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AN END TO END SIMULATION OF WIRELESS COMMUNICATION THROUGH AWGN AND FADING CHANNEL

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Abstract: The modelling of wireless communication channels has been a continuous tantalizing issue while being one of the most fundamental components based on which transmitters and receivers are designed and optimized. The ultimate performance limitation of any communication system are determined by the channel it operates in, Realistic channel models are thus of utmost importance for system design and testing. In this paper we analyse the overall performance of an communication system in different channels based on various parameters such as bit error rate, signal to noise ratio and eye diagram.

Index Terms **- Band limited, Fading, Bit-error rate, Eye pattern, Signal- noise ratio**

I. INTRODUCTION

Wireless communication system are designed to transmit information. In any communication system, there exists an information source that produce the information where physical transfer of data is carried over point to point or multipoint communication channel. Data transfer depends upon its characteristics of the environment. The system required higher data transmission rates in order to meet the higher demand of quality services and larger immunity to noise at the cost of bandwidth. It provides facilities used in video conferencing which saves a lot of time, money and effort. There are two types of transmission in communication such as Analog and Digital. In digital data transmission higher level of noise immunity and more flexibility in the bandwidth is achieved. In general, transmitting signals will be weak so inorder to increase the signal strength a technique is used known as Modulation. It is the process of changing some characteristics of a carrier in accordance with modulating signal. In digital communication the modulation is performed by switching the characteristics of the carries in accordance with the input data sequence. If we want to transmit the digital data over a large distance then we have to modulate that data with continuous wave. The modulating signal changes the characteristics like amplitude, frequency or phase in accordance with the input digital signals. There are many number of modulation schemes available. Each and every schemes has its own advantages and also disadvantages. In this paper, we analyse various modulation techniques for better transmission in different communication channels with respect to the error rate calculation, Bit Error graph (BER) and Eye pattern. BPSK, BFSK and QAM are involved.

II. SYSTEM DESCRIPTION

Digital modulation techniques may be classified into coherent and non-coherent techniques, depending upon whether the receiver is equipped with a phase recovery circuit or not. These digital modulation techniques can also be classified basically either on the basis of their detection characteristics or in terms of their bandwidth compaction characteristics . After the conversion of an Analog signal to digital by sampling different type of digital modulation schemes can be achieved by the variation of different parameter of the carrier signal for example the Amplitude variation gives BASK, Frequency variation gives BFSK and the phase variation gives BPSK. Here we analysed certain modulation techniques such as BPSK,BFSK and QAM interms of its BER graph. The BER graph defines the relation between the bit error rate and the signal to noise ratio. Where bit error rate is the error rate calculation of the received bits with respect to transmitted bits as message signal and the signal to noise ratio is the amount of signal power to noise power ratio at the receiver end. Also sometimes a combinational variation of this parameter is done to generate the hybrid modulation technique viz. a combinational variation of Amplitude and Phase Shift Keying (APSK). Many more digital modulation techniques are available and can also be designed depending upon the type of signal and the application The following are the various digital modulations techniques we concentrate in this paper

BPSK (Binary Phase Shift Keying) Modulation:

The Bpsk is the simplest form of phase shift keying(psk).The phase of a constant amplitude carrier signal is switch between two values according to the two possible signals m1 and m2 corresponding to binary 1 and 0 respectively.Normally two phases are separated by 180 degree.The bpsk signal is equivalent to a double sideband suppressed carrier amplitude modulated waveform.Hence a bpsk signal can be generated using a balanced modulator can be performed by the matched filter.The balanced modulator is used to generate the bpsk signal.Two inputs to the balanced modulators are involved a carrier signal and a bipolar NRZ signal.The input is given to the balanced modulator to convert a signal.The bpsk detection signal is allowed to pass through a band pass filter through the center frequency of the

