which is developed by National Instruments. It can be used to design the system platform. SDR has a reconfigurable hardware which may be programmed over-the-air or software. Which is helpful in working under different Wireless standards. mainly it emphasizes on OFDM transceiver because of its bandwidth scalability and its popularity in many next generation wireless air interfaces. In broadband wireless networks for the adoption of software defined radio in 21st century, these concepts are very helpful.

NI USRP RIO

For rapidly prototyping and designing high-performance wireless communication system, An Integrated hardware and software solution, USRP RIO software defined radio platform is used. Each USRP RIO device has two RF transceivers and a large Xilinx Kintex-7 FPGA. It is a reconfigurable LabVIEW FPGA target which incorporates DSP48 co-processing. It is useful for high-rate and low-latency applications.

For faster prototype LabVIEW unified design flow and flexible hardware architecture is very useful. It requires

comparatively less time for getting results many of researchers are using this design flow to prototype over a wide range of advanced research applications. The various applications are such as multiple input, multiple output (MIMO), LTE relaying, synchronization of heterogeneous networks, Spectrum Sensing, cognitive radio RF compressive sampling, and beam forming.

II. OFDM SYSTEM

Multicarrier communication system employs the fast Fourier transform algorithm. The block diagram of Multicarrier OFDM system is as shown in Fig. 1.

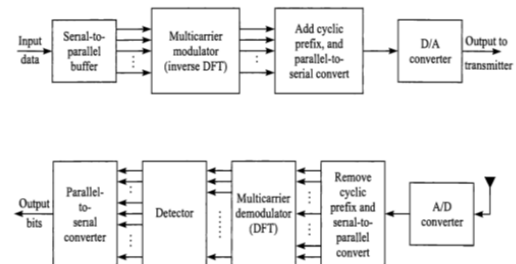


Fig. 1. Block diagram of multicarrier OFDM system [6]

III. EXPERIMENTAL SETUP

A. OFDM Transmitter

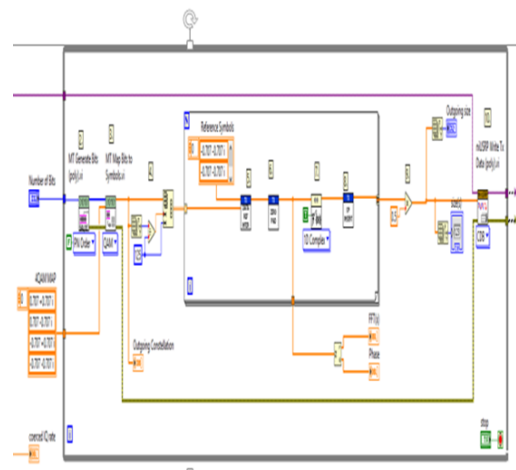


Fig. 2. OFDM transmitter

First Initialize the USRP setting the TX parameters and moving the LO outside the transmission band. After initializing, generate random data bits (PN Sequence) of 125 bits. Then next

step is map bits to symbols (625 symbols).

Then the array of symbols are divided into 5 sets of 125 point data sets and the OFDM symbols are build. After every 6th data symbol, one of 25 reference symbol is Inserted. That is 150 points per OFDM symbol. Next 53 zeroes are inserted at the edges of the passband and at 1 zero at DC.it becomes 256 points per OFDM symbol. After that inverse FFT is performed to convert the frequency domain signal into time domain signal. That is 256 point IQ time domain waveform.

Next Insert 64 point cyclic prefix by duplicating the last 64 points of the array to the beginning which becomes 320 point IQ time domain waveform.

Next step is to scale the 5 time domain OFDM waveforms to a complex magnitude below 1, and for each I and Q (1600 point IQ time domain waveform). At last transmit I and Q using the NI USRP Write Tx Data.

