ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 7, Issue 2, February 2018

BER analysis in OFDM and MIMO system with different channel capacity and long term evolution.

Puja Gonde, *Electronic and communication, NRIIST, (e-mail: poojagonde@gmail.com). Bhopal, India. 9589745190,* ***Rohit Shrivastava,*** *Electronic and Communication, NRIIST, Bhopal, India, 8889388421, (e- mail: rohit.shrivastava@nrigroupindia.com).* ***Shweta Gonde****, Computer Science, TIT-A, Bhopal, India, 9074776245, (e-mail: shwetagonde88@gmail.com).*

Abstract— In **this paper various aspects of orthogonal frequency division multiplexing (OFDM) and multiple inputs and multiple outputs (MIMO) system with different channel capacity and long term evolution have been discussed. This paper addresses and highlights the drawback of communication systems. The main problem is signal attenuation and spectrum fading and it is because of the diverse mobility factor associated with it. The motivation of this dissertation is to use the OFDM as a multicarrier system which can be able to achieve high efficiency in terms of spectral efficiency. Parametric study along with the previous results discussion have been presented and discussed. Based on this analysis problem statements have been identified. Some future suggestions have been discussed and suggested based on the overall study and discussion.**

Index Terms— **OFDM, MIMO, BER, AWGN, Rayleigh Channel**

I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) is a system for the means of communication and provides transmission modes. OFDM is a frequency division multiplexing (FDM) system which is beneficial in multi-channel communication [1, 2]. It is frequency division multiplexing of multi-carrier which is orthogonal to each other i.e. they are put definitely at the nulls in the control spectrum of each other. This makes OFDM horrifyingly all the all the more persuading [3]. In OFDM data is segregated into a couple parallel data streams or sub-channels, one for each channel which is orthogonal to each other with the way that they cover shockingly. Each sub-channel is controlled with a common direction course of action, (for example, quadrature amplitude modulation (QAM) or Phase-shift keying (PSK)) at a low picture rate keeping up total data rates like routine single-system change plots in a similar transmission channel. In today's circumstance multiple inputs and multiple outputs (MIMO) is to a great degree obliging with the mix of OFDM structure. The versatility of MIMO systems remembering the last objective to have high data rates is an especially captivating examination subject for future booking course of action sorts out and their applications. MIMO systems offer substantially more essential channel restrict over standard single-data single-yield structure. As of various transmit Algorithms have been passed on to experience past what many would consider conceivable in the MIMO systems [4, 5]. Furthermore, in MIMO structures, coming to choosing the social affair of customers with the at present most obvious achievable rates administered by a package scheduler in without miss the mark opening, we need to delegate them to the transmitter's radio wires in such a course, to the point that we can finish the best throughput in the system. Gathered qualities strategies, for event, space-time coding have gotten an enormous measure of thought in context of their ability to give higher efficiency [6-9]. While applying this method in a repeat specific channel, a space-time equalizer is required at the receiver to change for the frequency and carrier signal [10]. This multipath spread reasons optional time diffusing, settling, and stage change, known as blurring, in the got flag [11-13]. Code division multiple access (CDMA) structure has the upsides of extending past what many would consider conceivable adjoining the resistance against staying [14-16]. In multi-customer CDMA structures, different multiple access interference (MAI) is viewed as one of the standard wellsprings of execution debasement. Versatile isolating frameworks have been sufficient used to level the direct and accordingly lessen the MAI in the

direct sequence (DS)-CDMA structure [17-19].

II. RELATED WORK

In 2012, Samir et al. [20] proposed an enhancement to the performance of a direct sequence code division multiple access (DS-CDMA) system by utilizing an adaptive filter in the presence of different jamming techniques. In order to combat the impact of such jamming, the adaptive filter utilizes three adaptive algorithms which are the variable step-size affine projection (VSS-APA) algorithm, the generalized normalized gradient descent (GNGD) algorithm, and the generalized square-error-regularized (GSER) NLMS algorithm. These algorithms have the advantages of fast convergence, low steady state mean squared error and the ability to improve the bit error rate (BER) performance of the conventional CDMA system, in the presence of multi-path, multiple-access, and different jamming signals. Their results show that the VSS-APA outperforms other algorithms in the presence of barrage jamming.

