SIMULINK MODEL OF OFDM USING 64 QAM WITH DIFFERENT COMBINATION OF CHANNEL

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Abstract

A Matlab Simulink program has been written to investigate Orthogonal Frequency Division Multiplexing (OFDM) communication systems. This program is valuable for future researchers simulating systems that are too theoretically complex to analyze.Single-carrier QAM and multicarrier OFDM are compared to demonstrate the strength of OFDM in multipath channels. Two graphical user interface demonstrations show some of the basic concepts of OFDM. The Master's thesis details the analysis of a generic OFDM system using 64-QAM simulink model with AWGN channel, NONE channel, Rayleigh fading channel, multipath Rayleigh fading channel plus AWGN and Rician fading channel used to study delays between transmitted signal and received signal and bit synchronization from transmitter to receiver. Several channel models are analyzed and added to the transceiver simulator. The extreme programming methodology is used and evaluated during the development of the MATLAB simulator for the OFDM system model with different combination of channels. A brief study of OFDM using 64-QAM simulink with different channels is very useful to overcome the problems of ISI, ICI and Orthogonality.

1. Introduction

The history of Orthogonal Frequency Division Multiplexing (OFDM) dates back to 1957 but it was used in a standard for the first time in 1995. This standard was developed by the European Telecommunications Standards Institute (ETSI) for Digital Audio Broadcasting (DAB). The long application list of OFDM includes Asynchronous Digital Subscriber Line (ADSL), Wireless LAN (IEEE 802.11), Digital Video Broadcast (DVB), WiMAX (IEEE 802.16), and others. With time, the use of OFDM has also been increasing. OFDM is considered to be the most prospective candidate for use in 4th generation mobile communications, which makes it a good candidate for research. The basic idea of OFDM is to use a large number of parallel narrow-band sub-carriers instead of a single wideband carrier to transmit information. This way of transmitting information helps in handling the effects of multipath propagation efficiently. The transmission is efficient because of the spectral overlap of narrowband sub-carriers. OFDM supports various modulations techniques like BPSK, QAM, and QPSK etc. QAM is further divided in 4, 16, 32, 64 and 128 and 256 QAM techniques.

OFDM is a method of encoding digital data on multiple carrier frequencies. OFDM has developed into a popular scheme for wideband digital communication, whether wireless or over copper wires, used in applications such as digital television and audio broadcasting, DSL Internet access, wireless networks, power line networks, and 4G mobile communications.

1.1 Objective

The paper details the analyze of a generic OFDM system using 64-QAM SIMULINK MODEL used to study Packet Loss, Bit Loss and Total Bits Counted and effect on bit rate by

using AWGN channel, NONE channel, Multipath Rayleigh fading channel, Multipath Rayleigh fading channel plus AWGN channel and Multipath Rician fading channel. And used to study delays between transmitted signal and received signal and bit synchronization from transmitter to receiver.

1.2 Motivation

OFDM is considered to be the most prospective candidate for use in 4th generation mobile communications, which makes it a good candidate for research. The basic idea of OFDM is to use a large number of parallel narrow-band sub-carriers instead of a single wideband carrier to transmit information. The long application list of OFDM includes Asynchronous Digital Subscriber Line (ADSL), Wireless LAN (IEEE 802.11), Digital Video Broadcast (DVB), WiMAX (IEEE 802.16), and others.

2. Statement of Problems

There are basically two limitations or statement of problem in OFDM using 64 QAM. First problem is Orthogonality as we know several carriers is actually advantageous whenever they are mathematically orthogonal. So carrier orthogonality is a problem that can leads to a wrong operation of OFDM systems if not respected. The orthogonality is provided by IFFT. And the second problem is synchronization in the receiver to sample the incoming signal correctly.

3. Proposed Work

The objective of this model is to develop and explore a simulink model using QAM modulation technique the objective of this model is just to study Packet Loss, Bit Loss and Total Bits counted and effect on bit rate by using 64 QAM when we used Multipath Rayleigh Fading channel plus AWGN channel both for OFDM. And used to study delays between transmitted signal and received signal and bit synchronization from transmitter to receiver. It also counts the various parameters during the communication process like packet loss, bit loss. As we know that by increasing orthogonality the data rate is decreases because of synchronization problem. When we used 16 QAM modulation the rate of transmission is low as compared to 64 QAM modulation techniques but it has one drawback that its orthogonality reduces.