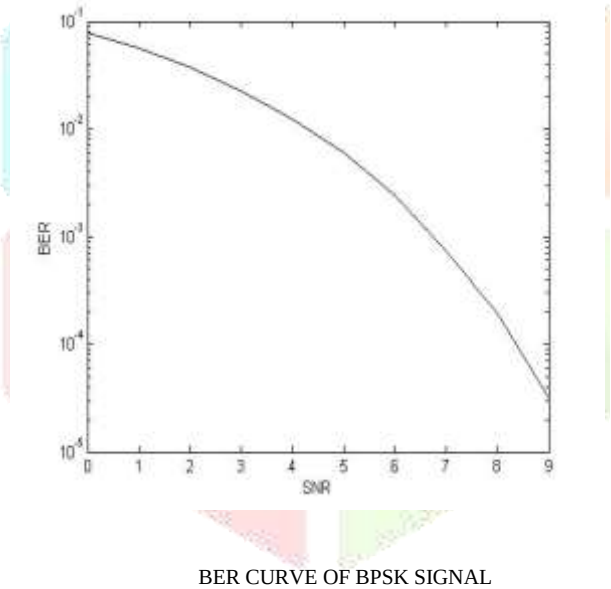
2fc.The carrier phase contains all the information that is being transmitter and two constellation points lying on the x-axis(in phase) and y-axis(quadrature).End to end transmission can be used.It is able to modulate 1bit/symbol.

BFSK (Binary Frequency Shift Keying) Modulation:

The Bfsk is the two different frequency signals are used.Based on the input binary symbols the frequency of the carrier is shifted but this doesn't change the phase of the carrier signal.M-ary(M=2) frequency shift keying(FSK) modulation modulates a digital signal by changing the frequency of the output signal depending on the value of the input signal.The mapping and analog modulation are two parts of M-FSK.The mapping process maps the input symbol into the value of the frequency shift from the carrier frequency and the analog modulation is analog frequency modulation.If the carrier frequency FC and the tone space DF(frequency between two consecutive frequencies in the modulated signals).Then the frequency range of a modulated signal in the range of [fc,fc+(M-1)Df].The phase information of the modulated signal from the receiving side where phase locked loop are used and in non coherent method it does not require phase information it recovers the phase of the modulated signal during the demodulation.The frequency of output signal depending on the value of input signals.It is a pair of frequencies to transmit binary 0's and 1's information.In bfsk the generation of signal is easy,greater bandwidth and higher error rate.

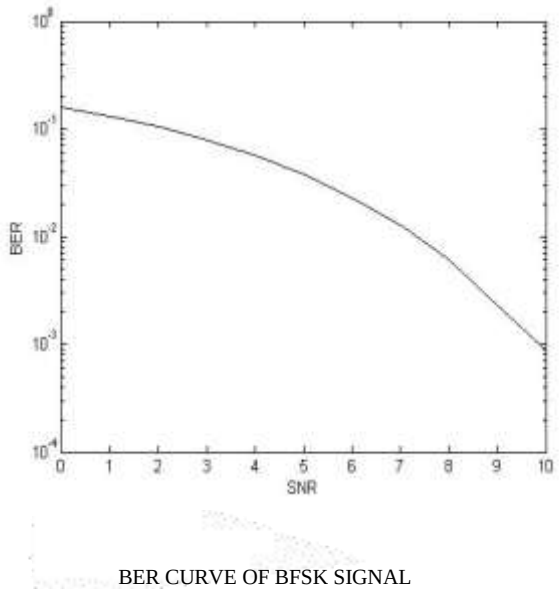
QAM (Quadrature Amplitude) Modulation:

The QAM is aform of modulation used for modulating data signals into a carrier used for radio communication.It is a a combination of amplitude shift keying and phase shift keying.Two carriers for modulation are involved.The resultant signals are summed together and it consists of both amplitude and phase modulation.It is used for two carriers each having the frequency and different phases.One signal is called as I-phase which is a sine wave and other called Q-quadrature which is a cosine wave.There are two input message signals the mixer and a carrier signal are involved.The transmitted signal are given as a input to the splitter.Qam can be used as a modulation schemes for digital telecommunication systems such as 802.11 wifi standards.It involved x and y plane to perform better performance.



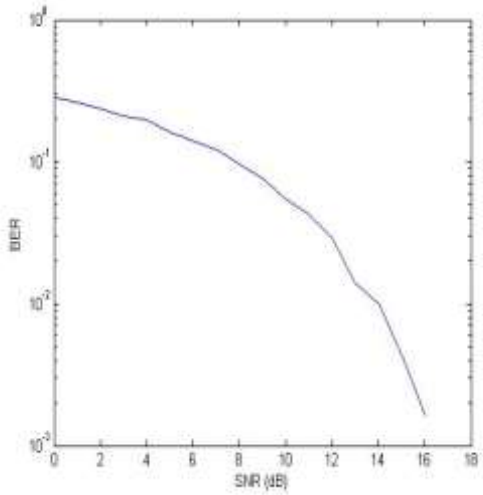
BER CURVE OF BPSK SIGNAL

(b)



