Effect of Various Parameters on BER of Wireless Communication System

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Abstract: ***purpose of this paper presents 802.11b PHY simulation model BER. In this model various parameters are given like data rate, packet size, various wireless channel number and channel type. So we perform the model for fixed channel AWGN, data rate1mbps, 2mbps 5.5 mbps and 11 mbps and Packet size varies from 1-4095. It's give various BER graph for various channel number.***

***Key Words*—Transmission, IEEE 802.11b, PHY, Simulink, BER**

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I. INTRODUCTION

Bit error rate, BER is a key parameter that is used in assessing systems that transmit digital data from one location to another. Systems for which bit error rate, BER is applicable include radio data links as well as fiber optic data systems, Ethernet, or any system that transmits data over a network of some form where noise, interference, modulation technique, data rate signal to noise ratio and phase jitter may cause degradation of the digital signal. So BER is generated. Although there are some differences in the way these systems work and the way in which bit error rate is affected, the basics of bit error rate itself are still the same.

When data is transmitted over a data link, there is a possibility of errors being introduced into the system. If errors are introduced into the data, then the integrity of the system may be compromised. As a result, it is necessary to assess the performance of the system, and bit error rate, BER, provides an ideal way in which this can be achieved. So different wireless standard have different data rate, modulation technique, signal to noise ratio & phase jitter.

Over the past few years, there has been increasing importance on extending the services available on wired public telecommunications networks to mobile users. At present in addition to it, only low bit data services are available to mobile users. However, standards for wireless broadband multimedia communication systems are anticipated within both public and private sectors.

The purpose of this paper is to a physical layer simulator of the W-LAN (defined by IEEE 802.11b) has been constructed in Matlab in order to simulate the radio interface. Both the 5.5 Mbps and the 11 Mbps modes have been implemented, but the slower basic and enhanced access rates, i.e. 1 Mbps and 2 Mbps, are not implemented. According to the IEEE specification the W-LAN should transmit the data in frames, but the preamble and the header are not implemented. Only the part which contains the data to be transmitted is implemented. [7]

This efficient work is a useful to find BER of WLAN 802.11b PHY wireless model[9] for different supported data rate as per protocol 802.11b like 1mbps, 2 mbps, 5.5 mbps and 11 mbps over an Additive White Gaussian Noise (AWGN) channel.

II. BER AND SIGNAL TO NOISE RATIO

Signal to noise ratios and Eb/No figures are parameters that are more associated with radio links and radio communications systems. In terms of this, the bit error rate, BER, can also be defined in terms of the probability of error or POE. The determine this, three other variables are used. They are the error function, erf, the energy in one bit, Eb, and the noise power spectral density (which is the noise power in a 1 Hz bandwidth).[5][3]

It should be noted that each different type of modulation has its own value for the error function. This is because each type of modulation performs differently in the presence of noise. In particular, higher order modulation schemes (e.g. 64QAM, etc) that are able to carry higher data rates are not as robust in the presence of noise. Lower order modulation formats (e.g. BPSK, QPSK, etc.) offer lower data rates but are more robust. [5]

The energy per bit, Eb, can be determined by dividing the carrier power by the bit rate and is a measure of energy with the dimensions of Joules. No is a power per Hertz and therefore this has the dimensions of power (joules per second) divided by seconds). Looking at the dimensions of the ratio Eb/No all the dimensions cancel out to give a dimensionless ratio. It is important to note that POE is proportional to Eb/No and is a form of signal to noise ratio. [3]

III. 802.11b PHY MODEL DESCRIPTION

802.11b and 802.11g use the 2.4 GHz ISM band, operating in the United States under Part 15 of the US Federal Communications Commission Rules and Regulations. Because of this choice of frequency band, 802.11b and g equipment may occasionally suffer interference from microwave ovens, cordless telephones and Bluetooth devices. 802.11b and 802.11g control their interference and susceptibility to interference by using direct-sequence spread spectrum (DSSS) and orthogonal frequency-division multiplexing (OFDM) signaling methods, respectively. 802.11a uses the 5 GHz U-NII band, which, for much of the world, offers at least 23 non-overlapping channels rather than the 2.4 GHz ISM frequency band, where adjacent channels overlap - see list of WLAN channels. Better or worse performance with higher or lower frequencies (channels) may be realized, depending on the environment. [7]

