JOURNAL OF CRITICAL REVIEWS

ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

BIT ERROR ANALYSIS OF REED SOLOMON DECODER AND BCH DECODER WITH QAM

[1]N.MAGESWARI, [2]M.DEIVAKANI, [3]J.BOOMA

[1]Assistant Professor, Department of Electrical and Electronics Engineering SBM College of Engineering and Technology, Dindigul
[2,3]Associate Professor, Department of Electronics and Communication Engineering, PSNA College of Engineering and Technology, Dindigul

Emails**:** [1]magesmaniengg@gmail.com, [2]mdeivakani82@gmail.com, [3]boomakumar2005@gmail.com

Received: 14 March 2020 Revised and Accepted: 8 July 2020

ABSTRACT: During digital data transmission over a channel is liable to various errors that make unreliable transmission or contradictory by means of noise, crosstalk or various other aggravations. A new mechanism has to be made that detects these peculiarities in the received information and rectifies it to get the original information as it was sent by the sender. In past years, a number of error detection and correction methodologies have been formulated to transmit and receive the correct information for better reliability. The optimum of these methodologies ensures that the data is received correctly by the receiver in less number of retransmissions. Another important factor is the computation of Syndrome for low erasure. Here the enhanced syndrome computation cell has utilized with primitive element look up table. In this paper execution of Reed Solomon Code (RS) and BCH Code is analyzed over Rayleigh fading channel in terms of Bit Error Rate (BER**).**

KEYWORDS: RS Decoder, BCH Decoder, BER, Syndrome Computation.

I. INTRODUCTION

While transmitting data, which is to be transmitted through human beings or computers. Data should be more effective for communication and so the data transmission over channel is consistent at the receiver. Wireless communication is vulnerable due to Gaussian noise, fading etc. Besides, information explicitly sent through a remote channel shows up at the receiver by means of various ways and this prompts signal mutilation and more number of errors [1]. Therefore, constancy of transmission is very much demanding on communication channels. There are various methods to get reliable transmission. Error Control Coding plays a major role in error detection and correction. Information Coding Theory is the study of codes, including error detecting and error correcting codes. Now the demand is to develop new technologies for data communications and data storage with low clock rate, latency, gate count, better reliability, high throughput. In Error Coding technique [2], there are number of codes to encode the data and decode the received encoded data at the reception to get the corrected original data bits over the communication channel. Most broadly a utilized method for better communication is forward error correction (FEC). The FEC with efficient decoder provides better Bit Error Rate (BER) [3]. In this research work, the output performance of decoding scheme is toward enhancing the capability of error correction with as less number of redundancy computed with new syndrome block. Here, Reed–Solomon (RS) and Bose, Ray–Chaudhuri, and Hocquenghem (BCH) codes in various QAM through Rayleigh Fading Channel at ease with afford high information rate and BER.

II. RELATED WORK

Nowadays, researcher’s works towards enhancing the performance of various forward error correction techniques with linear block codes. They used a choice of communication channels to evaluate the behavior of error correcting codes. In [4] they have considered various concatenated error correcting codes using Quadrature Amplitude Modulation (QAM) modulation scheme like Convolutional-Hamming, Convolutional-Cyclic, Convolutional-Bose chaudhuri Hocquenghem was designed and the BER performance was measured for Rayleigh Fading Channel [5]. In general Bose Chaudhuri Hocquenghem demonstrated better performance while compared to Hamming and Convolution-Cyclic concatenation pair. In [6] paper researchers done their work with Reed-Solomon code with Rayleigh Channel. In this paper, error correcting codes use QAM modulation scheme and shows BER Performance. In [7], authors considered RS code in terms of Bit Error Rate (BER), the efficiency was evaluated and compare theoretically. Finally they concluded the simulated BCH code Symbol Error Rate shows high-quality performance over RS code with Rayleigh Channel.

