IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE
AND TECHNOLOGY

VOLUME : 10 ISSUE : 10 Print / Issue Publication Date: 08-Apr-2026

ISSN : 2455-2143

DOI : 10.33564/IJEAST.2026.v10i10.003

Indexed In

WWW.IJEAST.COM

editor@ijeast.com

International Journal of Engineering Applied Sciences and Technology, 2026
Vol. 10, Issue 10, ISSN No. 2455-2143, Pages 15-19
Published Online February 2026 in IJEAST (http://www.ijeast.com)

BIT ERROR RATE ANALYSIS BASED ON BITS IN A SAMPLE AND BITS IN DATA IN THE PROCESS

Abrol Ajay
Associate Professor
Department of Electronics & Communication Engineering
Government College of Engineering & Technology
Jammu, India.

Verma. G.N
Prof
Sri Sukhmani Institute of Engineering & Technology
Mohali Punjab

Kaur Harmeet,
Department of Higher Education
H.P

Abstract: **Various modulation techniques are applied for establishing communication in a digital communication channel. Key parameters in deciding the modulation approaches in particular applications are Bit Error Rate (B.E.R) and Signal to Noise ratio (SNR). The present work shows the analysis of B.E.R dependency on number of samples per symbol, number of bits transmitted and received and number and location of bits corrupted in a data sequence. Performance of the network with Additive White Gaussian Noise (AWGN) channel and with modulation order 2,4 is evaluated. Differential encoding is used for analysis. Pulse shaping filter is employed. Transmitted and received data is 4,6,8,10,12,14,28 bits,32 bits. The results indicate B.E,R improvement with increase in Eb/No dB. This can help in deciding the channel band width for a particular application.**

Keywords: **B.E.R, Eb/No, SNR, AWGN, Sample, Key Performance Indicator**

I. INTRODUCTION

In a communication system signal is being processed so that it is utilized for a particular application. An analog information is converted into digital one with the help of analog to digital conversion techniques. Signal in the form of bits is modulated and need traversing through the medium. Thermal noise follows Gaussian distribution function. Other noises occur because of components like flicker noise. Errors due to quantization are modeled as additive white Gaussian noise. Bit error rate in the transmission is the ratio of number of bits received in error by total bits transmitted within same time period. Components in the selection in adopting modulation approaches are bit error rate and signal to noise ratio. [1] In soft decision decoding there are group of possible code words. Received code words have to be compared with possible code words. Code word with minimum euclidean distance is picked for processing. Decoders receive analog information which is converted to digital form. In this study decoder word length is being adjusted for efficient throughput and also for lower power dissipation. Voltage scaling is utilized with variable word length in order to reduce the power consumption in the study with soft decision viterbi decoder. [2] Disturbances on channel occur with small probability. sometimes decoder might not decode in correct manner. Errors introduced due to overloading are compared to lowest level digits for the decoded data. The degradation does not occur in system design with minimum probability of word. [3] Accuracy related to data transmitted in a communication channel is ascertained by B.E.R. B.E.R is influenced by noise, attenuation, interference. In the study by this author, noise and interference are reduced to achieve better B.E.R. [4] The work bases on determining conditional probability for Bit Error in situations of amplitude fading and there after averaging the conditional probability that follows Ray Leigh Distribution. [5] In the study B.E.R performance is evaluated for AWGN Channel and Rayleigh fading channel in a range undertaken for Signal to Noise Ratio. Performance approaches an ideal case for a single input signal and single output without fading as number of receivers increase. [6] Q parameter results in variations due to interference in EYE Diagram due to which BER might lead to incorrect results in estimation. Effectiveness of the Approach is studied for bit error rates up to 10 Gbp. Measurements in such cases are performed on an ongoing basis. [7] In a digital system ,estimation of bit error rate can be evaluated by adopting various simulation approaches. [8] Coding and decoding play an important role in order to enhance quality of trans receiver. Schemes like QAM, MSK, QPSK and BPSK have been studied in presence of additive white Gaussian noise channel in which transmission parameters and code rates have been dynamic for utilizing the channel capacity. Optimum decoding for convolutionally encoded data is performed using Viterbi decoder. [9] Additive White Gaussian Noise (AWGN) and Rayleigh fading degrades the performance parameters of the wireless communication systems. Such systems need knowledge of the channel Signal-to-Noise ratio for working. [10] B.E.R indicates measures the operational performance of a communication system. Raising of B.E.R degrades the performance. In this work bit error rate performance is studied using simulation by adding controlled noise to the transmitted signal. Demodulated signal at the output of receiver ensures number of bits recovered by making a comparison between transmitted and received signal. [11] In this study Finite in time optimal approach provides a symbol rate higher than rate in Nyquist barrier without making use of any encoding and is a result of corresponding optimization problem. Signals are characterized by inter-symbol interference. [12] Performance of underwater wireless communication is evaluated in a laboratory setup with different salinity and different turbulence close to sea water conditions. B.E.R was found to deteriorate with increased values of salinity and turbidity. [13] Multitone modulation approach in a filter mode is applied in the calculation of bit error rate. Data carriage is through multipath fading channel. [14] Filteration and delay operations are needed in a communication channel when data is reterived at the receiver resulting in an offset in transmitted and received bits. The offset needs to be determined. Correlation among transmitted and received bits determine the offset. Received bits are more than transmitted bits with the effect of filter. [15] B.E.R helps in analyzing the channels resulting in quality improvement. Channel assignment also gets enhanced in cognitive radio networks. Cognitive radio is a type of radio that can intelligently sense and adopt to surrounding. It is a smart radio that detects which channels are in use and which are available and as per information dynamically adjustment in operating parameters is done to avoid interference and optimize performance. [16] In this study BER inside a WCDMA digital receiver is analyzed. Approach employs signal to noise estimator and performance is enhanced by probability density function. [17] Crimmins et al (1970) showed minimizing the errors in 1-1 mapping in digital data to binary group code elements for the cases of uniform probability of the data [18] Viterbi algorithm eliminates paths from trellis diagram that are not candidate for maximum likelihood choice. In situation with two paths arriving at same time, a minimum path is chosen andis called surviving path. Algorithm forms the basis that distances measured for received signal at a time and all other paths in trellis diagram reaching at every possible state at time t1. [19] Data protection is achieved by a design for minimum square error between representations of input and output words. If a channel noise exceeds in random manner in performance of the codes wherein decoding errors confine to least significant positions. Model works with conditional probability density function. For a memoryless channel, decoder uses a mechanism that resembles the Viterbi decoder. [20]