And 802.11g fall within the2.4 GHz amateur radio band. Licensed amateur radio operators may operate 802.11b/g devices under Part 97 of the FCC Rules and Regulations, allowing increased power output but not commercial content or encryption. [7]

802.11g devices may be operated without a license, as allowed in Part 15 of the FCC Rules and Regulations. Frequencies used by channels one through six of 802.11b
The segment of the radio frequency spectrum used by 802.11 varies between countries. In the US, 802.11a and 802.11g devices may be operated without a license, as allowed in Part 15 of the FCC Rules and Regulations. Frequencies used by channels one through six of 802.11b and 802.11g fall within the2.4 GHz amateur radio band. Licensed amateur radio operators may operate 802.11b/g devices under Part 97 of the FCC Rules and Regulations, allowing increased power output but not commercial content or encryption. [6]

The model is developed in such a way that it gives complete analysis of transmitted bit. The Figure 1 depicts the modeling of the simulation. In this model the first task is to load the bit, do the packetization and generates various vectors needed at later stage.
Then after all the data goes into the Simulink file WIFI.mdl that implements PHY of the IEEE 802.11b networks. This model is shown in Figure 2.This model Implements: IEEE Std 802.11b-1999 PHY [11] for all the technical configuration mention below

- Mode/Data Rate: Choose from 1Mpbs, 2Mbps, 5.5Mbps or 11Mbps
- Packet size: 1-4095 Bytes
- Use short preamble: An option for 2, 5.5 or 11Mbps options only
- Channel number: Select from 1 to 11
- Channel type: AWGN
- Es/No: Channel noise power for AWGN channel

The transmitter and receiver are shown in Figure 3 and 4 respectively.

IV.SIMULATION RESULT

The behavior of a typical mobile wireless channel is considerably more complex than that of an Additive White Gaussian Noise (AWGN) channel. The mobile wireless channel is susceptible to a number of impairments including multipath fading, shadowing, interference and noise. These impairments can cause large degradation on performance when compared to AWGN channel.

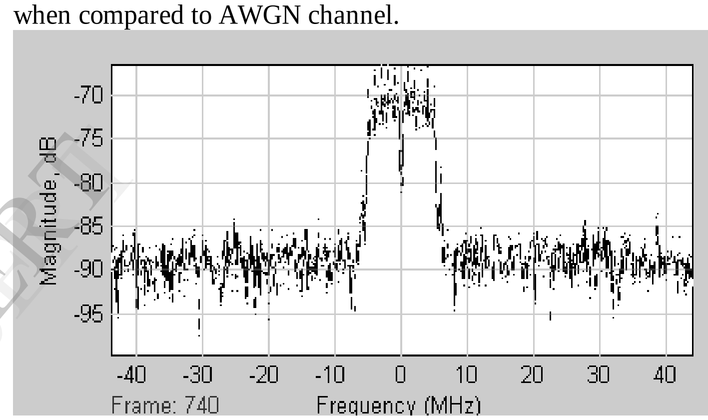

Fig 1: Frequency Spectrum at Receiver end

The Figure 1 shows the Frequency Spectrum of the system at receiver side. The Eye-Diagram analysis at the receiver end is shown in Figure 2 and Figure 3 respectively for In-phase and Quadrature-phase amplitude. It was observed that eye was opened considerably to be said as good reception.

