Performance Analysis of MIMO OFDM system for Rayleigh Fading Channel under MSK and QAM-32 Modulation Scheme

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ABSTRACT
There are various kinds of channel used in wireless communication. Here we want to show a performance analysis on the basis of Multipath Rayleigh fading channel. This is analysis with different kinds of modulation techniques. Here we have also measured the Bit Error Rate, signal to noise ratio and energy per bit to noise power spectral density ratio under the Rayleigh fading channel for different modulation techniques. Our objective is to compare the different characteristics of the transmitter and receiver for different types of modulator under Rayleigh fading channel.
KEYWORDS: *Rayleigh fading channel, Bit Error Rate, BER and SNR.*

I.INTRODUCTION

Rapid attenuation is that the foremost drawback for digital mobile communication. It mortifies the bit error rate and repeatedly introduces an exclusive BER. Here, during this issue we would like to point out the BER modification for various modulation techniques within the Rayleigh fading channel atmosphere.
Channel is that the foremost vital subject issue for any communication system. There are various types of channel – AWGN channel, , Rayleigh Fading channel , Riccian attenuation channel . Rayleigh Fading channel is the standard statistical distribution for amplitude modeling of radio signal in attenuation atmosphere. Attenuation is the vital issue for today wireless communication system. Mobile antenna receives an oversized variety of mirrored and scattered waves from varied directions. Any quite received signal with, Rayleigh Fading distribution follows the exponential distribution property.Due to reflections, scattering, and diffraction of the transmitted signal in a wireless channel, multiple versions of the transmitted signal reach the proper destination at the receiver withdifferent amplitudes and phases. We have used flat fading model for this issue.

MIMO- OFDM SYSTEM:

Today's integrationofOrthogonalFrequency Division Multiplexingtechnique with Multiple Input Multiple Outputsystems has been an area of interesting and challenging research in the field of broadband wireless communication. Multiple input multiple output (MIMO) systems using multiple transmit and receive antennas are widely recognized as the vital breakthrough that will allow future wireless systems to achieve higher data rates with limited bandwidth.The MIMO system transmits different signals from each transmit element so that the receiving antenna array receives a superposition of all the transmitted signals. All signals are transmitted from all elements once and the receiver solves a linear equation system to demodulate the message. MIMO-OFDMsystem is an efficient answer to boost communication quality, performance, capacity, and transmission rate.

II. Digital Modulation

Phase-shift keying is a digital modulation scheme that conveys data by changing, or modulating, the phase of a reference carrier signal.Digital modulation schemes transform digital signals into waveform that are compatible with the communications channel. One category uses a constant amplitude carrier and the other carries the information in phase or frequency variations (FSK, PSK). A major transition from the simple amplitude modulation (AM) and frequency modulation (FM) to digital techniques such as Quadrature Phase Shift Keying (QPSK), Frequency Shift Keying (FSK), Minimum Shift Keying (MSK) and Quadrate Amplitude Modulation (QAM).in this paper we areusing MSK and QAM-32 modulation techniques for the analysis purpose.

QuadratureAmplitudeModulation:

A modulation technique that employs both phase modulation (PM) and amplitude modulation (AM). It is widely used to transmit digital signals such as digital cable TV and cable Internet service.it is also used as the modulation technique in orthogonal frequency division multiplexing. The "quadrature" comes from the fact that the phase modulation statesare 90 degrees apart from each other.Analog QAM uses two carriers 90 degrees out of phase with each other. Each carrier is modulated by an analog signal, and the resulting modulated waves are combined. In digital QAM, the number of modulation states determines how the digital signal is split up. For example, in 8QAM, each three bits of input alters the phase and amplitude of the carrier to derive eight unique modulation states.32 QAM has six possible states on the I & Q axis. The four corner states are not used,

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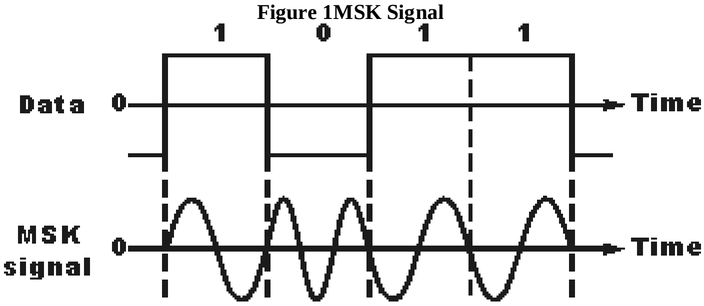
thus encoding 5 bits into 32 states.

