Performance Analysis of RS and CC Coding Methods in OFDM WiMAX System for BPSK and QPSK Modulation Techniques

Kavita Rani[1], Ankur Sood[2], Nitin Arora[3]
(Lecturer, Chhotu Ram Rural Institute of Technology, Kanjhawala, Delhi,)
(Assistant Professor, Ideal Institute of Technology, Ghaziabad, UP)
(Assistant Professor, Haryana Institute of Technology, Bahadurgarh)

ABSTRACT: *Coding techniques is used for providing reliable information through the transmission channel to the user. In coding techniques the number of symbols in the source encoded message is increased in a controlled manner in order to facilitate two basic objectives at the receiver one is Error detection and other is Error correction. The amount of error detection and correction required and its effectiveness depends on the signal to noise ratio (SNR). In digital communication, coding techniques is a broadly used term mostly referring to the forward error correction code. The WiMAX technology based on air interface standard 802-16 wireless MAN is configured in the same way as a traditional cellular network with base stations using point to multipoint architecture to drive a service over a radius up to several kilometers. The range and the Non Line of Sight (NLOS) ability of WiMAX make the system very attractive for users, but there will be slightly higher BER at low SNR. In this paper, a comparison between the performance of WiMAX using convolution code and Convolution Product Code (CPC) is made. CPC enables to reduce BER at different SNR values compared to the convolution code.*

Keywords: *WiMAX, BER, CPC, IEEE 802.16*

I. INTRODUCTION

WiMAX is introduced by the Institute of Electrical and Electronic Engineers (IEEE) which is designated by 802.16 to provide worldwide interoperability for microwave access. There are fixed (802.16d) and mobile (802.16e) WiMAX. This technology offers a high speed, secure, sophisticate, last mile broadband service, ensuring a flexible and cheap solution to certain rural access zones[1]-[7]. In a fixed wireless communication, WiMAX can replace the telephone company's copper wire networks, the cable TV's coaxial cable infrastructure.

In comparison with Wi-Fi and Cellular technology, Wi-Fi provides a high data rate, but only on a short range of distances and with a slow movement of the user. And Cellular offers larger ranges and vehicular mobility, but it provides lower data rates, and requires high investments for its deployment. WiMAX tries to balance this situation. WiMAX fills the gap between Wi-Fi and Cellular, thus providing vehicular mobility, and high service areas and data rates. WiMAX is a standards based technology for wireless MANs conforming to parameters which enable interoperability[1][2]. WiMAX developments have been rapidly moving forward.

The main objective of this paper is to transmit the data in WIMAX with low bit error rate in the noisy environment for that we using Forward Error Correction method which is Convolution coding. This method is useful to reduce the bit error rate (BER) and increase the efficiency.

The paper is organized as follows: Section II introduces a description for the simulation model. Description of CC and CPC scheme is presented in Section III. Simulation results are given in Section IV, and finally conclusions are reflected in Section V.

II. CONVOLUTIONAL ENCODER

The channel coding scheme, IEEE 802-16, as shown in fig 1 is based on binary non-recursive Convolutional Coding (CC) [4]. The convolutional encoder uses a constituent encoder with constraint length 7, code rate 1/2 and generator polynomials (133,171) octal. In this stage, the CPC method will be applied for coding the message and this will be shown in the following section.

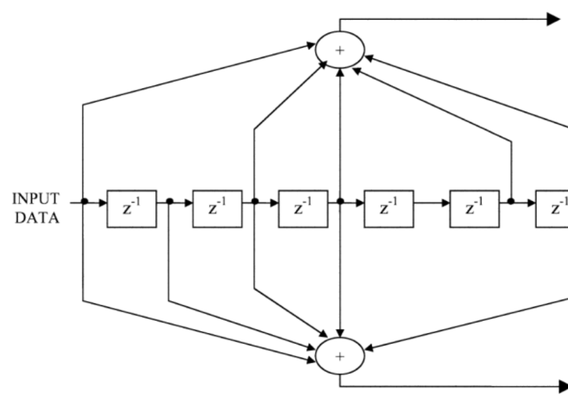

Fig: 1 Convolutional Encoder in IEEE 802.16e

A. CONVOLUTION PRODUCT CODE (CPC) METHOD

CPC is a new coding method [1], in which the information bits are placed into two dimensions (2D)
Matrix. The rows and the columns are encoded separately by using recursive systematic convolutional encoders. Each row of the matrix is encoded using a convolutional code the same recursive systematic convolutional code is used to encode each

row. Once all rows have been encoded, the matrix is sent, if desired, to an interleaver. Our original data matrix dimensions are (nxk), and the encoded data matrix dimensions will be (Znxk). The
coded rows matrix is then recoded column by column using the same or different recursive systematic convolutional encoder. CPC uses a recursive systematic convolutional code with rate 1/2 and generator polynomials (1,5/7) octal to encode each row and column. Hence, the overall code rate is 1/4. The coding by CPC will be done in 2 stages. First each column will be independently coded, and then each row of the resulting matrix will be coded by the same generator polynomials.

