Comparative Performance Analysis of OFDMA over AWGN and Rician Channel

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***Abstract*— Wireless communications is a rapidly developing branch of the telecommunication sector. The mobile communication is a branch that is used on broader canvas. But, it has many challenges that must be studies, analyzed and compensated. A signal that is transmitted over a wireless channel has to face Interference, Fading, Propagation path loss shadowing, etc. As in wireless communication it always requires a potential with the high quality service. In this scenario, orthogonal frequency division multiplexing (OFDM) is best suited communication technique, OFDMA is a effective technique for high band width data communication, It converts the wideband signal into narrow band signals for communication. The transmission of each narrow band signals is done with orthogonal carrier. This paper presents simulation and Implementation of Multiuser orthogonal frequency division multiplexing (OFDM) using multiple modulation techniques. As well as this paper presents performance analysis of Implemented OFDMA over AWGN and Rician channel.**

Index Terms—Orthogonal frequency division multiple access, AWGN channel, Rician channel, Signal to Noise ratio, Symbol error rate, Bit error rate.

I. INTRODUCTION

In a basic communication system, the information to be transmitted is modulated over an individual carrier frequency. In such a technique, symbol totally occupies the available bandwidth. Such an implemented system can cause inter-symbol-interference (ISI) at frequency selective channel. The grass root idea of OFDMA is to separate the available spectrum into multiple orthogonal sub channels. Hence in such a technique that each narrowband, Sub channel will experience mostly flat fading. At OFDMA, there may be a condition to have overlapping sub channels at frequency domain. In recent years OFDMA technique has fetched an increased interest of researchers and developers. The European digital broadcast radio system is using this technique, also at asymmetric digital subscriber lines (ADSL) that is wired environment. OFDMA technique is used at digital subscriber lines (XDSL) to have high bit rate through twisted-pair of wires. Orthogonal Frequency Division Multiplexing (OFDM), a specialized version of multicarrier modulation (MCM) with heavily spaced subcarriers as well as number of overlapping spectra was patented at United States of America in 70s. At older frequency division multiple access system, steep band pass filters were used. These filters are totally removed from Orthogonal frequency division multiple access system. Instead, OFDMA time-domain waveforms are selected such that mutual orthogonality is confirmed considering that subcarrier spectra may overlap. It is understood that such a waveforms can be generated using a Fast Fourier Transform (FFT) at the receiver and transmitter. For a many years the use of OFDMA technique was relatively limited. Though it was very smart and effective although it wasn't used that much due to its complexity, problems at implementation of real time fast Fourier transform technique. In earlier days there were several issues regarding stability of transmitters and receivers due to oscillators in side it. Linearity required for RF power amplifiers was also an issue. After a year's many of problems related to OFDMA was solved. This paper will focus on Orthogonal Frequency Division Multiplexing (OFDMA) research and simulation. Due to resistivity towards inter symbol interference OFDMA is most suitable for high-speed communication. At communication systems with increased information transfer speed, the required time for each transmission becomes very short. But at the same time the delay time developed by multipath remains constant, Due to such condition ISI becomes a drawback of high-data-rate communication. OFDMA avoids this particular problem by transmitting several low speed transmissions at a time.

II. ADDITIVE WHITE GAUSSIAN NOISE CHANNEL

AWGN Channel is a basically noise model used in Communication & information theory. It provides conditions to have effects of random processes occurring in environment. The word Additive refers that it might be added to any noise that is intrinsic to information system. The second important word In AWGN that is White, white color refers uniform emissions everywhere. Here white refers to uniform emissions throughout the frequency band for information system. The third important word Gaussian refers to normal distribution at time domain. Generally AWGN channel is used for satellite communication. This model is not that much good for terrestrial links due to problems such as terrain blocking, multipath, interference, etc. The block diagram of AWGN channel is in figure.1.

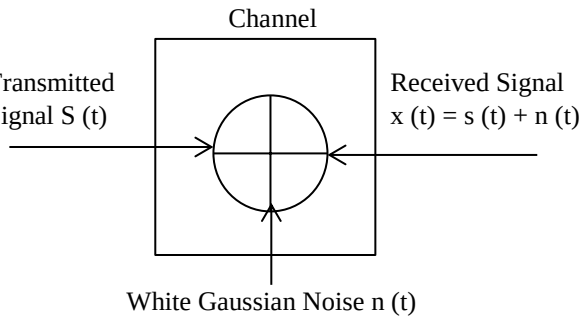

Figure. 1

III. RICIAN CHANNEL

It is a stochastic model used for radio communication showing condition of partial cancellation of a radio signal in propagation. Radio propagation with multipath propagation allows signals to arrive at receiver end with several paths. In this situation it may happen that one of path amongst multiple path may remain shorter or lengthier one. In such a condition there is a strong reflection of a particular signal as compared to other signals. This situation leads to rician fading effect. rician channel represents rician fading effect. here amplitude gain will be characterized by rician distribution.

