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Performance Evaluation of OFDM Based Link Using LabVIEW 2012

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Key Words: *LabVIEW 2012; Orthogonal Frequency Division Multiplexing (OFDM); QPSK; QAM.*

Abstract. *Background: Orthogonal Frequency Division Multiplexing (OFDM) has emerged as the core technology of the 4th generation mobile communication due to its capacity to combat channel fading also OFDM is highly spectral efficient. Methods/ Statistical Analysis: LabVIEW 2012 is used to simulate and evaluate the performance of OFDM link. Bit Error Rate (BER) evaluation of discrete Fourier transform (DFT) based OFDM system is carried out in this work. The simulation based analysis is demonstrated by means of different modulation schemes like QPSK, 16-QAM for OFDM based wireless system. Findings: QPSK needs less SNR as compared to 16-QAM to achieve an acceptable BER Furthermore, the efficiency of OFDM increases with increase of cyclic prefix. In OFDM, ISI and ICI-interference reduced by implying cyclic prefix. Applications/Improvements: The performance analysis of orthogonal frequency division multiplexing is analyzed using LabVIEW 2012 based on performance parameters like cyclic prefix simulated at frequency of 2.4 GHz using FFT size 512, 1024.*

I. Introduction

Orthogonal frequency division multiple access (OFDMA) has been widely adopted as the air interface for high speed wireless multiuser communication networks, due to its immunity to channel delay spread and flexibility in resource allocation [1,2]. Advanced modulation schemes are required to transfer the huge amount of data as ordinary modulation schemes cannot support high speed data transfer. These schemes must be able to provide high data rate, minimum allowable Bit Error Rate (BER) [3], and minimum delay. Orthogonal Frequency Division Multiplexing (OFDM) is one of promising wireless modulation scheme OFDM [4] has also been standardized as the physical layer for the wireless networking standard as the IEEE 802.11a,g [4,5] promising raw data rates of between 6 Mbps and 54 Mbps. Orthogonal Frequency Division Multiplexing (OFDM) is a digital transmission method developed to meet the increasing demand for higher data rates in communication which can be used in both wired and wireless environment [6]. In this paper, the performance of the OFDM system has been simulated by analyzing the effect of the various design parameters like normalized signal to noise ratio (Eb/ No), cyclic prefix w.r.t power spectrum, BER spectrum and constellation plot using LabVIEW 2012 software. Orthogonal frequency division multiplexing (OFDM) is a widely used as a multiplexing technology. The OFDM scheme [7] is based on spreading the data to be transmitted over a large number of carriers, each being modulated at a low data rate. The carriers are propagated orthogonal to each other by appropriately choosing the frequency spacing between them. OFDM signal are generated by taking symbols in the spectral space using M- array modulation scheme like PSK, QAM etc., and convert the spectra to time domain using inverse discrete Fourier transform (IFFT) which is more cost effective to implement, it is usually used instead [7].

II. OFDM Link Design Consideration

The proposed OFDM link is designed using LabVIEW 2012. The system is operated with the basic communication system, which consists of a transmitter, transmission link and receiver. Based on the proposed OFDM model, the block window diagram has been designed which consists of number of sections i.e. Analysis block, data source, channel coding and these blocks consists of multiplexers, digital gates, flip-flop, coding techniques etc. The basic input parameters that are required to optimize the results are normalized signal to noise ratio (E_b/N_o), channel selection, cyclic prefix, type of mode. And the output is observed through power transmission and reception, BER, constellation diagram. The output is analyzed in terms of BER, Constellation diagram. The cyclic prefix is varied within limits to optimize the link performance.