Minimum Shift Keying (MSK):

Itis a type of continuous phase frequency shift keying that was developed within the late fifties and nineteen sixties.it is encoded with bits alternating between quadrature components, with the Q component delayed by half the symbol period.MSK encodes each bit as a half sinusoid. This results in a constant-modulus signal which reduces problems caused by non-linear distortion. it can also be viewed as a continuous phase frequency shift keyed signal with a frequency separation of one-half the bit rate. When looking at a plot of a signal using MSK modulation, it can be seen that the modulating data signal changes the frequency of the signal and there are no phase discontinuities. This arises as a result of the unique factor of MSK that the frequency difference between the logical one and logical zero states is always equal to half the data rate. This can be expressed in terms of the modulation index, and it is always equal to 0.5.

Figure 1MSK Signal



In MSK the difference between the higher and lower frequency is identical to half the bit rate. Consequently, the waveforms used to represent a 0 and a 1 bit differ by exactly half a carrier period.
The resulting signal is represented as given below:

$$S(t) = a_1(t)\cos\left(\frac{\pi t}{2T}\right)\cos(2\pi f_c t) - a_q(t)\sin\left(\frac{\pi t}{2T}\right)\sin(2\pi f_c t) \quad \text{.......................... (1)}$$

Where:
$a_1(t)$= Encode the even information with a sequence of square pulses of duration 2T.
a_q(t)= Encode the odd information with a sequence of square pulses of duration 2T.
f_c = Carrier frequency
By Using the trigonometric identity equation (1) can be written as:

$$S(t)=\cos\left[2\pi f_c\, t + b_k(t)\frac{\pi t}{2T} + \phi_k\right]$$

Where
$b_k(t)$=+1 when a_1(t)=a_q(t)
$b_k(t)$=-1 when a_1(t) &a_q(t) have opposite signs.
ϕ_k=0 ifa_1(t)=1 otherwise it will be equal to π.
So the signal is modulated in both phase and frequency.Also the phase is changing continuously and linearly.

III.SIMULATION MODEL

Here, Figure 2 shows the basic simulation model of MIMO OFDM system. Basically It consist of a transmitter with binary data generator, ASTC encoder,Interleaver, modulator.Transmitter and receiver are connected with a channel that is Rayleigh fading channel.Receiver consist of demodulator,decoder and deinterleaver as shown in the figure.Each block has its separate function.