This technical model plays a prominent role in the selection of good quality channel with minimum loss of information with high transmission rate for synchronization of transmitter with receiver. A brief study of OFDM using 64-QAM simulink with Multipath Rayleigh Fading channel plus AWGN is very useful to overcome the problems of ISI, ICI and Orthogonality. This chapter presents the response of OFDM system using 64-QAM with Multipath Rayleigh Fading channel. Here in this chapter a MATLAB Simulink model of OFDM using 64-QAM is designed, study, and analyzed to investigate when we use two channel in a communication system which is a combination of AWGN and Multipath Rayleigh fading channel. These two channels when used in a single communication system counts the various parameter like Packet loss during transmission of data, Bits loss and also used to study between transmitted signal and received signal and bit synchronization from transmitter to receiver.

4. Simulation Work

4.1 Simulink model of OFDM using 64-QAM with AWGN plus Multipath Rayleigh fading channel:

This is the simulink diagram of OFDM using 64-QAM when there is Multipath Rayleigh fading channel plus AWGN channel both simunataneously used between transmitter and receiver. This simulink model in fig. 4.1 gives results which are generated between transmitter and receiver to study and analyzed effect on bit rate by using 64-QAM and also count total number of Bits transmitted, Bit losses during transmission and total number of bits received when there is Multipath Rayleigh fading channel and Additive White Gaussian noise channel or AWGN channel used in an OFDM system.

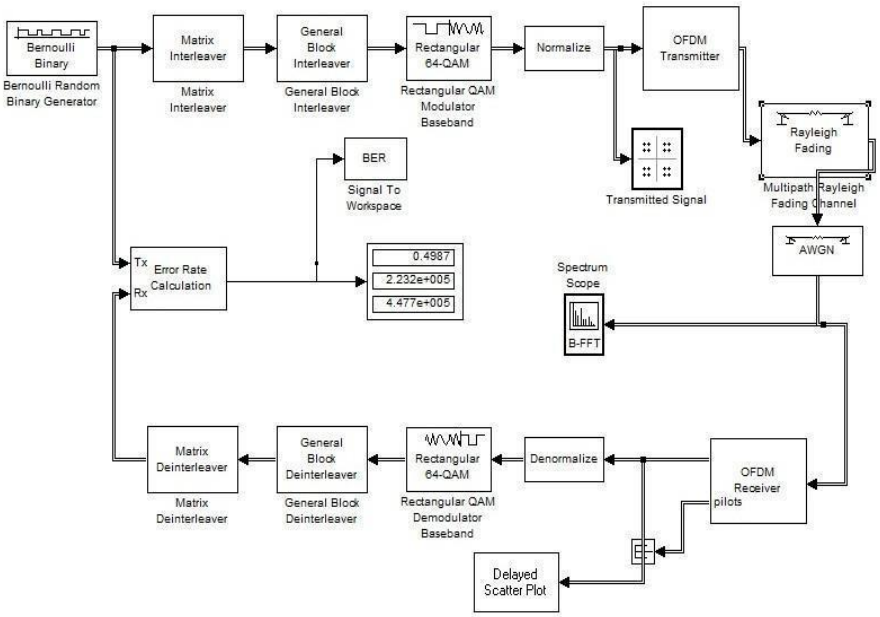

Fig 4.1 OFDM using 64-QAM with Multipath Rayleigh fading channel plus AWGN

Case-1. Transmitting spectrum of OFDM 64-QAM when using Multipath Rayleigh fading channel plus AWGN channel.

Here in the figure 4.2 spectrum of transmitting signal when given to OFDM is using 64 QAM modulation with Rayleigh fading channel plus AWGN shown. The constellation diagram is useful for QAM, the constellation points are usually arranged in manner with equal vertical and horizontal spacing although other configurations are possible.