ISSN- 2394-5125 VOL 7, ISSUE 15, 2020

2.1Bose, Ray–Chaudhuri, and Hocquenghem Code

A BCH code forms a class of cyclic error correcting codes discovered by Bose, Ray–Chaudhuri, and Hocquenghem [9]. This code has been constructed using polynomials over a finite field (also called Galois field). In BCH codes, the codeword are made by dividing a message polynomial m(x) by a generator polynomial g(x) and remaining is introduced as syndrome bits r(x).
The encoded data C(x) will be constituted as:

$$C(x) = m(x) + r(x)$$

The characteristics of the code are determined by the generator polynomial g(x). The syndrome polynomial can be computed with a new block to speed the processing time with the help of primitive polynomial lookup table.
The decoding process of BCH code is performed in three steps[8]:

- ✓ First the syndrome bits are computed from the received polynomial.
- ✓ The key equation solver is used to find the error location polynomial and error magnitude polynomial from the syndrome polynomial and
- ✓ Error bits are corrected by using the error location polynomial.

The most considerable advantages of this code are that it is moderately simple to encode and decode the information. The decoder can be enhanced with new syndrome computation cell compared to turbo and low-density parity check (LDPC) [9]. The BCH code able to detect and correct errors nearly 25% .

2.2Reed-Solomon Codes

The RS code is the sub-class of BCH codes and also called as non-binary codes. RS codes is more efficient to detect and correct burst errors [10] , even if all bits in symbol has error, then it count as only one symbol error in terms of the correction capacity of the RS code. Generally it is specified as RS (n,k), where n is the codeword length and k is the original data to be transmitted. RS code can detect and correct up to t number of errors i.e. 2t = (n-k).
The generator polynomial of RS code is represented as $g(x) = (x-\alpha)\ (x-\alpha^2)\ldots\ldots..(x-\alpha^{n-1})$. The transmitted codeword C(x) will be presented as:

$$C(x) = m(x) + r(x)$$

The general decoding process of RS code is:

- ✓ From the received codeword, syndrome has to be calculated.
- ✓ Find the error locator and error value polynomial by using key equation solver with Berlekamp Massey algorithm.
- ✓ Correct the erasure symbols by using Chein Search and Forney algorithm.

The most important advantage of the RS code is the capability of correcting both burst errors and random errors.

III. METHODLOGY

The RS/BCH encoder encodes the input symbols to distinctive n symbol sequence known as a Codeword. The generated Codeword is then fed to QAM [11] modulator. The QAM use to modulate the data symbols into signal waveforms. The modulated signal is sent over the Rayleigh fading channel for transmission [12, 13]. This Rayleigh channel is intense to various interference like man made noises and other disturbances which can break off the data. In prior to decoding the received data, it has been isolated from the carrier signal using a demodulator. The demodulated signal is subsequently fed to the decoder at the receiver's end to get original information. This has to be better by choosing the size of block etc. Finally by simulation, bit error ratio is intended for RS (255,239) and BCH (255,239) with 8, 16 and 64 bit QAM. The performance are shown in graph

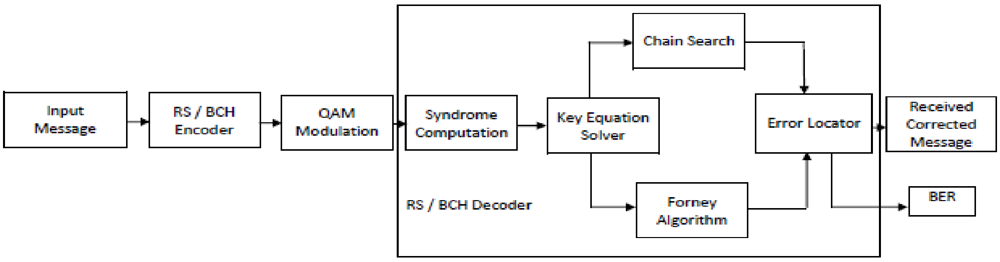

Figure 1. RS and BCH Encoder / Decoder

IV. RESULT AND DISCUSSION

The analysis of RS and BCH code with block length (255, 239) was performed. BER ratio was calculated by varying E_b/N_o from 0 to 10.