II. METHODOLOGY

The present work is divided into three sections: Section 1 gives an overview of the block diagram, Section 2 briefs about dependence of B.E.R on samples/symbol, section 3 explains variation in transmitted and received bits and related B.E.R, Section 4 explains position of bits corrupted in a digital data set and related B.E.R.

Section1: Bit error rate is the number of bits that are corrupted or altered due to various circuit conditions divided by the total number of bits. An encoder transforms binary equivalent to data information and decoder is used to recover data from coded values. Decoders find applications in seven segment display and applications employing multiplexing and demultiplexing. [21] In channel encoder analog signal is converted into frequency bands that are not overlapping each other. Individually each band is sampled and quantize to improve encoding efficiency. [22]

International Journal of Engineering Applied Sciences and Technology, 2026
Vol. 10, Issue 10, ISSN No. 2455-2143, Pages 15-19
Published Online February 2026 in IJEAST (http://www.ijeast.com)

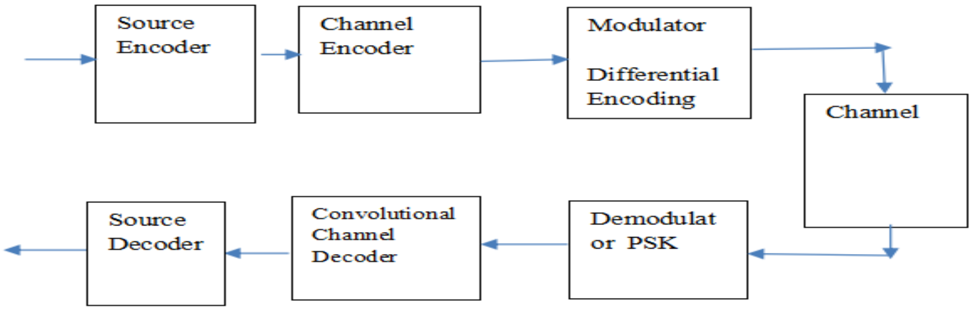

Figure 1. Digital Communication channel

Section 2: Observations are plotted in a graph presented in Figure 2. in which B.E.R is plotted against Eb/No ratio measured in dB. Symbols/ sample are 4, 8, 12, 32. B.E.R values have been observed to be low for higher values of SNR when samples/symbol are 12. An error shows a decline when sample/symbol are changed to 8, 4,32 and 16. Highest value of B.E.R is observed with samples/ symbol of 32. 25 observations have been used in the work.

Channel is AWGN, Phase shift keying (PSK) is the modulation. Order of modulation is 2 with differential encoding scheme used.