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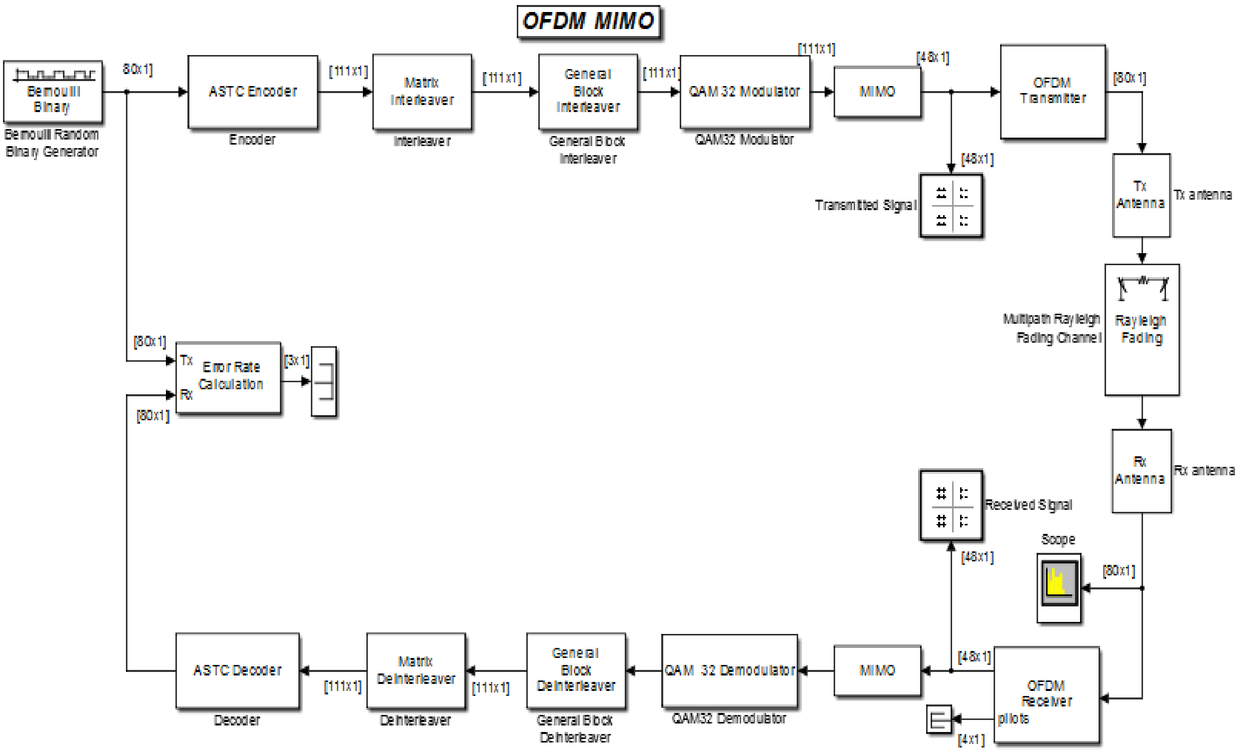
Figure 2 Proposed Model of MIMO OFDM



IV.SIMULATION RESULTS:

In This work we have considered Multipath Rayleigh Fading channel.We have considered 2 different modulation techniques – MSK& QAM-32 for this analysis. We have focused ontransmitted signal response, received signal frequency responseand received signal constellation.We have also measured bit error rate,signal to noise ratio andenergy per bit to noise power spectral density ratio for both the modulation techniques.

Figure 3, shows the signal frequency response for MSK modulation under Rayleigh fading channel.Figure 4 shows the transmitted signal response for MSK modulation.Figure 5 shows the received signal response for MSK modulation under Rayleigh fading channel.Fig 6.shows a graph between Bit error rate and energy per bit to noise power spectral density ratio for MSK modulation.The graph is taken for different value of nt.here we have considered two cases of nt=1 and nt=2.figure 7 shows a plot between bit error rate and signal to noise ratio.The curve is drawn for simulated vale as well as for theoretical values.Figure 8, shows the signal frequency response for QAM-32 modulation under Rayleigh fading channel.Figure 9 shows the transmitted signal response for QAM-32 modulation.Figure 10 shows the received signal response for QAM-32 modulation under Rayleigh fading channel.Figure 11 shows the graph between bit error rate and signal to noise ratio for simulated values and theoretical values for QAM-32 modulation.Figure 12 shows the multiple curves for different values of nt.in this case we have considered the value of nt=1 & 2.Figure 5& 10 shows the received constellation for different types of modulation under relyiegh fading channel. From the figure it is clear that large number of constellation points can be observed for different type of modulation in Rayleigh fading channel.

Fig.3. MSK signal FREQUENCY response of Multipath Rayleigh fading channel

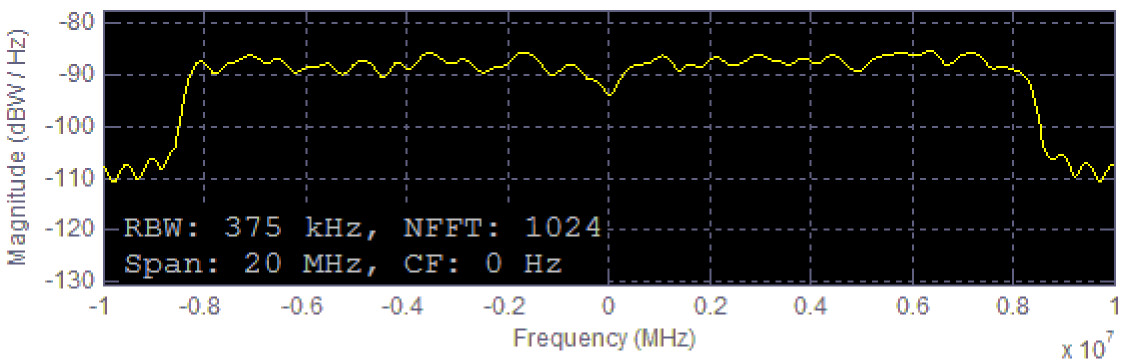


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Figure 4. MSK transmitted signal response of Multipath Rayleigh fading channel

