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Performance analysis and evaluation based on CFO and different channel capacity

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Abstract: *This paper shows and analyses the performance and evaluation based on carrier frequency offset (CFO) and different channel capacity. The proposed system includes the timing jitters to analysis the error rate. The bit error rate (BER) execution of the multi-carrier code-division multiple access frameworks with theAdditive white Gaussian noise(AWGN) channel and multi-way Rayleigh fading channel with different frequency offsets have been analysed. The sub-carriers considered are 16, 32, 64,128 QAM.The results based on CFO suggest that increasing N has decreasing error rate and the constellation points appear noisy.The performance of the multi-carrier transmission modulation scheme that uses multi-carrier transmission with orthogonal frequency division multiplexing (OFDM) have been analysed with the BER ratio. The results also indicate the same.*

Keywords: *BER, OFDM, AWGN, Rayleigh Channel, CFO*

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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) orPhase-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 directsequence (DS)-CDMA structure [17-20].

II. Related Work

In 2012, Samir et al. [21] 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. [22] suggestedcoherent optical orthogonal frequency divisionmultiplexing (CO-OFDM) is an attractive transmission techniqueto virtually eliminate inter-symbol interference caused bychromatic dispersion and polarization-mode dispersion. Design,development, and operation of CO-OFDM systems requiresimple, efficient and reliable methods of their performanceevaluation. They demonstrated an accurate bit errorrate estimation method for QPSK CO-OFDM transmission basedon the probability density function of the received QPSKsymbols. By comparing with data-aided and non-data-aided EVM, the method offers the most accurate estimate of the systemperformance for both single channel and wavelength divisionmultiplexing QPSK CO-OFDM transmission systems.

In 2014, Zahed et al. [23] 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. [24] 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 analysingBER 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.[25] 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 beenanalyzed. 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. [26]suggested that the MIMO technique is mostattractive techniques in wireless communication system andpopular for high data rate capacity and againstmultipath fading. The performance analysisand a comparative study of orthogonal space timeblock code (OSTBC) over Rayleigh fading channel for multiple input single output (MISO) defined that the transmitterhas multiple antennas at the same time the receiver has one antenna and MIMO showsthat the both the transmitter and receiver have multipleantennas. They proposed quadrature phaseshift key (QPSK), 16-QAM (Quadrature Amplitude Modulator)schemes and also observe that the performance of peak power-to-average ratio (PAPR), BER in MIMOand MISO.

In 2016, Guerra et al. [27] analysed 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 analyse and evaluate realistic communication channel scenarios. MIMO-OFDM systems were analysed 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 analysed in MIMO-OFDM context.

In 2016, Singh et al. [28] 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, Chakraborty et al. [29] suggested that the cooperative communication or distributed multipleinput 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. Proposed Work

The proposed system provides a detail analysis with variable timing jitters to analysis the error rate. It will provide the detail analysis based on different channel capacity. Specifically, we will give careful consideration on the BER execution of the multi-carrier code-division multiple accessframeworks because of the timing jitter both in added AWGN channel and multi-way Rayleigh fading channel with different frequency offsets. We firstly formulate the analytical expressions for the signals in presence of the timing, channel performance and temperature variance and then compare BER performance of the system with the BER performances affected by timing jitters when the timing jitters are independent and dependent, respectively. BER sensitivity is also calculated. Figure 1 shows the flowchart of our work.

$$BER = \frac{Number\ \ of\ errors}{Aggregate\ \ number\ \ of\ bits\ sent}$$

The following steps showed the process of our work:
Step 1: Channel modulation has been selected and the pilot symbols are generated according to the distribution equations specified.
Step 2: Modulation scheme has been selected.
Step 3: The symbols generated as the input for the error analysis.
Step 4: OFDM or MIMO frame has been selected.
Step 5: The timing frame and size are variant but for the different capacity it is same.
Step 6: Receiver side added the prefix input
Step 7: AWGN and Rayleigh fading channels have been considered for the estimation.
Step 8: Receiver received the data.
Step 9: Different sensitivity have been considered for BER impact calculation.
Step 10: data extracted successfully.
Step 11: The error rate is calculated based on CFO variants along with the AWGN channel.

