

**MODELING AND PERFORMANCE EVALUATION OF QAM-OFDM SYSTEM WITH
DIFFERENT TRANSMISSION SCHEMES**

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ABSTRACT

In wireless communication system, the receiver side Bit error ratio (BER) strongly affected by channel error, interference, distortion, synchronization error and wireless multipath fading channels. Multiple-input and multiple-output, (MIMO) is the use of multiple antennas at both the end in wireless communication to improve Bit error ratio (BER) performance. In this paper, has been performed evaluation of QAM-OFDM with transmission schemes. This model is used for performance evaluation of the OFDM with QAM modulation schemes and fading channel. The throughput and packet error rate are used to evaluate the performance of MAC layer with the change in physical layer parameter, the using FEC code. The results has been shown in the paper for the simulation in various condition.

KEYWORDS: OFDM (Orthogonal Frequency Division Multiplexing), QAM (Quadrature Amplitude Modulation), AWGN.

INTRODUCTION

Wireless communications is an emerging field. It has grown at a tremendous rate in the last ten to twenty years. They having lot of ideas for increasing capacity and BER performance. All emerged based on wireless technology to provide, immense mobility, higher throughput, longer range, and robust backbone to thereat.

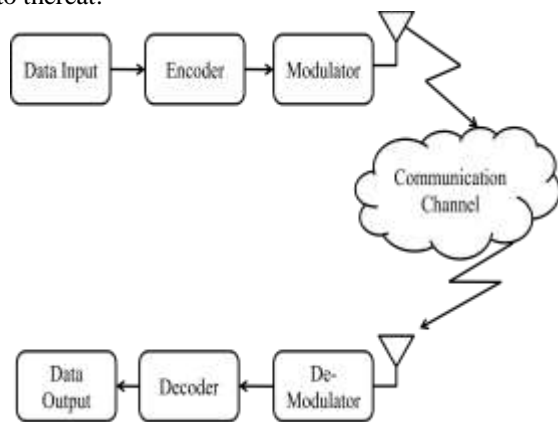


Fig:1 Wireless Systems.

The number of telecommunications innovations grew rapidly during the last half of the 20th century. Currently there is widespread and growing use of cellular phones, cordless phones, digital satellite systems, and personal mobile radio networks. In the wireless communications occurs at many different

frequencies, from underwater communication at extremely low frequencies. An there are various technology comes in the picture to improve the performance of the wireless communication like single carrier communication and multicarrier communication process [1].

OFDM is a multicarrier modulation technique used for high data rate in wireless applications that is suitable for eliminating ISI. The main merit of OFDM is the fact that the radio channel is divided into many narrow-band, low-rate, frequency-nonsselective sub-channels or subcarriers, while maintaining a high spectral efficiency, so that multiple symbols can be transmitted in parallel. Then each subcarrier may deliver information for a different users, or resulting in a simple multiple access scheme known as Orthogonal Frequency Division Multiple Access (OFDMA). This enables different media such as video, audio, graphics, speech, text, or other data to be transmitted within the same radio link, and depending on the specific types of services and their Quality-of-Service (QoS) requirements. The OFDM system is a special case of multicarrier transmission, in where a single data stream is transmitted over a number of lower rate subcarriers. In single carrier system if signal get fade or interfered then entire link gets failed where as in multicarrier system only a small percentage of the

subcarriers will be affected. The main reason to use OFDM is to increase the robustness against the selective fading or narrowband interference.

ORTHOGONAL FREQUENCY DIVISION MULTIPLEXING (OFDM)

Orthogonal Frequency Division Multiplexing (OFDM) is very similar to the well known and used technique of Frequency Division Multiplexing (FDM). The OFDM uses the principles of FDM to allow multiple messages to be sent over a single radio channel. However in a much more controlled manner, is allowing an improved spectral efficiency.

A simple example of FDM is the use of different frequencies for each FM (Frequency Modulation) radio stations. The all stations transmit at the same time but do not interfere with each other because they transmit using different carrier frequencies. They are bandwidth limited and are spaced sufficiently far apart in frequency so that their transmitted signals do not overlap in the frequency domain. This filtered signal can then be demodulated to recover the original transmitted information. At the receiver, each signal is individually received by using a frequency tunable band pass filter to selectively remove all the signals except for the station of interest.

OFDM is different from FDM in several ways. In the conventional broadcasting each radio station transmits on a different frequency, for effectively using FDM to maintain a separation between the stations. With an OFDM transmission such as DAB, information signals from multiple stations are combined into a single multiplexed stream of data. The subcarriers within the OFDM signal are time and frequency synchronized to each other, and allowing the interference between subcarriers to be carefully controlled. This data is then transmitted using an OFDM ensemble that is made up from a dense packing of many subcarrier. These multiple subcarriers overlap in the frequency domain, because do not cause Inter-Carrier Interference (ICI) due to the orthogonal nature of the modulation. In typically with FDM the transmission signals need to have a large frequency guard-band between channels to prevent interference. However with OFDM the orthogonal packing of the subcarriers greatly reduces this guard band, in improving the spectral efficiency. This lowers the overall spectral efficiency.