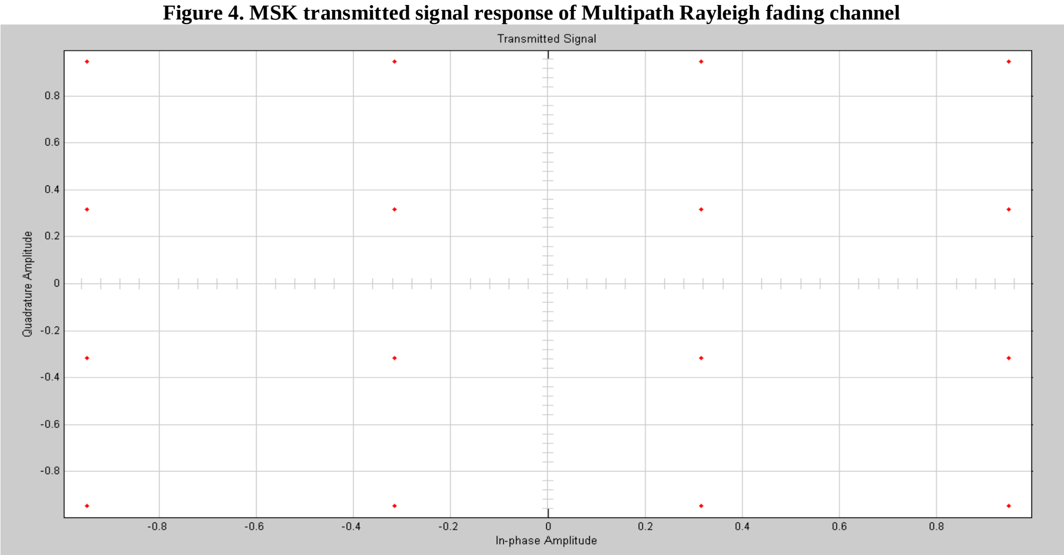

Figure. 5. MSK RECEIVED Signal Response Of Multipath Rayleigh Fading Channel.

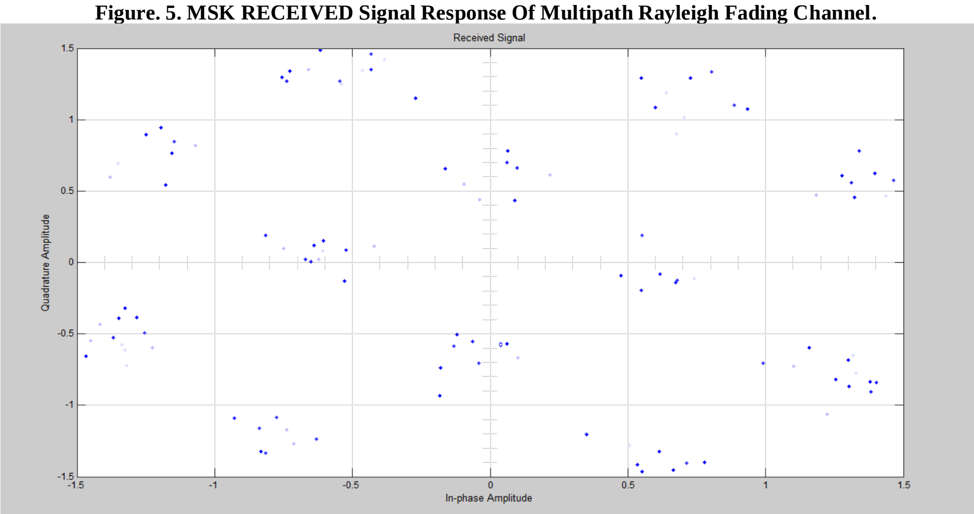

Figure 6. Bit error rate vs energy per bit to noise power spectral density ratio for MSK modulation.