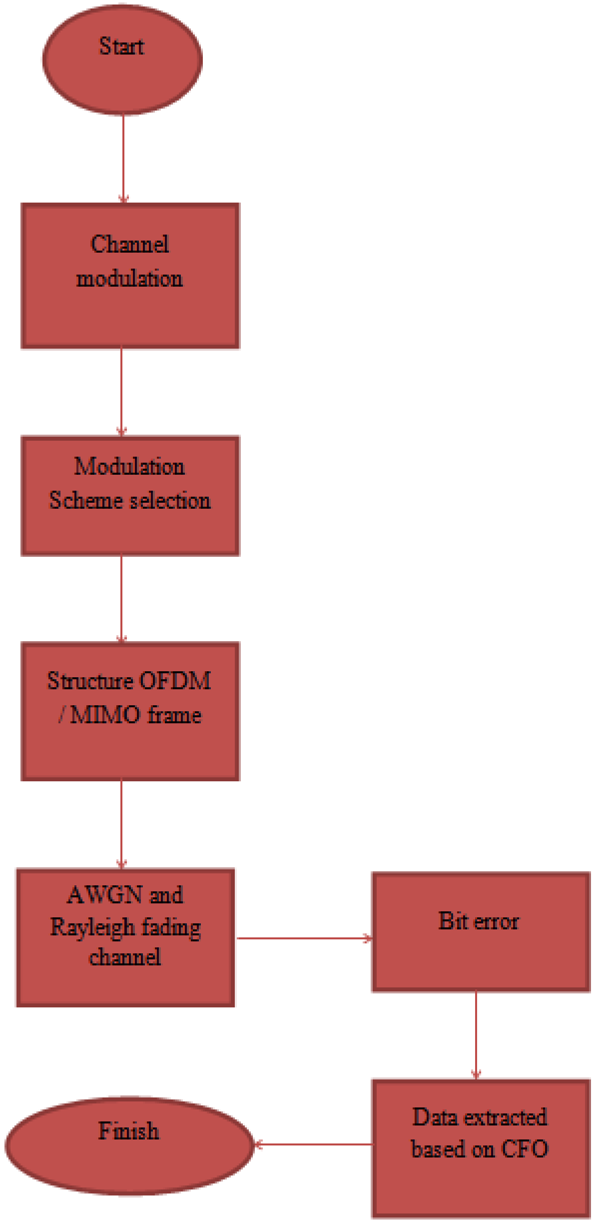

Figure 1: Flowchart

We have proposed this procedure to fulfil the objective of the efficient configuration of the proposed transmitter. It is important to dispense a fitting equalization bunch and/or a transmission rate. For this reason, to start with, we constantly check the data transmission capability by observing BER. At the point when BER is debased beneath the pre-characterized BER limit, we select a lower-request QAM design than the present balance arrangement to enhance it. For this 16 QAM, 32 QAM, 64 QAM, 128 QAM and 256 QAM are considered. On the other hand, if BER ends up being better than the lower uttermost spans of as far as possible, a higher-demand QAM design is given the high accuracy.

IV. Result Analysis

The results based on CFO has been shown first. It shows the degradation invoked by noise and non-ideal channel. It shows the the transmitting and receiving frequency mismatch and error chances can be recorded to show the system performance. In our case 16,32, 64, 128, 256, 512 QAM based single carrier have been considered.It is clear from figure 2 to 7 that increasing N has decreasing error rate and the constellation points appear noisy.