III. Results and Discussions

The analysis and optimization of the design is done by LabVIEW software. The results are tabulated into *table 1.*

Table 1. BER of diverse QPSK at different normalized signal to noise ratio and cyclic prefix

Eb/No	Number of Bits	BER at ¼ cyclic prefix	BER at 1/8 cyclic prefix	BER at 1/16 cyclic prefix
5	3.06816+5	4.740-2	3.810-2	4.0697-2
9	3.048696+5	1.84066-2	1.52577-2	1.69654-2
13	3.00424+5	9.75288-3	8.97606-3	9.96679-3
17	3.0866+5	7.0011-3	6.79706-3	7.56803-3

Results of QPSK are given in *figure 2. Figure 2* shows that at QPSK Modulation scheme with cyclic prefix of 1/8 and Eb/NO Value of 13, the OFDM Based link has BER value of 1.525*10-2.

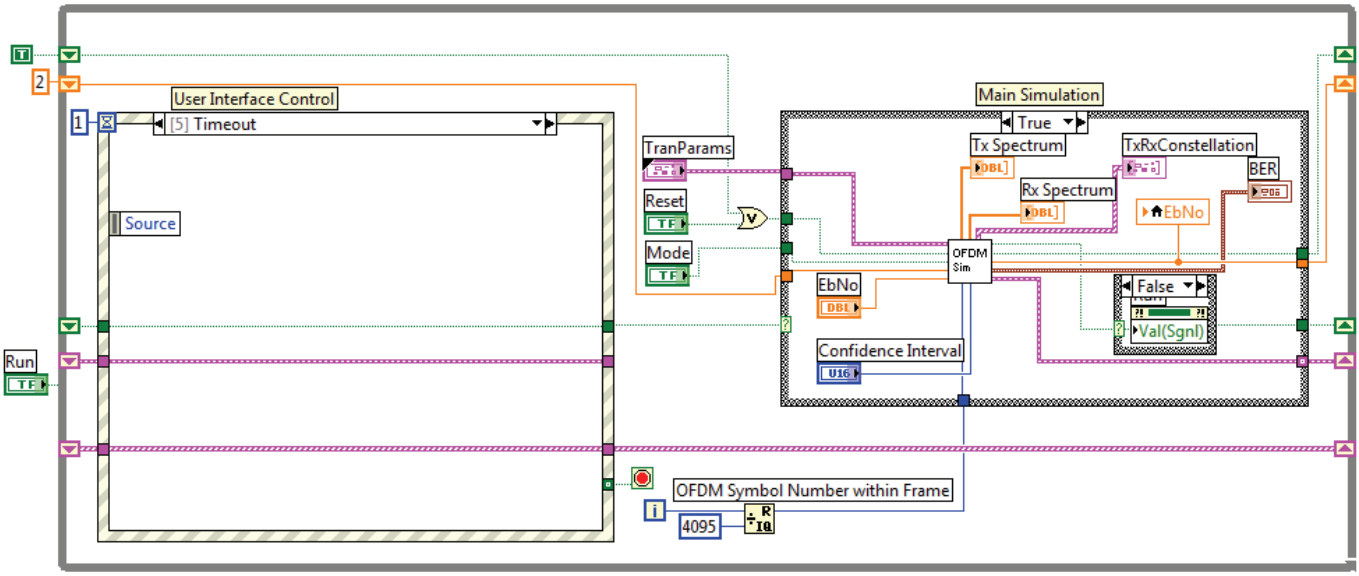

Figure 1. Block diagram of OFDM

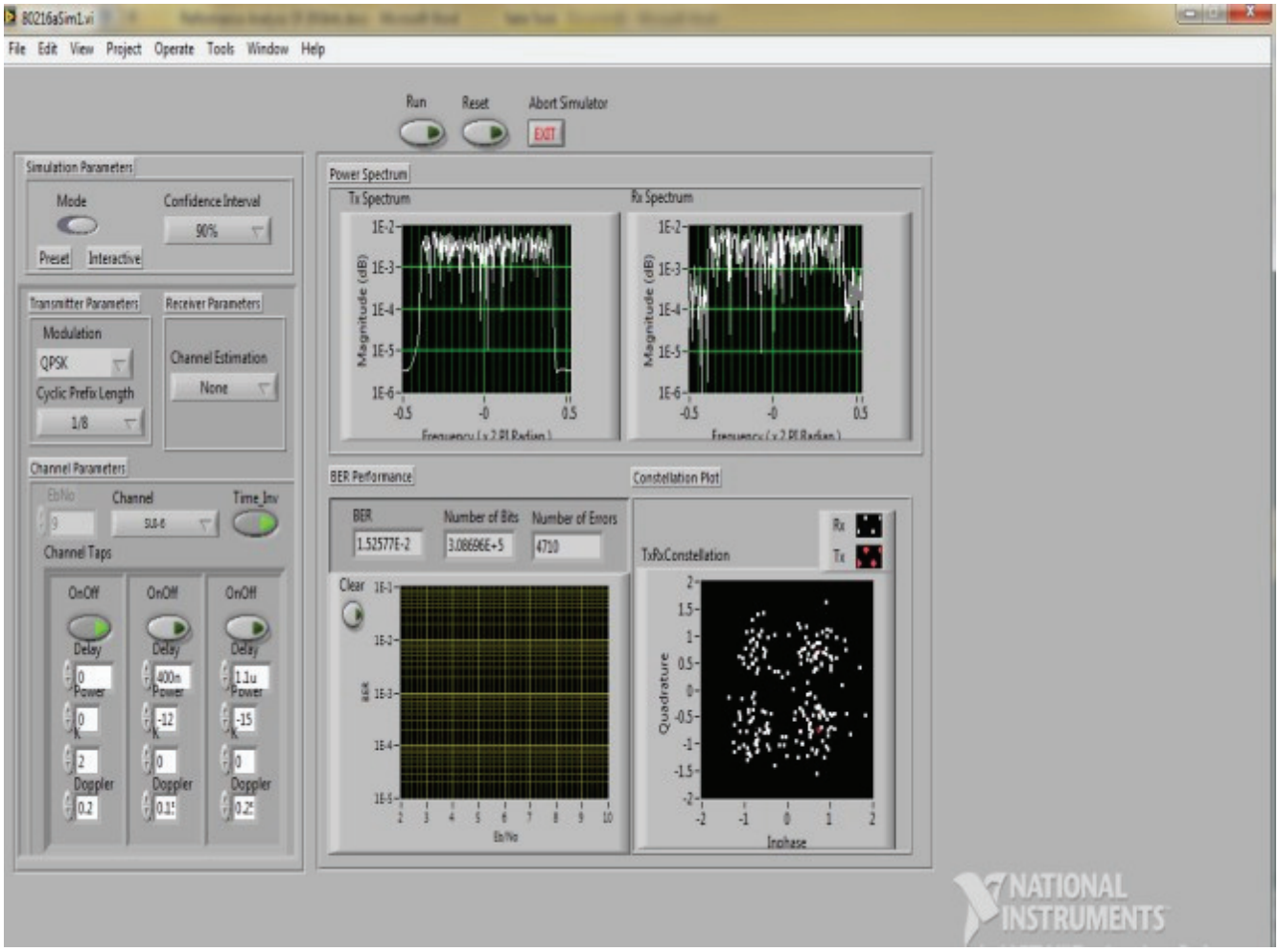

Figure 2. QPSK using Eb/No. 13 and cyclic prefix 1/8

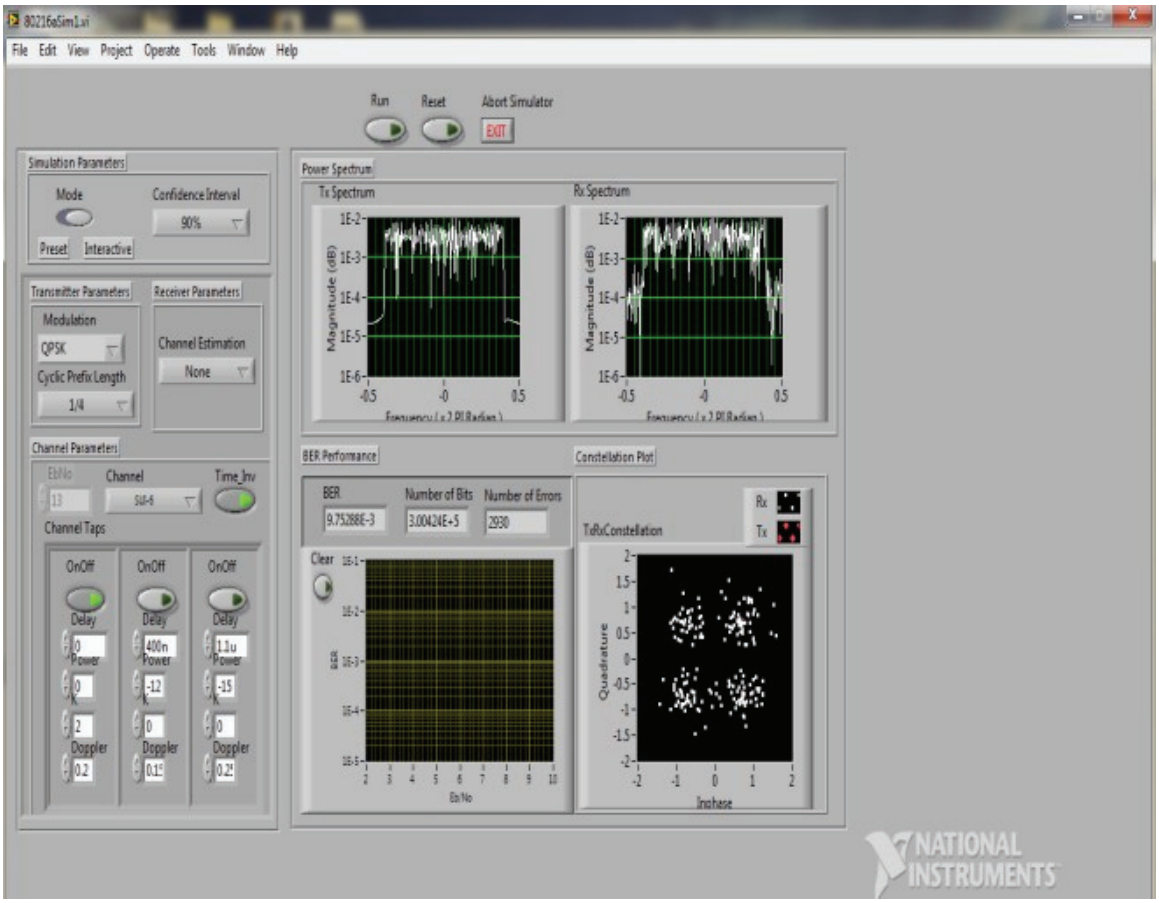

Figure 3. QPSK using Eb/No. 13 and cyclic prefix j

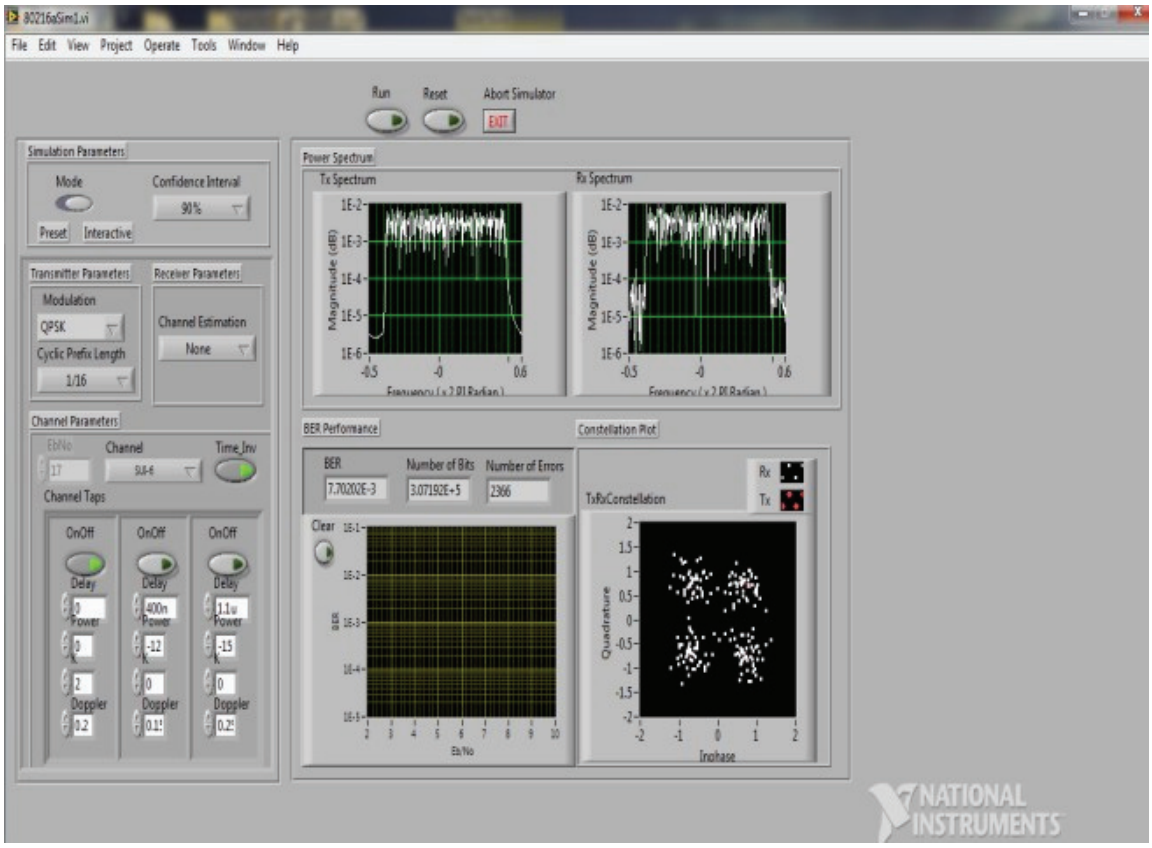

Figure 4. QPSK using cyclic prefix 1/16 and Eb/No. 17

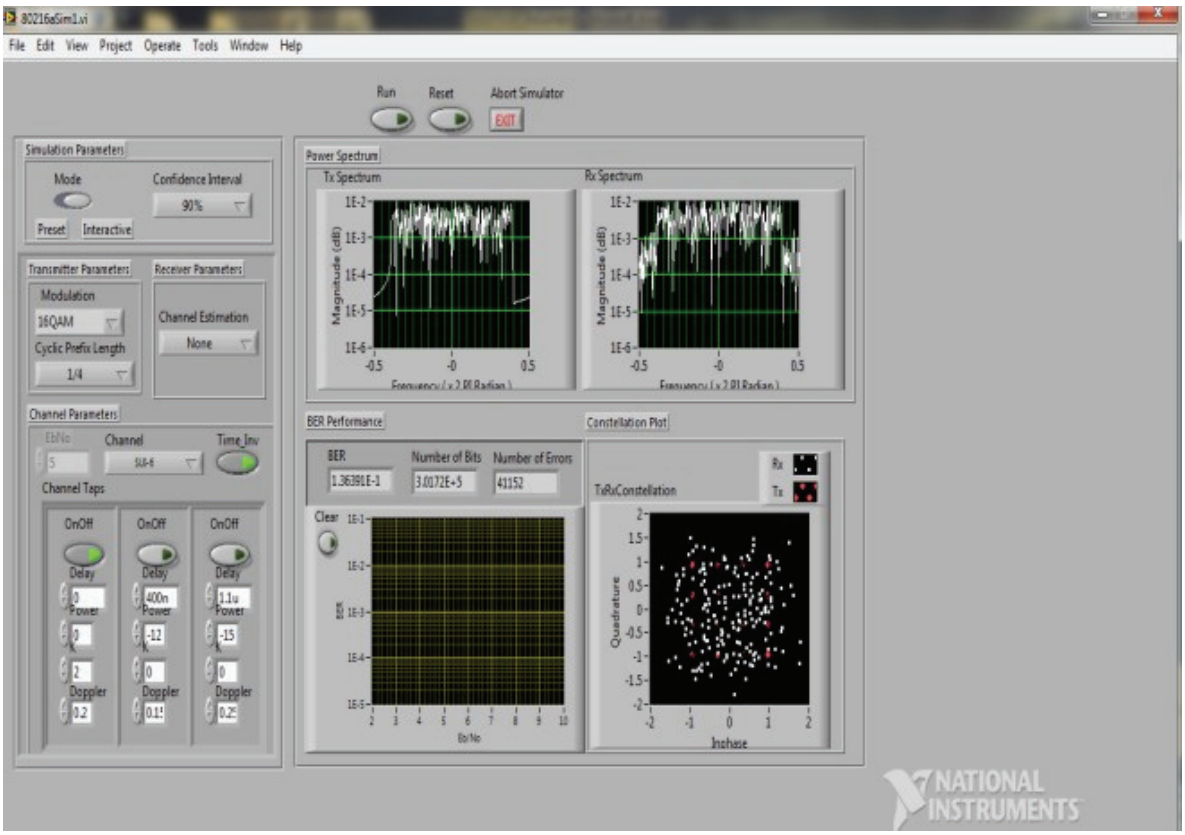

Figure 5. 16 QAM at 1/4 cyclic prefix and Eb/No. 5