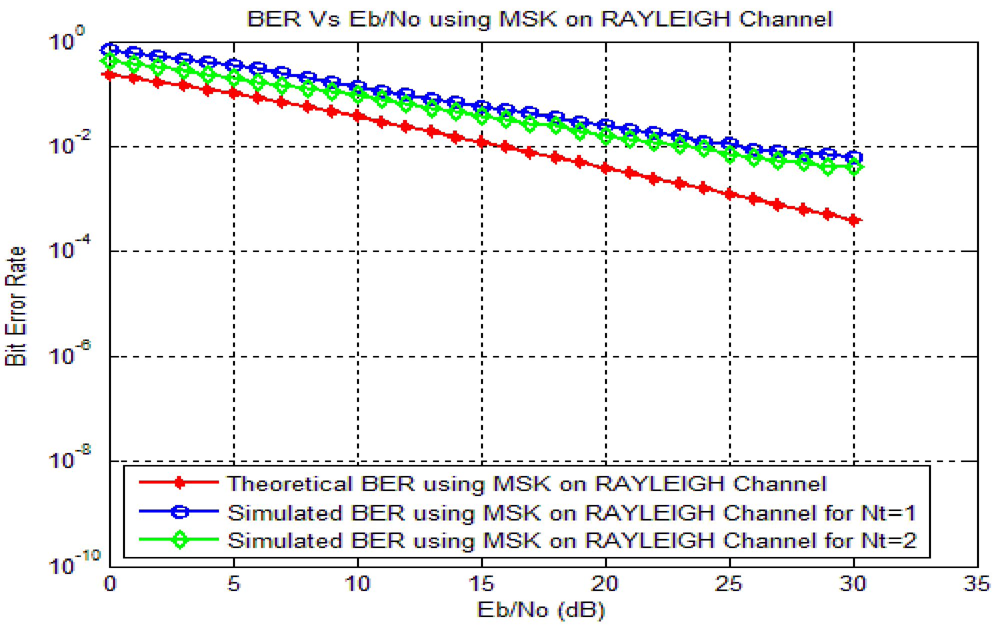

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Figure 7. Bit Error Rate Vs Signal to Noise Ratio for MSK Modulation.

