OFDM performance in an Additive White Gaussian Noise (AWGN) channel

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***Abstract*— Orthogonal Frequency Division Multiplexing (OFDM) is a rising technology for high speed data. Many wireless standards are working on OFDM technology so that future wireless communication can be made better. OFDM is gaining popularity very much as it can provide much better environment to use internet, multimedia etc.The mentioned schemes used in OFDM system can be selected on the basis of the requirement of power or spectrum efficiency and BER analysis under different channel conditions.**
Traditional communication system suffers from noisy and unfair data; speed is to low so that's why OFDM is growing. Transceivers are designed in such a way that a user gets high bandwidth efficiency. Because of fading and multipath delay spread in signals in different wireless environments, traditional single carrier mobile communication systems do not perform well. Inter Symbol Interference (ISI) and high fading of the signal are main problems at the receiver side. Due to this a high probability of errors occur and the overall performance of system becomes very much poor.

***Index Terms*—OFDM, communication system, Inter Symbol Interference**

I. INTRODUCTION

A. Principle of OFDM

According to the OFDM principle a high-rate data stream is divided into a number of lower rate streams. These lower rate streams are individually modulated and transmitted over different sub carriers. Due to increase in symbol period, the time dispersion decreased. Guard interval is inserted at the end of each subcarrier so chances of inter symbol interference becomes null. It also diminishes the chances of inter carrier interference. Many subcarriers are there and orthogonal so interference is less.

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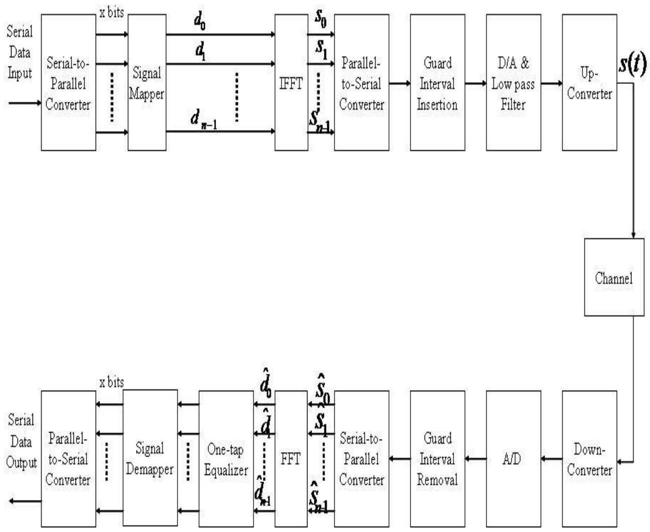

Fig. 1 OFDM Model used for simulations

Many orthogonal sub-carriers combine into a single OFDM baseband signal such that each sub-carrier is modulated differently by its own data. We can send data on various sub-carriers simultaneously in a low frequency space without interference from each other. Thus, they are able to overlap without interfering. So in OFDM systems spectral efficiency is maximized .Also we save the signal from adjacent channel interference.

Inverse Discrete Fourier Transform (IDFT) is used to form pulse and modulation. It is done very efficiently by using Inverse Fast Fourier Transform (IFFT). FFT is used at receiver side.

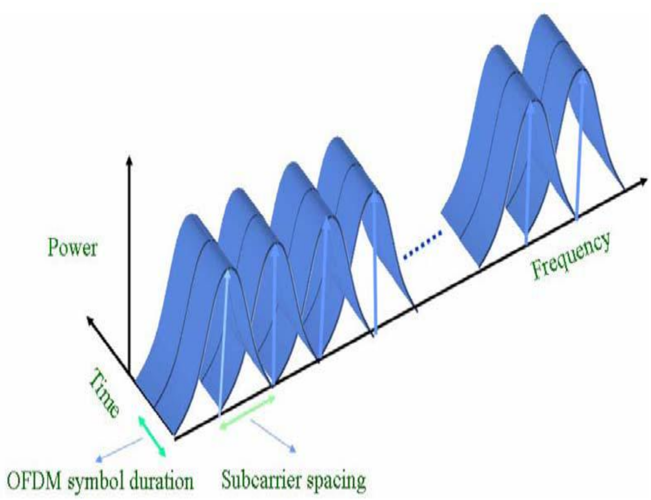

Fig. 2 OFDM signal

II. .MODULATION TECHNIQUES

The choice of modulation scheme will significantly affect the characteristics, performance and resulting physical realization of a communication system. It is important to select a modulation scheme that is appropriate for the Doppler spread and the delay spread of the channel

A. BPSK

BPSK is the basic form of phase shift keying (PSK) A digital signal alternating between -1 and +1 (or 1 and 0) will create phase reversals, i.e. 180 degree phase shifts as the data shifts state.