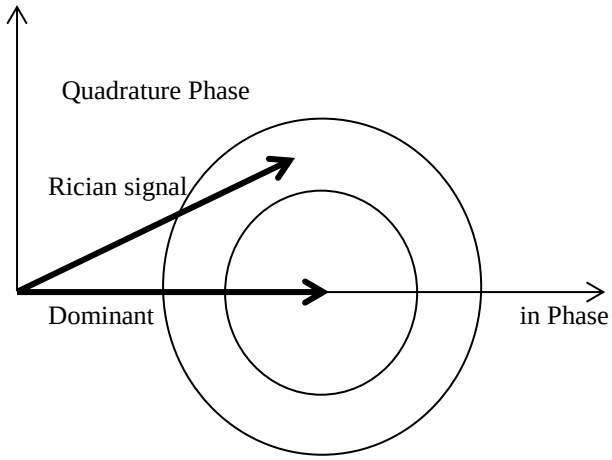

Figure.2 Rician Fading Signal

Signal received over a Rician multipath channel is mathematically represented as:

$$v(t) = C \cos w_c t + S^{N}_{n=1} \; r_n \cos (w_c t + f_n) \qquad (1)$$

Where,

C is the amplitude of the line-of-sight component
r_n is the amplitude of the n-th reflected wave
f_n is the phase of the n-th reflected wave
$n = 1 .. N$ identify the reflected, scattered waves

IV. SYSTEM DEVELOPMENT

The proposed system is implemented for multiple users. To make it more effective and efficient the proposed system is implemented with eight modulation and demodulation techniques.It has following main functional blocks at transmitter side:

1. Information source
2. Transmitter
3. Modulators
4. OFDM Transmitter
5. Inverese Fourier Transform
6. Insertion of guard band
7. Parallel to Serial Converter
8. Channel

At receiver end it has following main functional blocks :

1. Guard band removal
2. Seriasl to Parallel Converter
3. Fast Fourier Transform
4. Equalizer
5. OFDM Receiver
6. Demodulators
7. Data source

Ultimate goal of this system is to provide multiple channels with well security and better transmission rate without any interference. The block diagram of proposed system is shown in figure. 4.

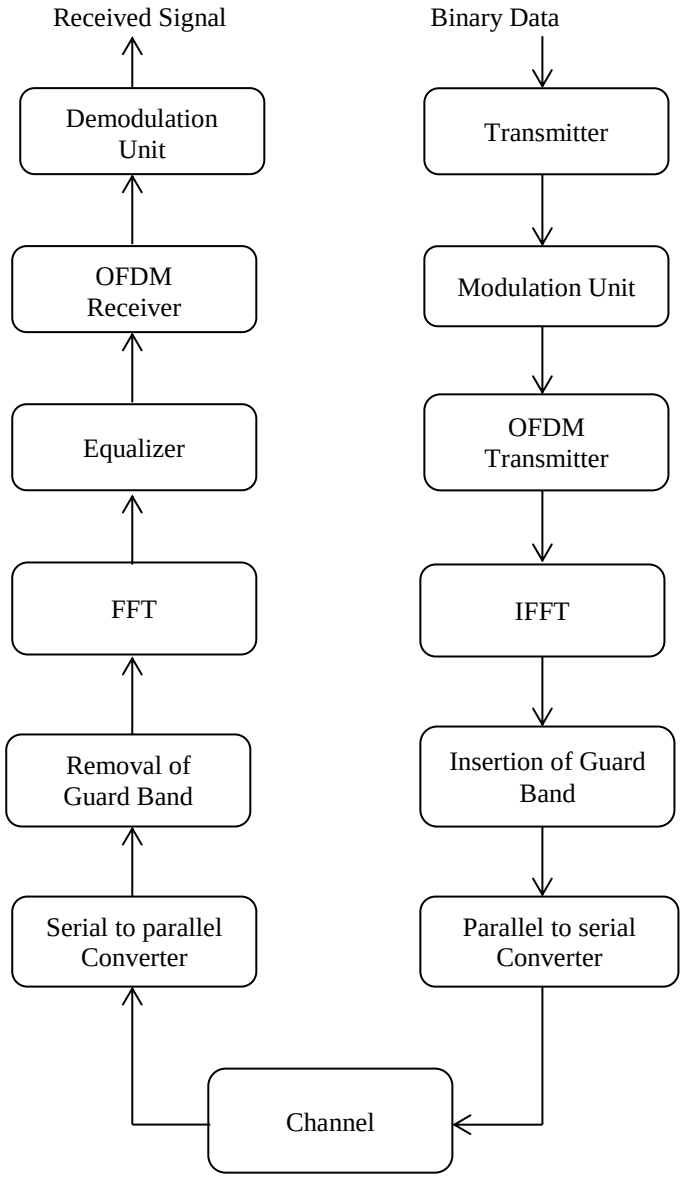

Figure.3

The proposed system shown in figure. 3 is used for comparative analysis of Orthogonal frequency division multiplexing access over AWGN channel and rician channel. For comparative analysis quality parameters such as symbol error rate,bit error rate, signal to noise ratio, packet loss,received power,etc, are used.

V. CONCLUSION

The proposed system testified and evaluated using MATLAB. For two different channels AWGN and Rician channels the system is evaluated against multiple quality parameters. Comparative analysis shows that Rician channel

has an edge over AWGN channel in terms of symbol error rate,bit error rate, signal to noise ratio, packet loss,received power,etc. The proposed system is found effective in terms of less packet loss and better received power without inter symbol interference in both channels.

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