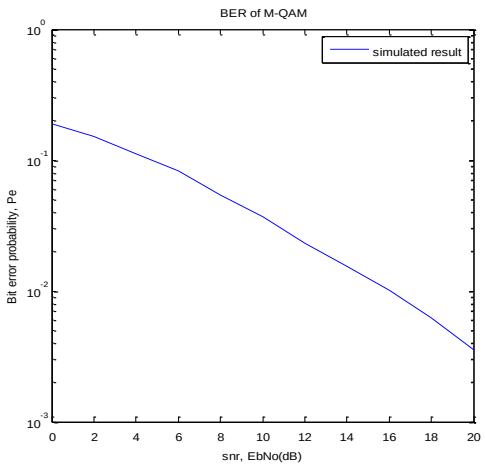
BER CURVE OF BFSK SIGNAL

(a)



BER CURVE OF QAM IN AWGN

(c)



BER CURVE OF QAM IN FADING

(d)

Fig. 2.1. BER Vs SNR GRAPH FOR BPSK(a),BFSK (b) AND QAM (c) in Matlab

From the above techniques its analysed that the higher BER prediction give as more data for further needful measures. Thus from the graph we can observe that QAM results in high bit error rate . thus we proceeded our further analysis with this type of QAM modulation using simulink software in different following channels .

AWGN (Additive-White Gaussian Noise)Channel & Bandlimited AWGN Channel :

Additive White Gaussian Noise is a basic noise model used in information theory to mimic the effect of many random processes that occur in nature.The modifiers denote specific characteristics.AWGN channel often used as a channel model in which the only impairment to communication is a linear addition of wideband or white noise with constant spectral density and a Gaussian distribution of amplitude.The model does not account for fading,frequency selectively,interference,dispersion.It produces simple and tractable mathematical models which are useful for gaining insight into the underlying behaviour of system before these phenomena are considered.It is a good model for many satellite and deep space communications links.It is a most basic model of a communication system.

In Bandlimited AWGN channel the bandwidth of the channel is limited with help of filter, which can filter signals at high frequency rate .Where signal at high frequency rate induce more impact for better transmission.

Fading Channel:

The fading is the used to describe the rapid fluctuations of amplitude,phase, multipath delays of a radio signal over a short period of time or travel distance,so that large scale path loss effects may be ignored. There are different types of fading channels withrespect to the circumstances , here we mainly concentrate on Rayleigh fading channel, where

the impulse response may follow distributions of Rayleigh distribution (in which there is no Line of Sight (LOS) ray between transmitter and receiver.

We know the transmission must be for better data rate , for which we always prefer Passband Transmission where modulation techniques is carried out to improve the signal power and system Performance.

2.1 Passband Transmission via AWGN:

The below figure is a design of AWGN systems on matlab simulink to identify the results in different parameters.

The data input is given from the first block called Random Integer generator followed by a sign block to give a binary input. In the next block modulation is done. We obtain the modulated signal. After modulating, the signal is allowed to pass through the AWGN Channel where the signal characteristic is varied based on the channel parameters such as signal to noise ratio, thus the signal is convoluted with the impulse response of the channel where the channel impulse response is combination of two independent Gaussian random variables uniformly distributed between 0 and 2pi.