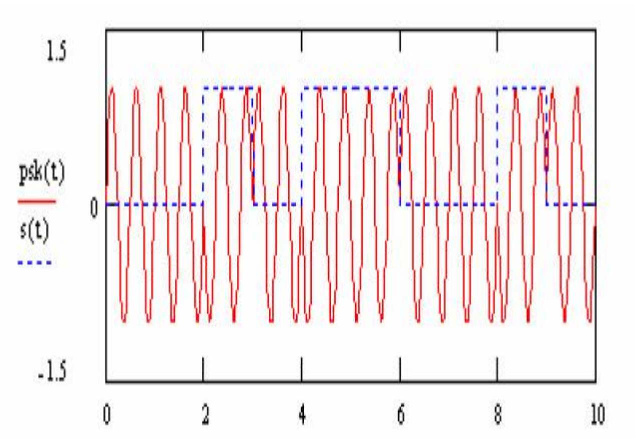

Fig. 3 Binary PSK Carrier
(Note the 180^{o} phase shifts at bit edges)

B. QPSK

QPSK offers higher spectral efficiency than BPSK, and is used as per need. QPSK uses four points on the constellation diagram. With four phases viz 0,90,180,270 QPSK can encode two bits per symbol, shown in the diagram with Gray coding to minimize the BER twice the rate of BPSK. Analysis shows that this may be used either to double the data rate compared to a BPSK system while maintaining the bandwidth of the signal or to maintain the data-rate of BPSK but halve the bandwidth needed.

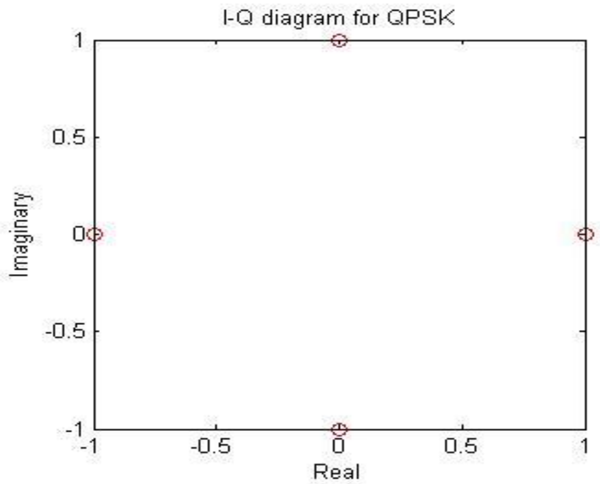

Fig.4 I-Q diagram for QPSK

C. Quadrature Amplitude Modulation (QAM)

Quadrature Amplitude Modulation refers to QPSK with Amplitude Modulation. Basically, it is a mix of phase modulation and amplitude modulation.. It is widely used as it offers advantages over other forms of data techniques. It is a signal in which two carriers shifted in phase by 90 degrees are modulated and the resultant output consists of both amplitude and phase variations.

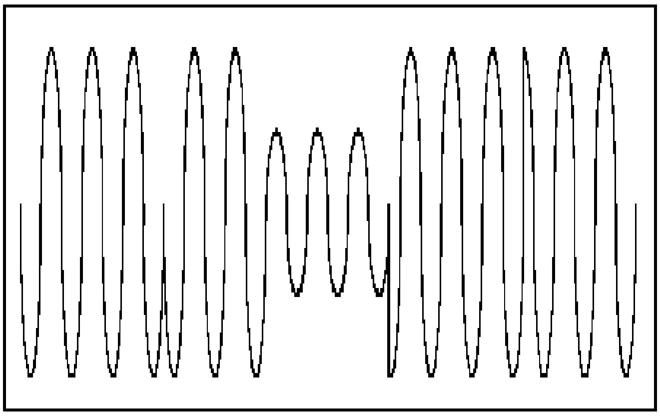

Fig. 5 Phase Modulated and Amplitude Modulated Carrier

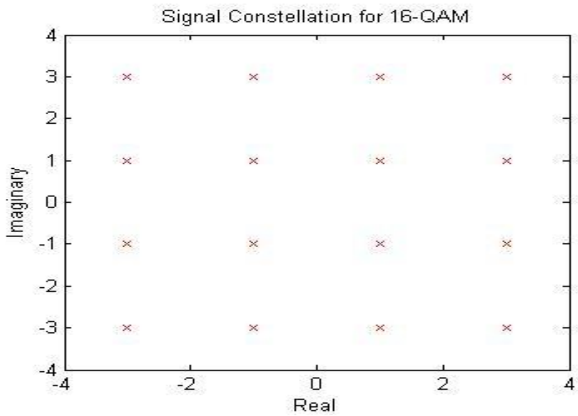

Fig. 6 Constellation diagram for 16 QAM

2.4 OFDM Simulation using DPSK modulation
Effect of Additive White Gaussian Noise (AWGN)

Parameters	**Value**
Carrier Modulation used	BPSK , QPSK, 16PSK
Bits per Symbol	BPSK = 1, QPSK = 2, 16PSK = 4
FFT size	512
Number of carrier used	250
Guard Time	10% of FFT size

