Analysis Of Impact Of Various Parameters On BER Performance For IEEE 802.11b

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Abstract : This paper discusses about IEEE 802.11b simulation model implemented using LabVIEW® software and its analyses for impact on bit error rate (BER) for different parameters as channel type, channel number, data transmission rate and packet size. Audio file is being transmitted, processed and analyzed using the model for various parameters. This paper gives analysis of BER verses ES/N0 for various parameter like data rate, packet size and communication channel for the IEEE 802.11b simulation model generated using LabVIEW®. It is proved that BER can be optimized by tweaking different parameters of wireless communication system.

Index Terms: LabVIEW, IEEE 802.11b, BER, WLAN, AWGN, Rayleigh, Rician

1 Introduction

A wireless local area network (WLAN) is a digital transmission system designed to provide location independent network access between computing devices by using radio waves in a limited area. Mainly IEEE 802.11 standards are used to provide wireless connectivity at higher speeds. The 802.11b standard is the first standard to make WLANs usable in the general workplace by providing robust and reliable 11 Mbps performance, five times faster than the original standard IEEE 802.11. [1] This paper consist analysis of BER performance of IEEE 802.11b model implemented in LabVIEW software from National Instruments for various data rates, wireless communication channels types, packet size and non-overlapping channels (or in other words, frequency of transmission). By increasing the signal power or reducing the noise spectral density so as to maximizing the signal to noice ratio Es/N_0, data transmission reliability can be increased. There is a limitation on the maximum value of the Es/N_0. Hence, for a fixed value of Es/N_0, we have to change other parameter to improve quality of the transmitted signal. [2]

2 Description of IEEE 802.11b model using LabVIEW

2.1 Wlan 802.11b Generation

Modulation tool kit and WLAN tool kit are used to generate this VI. In this model First Audio file is converted to digital using Convert analog to digital VI. niWLAN generation property node has been used to get or set properties and methods on Vis. In which few controls are given on front panel to set the user defined data. User can set the Data rate, preamble type, payload data length and carrier frequency (Channel No.) as per requirement of analysis. niWLANG create waveform VI is used to Creates WLAN I/Q waveform data according to the properties that is specified in VI. This VI returns one frame, including the idle interval, at a time.

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2.2 Channel

AWGN Channel, Rayleigh channel and Rician channel are used for the analysis of 802.11b model for various parameter. MT Rayleigh Fading profile is used to generate Rayleigh fading. This VI generates a Rayleigh flat-fading profile with an envelope that statistically obeys the Rayleigh distribution, using the Jakes fading model. MT Rician fading profile is used to generate Rician fading. This VI generates a Rician flat-fading profile with an envelope that statistically obeys the Rician distribution, using the Jakes fading model.

2.3 WLAN 802.11b Analysis

niWLANAnalysis property node has been used to set the parameter for the analysis of 802.11b model. niWLANA Analyze VI is used to Performs direct sequence spread spectrum (DSSS) demodulation measurements on the complex-valued signals specified by the input complex waveform parameter. Sequence of bits obtained from the signal after demodulation and decoding is compared with the transmitted sequence of the bits using MT calculate BER VI. Bit error rate for the various parameters has been analyzed for the WLAN 802.11 b standard and graph of the BER has been plotted for different Signal to Noise ratio. Fig. 1 shows the block diagram of the IEEE 802.11b model generated using LabVIEW and Fig. 2 shows the front panel of the VI. User can set the different parameter to analyze the effect of it on 802.11b model.