III. REED SOLOMON CODING

The randomized data are arranged in block format before passing through the encoder [6] and a single 0X00 tail byte is appended to the end of each burst. The implemented RS encoder is derived from a systematic RS (N=255, K=239, T=8) code using GF (2^8). The following polynomials are used for code generator and field generator.

$$G(x) = (x+\alpha^0)(x+\alpha^1)\ldots.(x+\alpha^{2T-1}), \alpha = 02_{HEX}$$

$$p(x) = x^8 + x^4 + x^3 + x^2 + 1$$

IV. SIMULATION RESULTS

In this chapter the simulation results are shown and discussed.

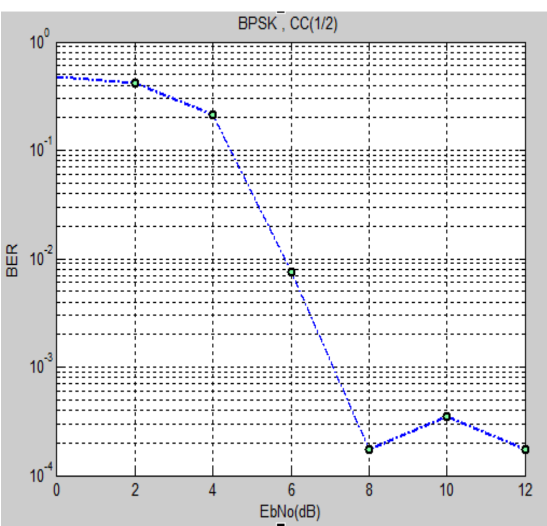

Fig: 2 BER vs EbNo for BPSK (1/2) with CC coding

We have presented various BER versus Eb/No plots for BPSK and QPSK according to the IEEE 802.16 standard. Fig: 2 and Fig: 5 BER versus Eb/No plots for BPSK and QPSK.