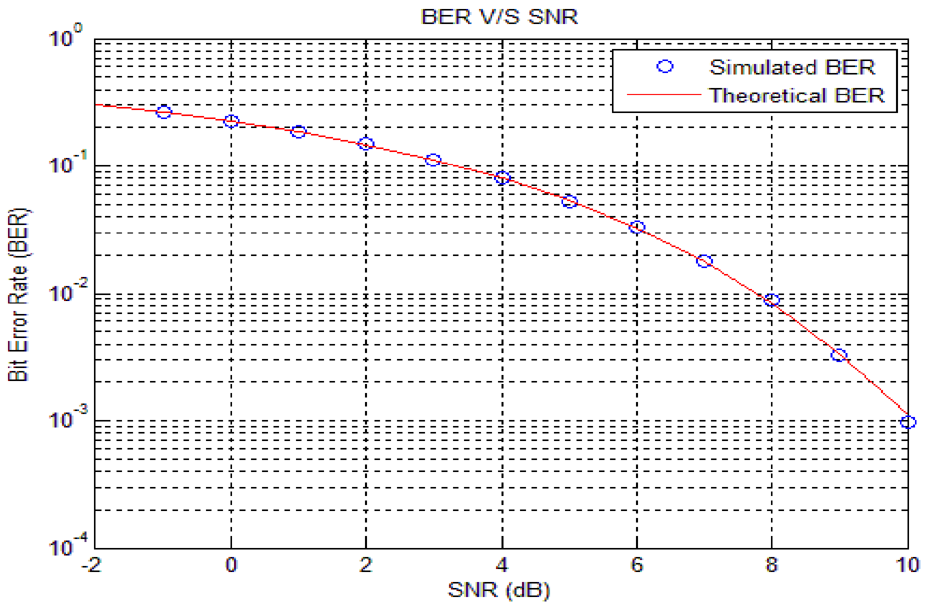

Fig 8. QAM-32 Signal Frequency response under Multipath Rayleigh fading channel

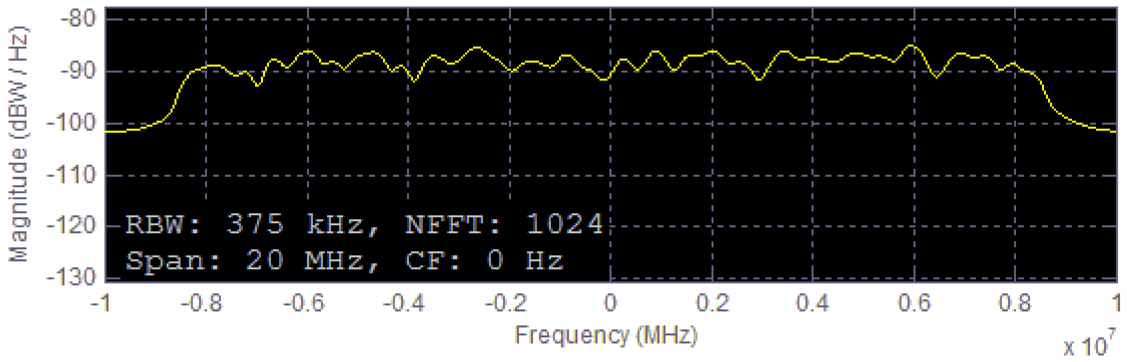

Figure 9 Transmitted Signal Response for QAM-32 under Multipath Rayleigh fading channel

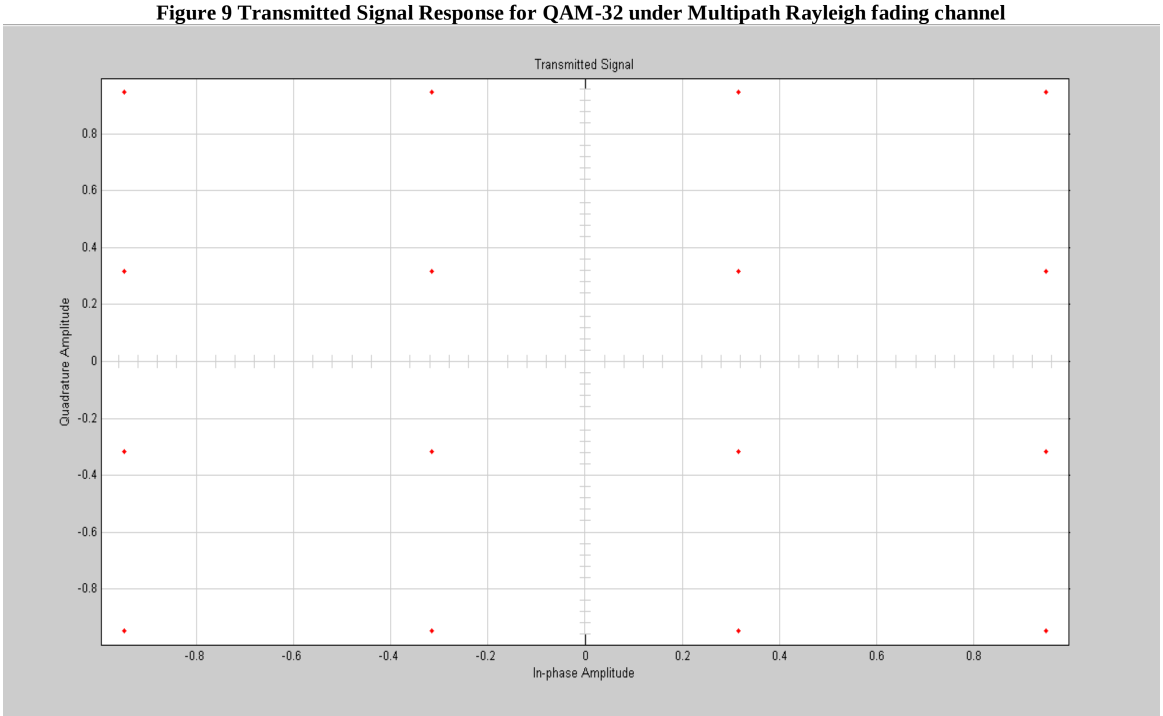

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Figure. 10. Received Signal Response for QAM-32 under Multipath Rayleigh fading channel