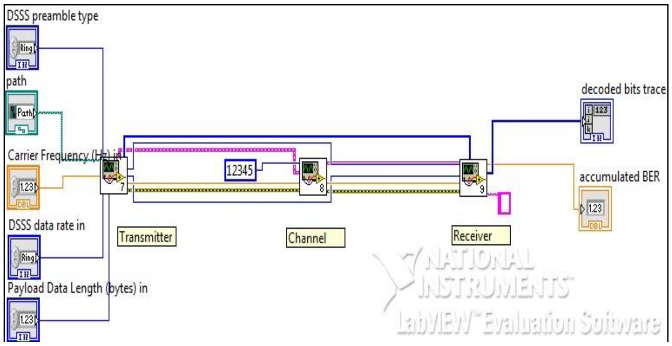

Fig. 1 *block diagram of IEEE 802.11b model using LabVIEW*

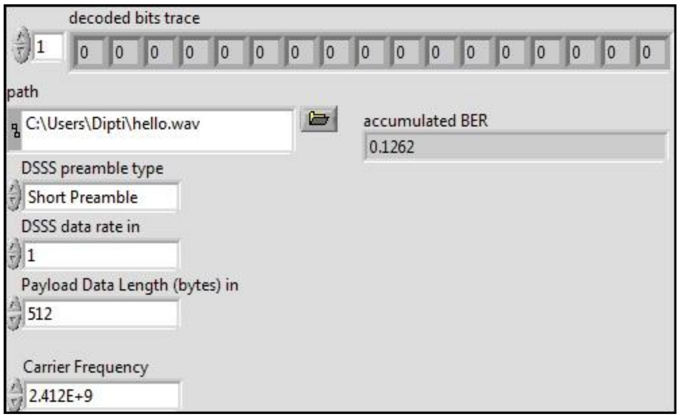

Fig. 2 *Front panel control for IEEE 802.11b model*

3 RESULTS

In this work results were generated for the different data rates, Channel numbers and packet size for AWGN, Rician and Rayleigh channel to analyses the effect of different parameter on 802.11b model. BER verses Es/N_0 graph is plotted for various data rate. Fig. 3, Fig. 4 and Fig. 5 represents the effect of Es/N_0 on the BER at data rates of 1Mbps, 2Mbps, 5.5Mbps and 11Mbps for the wireless channel AWGN, Rician and Rayleigh respectively. Performance of Rician channel is best among all the three channels.

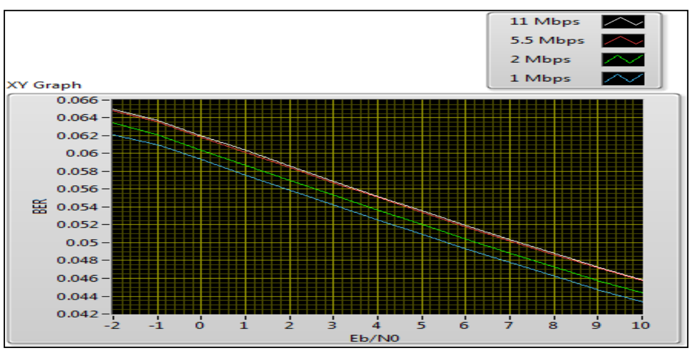

Fig. 3 *Plot of BER vs. Es/N0 for AWGN channel For Channel Type – AWGN; Channel N0. – 1; Long Preamble; Packet Size – 512*

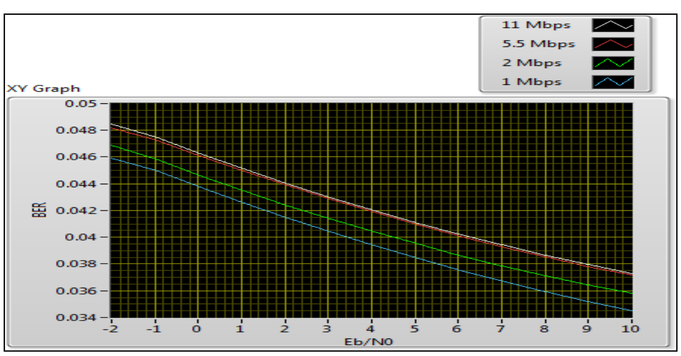

Fig. 4 *Plot of BER vs. Es/N0 for Rician channel for Channel Type – Rician; Channel No. – 1; Long Preamble; Packet Size - 512*

