Performance Analysis of Convolution Coded WLAN Physical Layer under Different Modulation Techniques

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Abstract

WLAN plays an important role as a complement to the existing or planned cellular networks which can offer high speed voice, video and data service up to the customer end. The aim of this paper is to analysis the performance of coded WLAN system for different digital modulation schemes (BPSK, 16-PSK, QPSK, 4-QAM and 16-QAM) under AWGN channel. The performance of convolution encoder WLAN system is in terms of graph between BER and SNR. We also verify the system performance with different code rates (1/2, 1/3, 2/3 and 3/4) and different constraint length.

Keywords: OFDM, BER, SNR, WLAN, AWGN, Constraint length (K) and Code rate (r).

1. INTRODUCTION

The Wireless Local Area Network (WLAN) technology is defined by the IEEE 802.11 family of specifications. The standard defines a medium access control (MAC) sub-layer and three physical (PHY) layers. The goal of the IEEE 802.11 protocol is to describe a wireless LAN that delivers services commonly found in wired networks, e.g., throughput, reliable data delivery, and continuous network connections. Orthogonal Frequency Division Multiplexing (OFDM) is a very attractive technique to achieve the high-bit-rate data transmission and is used in WLAN standard. The OFDM system divides the wide signal bandwidth into many narrowband sub channels that are transmitted in parallel. The subcarriers are orthogonal to each other means that they are mathematical independent. In 1960, Chang [1] postulated the principle of transmitting messages simultaneously through a linear band-limited channel without ICI and ISI. The Saltzberg [2] in 1967 analyzed the performance of such a system. The major contribution to the OFDM technique is given by Weinstein and Ebert [3] which demonstrated the use of the discrete Fourier transform (DFT) to perform the baseband modulation and demodulation. Peled and Ruiz [4] suggested the filling of guard space with the cyclic extension of the OFDM symbol which solves the problem of orthogonality over dispersive channel.

A convolutional coding is done by combining the fixed number of input bits. The input bits are stored in the fixed length shift register and they are combined with the help of mod-2 adders. This operation is equivalent to binary convolutional and hence it is called the convolutional coding. Figure 1 shows that for every input message bit two encoded bits V1 and V2 are transmitted one after the other. K is the constraint length of the encoder as it is defined as the number of shifts over which input message bit can influence the encoder output. The k is the number of message bits and n is the number of encoded output bits. Therefore the code rate, r, of the encoder is r = k/n.

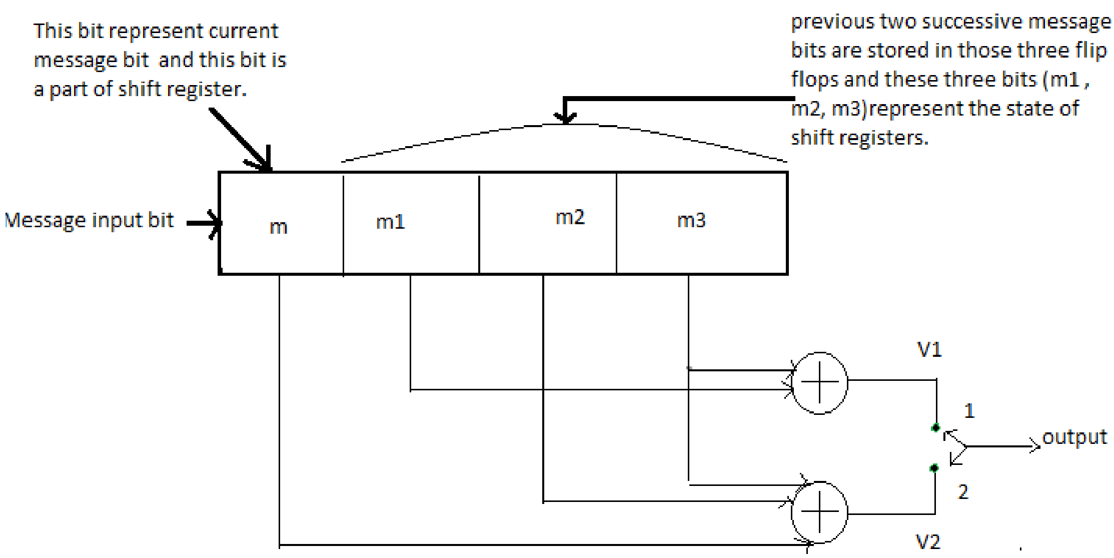

FIGURE 1: Convolutional encoder with K=4, k=1 and n=2

Commonly k and n parameters range from 1 to 8, K from 2 to 10 and code rate from 1/8 to 7/8, except for deep space application where code rate is as low as 1/100 or even longer to be employed.

