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ENHANCED PERFORMANCE OF OFDM MEASURING BIT ERROR RATE & PEAK TO AVARAGE POWER RATIO USING DIFFERENT MODULATION SCHEME

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ABSTRACT

The objective of this research work is to describe different modulation schemes (Phase-shift keying (PSK), Binary Phase-shift keying (BPSK) and Quadrature amplitude modulation) in OFDM using Rayleigh fading channel and evaluate the performance using Bit Error Rate (BER) and Signal-to-Noise Ratio (SNR). Peak-to-Average Power Ratio (PAPR) is also calculated for these modulation schemes.

INTRODUCTION

In recent years orthogonal frequency division multiplexing (OFDM) has gained a lot of involvement in diverse digital communication applications. It is a new ensuring transmission scheme for broadband communications over a wireless channel. In OFDM data is transmitted simultaneously through multiple frequency bands [14]. It offers many advantages over single frequency transmission such as high spectral efficiency, robustness to channel fading, immunity to impulse interference, and the capability to handle frequency-selective fading without resorting to complex channel equalization schemes. OFDM also uses small guard interval, and its ability to combat the ISI problem. So, simple channel equalization is needed instead of complex adaptive channel equalization.

In the conventional serial data transmission system, the information symbols are transmitted sequentially where each symbol occupies the entire available spectrum bandwidth. But in an OFDM system, the information is converted to N parallel sub-channels and sent at lower rates using frequency division multiplexing. The subcarrier frequency spacing is selected carefully such that each subcarrier is located on the other subcarriers zero crossing points [7]. This implies that there is overlapping among the subcarriers but will not interfere with each other, if they are sampled at the sub carrier frequencies. This means that all subcarriers are orthogonal.Due to the orthogonality of the subcarriers the transmission bandwidth is used efficiently as the subcarriers are allowed to overlap each other and still be decoded at the receiver.

OFDM has been used for Digital Audio Broadcasting (DAB) and Digital Video Broadcasting (DVB) in Europe, and for Asymmetric Digital Subscriber Line (ADSL) high data rate wired links. OFDM has also been standardized as the physical layer for the wireless networking standard 'HIPERLAN2' in Europe and as the IEEE 802.11a, g standard in the US, promising raw data rates of between 6 and 54Mbps.OFDM has various properties that make it desirable over existing single carrier systems, the main advantage is OFDM's immunity to frequency selective fading.

DIVERSITY

The paradigm of fading and its time-varying nature constitute a fundamental problem when communicating over wireless channels. During some time periods, the transmitted symbol can well be recovered by the receiver despite the presence of fading; while during other time periods, fading may reach extents that make faultless transmission of data impossible. This latter case is referred to as deep fading. Therefore, it is reasonable to assert that a communication scheme is likely to suffer from errors if it depends on the strength of a single signal path. One way to remove this dependency is to ensure that each individual symbol is sent over several paths which undergo independent fading. By this way, correct transmission of an information symbol is achieved as long as one of its paths is strong. This resource is known as diversity.

OFDM IMPLEMENTATION OF MULTICARRIER MODULATION

A more spectrally efficient implementation of the aforementioned multicarrier system is OFDM . In OFDM the transmit signals are constructed in such a way that the frequency spectra of the individual sub channels are allowed to overlap thereby utilising the frequency spectrum much more efficiently.

Mathematically the continuous time representation of the OFDM transmit signal is.

$$x_m(t) = \frac{1}{\sqrt{N}} \sum_{\frac{-N}{2}+1}^{\frac{N}{2}+1} X_{m,k} . e^{j2\pi k \Delta f t} . w_k(t - mT) \qquad 0 > t > T$$

ORTHOGONALITY IN OFDM

One of the key advantages of OFDM is its efficient use of the frequency band as the subcarriers are allowed to overlap each other in the frequency domain. The N equally spaced subcarriers will be orthogonal if the frequency separation between subcarriers is $\Delta f = \frac{1}{N.T_s} = \frac{1}{T}$, where, $N.T_s$is symbol duration, and rectangularwindowing of the IFFT is performed. Under these conditions the subcarriers will have a $sinc$ waveform frequency response.