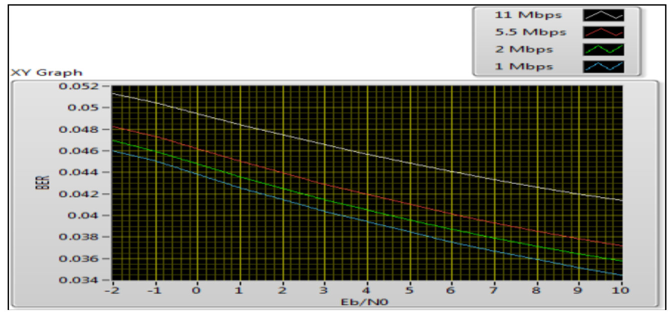

Fig. 5 *Plot of BER vs. Es/N0 for Rayleigh channel for Channel Type – Rayleigh; Channel N0. – 1; Long Preamble; Packet Size – 512*

TABLE I. *RESULTS FOR VARIOUS DATA RATES*

Channel	Data Rate			
	1 Mbps	*2 Mbps*	*5.5 Mbps*	*11 Mbps*
AWGN	0.05090	0.05200	0.05340	0.05355
RICIAN	0.03847	0.03954	0.04098	0.04111
RAYLEIGH	0.03941	0.04048	0.04100	0.04483

In Fig. 6, 7, 8 and 8, effect of Es/N_0 on BER is investigated for the packet size 512, 1024, 2048 and 4096. Table II shows impact on BER for various packet size for different data rates for channel number 6. As shown in the table II, BER increases as number of transmitted packets is increased. Hence, in order to reduce the BER, lower packet size can be used. The same table also proves that for higher packet size, lower data rate can be used to reduce BER.

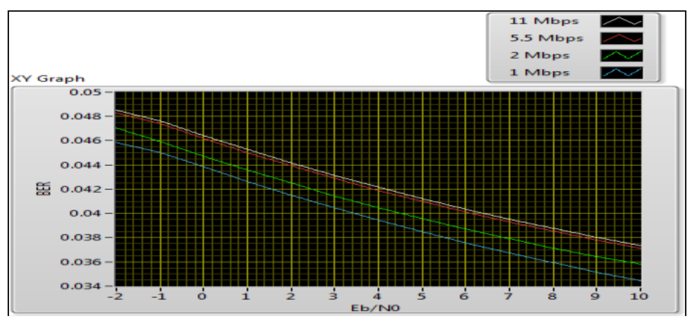

Fig. 6 *Plot of BER vs. Es/N0 for packet size 512 for Channel Type – Rician; Channel No. – 6; Long Preamble; Packet Size – 512*

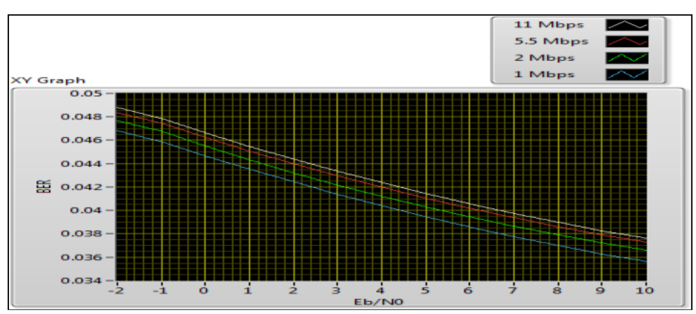

Fig. 7 *Plot of BER vs. Es/No for packet size 1024 for Channel Type – Rician; Channel No. – 6; Long Preamble; Packet Size – 1024*

