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Signal to Noise Ratio Estimation and Bit Error Rate for Wireless MAN-OFDM

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Abstract

The aim of this paper is to study, analysis, plan and design OFDM physical layer for WMAN using Matlab simulator. As a result, we examine how well the receiver performs with different types of fading (Flat fading and Frequency Selective fading) then generate BER and SNR curves for varying channel bandwidth and cycle prefix values.

Keywords: *OFDM, SNR, BER, Est.SNR, WMAN, Flat fading, Frequency Selective fading*.

1. Introduction

Recently, a worldwide convergence has occurred for the use of Orthogonal Frequency Division Multiplexing (OFDM) as an emerging technology for high data rates. In particular, many wireless standards (WiMAX, IEEE802.11a, LTE, and DVB) have adopted the OFDM technology as a mean to increase dramatically future wireless communications. [1]

Signal-to-noise ratio (SNR) is broadly defined as the ratio of the desired signal power to the noise power. SNR estimation indicates the reliability of the link between the transmitter and receiver. In adaptive system design, SNR estimation is commonly used for measuring the quality of the channel. Then, the system parameters are changed adaptively based on this measurement. [2] With increase in data rate requirements, large bandwidths are needed to support it. Higher bandwidths (subcarriers) drastically increase the BER. [3]

2. Description

The IEEE 802.16 wireless metropolitan area network (WirelessMAN) standard, also known as WiMAX (Worldwide Interoperability for Microwave Access) is designed to deliver high speed wireless data over distances that exceeds the 802.11WiFi standard, and to be able to support different network configurations such as point to point links as well as cellular networks.[4]

WirelessMAN-OFDM air interface is based on OFDM (orthogonal frequency division multiplexing) modulation technique which supports point-to-multipoint communication. This multicarrier modulation technique uses 256-subcarrier which operates within 2-11GHz frequency band in a NLOS environment. Access is done by TDMA. Like other air interface, it implements TDD and FDD. Finally, as an optional support like transmit diversity and AAS (advanced antenna system) are also included here. Because of orthogonality between subcarriers, it saves almost half bandwidth than single carrier technique. This air interface is the most suitable candidate to support fixed SS related applications. [6]

3. Computer Model

This computer model shows the steps of simulation model which is begin by inter model parameters then generating signal