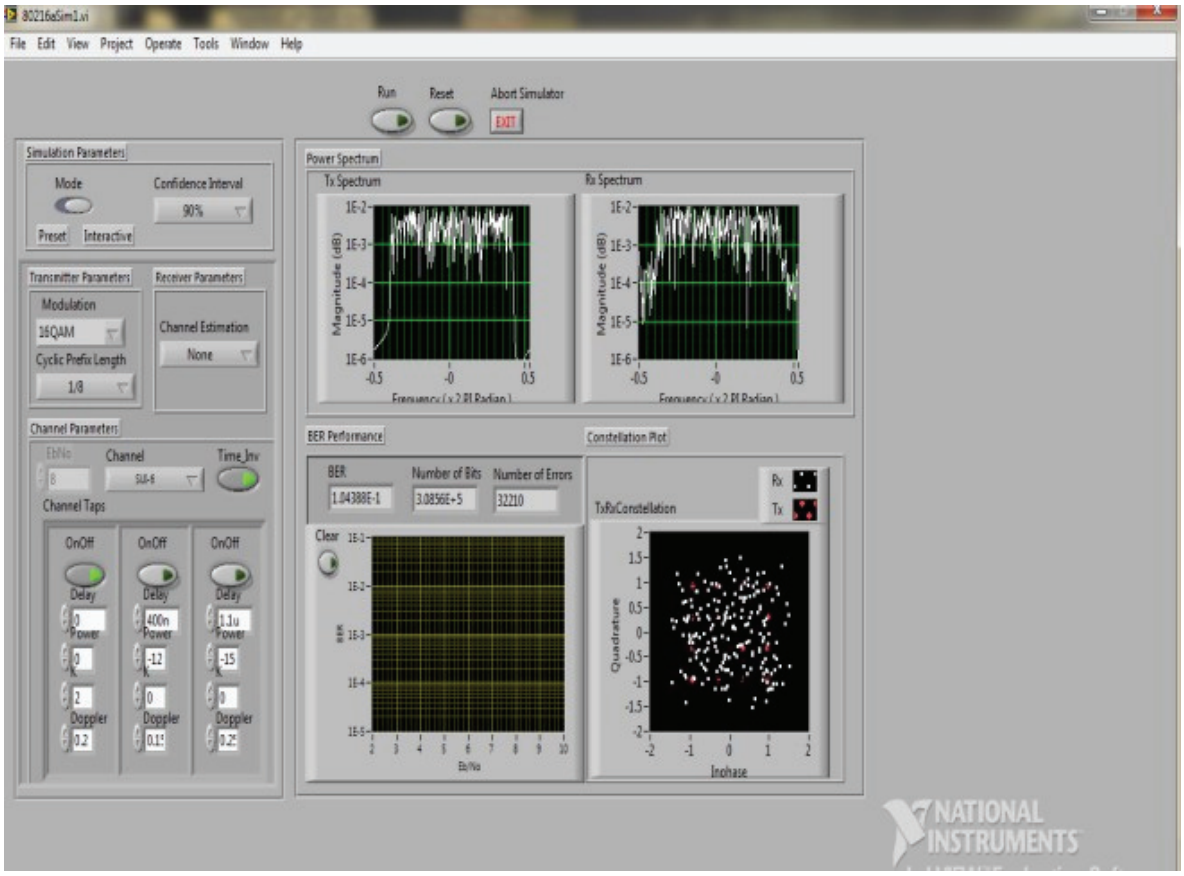

Figure 6. 16 QAM using 1/8 cyclic prefix and Eb/No. 8

Here results can be further improved by making improvement in Signal to noise ratio and cyclic prefix.

Results of QPSK are given in *figure 3*. *Figure 3* shows that at QPSK Modulation scheme with cyclic prefix of 1/4 and Eb/NO Value of 13, the OFDM Based link has BER value of 9.75*10-3. Here results can be further improved by making improvement in Signal to noise ratio and cyclic prefix.