2. PHYSICAL LAYER STRUCTURE OF WLAN

The complete channel encoding setup at transmitting side and decoding setup at receiving side of the WLAN physical layer is shown in figure 2. In this setup, the input binary data stream is ensured against errors with convolution codes and interleaved.The convolutionally encoded bits are interleaved further prior to convert into each of the either four complex modulation symbols in BPSK, QPSK, 16-PSK, 4-QAM, 16-QAM modulation. The symbols which are digitally modulated transmitted in parallel on subcarriers through implementation as an Inverse Fast Fourier Transform (IFFT). To mitigate the effects of inter-symbol interference (ISI), each block of IFFT coefficients is typically presented by a cyclic prefix [5, 6, 7].

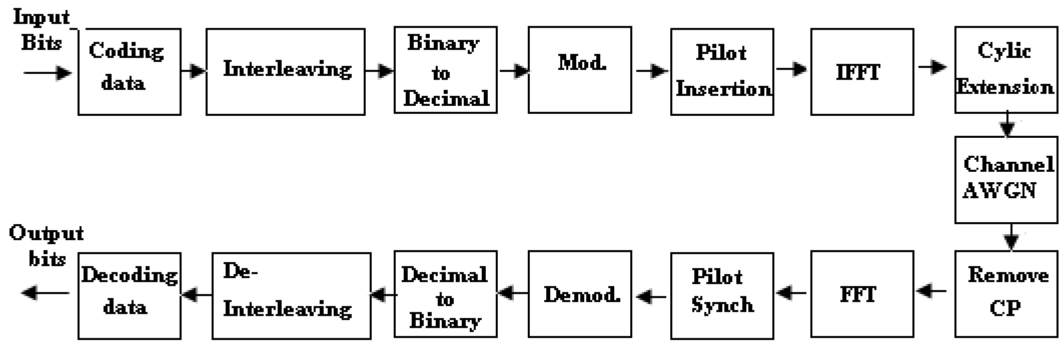

FIGURE 2: Block diagram showing WLAN Physical Layer transceiver

At the receiving side, a reverse process (including deinterleaving and decoding) is performed to obtain the original data bits. The degradation of OFDM performance due to frequency offset or/and phase noise is much more severe in comparison with single carrier modulation [8, 9]. A few techniques to reduce the frequency and phase error of OFDM may be found in [10, 11]. The methods to extend IEEE 802.11 to incorporate adaptive antennas, thereby enhancing security is given by Carey, J.M. [12].

3. SIMULATION RESULTS

The WLAN system using different modulation schemes in the presence of AWGN channel was simulated using Matlab.The different digital modulation schemes using for the simulation are BPSK, QPSK, 16-PSK, 4-QAM and 16-QAM. We are using Convolution encoder with different code rates (1/2, 2/3, 1/3, 3/4) and with different constraint length. Figure 3 shows the garph of BER vs SNR for BPSK modulation with different code rates and constraint length (K) Whereas Figure 4 and Figure 5 shows the performance of system for QPSK and 16-PSK modulation.