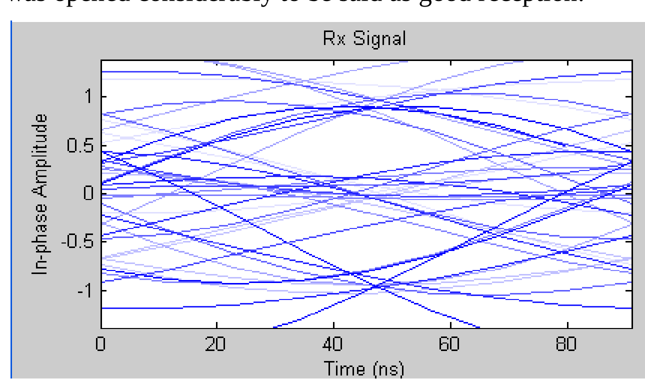

Fig 2: Eye Diagram for Received In-Phase Amplitude

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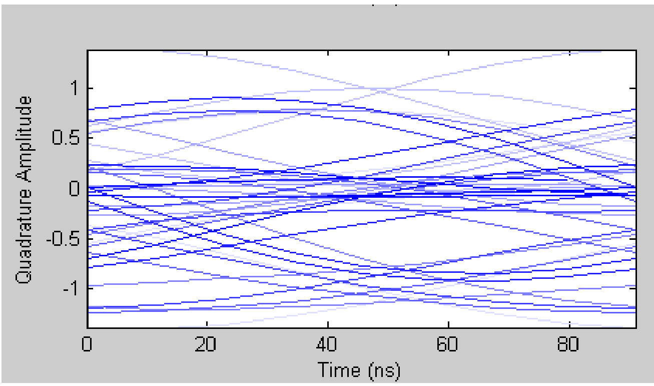

Fig 3: Eye Diagram for Received Quadrature Amplitude

Now finally, at the end we have developed the BER Vs Signal to noise ratio comparison for various speed of the transmission i.e. from 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps with various channels And various data packages. The graph for BER Vs Signal to Noise Ratio (Es/No) is shown in Figure 10 as performance statistics. From that figure we can also verify that as Noise power increases or Es/No decreases the performance of the systems degrades.

Channel no. 1 BER graph for various data packets.

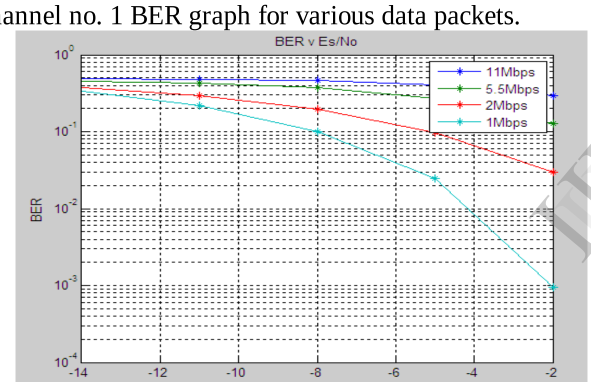

Fig 4: BER performance of ch-1 with data size-512

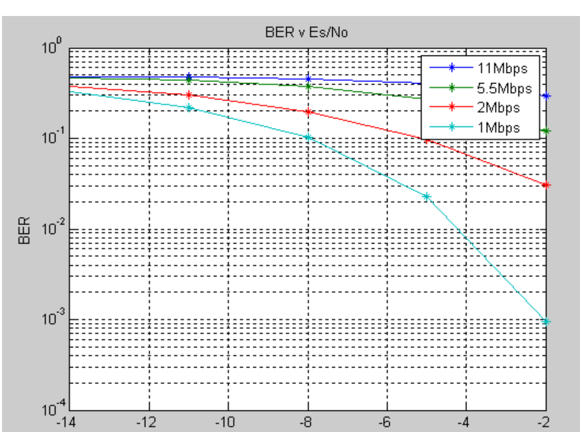

Fig. 5: BER performance of ch-1 with data size-1024

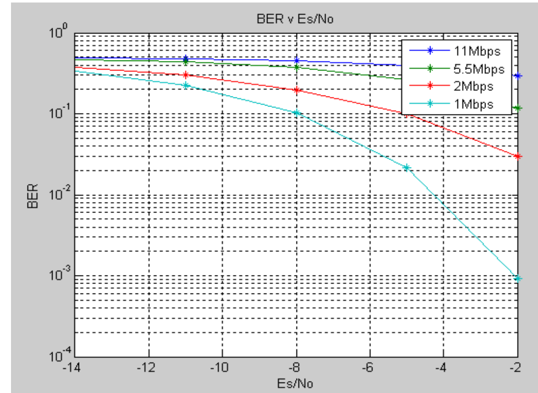

Fig 6: BER performance of ch-1 with data size-2048

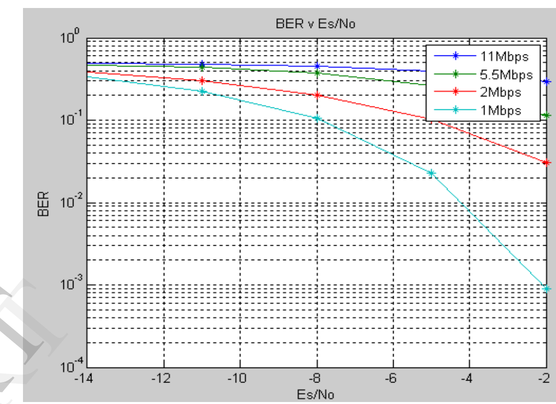

FIG 7: BER PERFORMANCE OF CH-1 WITH DATA SIZE-4096

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V. CONCLUSION

From this paper we can conclude that as per Simulation results of AWGN channel with different Eb/No ratio and different data rates we may say that as Eb/No ratio is increased and data rate is increased BER is decreased estimated bits of receiver is maximum likely to the transmitted bits. But we have limitation to increase Eb/No ratio. We may change size of packet for decreased BER. we can implement standard modulation techniques as per data rate for decreased BER