In 2014, Le et al. [21] suggested coherent optical orthogonal frequency division multiplexing (CO-OFDM) is an attractive transmission technique to virtually eliminate inter-symbol interference caused by chromatic dispersion and polarization-mode dispersion. Design, development, and operation of CO-OFDM systems require simple, efficient and reliable methods of their performance evaluation. They demonstrated an accurate bit error rate estimation method for QPSK CO-OFDM transmission based on the probability density function of the received QPSK symbols. By comparing with data-aided and non-data-aided EVM, the method offers the most accurate estimate of the system performance for both single channel and wavelength division multiplexing QPSK CO-OFDM transmission systems.

In 2014, Zahed et al. [22] presented to determine the impact of frequency offset, timing jitter and additive white Gaussian noise (AWGN) on the bit error rate (BER) performance of a multi-carrier direct-sequence code division multiple access (MC-DS-CDMA) system over a Rayleigh Fading Channel. The analysis developed the probability density function (PDF) at the receiver considering combined influence of fading, timing jitter and Doppler frequency offset etc with maximal ratio combining (MRC) scheme. The expression for the conditional BER conditioned on a given timing error and fading is derived and the average BER is evaluated in the presence of multiple access interference (MAI) and inter-carrier interference (ICI). The performance results are evaluated numerically in terms of SINR and BER considering system parameters like number of users, number of sub-carriers. The result shows significant deterioration in SINR and BER performance due to fading along with the changes in parameters.

In 2015, Kumar et al. [23] suggested long term evolution (LTE) has adopted single carrier frequency division multiple access (SCFDMA) technique for uplink and orthogonal frequency division multiple access (OFDMA) for downlink. Wavelet based SCFDMA have been proposed for analyzing BER performance. Analysis is carried out using different wavelets and different modulation schemes under AWGN channel. Their analysis showed that the reduction in BER takes place by using wavelet transform in SCFDMA. Thus wavelet based SCFDMA provides better BER performance than that of DFT based SCFDMA.

In 2015, Jie et al. [24] suggested that the MIMO-OFDM system can live up to a high data transmission rate with reliability through diversity. MIMO-OFDM with STBC has excellent performance against Multi-path effects and frequency selective fading, what's more, the BER and the coding complexity is low. A simulation model of MIMO-OFDM system based on STBC is built and transmission performances under different channels have been analyzed. The simulation results show that the MIMO-OFDM system based on STBC outperforms other MIMO-OFDM system without STBC in BER performance.

In 2015, Suryavanshi et al. [25] suggested that the MIMO technique is most attractive techniques in wireless communication system and popular for high data rate capacity and against multipath fading. The performance analysis and a comparative study of orthogonal space time block code (OSTBC) over Rayleigh fading channel for multiple input single output (MISO) defined that the transmitter has multiple antennas at the same time the receiver has one antenna and MIMO shows that the both the transmitter and receiver have multiple antennas. They proposed quadrature phase shift key (QPSK), 16-QAM (Quadrature Amplitude Modulator) schemes and also observe that the performance of peak power-to-average ratio (PAPR), BER in MIMO and MISO.

In 2016, Guerra et al. [26] analyzed the performance of the OFDM technique, which is widely employed in wireless communication. The modified Jakes model for expeditious fading coefficients generation is adopted aiming to analyze and evaluate realistic communication channel scenarios. MIMO-OFDM

systems were analyzed for the purpose of achieve high performance combined with high capacity systems. Numerical results for bit-error-rate (BER) performance under different system and channel scenarios were obtained via Monte-Carlo simulation. Moreover, channel selectivity are discussed in SISO-OFDM while the impact on the system performance of the number of antennas, adoption of linear detection schemes and the spatial correlation are analyzed in MIMO-OFDM context.