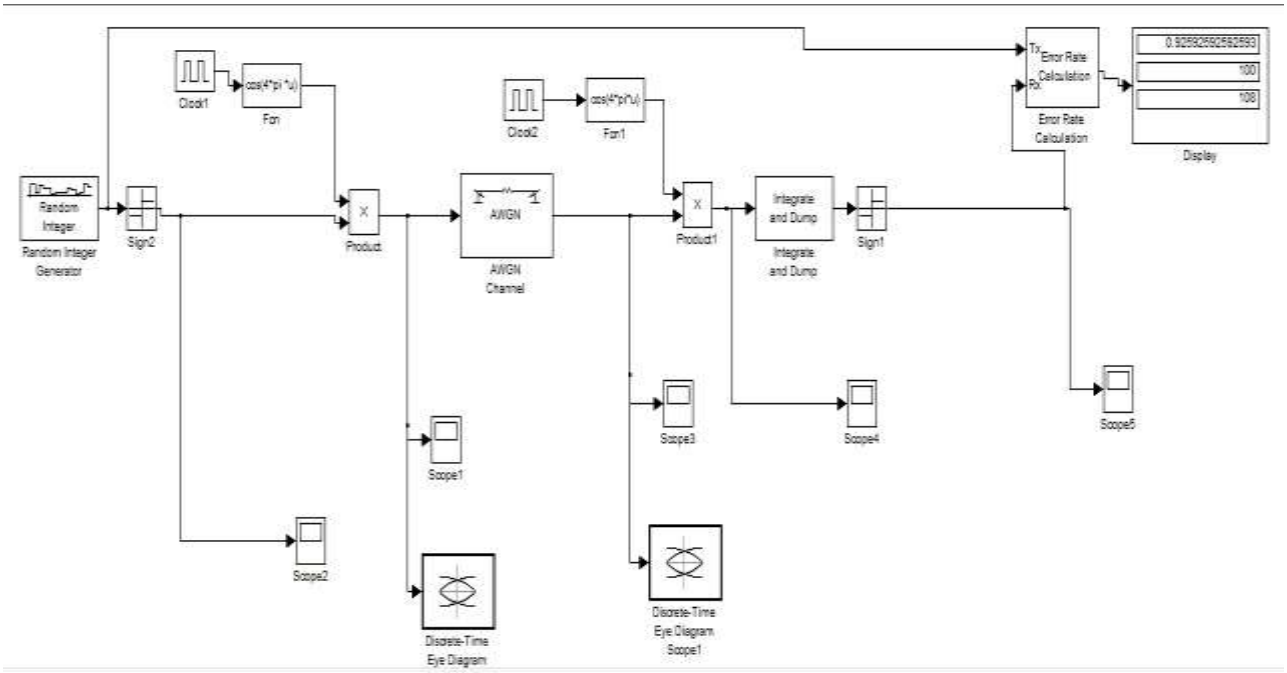


Fig. 2.2. BLOCK DIAGRAM OF SIMULINK IN AWGN

After which the Gaussian noise is added to the signal, where the noise is the combination of two gaussian random variables with zero mean, independent and identically distributed between 0 and 2pi. Then the signal is demodulated using demodulator block were we multiply the received signal by a reference frequency generator ,then it pass through sign block, Then finally from the error rate calculation block which display the number of bit transferred and received in this system with their bit error rate.

2.2 Passband Transmission via Band limited AWGN:

The below figure is a design of Bandlimited AWGN system on matlab simulink to identify the results in different parameters