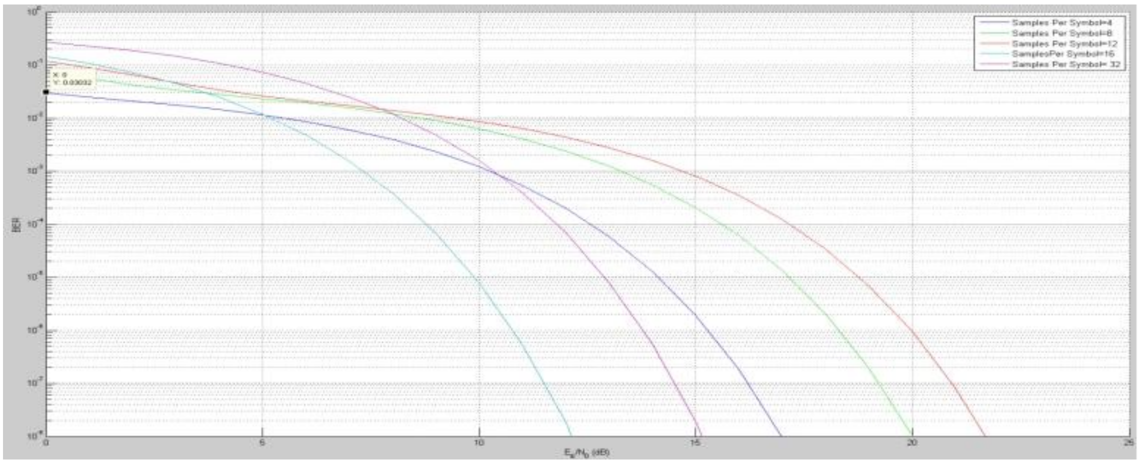

Figure 2. B.E.R Variations with Samples per Symbol.

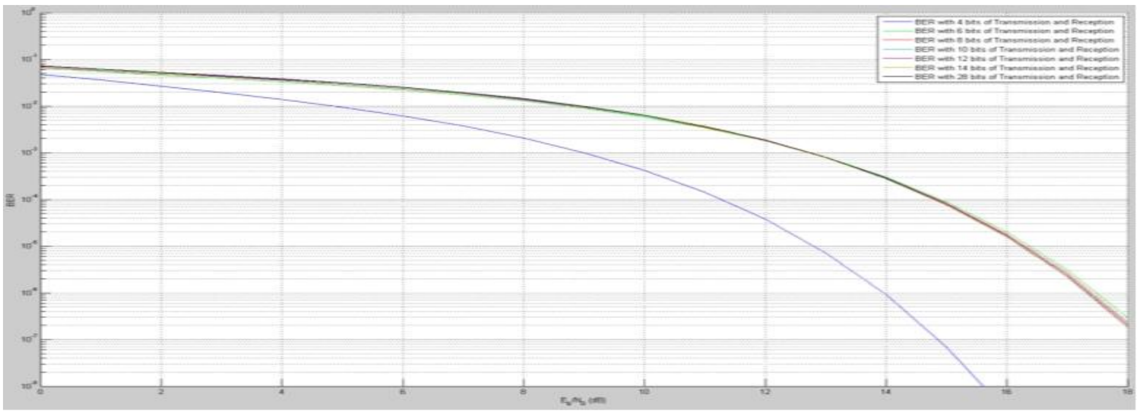

Figure 3. B.E.R with Bits Transmitted and Received are: 4, 6, 8, 10, 12 and 14 respectively

Section 3: Observations are presentedfor B.E.R v/s Eb/No ratio when transmitted bits have been 4,6,8,10,12,14 and 28 respectively. AWGN is the channel, Modulation order is 4. B.E.R has been found to be lowest with four number of bits, highest with fourteen number of bits. There is increasing trend for B.E.R for 6, 8, 10,12 and 14 number of bits.

Section 4: In this section AWGN is the channel, modulation order is 4. The variations in transmitted and received bits is related to B.E.R. B.E.R is highest when four number of bits are corrupted at 8^{th} ,9^{th} ,10^{th} 11^{th} position . Value is lowest when five number of bits have been corrupted at location at 18^{th}, 19^{th}, 21^{st}, 22^{nd} and 23^{rd} location. There is error dependence on bits corrupted and placement of bits in a digital data. Observations are plotted in Figure 4. The bit positions at which bits are corrupted are 26^{th}, 27^{th} bits, 24^{th} bit, 22^{nd} and 23^{rd} bit, 18^{th}, 19^{th} , 21^{st}, 22^{nd} and 23^{rd} bit respectively are corrupted at the receiver. B.E.R is least when 26^{th} and 27^{th} bits are corrupted. B.E.R increases when bit corrupted is 24^{th}. It has been observed B.E.R is samewhen