In 2016, Singh et al. [27] suggested that the MIMO channels can be used to increment the information rate and the channel limit by utilizing numerous transmitting and getting reception apparatuses at both the finishes of a remote correspondence framework. MIMO frameworks utilize OFDM system and it utilizes isolate reception apparatuses at both the transmitter and beneficiary to build the information rate and with OFDM, rather than a solitary transporter, the fundamental data is adjusted into various free sub-bearer signals which are orthogonal to each other. They have displayed an OFDM-MIMO handset plan and the execution investigation of the framework in light of Error rate for various tweak methods utilizing GNU Radio. OFDM is picked over a solitary transporter arrangement because of lower unpredictability of equalizers for high defer spread channels or high information rates. So the blend of MIMO-OFDM framework has turned into a potential innovation for fast information transmission and effective use of the channel range for the advanced remote correspondence systems.

In 2016, Chakra borty et al. [28] suggested that the cooperative communication or distributed multiple input multiple-output (DMIMO) system combined with OFDM is considered as an emerging paradigm for link reliability, high data rate, and coverage extension in 5G wireless communication system. DMIMO system employs multiple relays with single or multiple antennas which opportunistically form virtual antenna array (VAA) in between the source and destination. Authors addressed the issue of joint time-frequency and channel gains estimation for estimate-and-forward (EF) relaying protocol. EF is a cost effective solution but provides coarse estimation at the relays introducing inter-carrier interferences (ICIs). Authors proposed two iterative estimators, expectation conditional maximization (ECM) and space-alternating generalized expectation maximization (SAGE) to jointly estimate MTOs, MCFOs and channel gains in the presence of ICIs. Simulation results show that the proposed estimators provide a significant performance gain in DMIMO-OFDM system with MIMO configuration at the relays compared to single-input single-output (SISO) system.

III. PROBLEM FORMULATION

The following gaps are identified as per the review and analysis:

1. Variant modulation is missing in most of the research work as maximum of the research work relies on 64 QAM or 32 QAM.
2. Efficient use of temperature variance is missing so that BER rates may effect badly.
3. It can be spread with no impediment of balance procedure utilizing OFDM and MIMO.
4. The OFDM frameworks recurrence missing synchronization in the type of Carrier Frequency Offset (CFO).
5. Need of improvement in bit error rates with different channel capacity and channel fading variants.

This study investigation suggested that there is the need of efficient mechanism for finding the effects of BER on the MC-DS-CDMA system based on variant modulation scheme. It is found that the calculation of BER performance alone is not sufficient as it should be calculated on the basis of CFO along with other variants like temperature. So the BER effect along with the parametric evaluation has been performed. There is need of variant channel capacity analysis like AWGN channel and multi-way Rayleigh fading channel. It can be formulated on the basis of the MC-DS-CDMA signals and it can deduce the timing jitters also on the basis of different BER performance parameter. The MC-DS-CDMA framework with the BER exhibitions influenced by timing butterflies when the planning nerves are free and ward, individually. Temperature variety is considered with variation channels and the execution is expanded if there should arise an occurrence of more number of channels utilized.

III. STUDY ANALYSIS

Based on the study the following result comparison have been analyzed.