Results of QPSK are given in *figure 4*. *Figure 4* shows that at QPSK Modulation scheme with cyclic prefix of 1/16 and Eb/NO Value of 17, the OFDM Based link has BER value of 7.7*10-3.

Here results can be further improved by making improvement in Signal to noise ratio and Cyclic prefix.

Table 2 shows the various other results obtained by varying other parameters like Modulation scheme cyclic prefix and signal to noise ratio.

Results of QAM are given in *figure 5*. *Figure 5* shows that at 16QAM Modulation scheme with cyclic prefix of 1/4 and Eb/NO Value of 5, the OFDM Based link has BER value of 1.36*10-1.

Results of QAM are given in *figure 6*. *Figure 6* shows that at 16QAM Modulation scheme with cyclic prefix of 1/8 and Eb/NO Value of 8, the OFDM Based link has BER value of 1.04*10-1.

Results of QAM are given in *figure 7*. *Figure 7* shows that at 16QAM Modulation scheme with cyclic prefix of 1/16 and Eb/NO Value of 12, the OFDM Based link has BER value of 9.13*10-2. The various results show that with increase in signal to noise ratio and variation cyclic prefix from j to 1/16 using QPSK has better performance as compared to 16QAM.

The OFDM based link is designed and simulated using LabVIEW 2012. The OFDM system is designed based on QPSK and 16-QAM modulation scheme. The performance analysis of BER vs. SNR for OFDM link at transmitter and receiver is being investigated in this research. From the result it can be concluded that cyclic prefix of 1/8 gives the best result in both QPSK and 16 QAM modulations Technique. Further results show that with increase in signal to noise ratio and variation in cyclic prefix from 1/4 to 1/16 using QPSK has better performance as compared to 16-QAM.