as per simulation result very low BER in 1 mbps if we increased data rate 5 mbps BER also increased. So we can conclude that if data rate is lower BER is decreased. Increasing data rate BER is increased.

VI. REFERENCES

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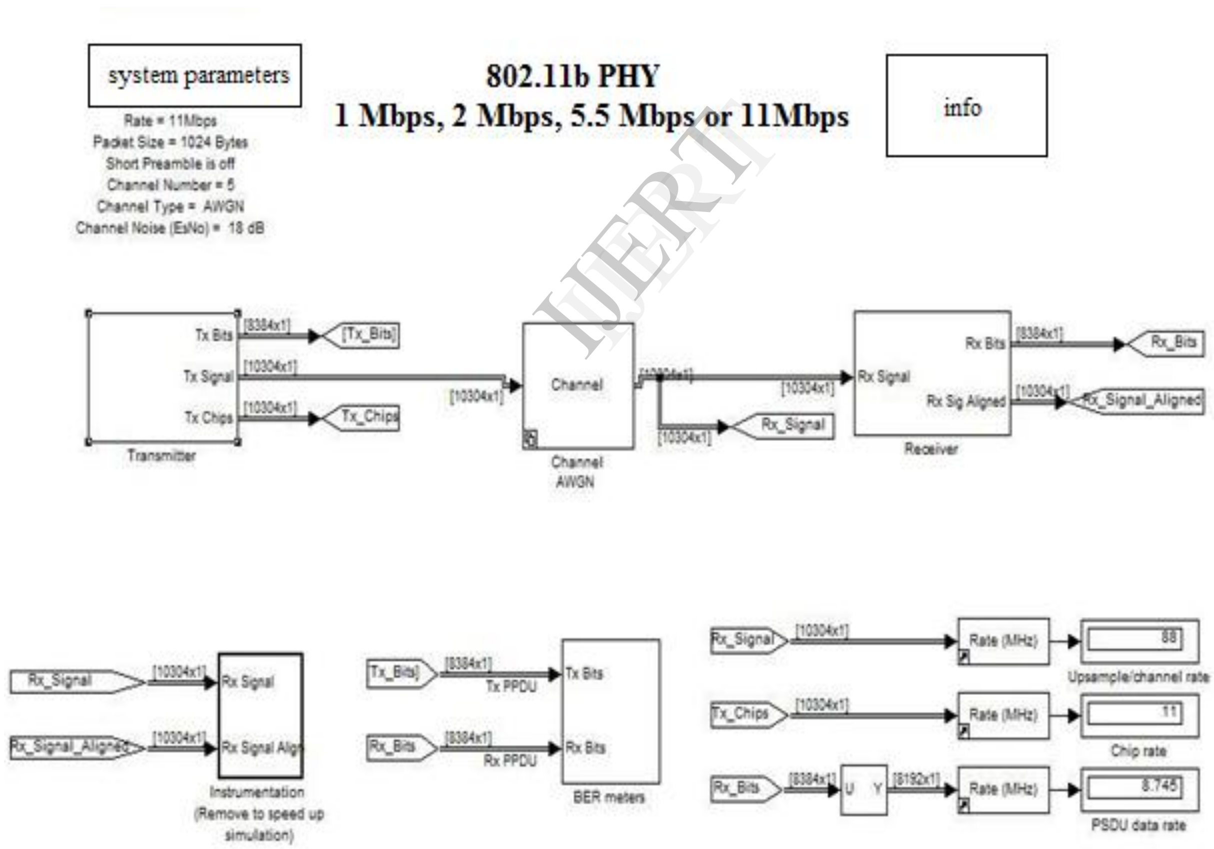

Fig 8: Simulink Model for Implementation of PHY of IEEE 802.11b [9]