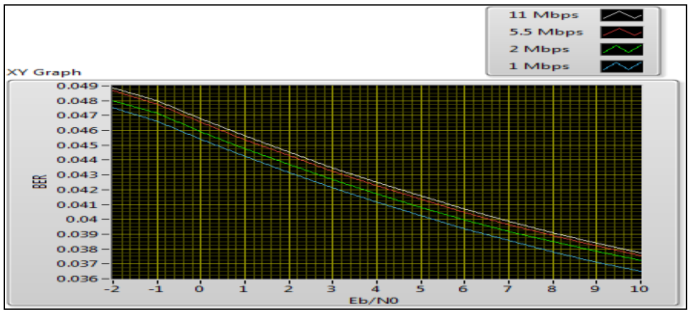

Fig. 8 *Plot of BER vs. Es/N0 for packet size 2048 for Channel Type – Rician; Channel No. – 6; Long Preamble; Packet Size – 2048*

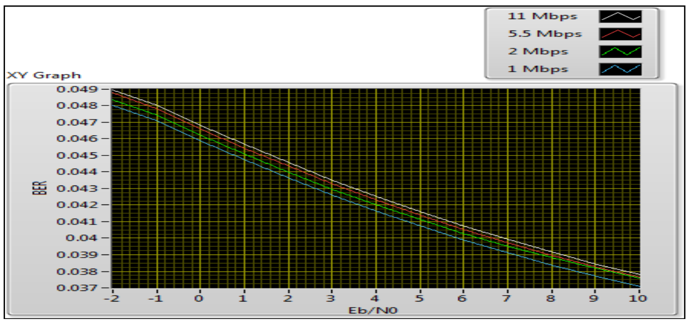

Fig. 9 *Plot of BER vs. Es/N0 for packet size 4096 for Channel Type – Rician; Channel No. – 6; Long Preamble; Packet Size - 4096*

TABLE II. *RESULTS FOR VARIOUS PACKET SIZE*

Packet Size	Data Rate for Non-overlapping channel No. 6			
	1 Mbps	*2 Mbps*	*5.5 Mbps*	*11 Mbps*
512	0.03848	0.03955	0.04097	0.04121
1024	0.03947	0.04027	0.04106	0.04143
2048	0.04116	0.04172	0.04225	0.04249
4096	0.04164	0.04200	0.04230	0.04254

For this analysis, non-overlapping channel no. 1, 6 and 11 are used to transmit the signal and effect of Es/No on BER is analyzed for data rate 1 Mbps, 2 Mbps, 5.5 Mbps and 11Mbps.

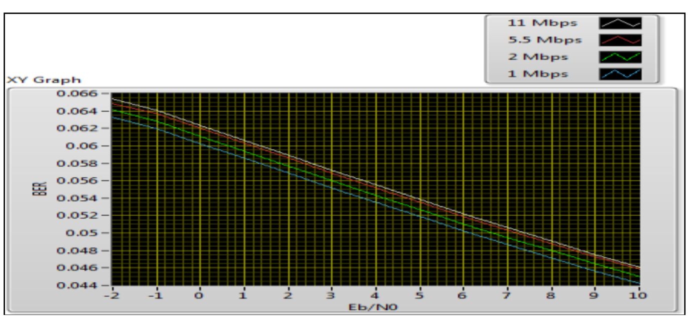

Fig. 10 *Plot of BER vs. Es/N0 for various non-overlapping channel number-1 For Channel Type – AWGN; Channel No. – 1; Long Preamble; Packet Size – 1024*

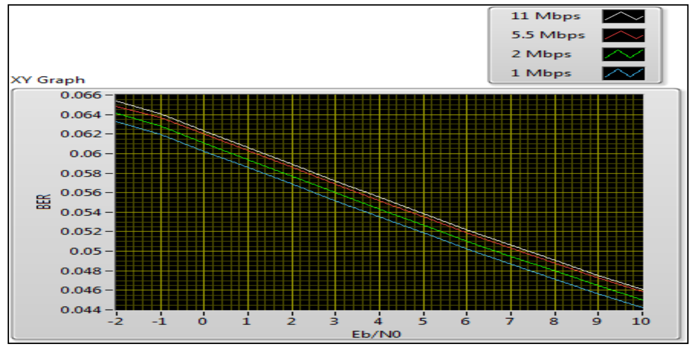

Fig. 11 *Plot of BER vs. Es/N0 for various non-overlapping channel number-6 For Channel Type – AWGN; Channel No. – 6; Long Preamble; Packet Size – 1024*