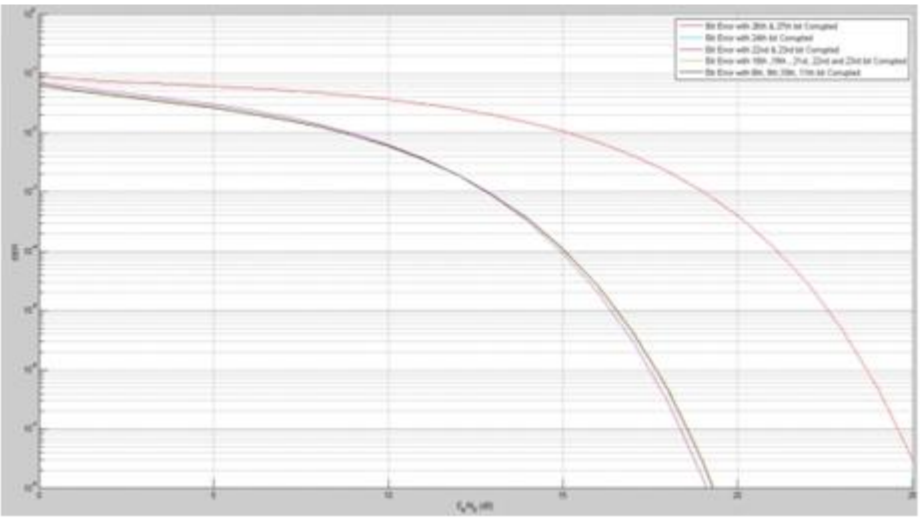

Figure 4. B.E.R when 2, 1, 5, 4 Number of Bits are Corrupted at Different Positions

two bits are corrupted at location 26^{th}, 27^{th} and 22^{nd} and 23^{rd} respectively. Error has been observed to be lesser when bits 8^{th}, 9^{th},10th and 11tth are corrupted. Least B.E.R occurs when bits corrupted are 18^{th}, 19^{th} , 21^{st}, 22^{nd} and 23^{rd}. B.E.R essentially helps in the selection of channel bandwidth required for various applications.Results are obtained using Matlab2013a.

III. CONCLUSION

In this work transmitted and received data has been same and a 32 bit data is used. The pulse shaping filter is used by the analyzer. Eb/N0 range set is 0:25 dB. BPSK is the modulator. AWGN is the channel. Order of modulation is 2. it has been observed that for lower values of B.E.R Eb/No in dB is highest when samples per symbol is are 12 and decreases for values samples per symbol as 8, 4,32 ,16. For higher values of B.E.R, Eb/No shows highest value when samples per symbol is 32 and decreases for values of samples per symbol as 16,12, 8 and 4 respectively. Differential encoding is used in this work. As samples per symbol are changed, B.E.R trend is showing varying trends. So for a particular type of channel a trade off between the Samples per symbol and BER decides the channel bandwidth in a communication channel. Further, there are variations introduced in transmission and received bits and respective B.E.R is calculated and discussed.

IV. REFERENCE

[1]. C.I.OFOE6BV, D.O.HJOKU, S.A.OKOLTE, C.G.ONUKWUGHA, O.C.NWOKONK WOJE (2022) Bit Error Rate Analysis of Digital Modulation Techniques in Wireless Communication System, IRE Journals, Vol(5), 7.

[2]. Jaeseog Kim, Shingo Yoshizawa, yoshikazu miyanaga (2012) Variable Word Length Soft Decision Viterbi Decoder For Power Efficient Wireless Lan. Integration , vol (45), 2, (pp. 132-140).

[3]. Kilgus and Gors 1972, Masnick and wolf 1967, Gore and Kilgus, 1971 Dinning and Robbins, 1978, Tsuruoda, 1978.

[4]. Lili Ren, Ming Xuan, Lili Qi,A (2023) Bit error Rate Analysis and testing systems. Proceedings of , 7^{th} International Conference on Electronics Information Technology and Computer Engineering.

[5]. F Electrical AND Electronics Ehninrrring, (2015) Bit Error Rate (BER) Performances of a Free Space Optical(FSO) Link Considering the Effect of

Cloud Induced Fading. Global Journal of Researches in Engineering

[6]. Hlaing NW, Farzamnia A, Kumar Haldar M, Yousefi Rezaii T (2020) BER Analysis of SIMO and MIMO Systems with Rayleigh Fading Using SIMULINK. InProceedings of the 12th National Technical Seminar on Unmanned System Technology 2020: NUSYS'20 2021 Sep 25 (pp. 769-782). Singapore: Springer Singapore.