B. OFDM Receiver

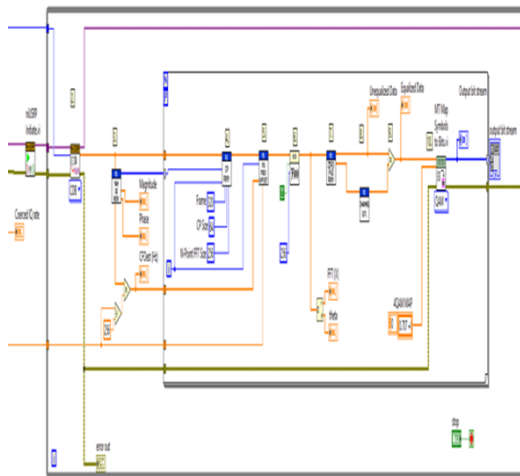


Fig. 3. OFDM receiver

First step is to initialize the USRP setting the RX parameters and moving the LO outside the transmission band. Then after antialiasing, random data bits PN Sequence of 125 bits are generated. After that use the Van De Beek algorithm to detect the cyclic prefix locations for synchronization and estimate frequency offset. Then remove the cyclic prefix. Remove the frequency offset from the incoming signal. And then compute the FFT converting the time domain OFDM symbol to the frequency domain. Once FFT are computed separate data bits and reference bits. After that remove zero padding. Then for both I and Q based on reference symbols equalization coefficients are computed using a linear fit .then apply the equalization is applied to the data symbols. At last convert data symbol mapping back to data bits.

IV. EXPERIMENTAL RESULTS

A. OFDM Transmitter

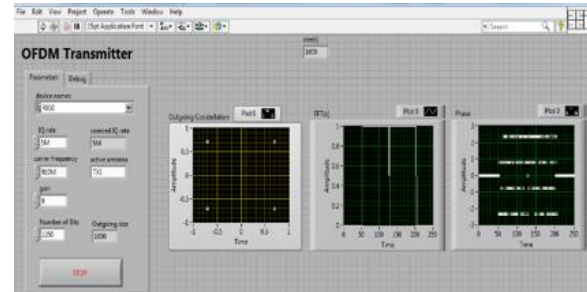


Fig. 4. OFDM transmitter

B. OFDM receiver

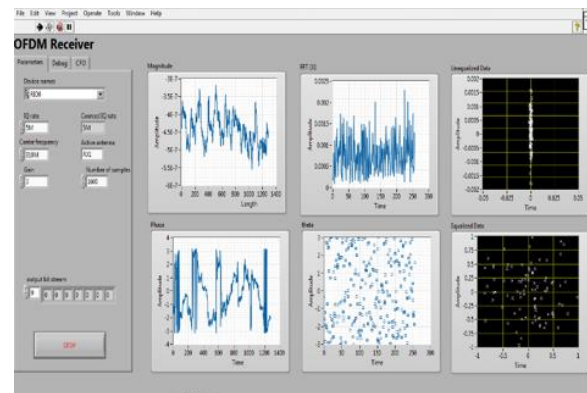


Fig. 5. OFDM receiver

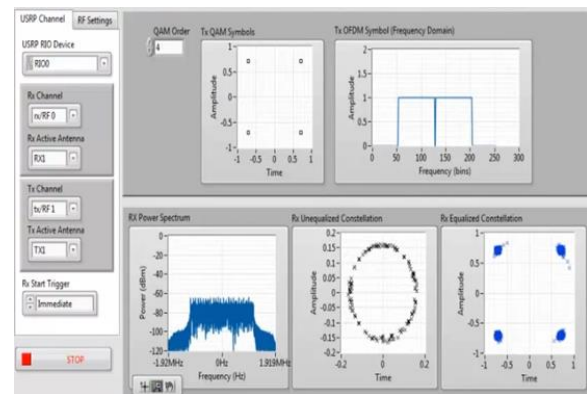


Fig. 6. Results

V. CONCLUSION

The implementation of OFDM system becomes very simple by using SDR. Since it replaces all hardware that is used in the traditional communication system with software. Thus the OFDM system is implemented on NI USRP RIO-2943R with LABVIEW software.

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