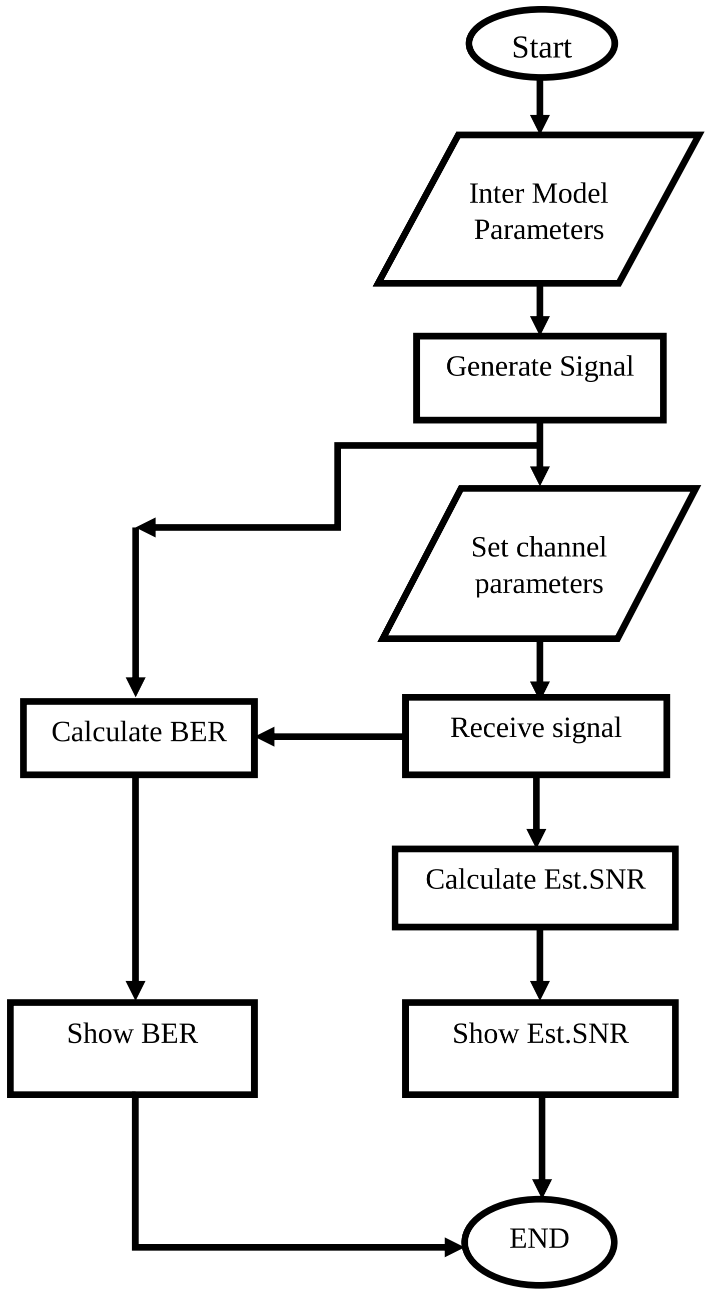


Figure 1: Flowchart for Wireless MAN-OFDM Physical Layer Simulation

4. Simulation Parameters

Table 1

Parameter	Value
Channel Bandwidth	1.4, 3, 5, 10, 15,20 MHz
Cycle Prefix	1/4, 1/8, 1/16, 1/32
Signal to Noise Ratio	0 – 30 dB
K factor	4
Maximum Doppler shift	0.5 Hz