Table 1 OFDM system parameters used for the simulations

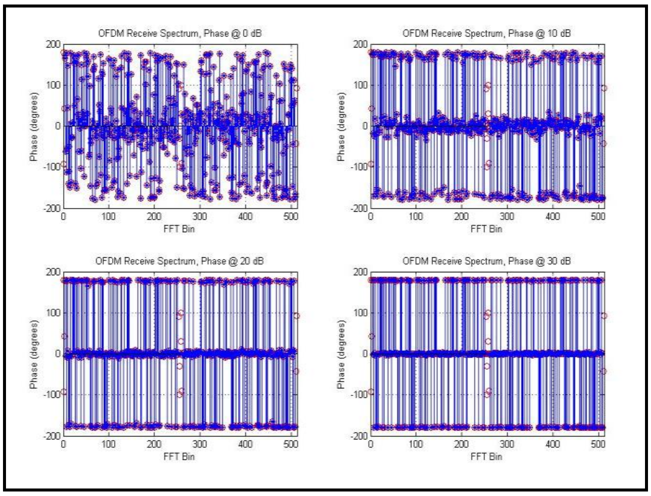

Fig.7 OFDM received magnitude at different SNR

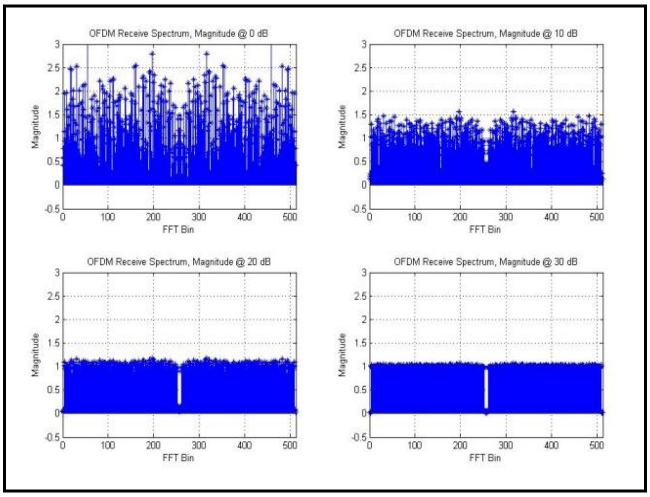

Fig.8 OFDM received phase at different SNR

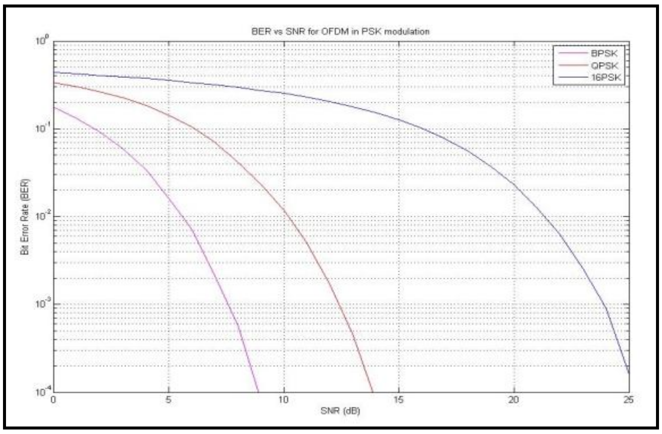

Fig. 9 BER vs SNR for OFDM in modulation technique

III. CONCLUSION

In this paper, a new scheme of data transmission based on the principle of OFDM can be considered as promising technique to reduce the effects of multipath fading in wireless communications. But there is a problem of BER (bit error rate) which cause the error in data. The solution to this problem is to increase the value of the SNR so, that the effect of the distortions introduced by the channel will also goes on decreasing, as a result of this, the BER will also decreases at higher values of the SNR. Also the BER can be controlled by help of using different channels. We can also conclude by the above graph that AWGN channel is best among all the above channels.

IV. SCOPE FOR FUTURE WORK

There is a wide scope of OFDM in data transmission because it is one of the best way of transmitting Multipath signal by controlling the effect of channel fading. In future it is also possible to design a channel using different coding and decoding techniques which removes the effect of Multipath fading more better than these channels.

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