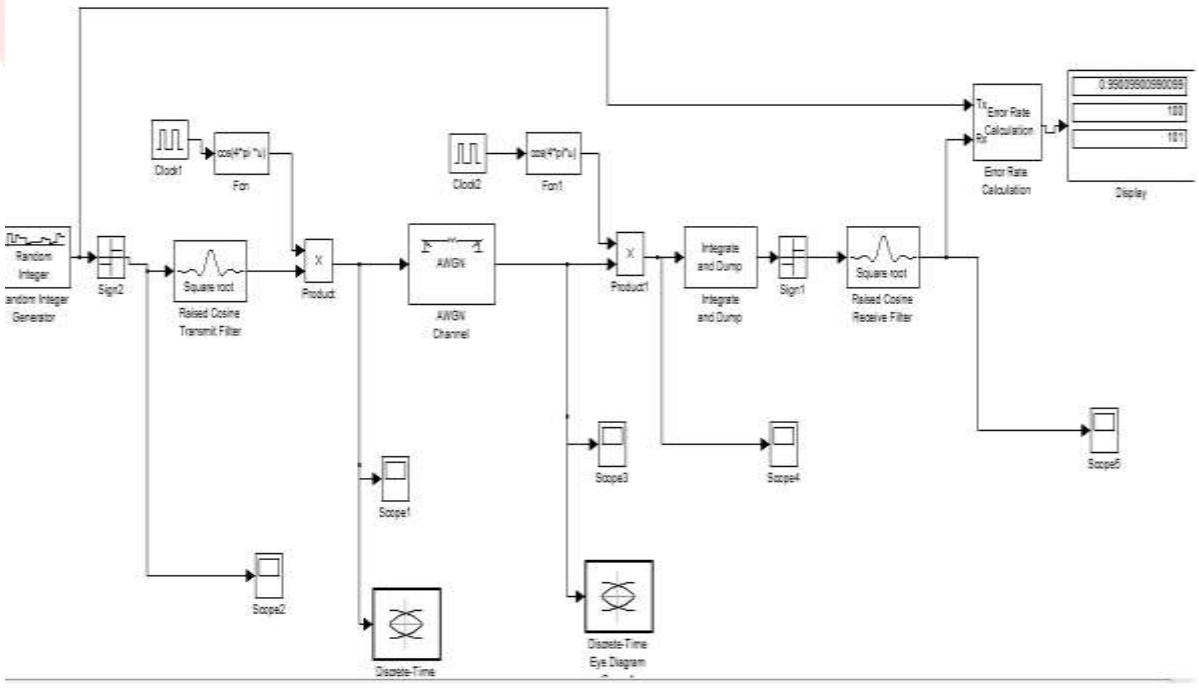


Fig. 2.3. BLOCK DIAGRAM OF SIMULINK IN BANDLIMITED AWGN

The data input is given from the first block called Random Integer generator followed by a sign block to give a binary input. For bandlimited channel we need pulse shaping for which we use raised cosine filter at transmitter and receiver. Thus before modulating the signal we introduce raised cosine transmit filter. After modulating, the signal is allowed to pass through the bandlimited AWGN Channel where the signal characteristic is varied based on the channel parameters like signal to noise ratio.Thus the signal is convoluted with the impulse response of the channel where the channel impulse response is combination of two independent Gaussian random variables uniformly distributed between 0 and 2pi. After which the Gaussian noise is added to the signal, where the noise is the combination of two gaussian random variables with zero mean, independent and identically distributed between 0 and 2pi. Then the signal is demodulated using demodulator block were we multiply the re- ceived signal by a reference frequency generator. Then the raised cosine receive filter is used and this is passed on to the thresh- old detector to detect the output based on the threshold value. Then finally from the error rate calculation block which display the number of bit transferred and received in this system with their bit error rate.

2.3 Passband Transmission via Fading:

The below figure is a design of Fading channels based on matlab simulink with different parameters on results.