5. Results

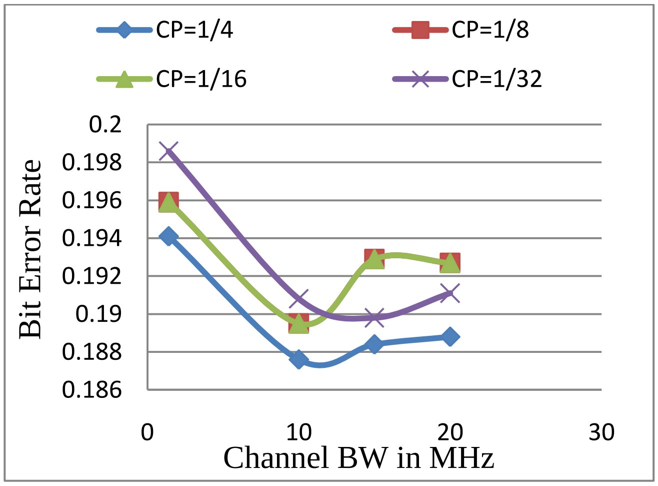


Fig 2.a. Flat fading

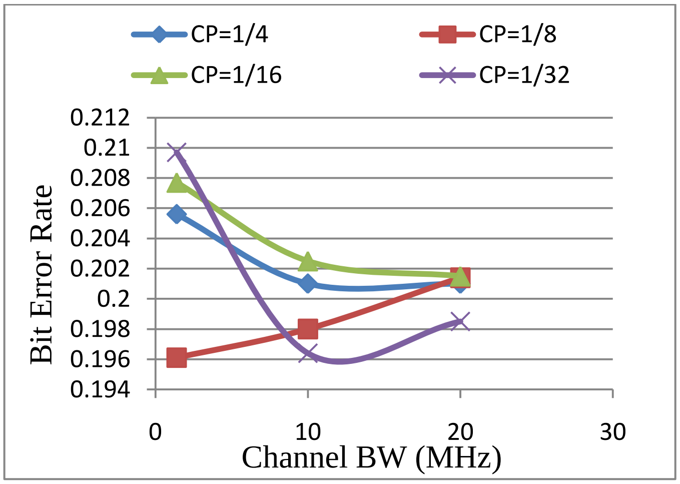
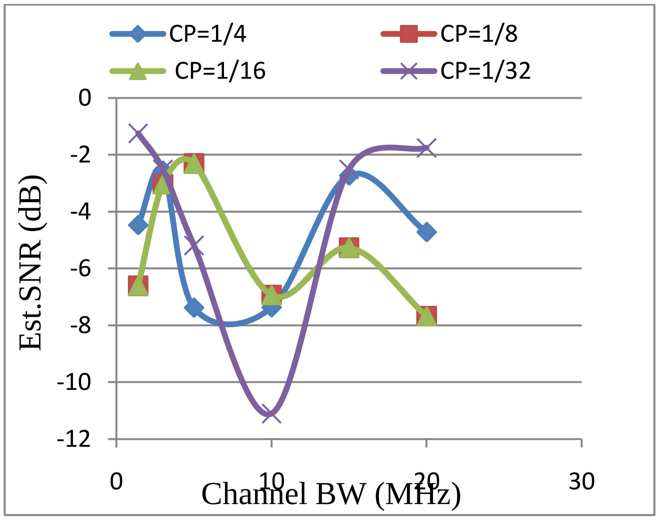


Fig 2.b. Frequency Selective Fading

Figure 2: Relationship between Channel BW and BER in different values of Cycle Prefix (CP)



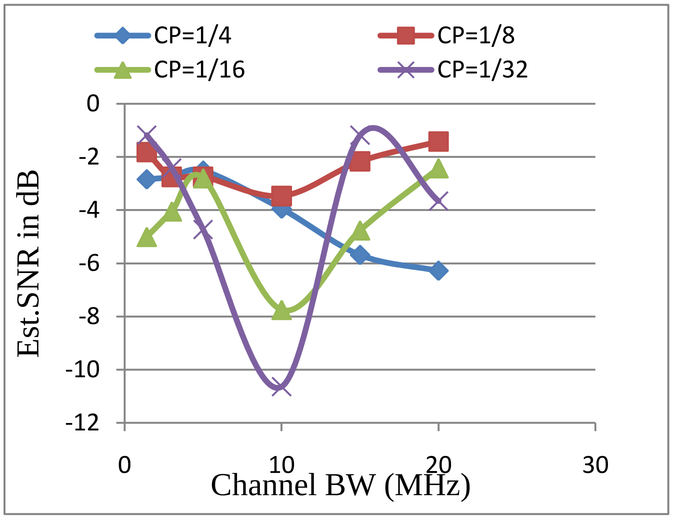
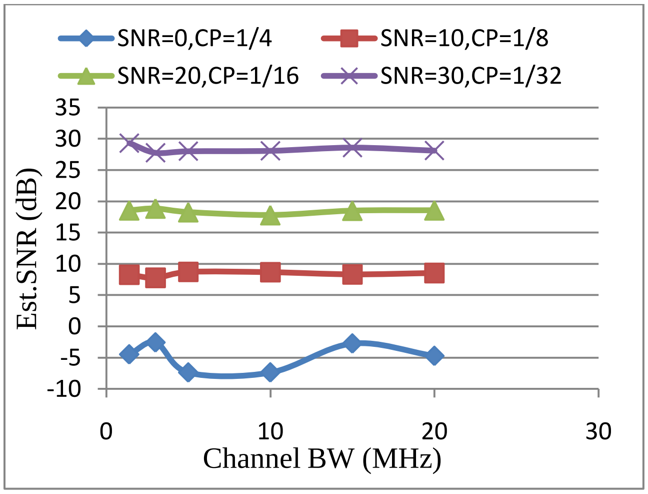


Fig 3.a Flat fading **Fig 3.b Frequency Selective fading**

Figure 3: Relationship between Channel BW and Est.SNR in different values of Cycle Prefix (CP)