S.No	Reference	Method used	Approach	Gap
1	[29]	Hybridization of MIMO-OFDM system	Their results indicates that as SNR increases, the data rate also increases for both conventional 2x2, 4x4, 8x8 MIMO and hybridized MIMO-OFDM antenna, in any case, the hybridized MIMO-OFDM system has higher information rate than regular MIMO. So also, BER values for the hybridized MIMO-OFDM are lower than the qualities acquired for the ordinary MIMO showing preferred execution in 4G over traditional MIMO.	There is a need of considering different channels like AWGN and Rayleigh fading for the comparison and calculating the variations.
2	[30]	Transmit selection in MIMO-OFDM	They have suggested the advantage of antenna selection technology in MIMO-OFDM systems, and gives exhaustive rules to frequency determination techniques in sensible situations, from both the execution and unpredictability points of view.	The receiving and sending communication is not specified.
3	[31]	BER Performance of MIMO-OFDM system	They have investigated the performance of MIMO-OFDM using different modulation schemes. It is used to encode and decode the data stream. AWGN channel is used data transmission and receiving. They have integrated the OFDM and MIMO system. They have applied MIMO detection methods based on vertical bells lab layered space time (VBLAST) architecture to improve spectral efficiency.	Varaint data carriers may need for check the performance.
4	[32]	QAM and QPSK Modulation Schemes	This have presented the design and implementation of an MIMO-OFDM handset framework for rapid wireless local area network (LAN) utilizing MATLAB tool. They have examined the impact of blurring channel on the execution of the MIMO-OFDM framework with various code rate and balance plans utilizing the BER. The execution of MIMO-OFDM is assessed on the premise of BER.	Different CFO and modulations schems are missing.
5	[33]	MIMO Schemes in LTE Systems	BER analysis is presented for MIMO schemes in the Long Term Evolution (LTE) system. Diagnostic expressions for the normal BER of the framework are determined over level Rayleigh fading channels for two diverse MIMO conspires as characterized in LTE, accepting M-ary quadrature amplitude modulation (M-QAM) schemes and are evaluated numerically. MonteCarlo simulation consequences of the LTE framework are likewise given to check the exactness of the numerical examination. It is demonstrated that the outcomes from Monte-Carlo inferred numerical equations.	There is a need of considering different channels like AWGN and Rayleigh fading for the comparison and calculating the variations.
6	[34]	Adaptive MIMO OFDM System	The authors aim is to comapare the adaptive single input single output (ASISO) -OFDM with adaptive multiple input multiple output (AMIMO)-OFDM system. The BER execution of MIMO OFDM system utilizing the same.	Varaint data carriers may need for check the performance
7	[35]	MIMO OFDM System for AWGN & Rayleigh Fading Channel	It is analyzed the BER performance of the MIMO-OFDM system for AWGN Channel, Rayleigh Fading Channel along with asimulation channel using different modulation technique. Likewise the aftereffect of the examination propose for the better strategy with a specific end goal to enhance the BER normal for the MIMO-OFDM framework.	Different CFO and modulations schems are missing.
8	[36]	Channel Impairment on STBC-OFDM	They have analyzed the performance of non STBC-OFDM system and STBC-OFDM system. The execution has been assessed for development regulation QAM procedure for OFDM system utilizing numerous transmit assorted qualities reception apparatus framework in the channel. Conjointly the	Varaint data carriers may need for check the performance

			condition of SNR and BER has been inferred for 16-QAM for different transmit and get radio wire for STBC-OFDM framework by considering the affect of ISI, stage clamor and worldly course of action commotion in Rayleigh fading channel.	
9	[37]	MIMO-OFDM System using STTC	They provides the channel parameter estimation and BER performance for MIMO –OFDM system in new transmission scheme. Channel estimation parameter and BER for 2 x 2 MIMO OFDM framework is performed. Thgeir transmission plan is utilized as a part of symmetric channels, for example, the connection between two transmit reception. Channel parameters are assessed with the assistance of pilot information. These are send by the recipient to the transmitter. The proposed 2 x 2 MIMO channel demonstrate gives great execution contrasted with traditional MIMO OFDM system show.	Other parameters which can affect the performance like temperature may be included.

IV. CONCLUSION

Based on the study and analysis presented in the paper it is investigated that the performance improvement is in the combination of MIMO-OFDM system. Several researches have been focused on different problems identified in communication. It is found that different approaches are used efficiently for the improvement in the performance and to reduce the error rates. Based on the complete discussion the following implications are suggested for the future.

1. There is a need of considering different channels like AWGN and Rayleigh fading for the comparison and calculating the variations.
2. Variant data carriers may need for checking the performance.
3. Different CFO variations may be applied.
4. Other parameters which can affect the performance like temperature may be included.

.