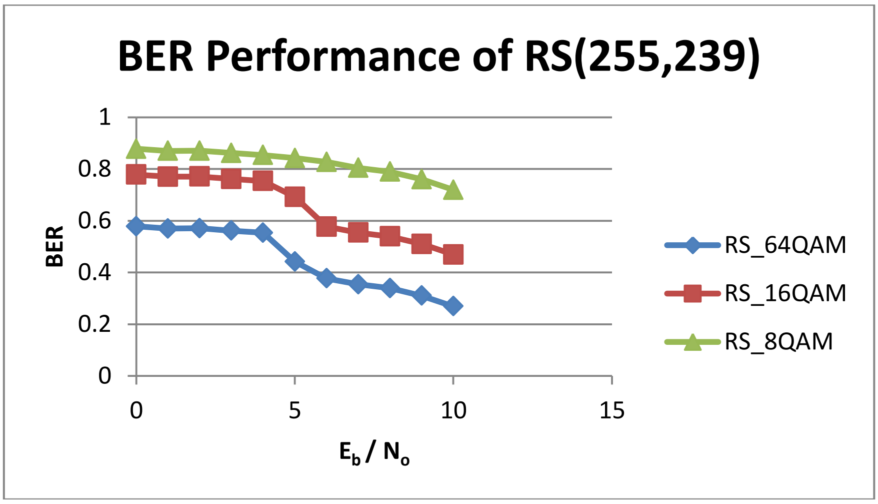

Figure 2. BER Performance of RS (255,239)

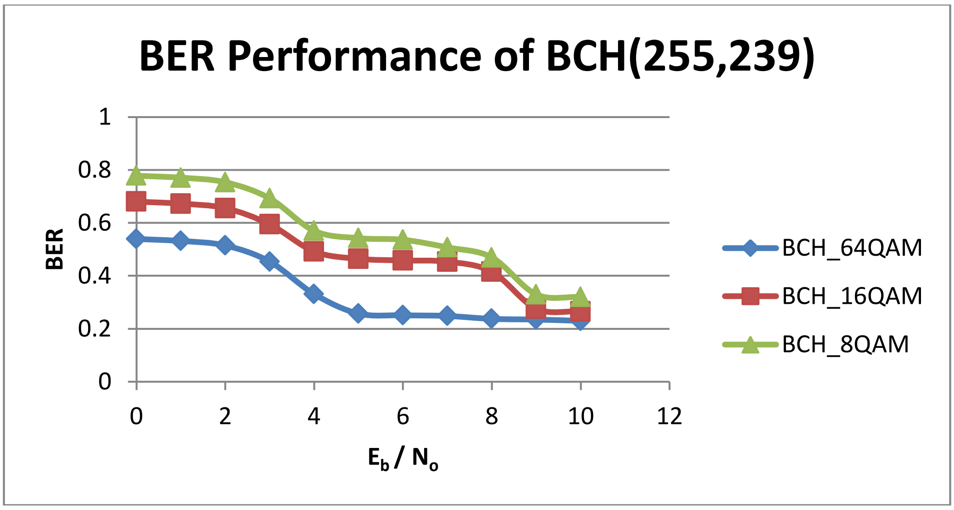

Figure 3. BER Performance of BCH (255,239)

V. CONCLUSION

The overall performance analysis of RS and BCH code is evaluated over Rayleigh fading channel. More number of iterations had been made to describe the syndrome, error locator and error magnitude polynomial. In that the efficiency of BCH code outperforms RS code in binary transmission. Bit energy and noise ratio varies commencing 1 to 10 and it turned into observed that at each value of E_b/N_o, BCH code performance is higher than RS code. QAM has been used and BCH code another time achieved higher efficiency. As E_b/N_o was improved beyond 1, performance of BCH code increases significantly while there is slight improvement in the performance of RS code. The graph drawn between RS code and BCH code offers the overall performance of BCH code over RS code through Rayleigh fading channel.