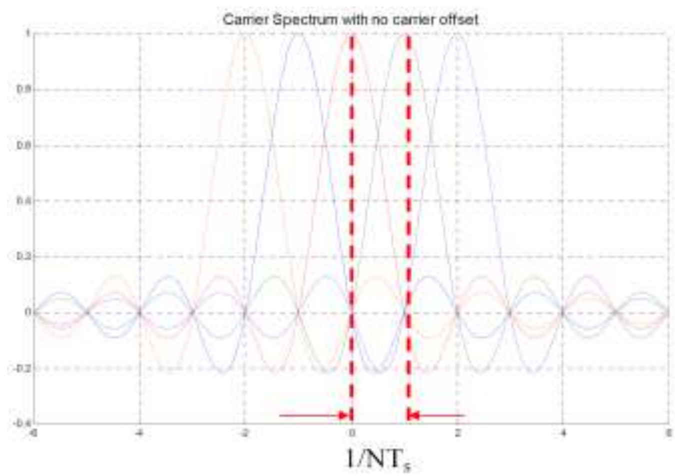

FIG 1.Frequency spectrum of 5 orthogonal subcarriers of an OFDM transmit signal

SIMULATIONS

To simulate the OFDM system a MATLAB test bench is created and simulated the BER performance

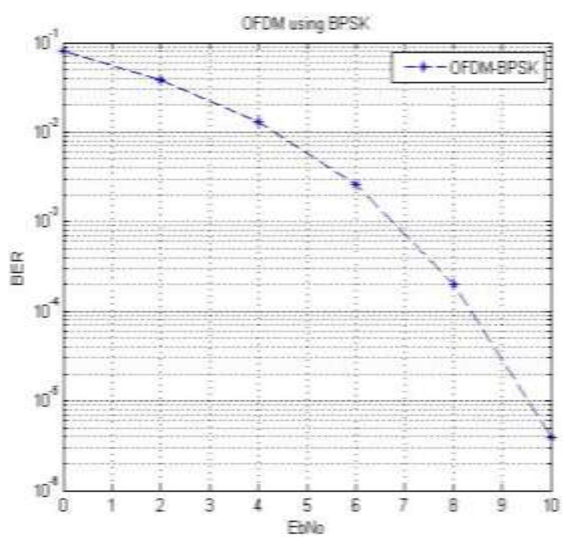

FIG 2.BER v/s SNR graph for BPSK modulation in Rayleigh channel

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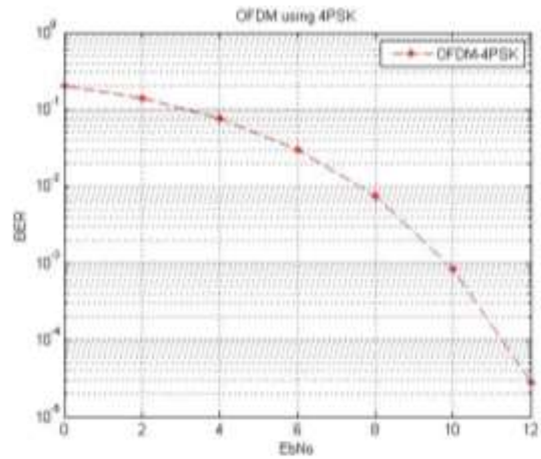

FIG 3.BER v/s SNR graph for 4-PSK modulation in Rayleigh channel

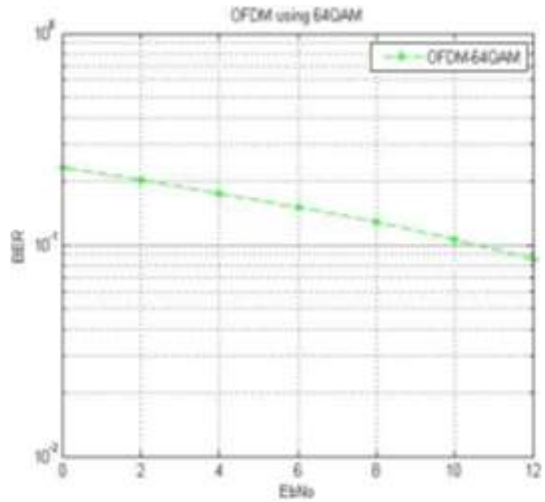

FIG 4. BER v/s SNR graph for 64-QAMmodulation in Rayleigh channel

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