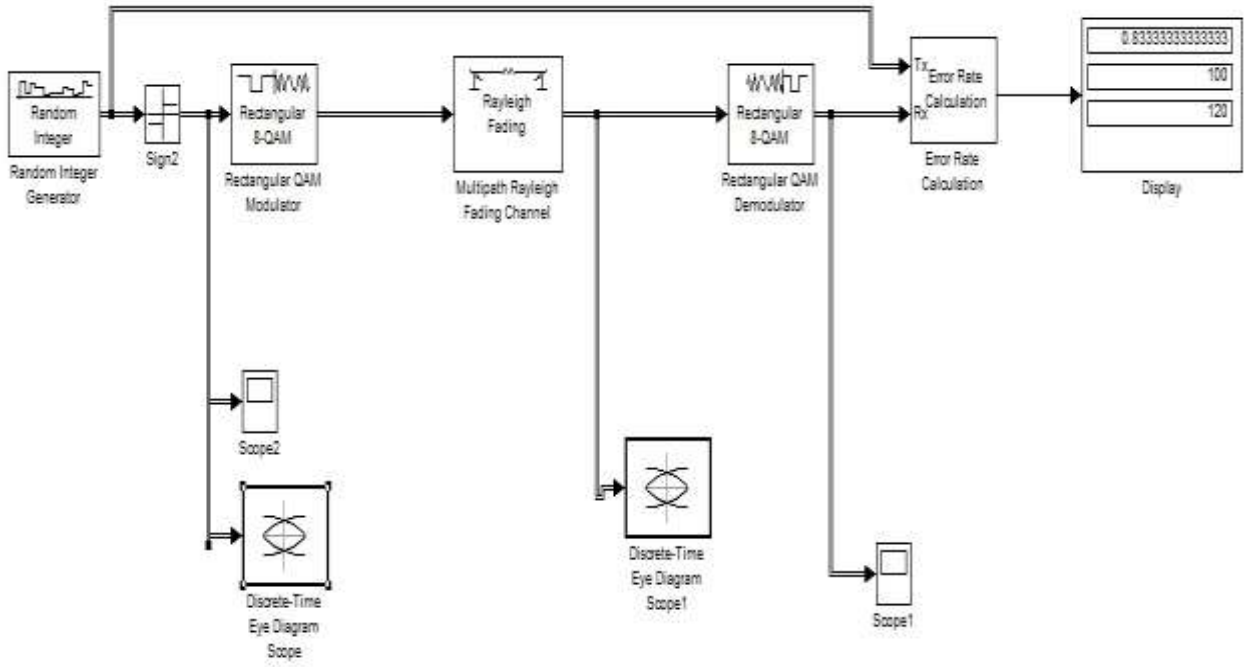


Fig. 2.4. BLOCK DIAGRAM OF SIMULINK IN FADING CHANNEL

The data input is given from the first block called Random Integer generator followed by a sign block to give a binary input. In the next block modulation is done by using Rectangular QAM Modulator. We obtain the modulated signal. After modulating, the signal is allowed to pass through the Multipath Rayleigh Fading Channel where the signal characteristic is varied based on the channel parameters such as signal to noise ratio, thus the signal is convoluted with the impulse response of the channel . Then the signal is demodulated using Rectangular QAM Demodulator block where we multiply the received signal by a reference frequency generator , Then finally from the error rate calculation block which display the number of bit transferred and received in this system with their bit error rate.

III. PERFORMANCE ANALYSIS

The performance analysis of our system were carried out with respect to BER and Eye pattern , where BER were the bit error rate which is used to calculate the average number of bits received , where in the display block of simulink after error rate calculation , the number of bits received , transmitted and its bit error rate is displayed for our reference . The Eye pattern is another important part of our analyser where the noise immunity of the system is observed , if the eye is in closed posture then our signals is highly dominated by much noisy signals which were added in the channel and also due to other external disturbances, and if the eye is in open posture then the signal power is comparatively high with respect to noise signal power, where SNR that is Signal to noise ratio is high , thus leading to better transmission of data.

3.1 Comparison of Error rate calculation for different QAM :

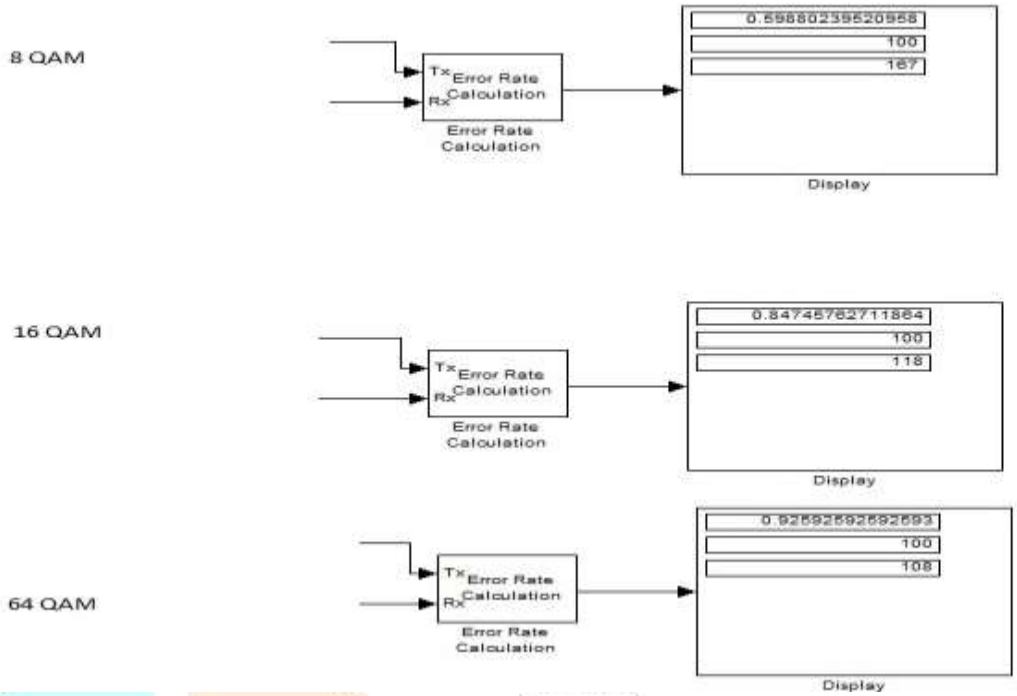


Fig. 3.1. SIMULINK OF QAM IN 8,16 AND 64 BIT ERROR RATES

The error rate calculation of various modulation of QAM is carried out , among which we can observe which high order qam , the number of bits received with respect to transmitted is better leading to better transmission of signals with high bite error rate .