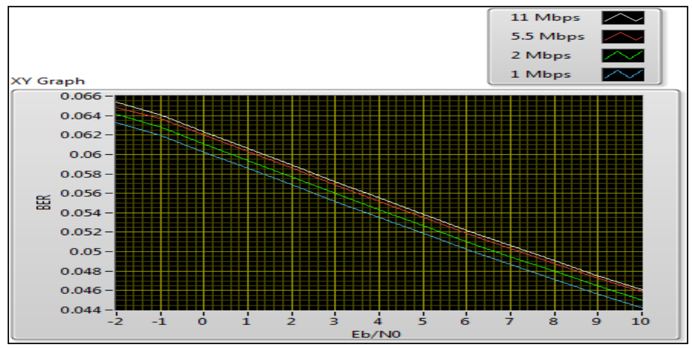

Fig. 12 *Plot of BER vs. Es/N0 for various non-overlapping channel number-11 For Channel Type – AWGN; Channel No. – 11; Long Preamble; Packet Size – 1024*

As shown in the table III below, selection of non overlapping channel does not have much impact on the BER value for AWGN channel type. However, we do observe variation in the BER value for Rician as well as Rayleigh channel type.

TABLE III*. BER VALUES FOR NON-OVERLAPPING CHANNELS*

Channel No.	Channel Type		
	AWGN	*RICIAN*	*RAYLEIGH*
1	0.05184	0.03943	0.03940
6	0.05184	0.03947	0.03946
11	0.05184	0.03942	0.03946

4 CONCLUSION

Lowest possible BER is one of the most desired properties for any digital communication system. As per the results shown in this paper, it is proved that BER is dependent on many parameters in a WLAN system. BER value can be improved tweaking various parameters. Selection of non-lapping channel does not have much impact on the BER value. Also BER performance improves in Rician and Rayleigh channel type compare to AWGN channel. The results obtained in this experiment can be very helpful to designed a cognitive radio system in which the system will adapt itself to match the desired BER.

REFERENCES

[1] "IEEE 802.11b Wireless LANs Wireless Freedom at Ethernet Speeds", technical paper, 3Com.

[2] Nilesh Kalani, Dipti Anant and Dr. G. R. Kulkarni, "Performance analysis of linear modulation techniques with different channel coding in LabVIEW ® ", IEEE International conference on Circuits, Controls and Communications (CCUBE), 2013

[3] Antonis Athanasopoulos, Evangelos Topalis, Christos Antonopoulos, Stavros Koubias,"Evaluation Analysis of the Performance of IEEE 802.11b and IEEE 802.11g Standards", Proceedings of ICNICONSMCL'06.

[4] Puttipong Mahasukhon, Michael Hempel, Hamid Sharif, Ting Zhou, Song Ci, Hsiao-Hwa Chen, "BER Analysis of 802.11b Networks under Mobility", ICC 2007 proceedings

[5] Nuzhat Tasneem Awon, Md. Mizanur Rahman, Md. Ashraful Islam, A.Z.M. Touhidul Islam, "Effect of AWGN & Fading (Raleigh & Rician) channels on BER performance of a WiMAX communication System", International Journal of Computer Science and Information Security, Vol. 10, No. 8, August 2012.

[6] Javier del Prado Pavon, Sunghyun Choi, "Experimental Performance Evaluation of Wireless 802.11b Networks", Proceeding IEEE ICC, Vol. 2, pp. 1108-1113, May, 2003.

[7] Sourangsu Banerji, Rahul Singha Chowdhury, "On IEEE 802.11: Wireless LAN Technology", International Journal of Mobile Network Communications & Telematics (IJMNCT) Vol.3, Issue 4, 2013.

[8] LabVIEW System Design Software, National instruments [Online]. Available: http://www.ni.com/labview/.