Table 2. BER of 16 QAM at different normalized signal to noise ratio and different cyclic prefix

Eb/No	Number of Bits	BER at ¼ cyclic prefix	BER at 1/8 cyclic Prefix	BER at 1/16 cyclic prefix
5	3.0712+5	1.36391-1	1.27459-1	1.29545-1
8	3.0586+5	1.11822-1	1.04388-1	1.06957-1
12	3.0932+5	9.26076-2	9.005-2	9.13358-2

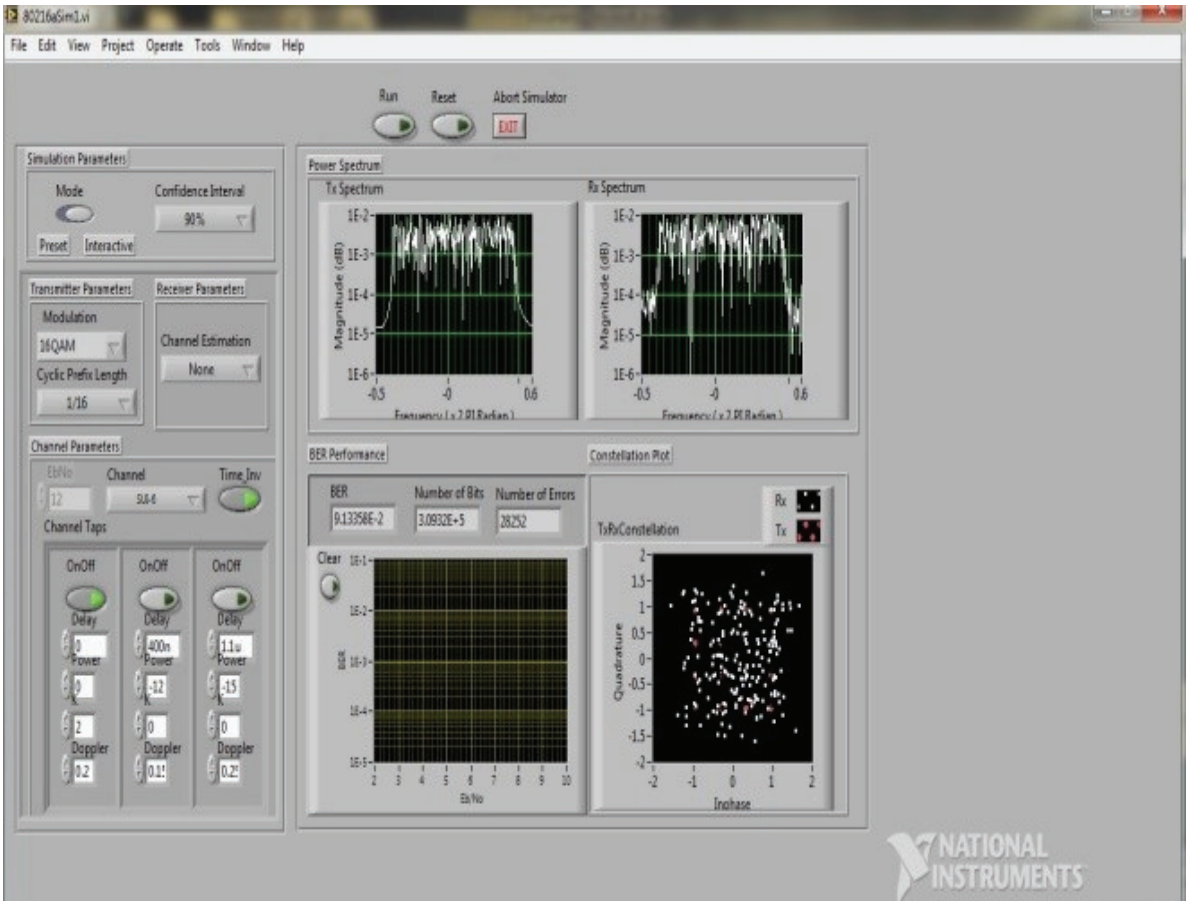

Figure 7. 16 QAM using 1/16 cyclic prefix and Eb/No. 12

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