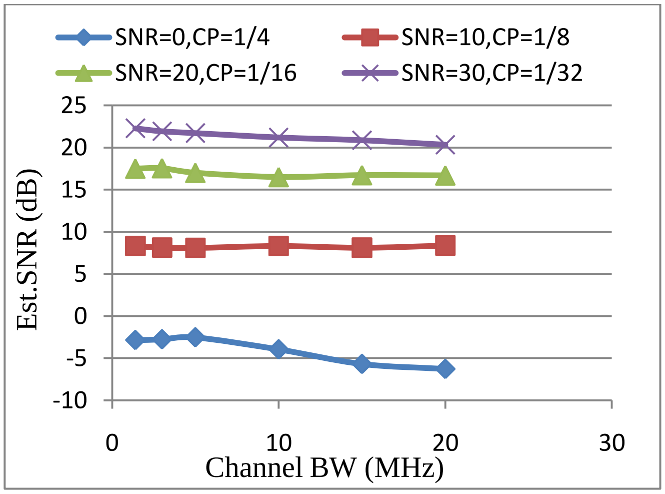


Fig 4.a. Flat fading **Fig 4.b. Frequency Selective Fading**

Figure 4: Relationship between Channel BW and Est.SNR in different values of SNR and CP

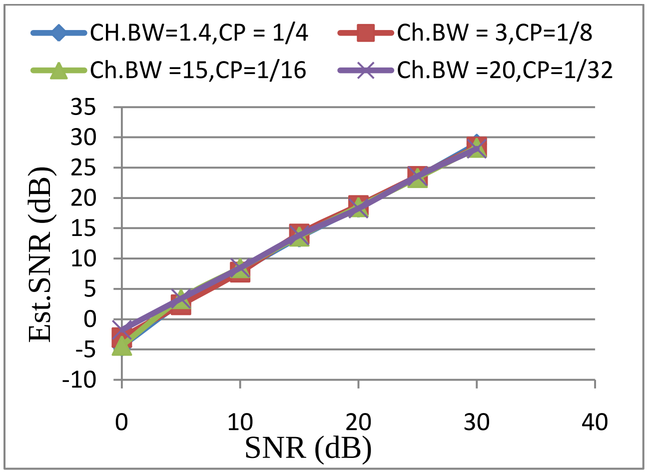


Fig 5.a. Flat fading

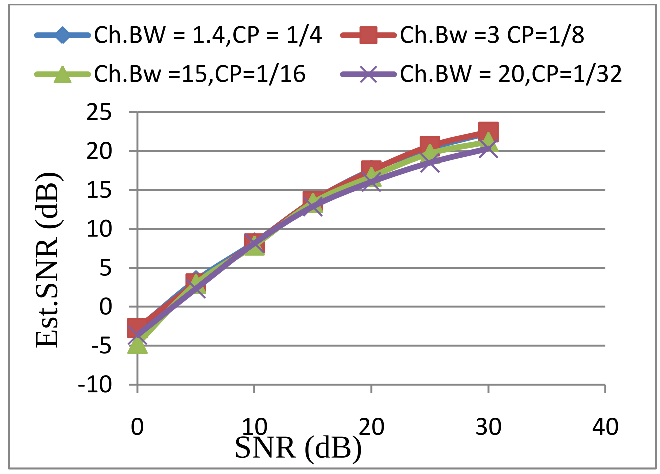


Fig 5.b. Frequency Selective Fading

Figure 5: Relationship between SNR and Est.SNR in different values of channel bandwidth and CP

6. Conclusion

The key contribution of this paper was the implementation of the IEEE 802.16 OFDM PHY layer using MATLAB in order to evaluate the PHY layer performance under reference channel model. A key performance measure of a wireless communication system is the BER and SNR. The BER and SNR curves were used to compare the performance of different channel bandwidth and cycle prefix used in different types of fading. These provided us with a comprehensive evaluation of the performance of the OFDM physical layer for different states of the wireless channel.

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