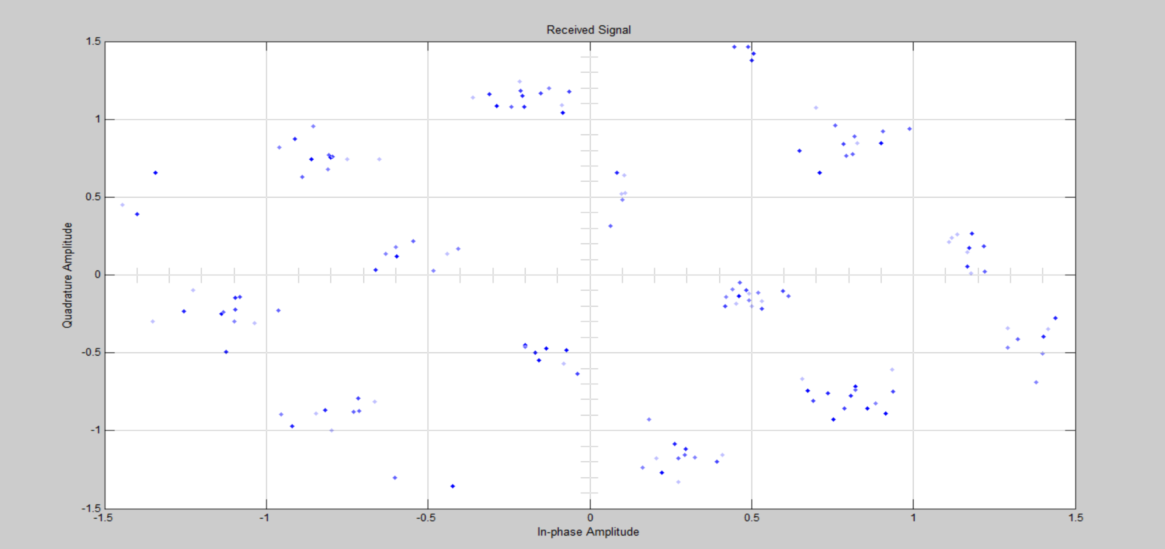


Figure 11. Bit Error Rate vs Signal to Noise Ratio for QAM-32 Modulation.

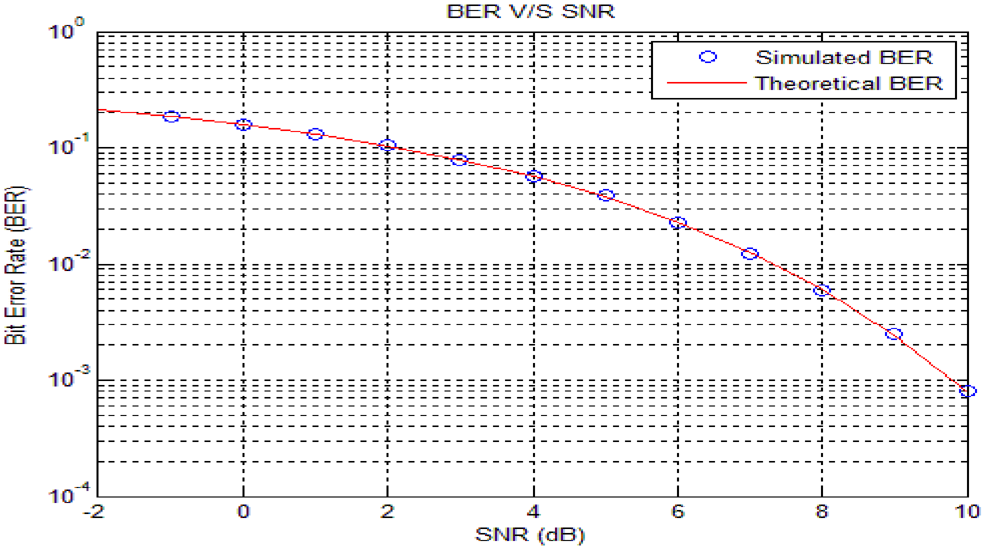
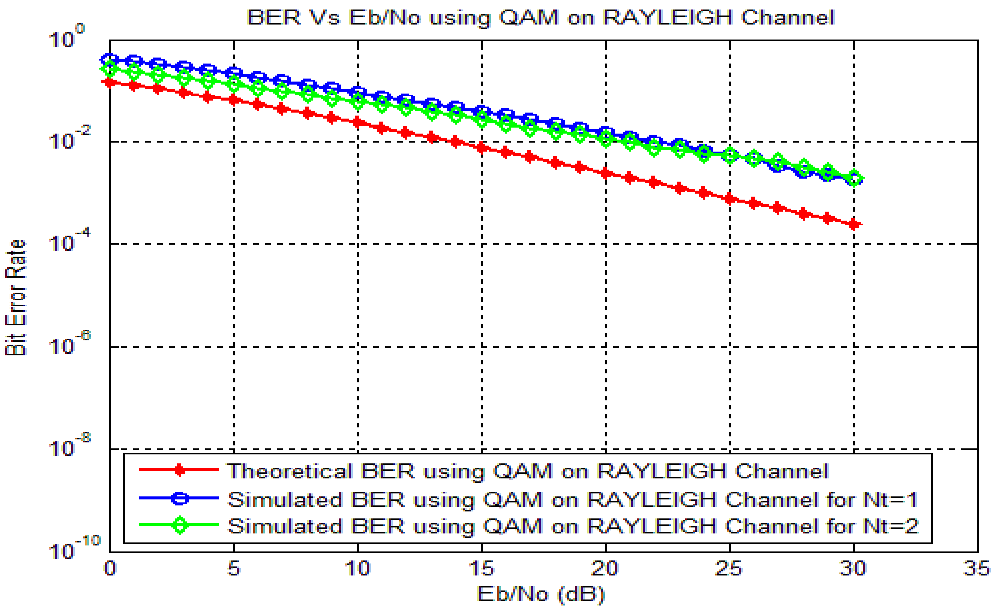