REFERENCES

1. Frederiksen FB, Prasad R, "An overview of OFDM and related techniques towards development of future wireless multimedia communications." In Radio and Wireless Conference, 2002, RAWCON 2002. *IEEE* 2002 (pp. 19-22), *IEEE*.
2. Bingham JA, "Multicarrier modulation for data transmission", an idea whose time has come, *IEEE Communications magazine*, 1990 May; 28(5):5-14.
3. Wang Z, Ma X, Giannakis GB, "OFDM or single-carrier block transmissions,'' *IEEE Transactions on Communications*, 2004 Mar; 52(3):380-94.
4. Trivedi S, Raeen MS, Pawar SS, "BER analysis of MIMO-OFDM system using BPSK modulation scheme," *International Journal of Advanced Computer Research*, 2012; 2(5):219-26.
5. Xia P, Giannakis GB, "Design and analysis of transmit-beam forming based on limited-rate feedback," *IEEE Transactions on Signal Processing*, 2006 May; 54(5):1853-63.
6. Paramita S, Singh SS, Mohanta J, "Time and frequency synchronization in OFDM system," *International Journal of Advanced Computer Research*, 2014 Sep 1; 4(3):856.
7. Gupta V, Tiwari R, "Performance Analysis and Simulation Result of MC-CDMA for AWGN Channel and Raleigh Based on SNR/BER," *International Journal of Advanced Computer Research*, 2011; 1(1): 13-7.
8. Rathore M, Tanwar P, "Reduction of co-channel interference in transmit/receive diversity (TRD) in MIMO System," *International Journal of Advanced Computer Research*," 2012; 2(5): 13-7.
9. Gupta P, Singh UP, Richhariya V, "Analysis and comparison of the 4-PSK and 8-PSK STTC over Rayleigh fading Channels for determining Performance," *International Journal of Advanced Computer Research*, 2012; 2(5): 140-6.
10. Zhou S, Wang Z, Giannakis GB, "Quantifying the power loss when transmit beamforming relies on finite-rate feedback, *IEEE Transactions on Wireless Communications*, 2005; 4(4):1948-57.
11. Tarokh V, Seshadri N, Calder bank AR, "Space-time codes for high data rate wireless communication, Performance criterion and code construction," *IEEE transactions on information theory*,1998 Mar; 44(2):744-65.
12. Foschini GJ, "Layered space-time architecture for wireless communication in a fading environment when using multi-element antennas," *Bell labs technical journal*, 1996 Jun 1; 1(2):41-59.
13. Anitha K, Sujatha BK, "FPGA implementation of high throughput digital QPSK modulator uses verilog HDL**,"** *International Journal of Advanced Computer Research*, 2014; 4(1):217.
14. Foschini GJ, Gans MJ, "On limits of wireless communications in a fading environment when using multiple antennas," Wireless personal communications, 1998; 6(3):311-35.
15. Telatar E, "Capacity of Multi-antenna Gaussian Channels" European transactions on telecommunications, 1999; 10(6):585-95.
16. Daksh JK, Mohan R, Sharma S, "Performance analysis with space-time coding in MIMO-OFDM systems with multiple antennas," *International Journal of Advanced Computer Research*, 2013 Jun 1; 3(2):126-9.
17. Choubey R, Mohan R, Sharma S, " A survey of BER performance of generalized MC DS-CDMA system," *International Journal of Advanced Computer Research*, 2013 Jun 1; 3(2):130-3.
18. Daksh JK, Mohan R, Sharma S, " A survey of Performance Analysis in MIMO-OFDM Systems," *International Journal of Advanced Computer Research*, 2013 Jun 1; 3(2):91-4.
19. Dubey AK, Khandagre Y, Kushwaha GR, Hemnani K, Tiwari R, Shrivastava N, "PAPR Reduction in OFDM by Using Modernize SLM Technique," In Recent Trends in Wireless and Mobile Networks 2011 (pp. 397-405), Springer Berlin Heidelberg.
20. Samir M, Shaheen EM, El Wahab AA, "Performance analysis of DS-CDMA system using fast adaptive filtering under different jamming techniques," In Engineering and Technology (ICET), 2012 *International Conference on* 2012 Oct 10 (pp. 1-6), IEEE.
21. Le ST, Blow KJ, Mezentsev VK, Turitsyn SK, " Bit error rate estimation methods for QPSK CO-OFDM transmission," Journal of Light wave Technology, 2014 Sep 1; 32(17):2951-9.
22. Zahed MI, Majumder SP, "Performance analysis of MC-DS-CDMA in the presence of carrier frequency offset and timing jitter over Rayleigh Fading Channels," In Computer and Information Technology (ICCIT), 2013, *16th International Conference on*, 2014 Mar 8 (pp. 1-5), IEEE.
23. Kumar N, "BER analysis in Wavelet based SC-FDMA for LTE uplink transmission," In Advanced Computing & Communication Technologies (ACCT), 2015), *IEEE Fifth International Conference on* 2015 Feb 21 (pp. 437-440), IEEE.