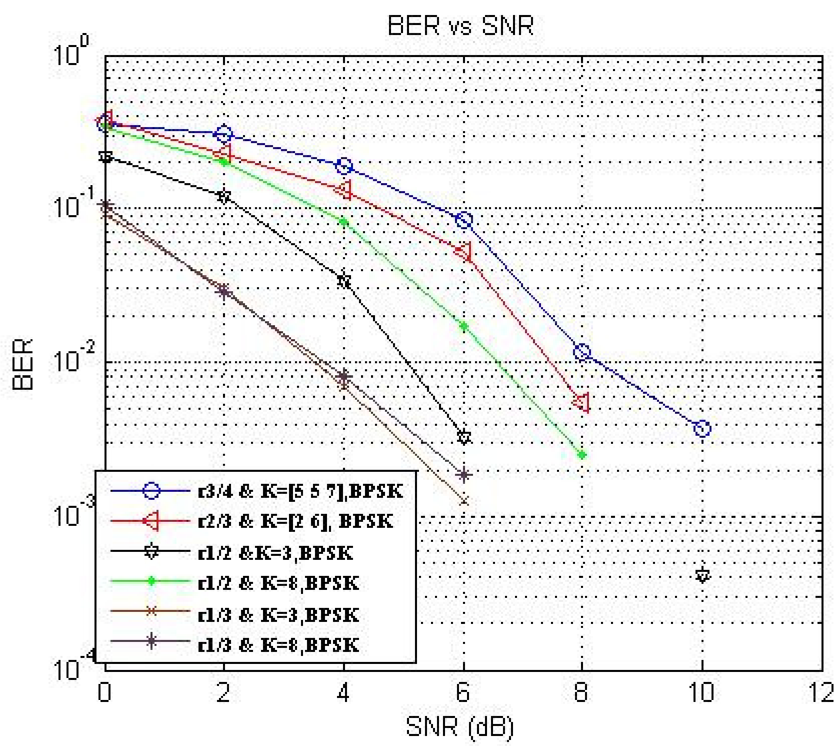

FIGURE 3: BER Vs SNR of BPSK in AWGN channel

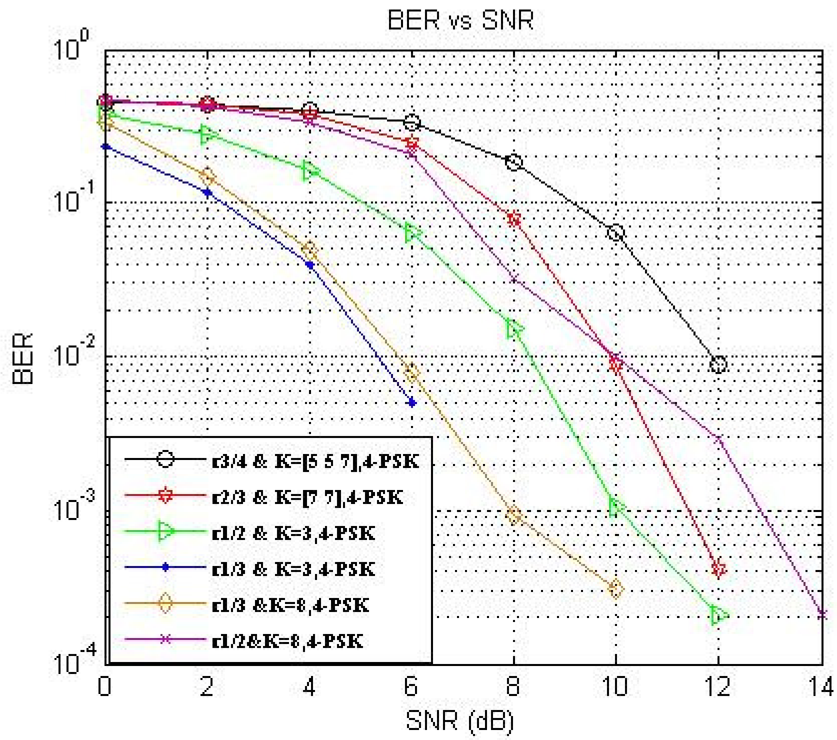

FIGURE 4: BER Vs SNR of QPSK in AWGN channel

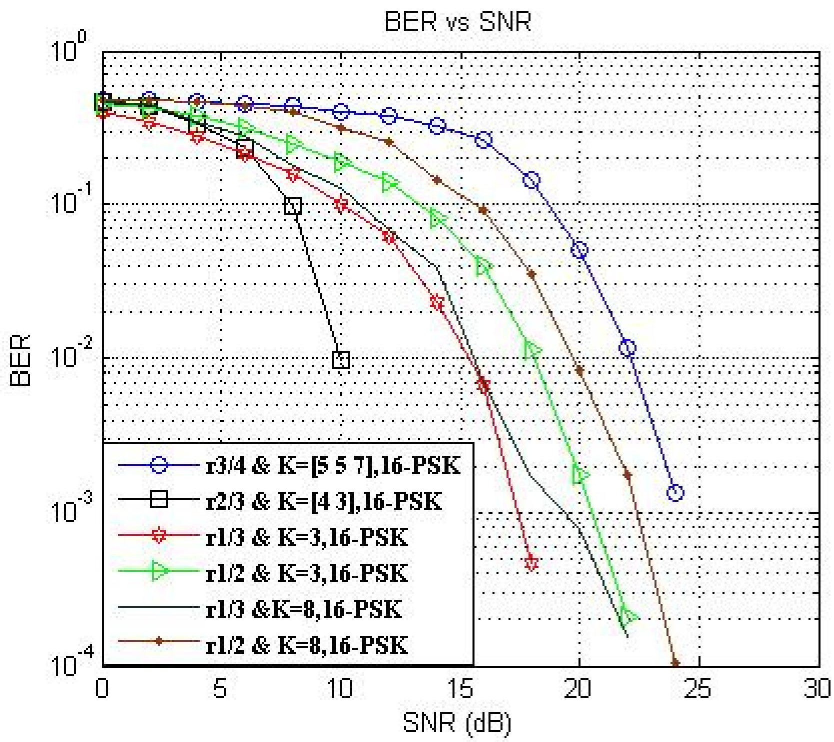

FIGURE 5: BER Vs SNR of 16-PSK in AWGN channel

4. CONSLUSION

A performance analysis of WLAN system adopting convolutional encoding with block interleaver has been carried out. The BER curves were used to compare the performance of different modulation techniques. Performance results highlight the impact of modulation scheme and show that the implementation of an rated convolutional code under different modulation.It is concluded from plots that Convolutional encoder with rate equals to 1/3 perform better in 4-PSK (QPSK) and BPSK as compared to other code rate. However the convolution encoder with code rate equals to 2/3 gives better result compared to other for 16-PSK modulation. It is also concluded that BPSK modulation with rate equals to 1/3 gives better result as compared to other modulation i.e QPSK and 16-PSK.

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