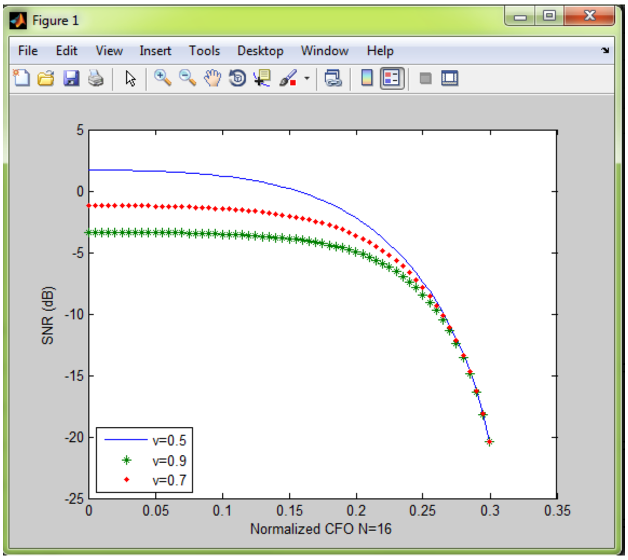

Figure 2: CFO at N=16

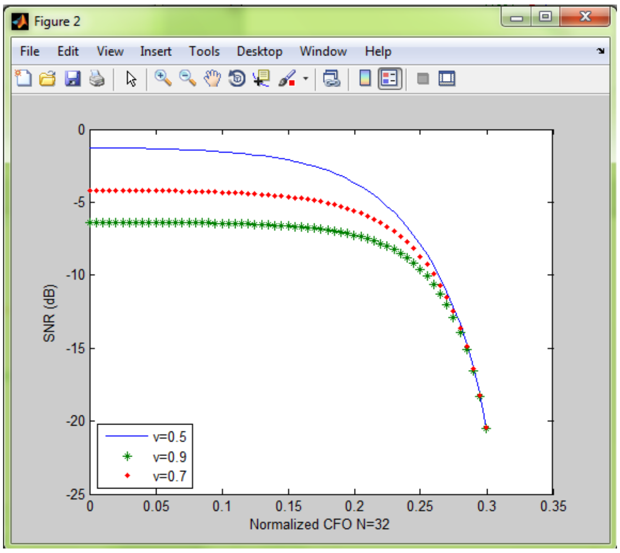

Figure 3: CFO at N=32

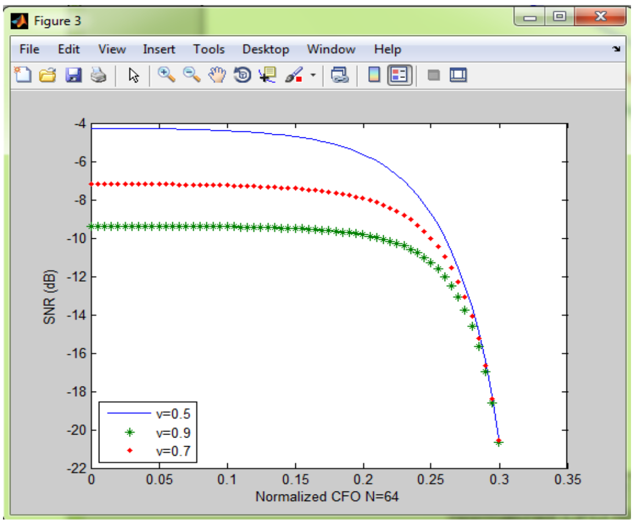

Figure 4: CFO at N=64

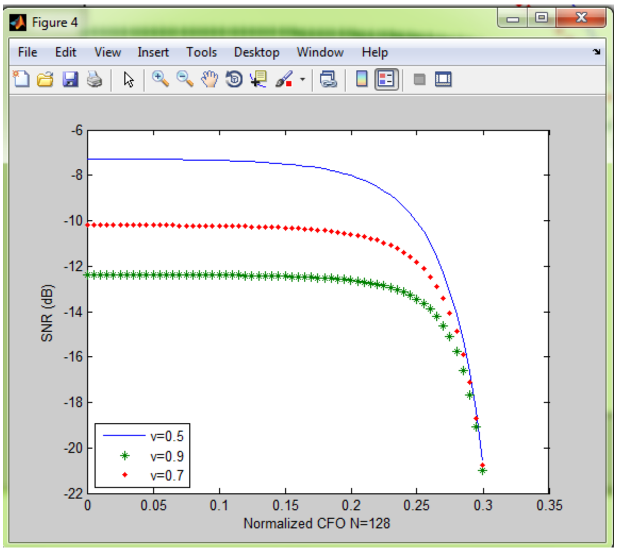

Figure 5: CFO at N=128

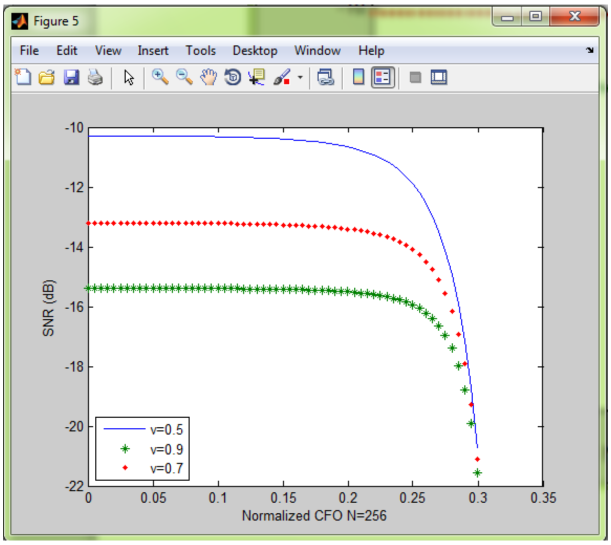

Figure 6: CFO at N=256

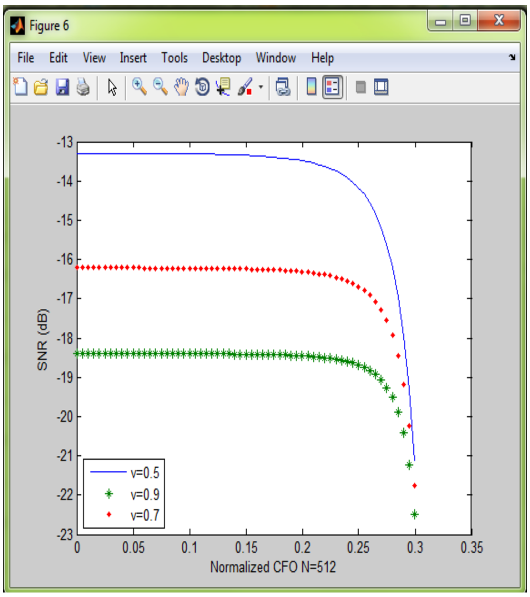

Figure 7: CFO at N=512

The performance of the multi-carrier transmission modulation scheme that uses multi-carrier transmission with OFDM have been analysed with the BER ratio. The subcarriers are denoted by N. spreading code length is denoted by L. Jitter correlation is denoted by a. Zero for uncorrelated timing jitter and 1for correlated timing jitter. The results are shown in figure 8 to 11. It clearly indicates that the increasing N can reduce the error and the channel strength is good.