24. Jie Z, Liang LI, Jin LI, "Performance analysis of space time block code in MIMO-OFDM systems," In Communication Software and Networks (ICCSN), 2011 *IEEE 3rd International Conference on* 2011 May 27 (pp. 13-16). IEEE.
25. Suryavanshi P, Thakur DS, Nayak KK, "Performance Analysis of MIMO-OFDM and MISO-OFDM System based on STBC Code, *"International Journal of Computer Applications*, 2015 Jan 1; 111(13).
26. Guerra DW, Fukuda RM, Kobayashi RT, Abrão T, "Linear detection analysis in MIMO-OFDM with spatial correlation," In Industry Applications (INDUSCON), 2016 *12th IEEE International Conference* on 2016 Nov 20 (pp. 1-8), IEEE.
27. Singh M, Kakkar S, Rani S, "BER performance analysis of OFDM-MIMO system using GNU radio," *In MATEC Web of Conferences* 2016 Jan 1 (Vol. 57), EDP Sciences.
28. Chakra borty S, Sen D, "Joint Estimation of Time, Frequency Offsets and Channel Gains with ICIs in EF multi-relay DMIMO-OFDM system," *IEEE Transactions on Vehicular Technology*, 2016 Dec 1.
29. Abolade RO, Adeyemo ZK, Eleshin O, Ajayi OO, "Hybridization of MIMO-OFDM Wireless System with Different Antenna Configurations over Rayleigh Channel, Journal of Wireless Networking and Communications, 2015; 5(2):67-74.
30. Zhang H, Nabar RU, "Transmit antenna selection in MIMO-OFDM systems, bulk versus per-tone selection," In Communications, 2008. ICC'08, *IEEE International Conference on* 2008 May 19 (pp. 4371-4375). IEEE.
31. Divyatha MV, Reddy BS, "Design and BER Performance of MIMO-OFDM for Wireless Broadband Communications," *International Journal of Modern Engineering Research (IJMER)*, 2013 May; 3(3).
32. Mangla R, Singh M, "Performance Comparison of MIMO-OFDM Transceiver Wireless Communication System using QAM and QPSK Modulation Schemes," *International Journal of Advances in Engineering Science and Technology*, 2012; 1(2):66-72.
33. Jemmali A, Conan J, Torabi M, " Bit Error Rate Analysis of MIMO Schemes in LTE Systems," *In The Ninth Int. Conf. on Wireless and Mobile Communications*, 2013 Jul (pp. 190-194).
34. Khasdev MB, Hirwe MA, "Performance Analysis of Adaptive MIMO OFDM System," *International Journal of Advanced Research in Electronics and Communication Engineering*, 2016; 5(7): 2089-93.
35. Agrawal M, Raut Y, "BER analysis of MIMO OFDM system for AWGN & Rayleigh fading channel," *International Journal of Computer Applications*, 2011 Nov; 34(9):33-7.
36. Sinha H, Meshram MR, Sinha GR, "Degrading the Effect of Channel Impairment on STBC-OFDM System in Rayleigh Fading Channel," *International Journal of Sense Network Data Communication*, 2016; 5(146):2.
37. Vidhya K, Shankarkumar KR, "BER performance of MIMO-OFDM system using STTC," *International Journal of Scientific and Research Publications*, 2013 Feb; 3(2):1.

Author Details

Puja Gonde

Educational qualification: - B.E (EC), M-TECH pursuing (DC)

Publication Details: -

I. "A Survey Paper on LTE Transmission Scheme", *International Journal of Electronics and Communication Engineering and Technology (IJECET), Volume 07, Issue 6, (Nov-Dec 2016)*

II. "Performance analysis and evaluation based on CFO and different channel capacity", *IOSR Journal of Electronics and Communication Engineering (IOSR-JECE) e-ISSN: 2278-2834,p-ISSN: 2278-8735.Volume 13, Issue 1, Ver. I (Jan.- Feb. 2018), PP 52-60.*