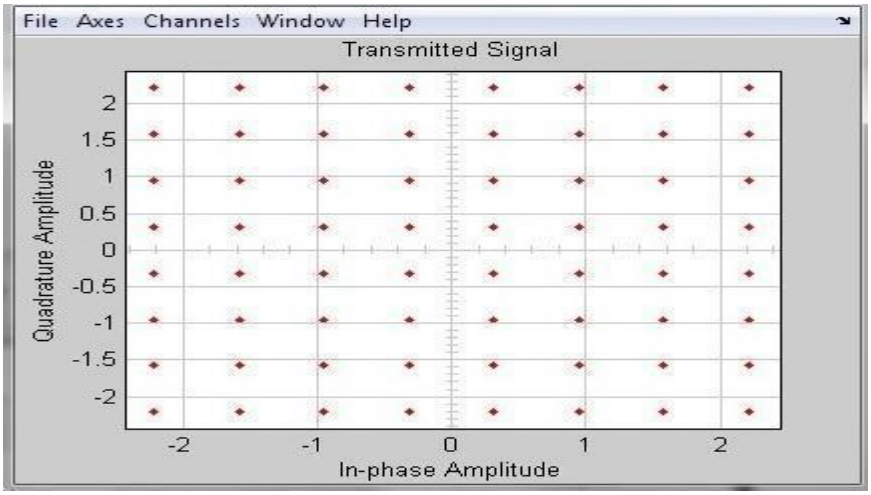

Figure 4.2 Transmitted spectrum when using Multipath Rayleigh fading plus AWGN

By moving a higher-order constellation, like 128 and 256 QAM it is possible to transmit more bits per symbol. However, if the mean energy of the constellation is to remain the same, the points must be closer together and are thus more susceptible to noise and other corruption; this results in a higher bit error rate and so higher order QAM can be deliver more data less reliably then lower order QAM, for constant mean constellation energy, reducing noise, or both.

Case 2: Received spectrum of OFDM using 64-QAM when using Multipath Rayleigh fading channel plus AWGN

This is the received spectrum when using Multipath Rayleigh fading channel plus AWGN for OFDM using 64-QAM modulation technique.

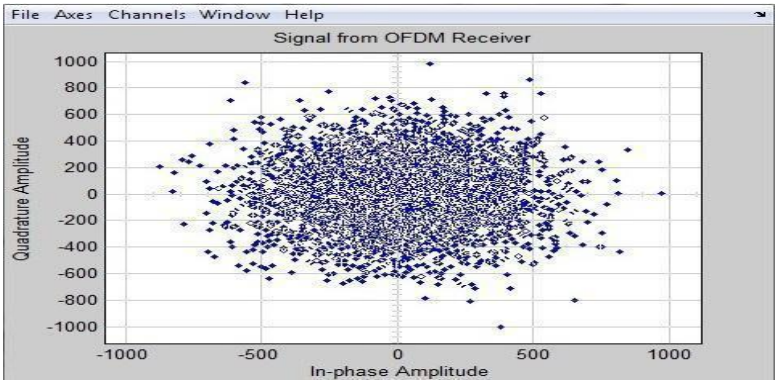

Figure 4.3 Received spectrum when using Rayleigh fading plus AWGN channel

Here the signal in figure 4.3 which is received from OFDM 64-QAM shown.

Graph showing spectrum scope when using Rayleigh fadind channel plus AWGN channel

In fig above a graph is shown between magnitude (db) and frequency (MHz) which shows continuous variations between frequency and magnitude. A fluctuation is note down which is varying between magnitude and frequency.

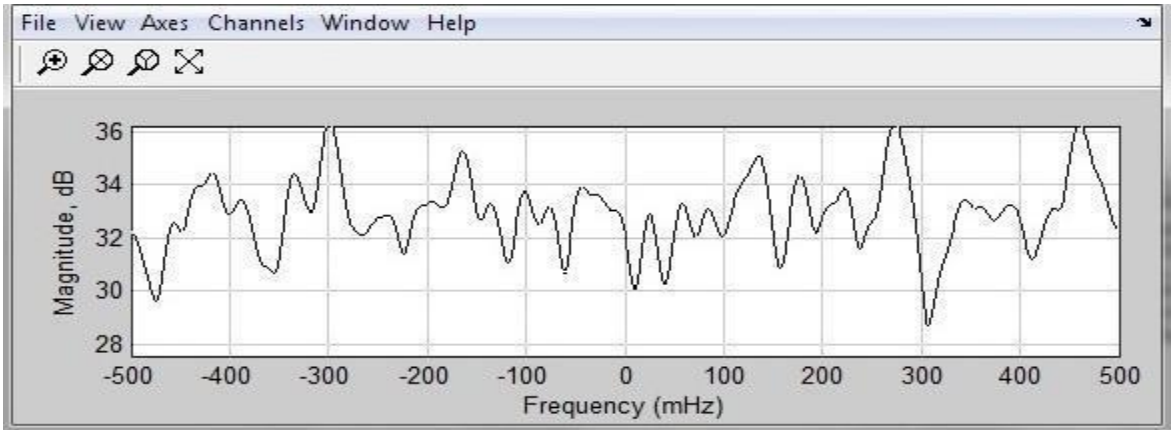

Figure 4.4 Spectrum scope for Rayleigh fading plus AWGN

Simulink model of OFDM using 64-QAM with Multipath Rician fading channel

This is the simulink diagram of OFDM using 64-QAM when there is Multipath Rician fading channel used between transmitter and receiver. This simulink model in fig. below gives results which are generated between transmitter and receiver to study and analyzed.