3.2. Comparison of Error rate calculation of a system with respect to different various Channel:

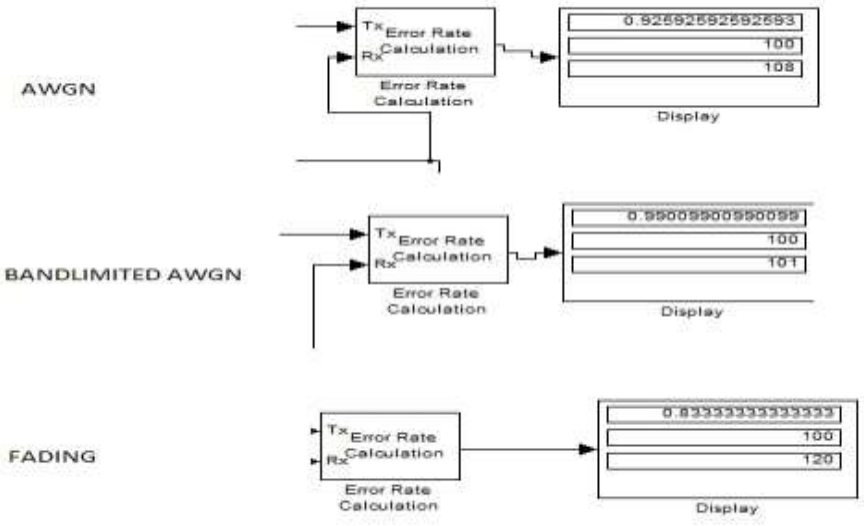
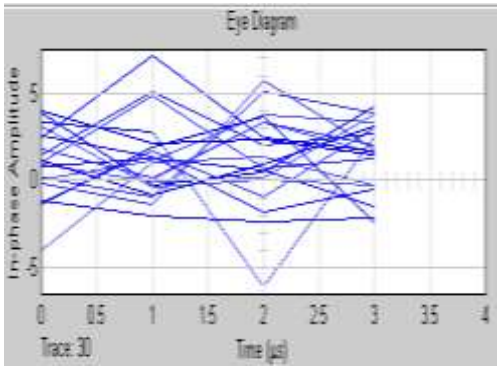


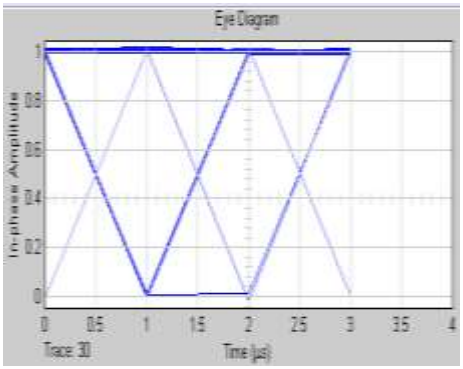
Fig. 3.2. DIFFERENT SIMULINK OF QAM IN AWGN,BANDLIMITED AWGN,FADING

In the above diagram , bit error rate calculation is carried out at various channel by using qam modulation. Where we can observe that the bandlimited awgn channel compare with awgn makes a perfect signal transmission of better BER. The fading channel as we know result in much lower ber as the noise is much more, thus in order to overcome it we have to go for more advanced methods for better transmission.

3.3 Channel performance with respect to SNR:

Snr=50 **Snr=100**





Recived Eye patern in AWGN (SNR=50 db) Recived Eye patern in AWGN (SNR=100 db)

Fig. 3.3. EYE PATTERNS

In the above figure it is observed that when ther is higher SNR , the recived eye pattern of the system is highly in opened posture , indicating the noise immunity is in better way .

IV. CONCLUSION

In this paper , we analysed the Bpsk , Bfsk and QAM in matlab with respect to its bit error rate calculation , where Qam gave better Ber and further for our further analysis in different channels we proceeded with QAM modulation , in which higher order of qam modulation is compared using matlab simulink software, which resulted in higher order qam for best high data rate transmission . And the different channel performance is analysed such as AWGN, Bandlimited AWGN and fading channel in terms of eye pattern and ber analysis , where bandlimited AWGN channel resulted in better performance . Therefore from this paper analysis we always prefer for high data rate transmission with better BER, SNR and Eye pattern .

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