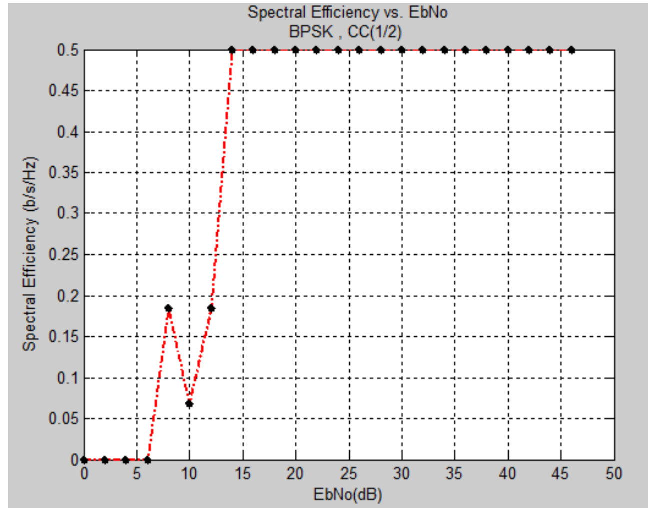

Fig: 3 Spectral Efficiency vs EbNo for BPSK (1/2) with CC coding

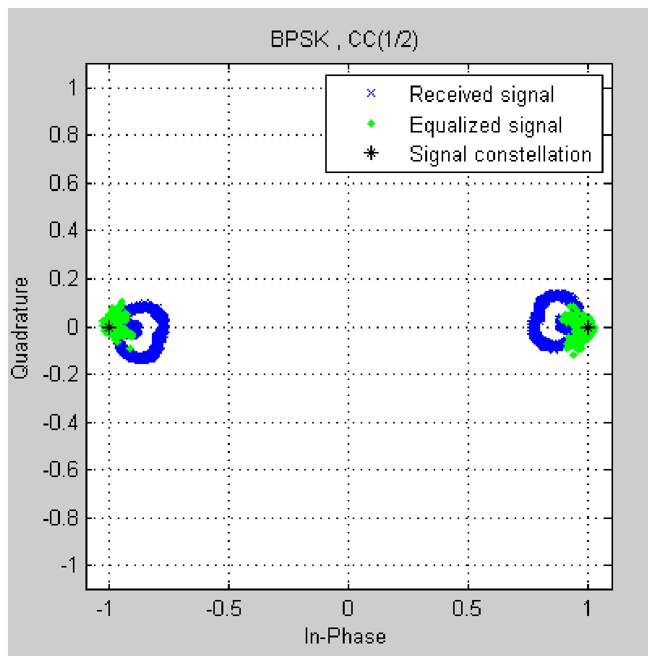

Fig: 4 Signal Constellation diagram for BPSK (1/2) with CC coding

We have presented various Spectral Efficiency versus Eb/No plots for BPSK and QPSK according to the IEEE 802.16 standard. Fig: 3 and Fig: 6 Spectral Efficiency versus Eb/No plots for BPSK and QPSK.

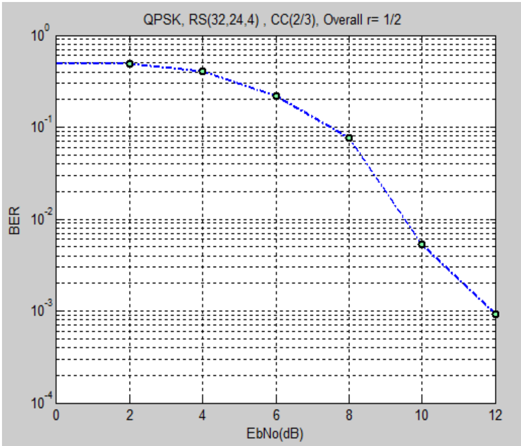

Fig: 5 BER vs EbNo for QPSK (1/2) with RS and CC coding

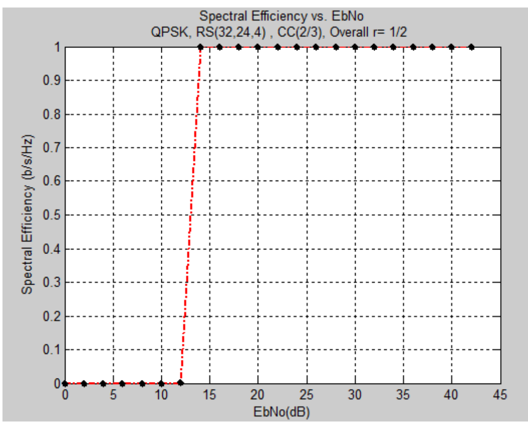

Fig: 6 Spectral Efficiency vs EbNo for QPSK (1/2) with RS and CC coding

We have presented various Signal Constellation diagram plots for BPSK and QPSK according to the IEEE 802.16 standard. Fig: 4 and Fig: 7 Signal Constellation diagram plots for BPSK and QPSK

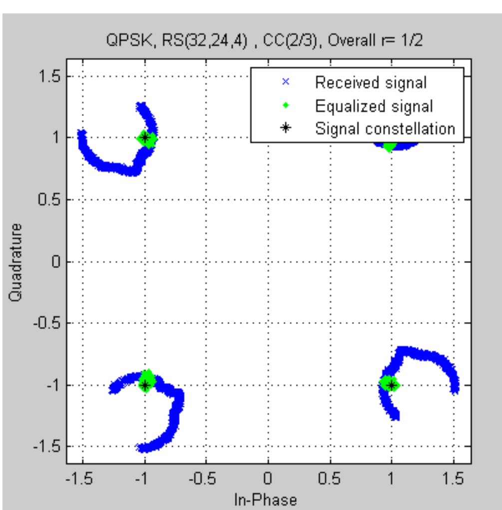

Fig: 7 Signal Constellation diagram for QPSK (1/2) with RS and CC coding

V. CONCLUSION

In this paper, performance of WIMAX systems is studied under using CC and CPC coding method using BPSK and QPSK modulation Techniques. This lead to the reduction of BER. We investigate the performance of the OFDM WiMAX system with BPSK and QPSK modulation scheme which lead to the improvement in the BER with QPSK scheme compare to the BPSK. Spectral efficiency of WiMAX system will also improve with QPSK modulation Scheme.

VI. FUTURE SCOPE

Further scope of this paper is that performance analysis of WiMAX MC-CDMA based system using CPC coding and convolution coding method. Which may gives better result as compare to WiMAX OFDMA based system using CPC coding and convolution coding method.

VII. REFERENCES

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