[7]. Peksinski, J., Zeglinski, G., Mikolajczak, G. and Kornatowski, E., 2021. Estimation of BER Bit Error Rate Using Digital Smoothing Filters. Elektronika ir Elektrotechnika, 27(5), (pp.75-83).

[8]. Jeruchim, M. (2003). Techniques for estimating the bit error rate in the simulation of digital communication systems. IEEE Journal on selected areas in communications, 2(1), (pp.153-170).

[9]. Performance comparison of different adaptive modulation schemes in presence of binary convolution encoder and Viterbi decoder, 2018, 6(4), (pp.001-009).

[10]. Gopal, L. and Sim, M.L., 2008, August. Performance analysis of signal-to-noise ratio estimators in AWGN and fading channels. In 2008 6th National Conference on Telecommunication Technologies and 2008 2nd Malaysia Conference on Photonics (pp. 300-304). IEEE.

[11]. CHINCHU S Ragamalika Suby maria sojan, Criss Jose, Sreekala Ks (2016). Bit error rate tester for wireless communication systems, International Journal of Science technology & engineering, vol 2, 10.

[12]. Sergey B Mararav, ILYA i. Lavrnyuk, Anna S (2020). Oveyannikova Sergey VZAVJALOV, BER Performance of finite in time optimal FTN Signals for Viterbi Algorithm, Journal of Electronic Science & Technology,Vol 18(1)

[13]. Umesh Kumar, Banerjee, appala Venkata ramana murthy(2022), Bit Error rate performance of under water optical wireless communication test bed simulating the sea water conditions, optic, vol 251.

[14]. Ramirez, M. and Molano, S., 2021. Analytical expression for the bit error rate of a filtered multitone modulation scheme (FMT) through a multipath fading channel. IEEE Latin America Transactions, 19(4), (pp.643-651).

[15]. Irfan ali (2013) international journal of engineering research and Applications, vol3 (1), 2013, (pp. 706-711).

[16]. Mohsen Riahi Manesh, Youness Arjoune, Naima Kaabouch, (2018) A Bit Error Rate Estimation Method For Wireless Communication Systems , IEEE 8thAnnual Computing And Communication Workshop And Conference (ccwc).

[17]. Enescu, A.A., Sandoi, B.M. And Dinu, C.G., 2014, May. A Low-Complexity Bit Error Rate Estimation Algorithm For Wireless Digital Receivers. In 2014 10th International Conference On Communications (Comm) (pp. 1-4). IEEE.

[18]. Crimmins, T. and Horwitz, H., 1970. Mean-square-error optimum coset leaders for group codes. IEEE Transactions on Information Theory, 16(4), (pp.429-432).

[19]. Encyclopedia of Information Systems (2003), Error Detecting and Correcting Codes Patric Verlinde. (pp. 203-228).

[20]. Redinbo, G.R., 1979. Optimum soft decision decoding with graceful degradation. Information and Control, 41(2), (pp.165-185).

[21]. Sujata, A.A. and Lalitha, Y.D., 2018. Performance Analysis of FINFET Based 16: 4 Encoder and 4: 16 Decoder-A Design Perspective. IOSR Journal of VLSI and Signal Processing (IOSR-JVSP), 8(6), pp.49-55).

[22]. Goodman, L.M., 1967. Channel encoders. Proceedings of the IEEE, 55(1), (pp.127-128).

IJEAST

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE AND TECHNOLOGY

ABOUT IJEAST

International Journal of Engineering Applied Science and Technology (IJEAST) is a peer-reviewed, open access journal that publishes high-quality research papers in the field of Engineering, Applied Science and Technology.

IJEAST aims to provide a platform for researchers, academicians, and professionals to share their innovative ideas, research findings, and practical experiences with the global scientific community.

FOCUS AREAS

- Engineering
- Applied Science
- Technology
- Innovation & Development
- Interdisciplinary Studies

PEER REVIEWED
All submissions are rigorously peer reviewed to ensure quality.

OPEN ACCESS
Free and unrestricted access to research for all.

GLOBAL REACH
Connecting researchers and professionals worldwide.

TIMELY PUBLICATION
We ensure a swift and efficient publication process.

For more information, visit our website
www.ijeast.com

INTERNATIONAL JOURNAL
OF ENGINEERING APPLIED SCIENCE AND TECHNOLOGY

editor@ijeast.com
www.ijeast.com
India

2455-2143