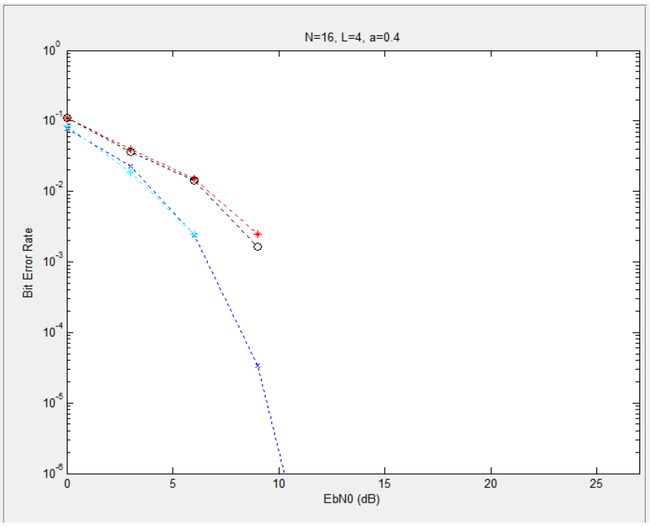

Figure 8: BER performance at N=16

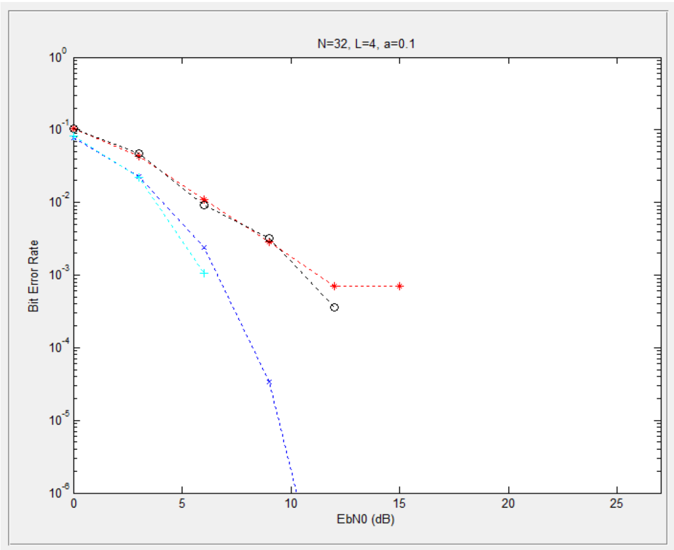

Figure 9: BER performance at N=32

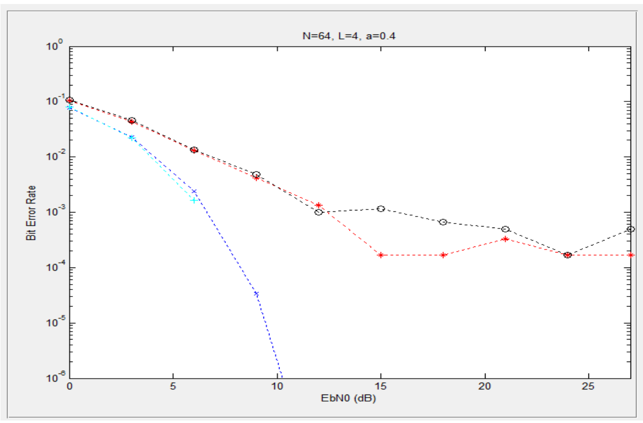

Figure 10: BER performance at N=64

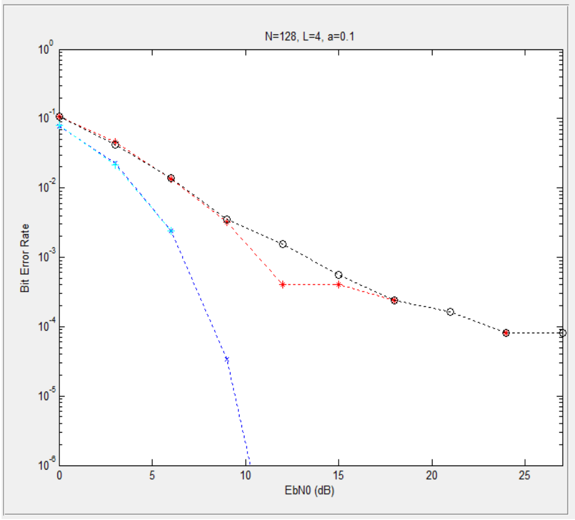

Figure 11: BER performance at N=128

V. Conclusion

The performance of AWGN and Rayleigh fading channel with different subcarriers frequencies and channel capacity has been analysed to showthe BERperformance in different condition. The performance clearly indicates the impact of our proposed system. It shows that the BER ratio may be decreased in case of increasing the channel subcarriers and the transmission strength is good.

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