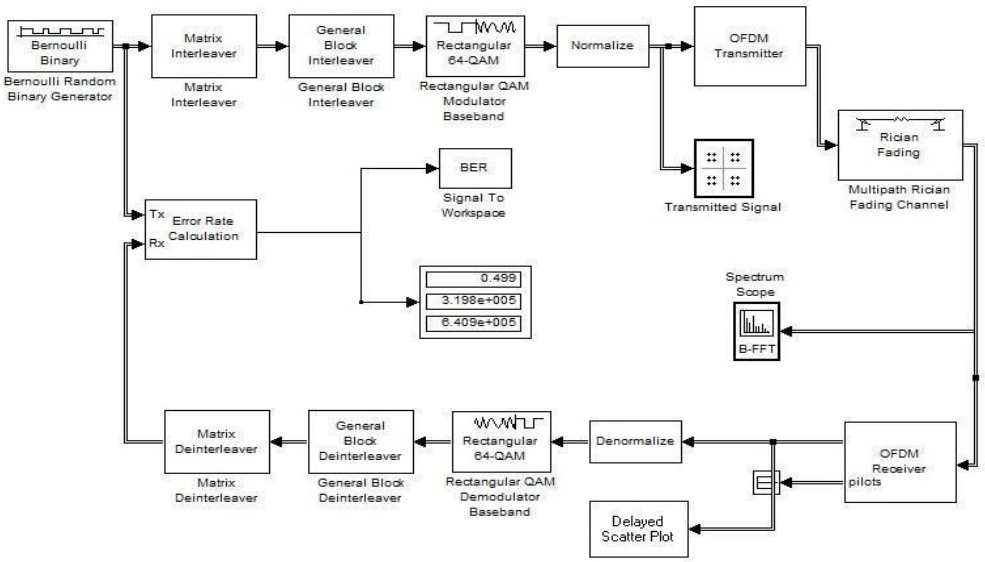

Figure 4.5 OFDM using 64-QAM with Multipath Rician fading channel

Effect on bit rate by using 64-QAM and also count total number of Bits transmitted, Bit losses during transmission and also total number of bits received when there is Multipath Rician fading channel used.

5. Result of simulink model

Here we are generating three cases for Multipath Rayleigh fading channel plus AWGN channel between transmitter and receiver. The result of each system with each step and the spectrum of transmitted signal and 64 QAM orthogonal with Multipath Rayleigh fading channel used as shown case by case.

6. Conclusion

The main goal of the thesis is just to study Packet Loss, Bit Loss and Total Bits counted and effect on bit rate by using 64 QAM. And used to study delays between transmitted signal, received signal and bit synchronization from transmitter to receiver. It also counts the various parameters during the communication process like packet loss, bit loss. As we know that by increasing orthogonality the data rate is decreases because of synchronization problem. When we used 16 QAM modulation the rate of transmission is low as compared to 64 QAM modulation techniques but it has one drawback that its orthogonality reduces. At the point of reception of signal, it is very important to distinguish the starting point of FFT to avoid wrong demodulation. And so synchronization has to be precise. It explains the use of special symbols (pilot) for synchronization in OFDM. Hardware design of transmitter and receiver is important because of high peak to average ratio which causes distortion if dynamic range of amplifiers and converters is not high enough. OFDM is very sensitive to carrier frequency offsets. Such offsets are mainly the cause of receiver local oscillators' instability and Doppler Effect when mobile is moving. We know that several carriers are actually advantageous whenever they are mathematically orthogonal. So carriers Orthogonality is a constrain that can leads to a wrong operation of OFDM systems if not respected. The Orthogonality is provided by IFFT.

7. Future Scope

In this study, different problems of OFDM system have been considered and suitable solutions have been provided. As it is an established fact, that research is never ending process, a new beginning is always waiting. Therefore, following are the works that may be considered as a future scope in this direction:

i. The channel estimation is an area which required a lot of attention and improper channel estimation degrades the performance of system. In this work, it is assumed that channel is estimated perfectly. Hence one can evaluate the performance of proposed work with different channel estimation method.

ii. The algorithm of timing offset estimation can be extended for channel estimation in OFDM system.

iii. The proposed timing offset and frequency offset estimator can be utilized for MIMO OFDM system.

iv. The proposed PAPR reduction method can be used with MIMO OFDM system.

v. The closed form expression of BER can be derived for OFDM system with proposed PAPR reduction method.

vi. The windowing method of ICI reduction can be clubbed with ICI self cancellation scheme

So, Orthogonal Frequency Division Multiplexing using 64-QAM can be improved in future by using 128-QAM and 256 QAM with the use of suitable channel taken which has high efficiency and low loss of information so by these technique it can be useful in forthcoming 4G technology and HDSL (high Digital Subscriber line).

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