Figure.12. Bit Error Rate vs Energy per Bit to Noise Power Spectral Density Ratio for QAM-32 modulation.



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V.CONCLUSION

Figure 7 & 11 gives an idea regarding the bit error rate for different types of modulations at Rayleigh fadingchannels. Figure 6 & 12 provides the analysis of bit error rate and energy per bit to noise power spectral density ratio for both the cases from the above graphs. It can be concluded that for all the mathematical terms and graphical plots QAM-32 modulation have a better response in multipath Rayleigh fading channel with respect to MSK modulation.

REFERENCES:

1. M. Jiang and L. Hanzo, July 2007, Multiuser MIMO-OFDM for next generation wireless systems, Proceedings of IEEE, vol.95, pp.1430-1469.

2. Mitalee Agrawal, YudhishthirRaut, 2011, Effect of Guard Period Insertion in MIMO OFDM System, (IJCTEE)International Journal of Computer Technology.

3. Yong Soo Cho, Jaekwon Kim, 2010, Won Young Yang, Chung G. Kang, MIMO-OFDM Wireless Communications with MATLAB, John Wiley & Sons (Asia) Pte Ltd.

4. Sarod Yatawatta and Athina P. Petropulu, 2006, Blind Channel Estimation in MIMO OFDM Systems with Multiuser Interference, IEEE TRANSACTIONS ON SIGNAL PROCESSING.

5. Hermann Rohling, 2011, OFDM Concept & Future, Springer Heidelberg Dordrecht London New York.

6. SrabaniMohapatra, Susmita Das, 2008, A study on OFDM System and its Performance Analysis, Proceedings of Emerging Trends in Computing and Communication. M. P. Chitra, Dr. S. k. Srivastsa, 2010, Impact of Guard Interval in Porposed MIMO-OFDM system for Wireless communication, (IJCSIS) International Journal of computer Science and Information Security.

7. Mishra, Ajay R. "Fundamentals of cellular network planning and optimization: 2G/2.5 G/3G... evolution to 4G." Wiley.com, 2004.

8. Michael Speth, Stefan A. Fechtel, Gunnar Fock, and Heinrich Meyr, 1999, Optimum Receiver Design for Wireless Broad-Band Systems Using OFDM, IEEE Transaction on Communications, Letters

9. Luis Litwin and Michael Pugel, 2001, The Principles of OFDM" RF signal processing.

BIBLIOGRAPHY:

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