VI. REFERENCES

[1] Hank Wallace, "Error detecting and correcting using BCH codes", Copyright (C) 2001 Hank Wallace.
[2] Ming-Fong Tsai; Ce-Kuen Shieh; Tzu-Chi Huang; Der-Jiunn Deng, "Forward-Looking Forward Error Correction Mechanism for Video Streaming Over Wireless Networks", Systems Journal, IEEE, Vol.5, No.4, pp. 460-473, 2011. doi: 10.1109/JSYST.2011.216559.
[3] Gurinder Kaur Sodhi ; Kamal Kant Sharma, "SER performance of Reed – Solomon Codes With AWGN & Rayleigh Channel using 16 QAM" ,at International Journal of Information and Telecommunication Technology, Vol. 3, No. 2, 2011.
[4] Arjun Puri, Sudesh Kumar, "Comparative Analysis of Reed Solomon Codes and BCH Codes in the Presence of AWGN Channel", International Journal of Information and Computing Technology, vol.3 no.3, 2013
[5] Himanshu Saraswat, Govind Sharma, Sudhir Kumar Mishra and Vishwajeet, "Performance Evaluation and Comparative Analysis of Various Concatenated Error Correcting Codes Using BPSK Modulation for AWGN Channel", International Journal of Electronics and Communication Engineering. ISSN 0974-2166 Volume 5, Number 3 (2012), pp. 235-244.
[6] Yingquan Wu, "Novel Burst Error Correction Algorithms for Reed-Solomon Codes," Information Theory, IEEE Transactions on, Vol. 58, No. 2, pp. 519-529, Feb. 2012. doi: 10.1109/TIT.2011.2173623.
[7] Saurabh Mahajan; Gurpadam Singh "Reed-Solomon Code Performance for M-ary Modulation over AWGN Channel", International Journal of Engineering Science and Technology (IJEST), Vol. 3 No. 5 May 2011.
[8] Sanjeev Kumar, Ragini Gupta,"Performance Comparison of Different Forward Error Correction Coding Techniques for Wireless Communication Systems", at International Journal of Computer science and technology Vol. 2, issue3, September 2011.
[9] R.C. Bose and D.K. Ray-Chaudhuri, " On A Class of Error Correcting Binary Group Codes", at Information and Control 3, 68-79 (1960).
[10] Mageswari, N, Mahadevan, K & Mohan Kumar, R 2019, 'An α – factor architecture for RS decoder implemented on 90nm CMOS technology for computer computing application devices', Microprocessor and Microsystems, vol. 71, Nov 2019.
[11] Zhinian Luo, Wenjun Zhang,"The Simulation Models for Rayleigh Fading Channels" IEEE Transactions on Communications, Vol. 61, No. 2, February 2013
[12] Shih-Ming Yang and Vinay Anant Vaishampayan "Low-Delay Communication for Rayleigh Fading Channels: An Application of the Multiple Description Quantizer"
[13] J Grolleau, D. Labarre, E. Grivel and M. Najim,"The stochastic sinusoidal model for Rayleigh fading channel simulation" .
[14] Kanimozhi, K., Pandian, R., Booma, J., "Effects of RFI in switched capacitor circuits", Proceedings of the International Conference on Electromagnetic Interference and Compatibility, 2008.
[15] M. Deivakani, Dr.D.Shanthi, "FPGA based adaptive resource efficient error control methodology for network on chip" Journal of theoretical and applied information technology, Volume 59,Issue 3 ,April 2014.
[16] M.Deivakani, Dr.D.Shanthi," Performance Analysis of Shared Buffer Router Architecture for Low Power Applications", Journal Of Semiconductor Technology And Science, Vol.16, No.6, December, 2016.