Orthogonality:

Two periodic signals are orthogonal when the integral of their product, are over one period, is equal to zero. In this is true of certain sinusoids as illustrated in the equation 1 and 2.

A. Continuous Time

$$\int_0^T \cos(2\pi nft) * \cos(2\pi mft) dt = 0; n \neq m \quad (1)$$

B. Discrete Time

$$\int_0^{N-1} \cos\left(\frac{2\pi kn}{N}\right) * \cos\left(\frac{2\pi km}{N}\right) = 0; n \neq m \quad (2)$$

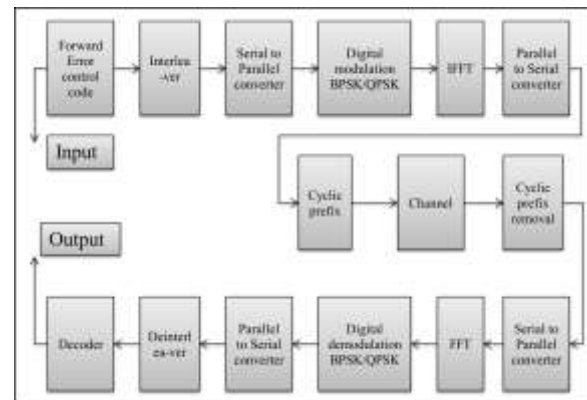


Fig: 2 OFDM System Model

ADDITIVE WHITE GAUSSIAN NOISE CHANNEL

AWGN channel is an additive noise channel. An instead of the logical values (0 and 1) which have been used to describe data, we consider real values should be considered to explain the AWGN channel. Assigning $\{-1,+1\}$ to the binary bit values $\{1,0\}$, the channel input is a stream of values from $\{-1,+1\}$. The channel output is adding white Gaussian noise (Gaussian distributed variable with zero mean and non-zero variance) to the input values. The effect of AWGN channel on bits. The effect of the channel can also be formulated below, where \tilde{N} is a Gaussian random variable, for the X is the channel input, \hat{Y} is the output, σ^2 is the variance of the Gaussian random variable. The AWGN channel is described by the ratio of the signal power to the noise power, $SNR = x^2/\sigma^2$, with x as symbol energy. Compare different coding schemes with different rates, $E_b/N_0 = (x_n^2)/[2.R\sigma]^2$ is used, where N_0 is the noise spectral density, E_b is energy per bit, and R

is the code rate. In this thesis, the SNR value is used for Eb/N0 value.

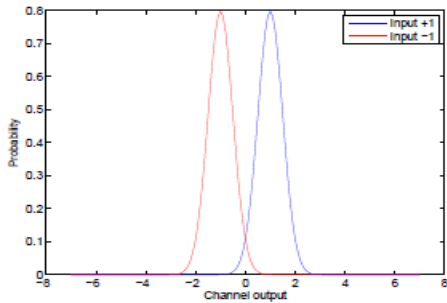


Fig: 3 The signal of AWGN channel output

MODULATION TECHNIQUE

Binary Phase Shift Keying (BPSK).

Binary Phase Shift Keying (BPSK) modulation is a special case of the general M-ary phase shift keying with M = 2. In particular, the binary data selects one of the two opposite phases of the carrier. This is modulated signal can be written mathematically as.

$$BPSK = A \cos(2\pi ft + \phi(t)) \quad (3)$$

Where A is the amplitude and ω is the angular frequency of the RF carrier. The phase shift $\phi(t)$ is given by:

$$\phi(t) = i\pi$$

With $i = 0$ or 1 corresponding to the binary data value.

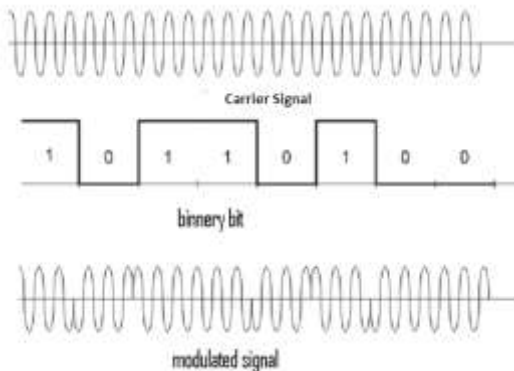


Fig: 4 PSK modulation

Quadrature Amplitude Modulation (QAM)

ASK is also combined with PSK to create hybrid systems such as amplitude and phase shift keying or Quadrature Amplitude Modulation (QAM) where both the amplitude and the phase are changed at the same time. The Quadrature Amplitude Modulation (QAM) is a modulation scheme which conveys data by changing (modulating) the amplitude of two carrier waves. These are two waves, usually

sinusoids, out of phase with each other by 90° and are thus called Quadrature carriers hence the name of the scheme.

$$v(t) = V \sin(2\pi \cdot f(t) + \theta) \dots \quad (4)$$

As for many digital modulation schemes, in constellation diagram is a useful representation. In Quadrature Amplitude Modulation (QAM) the constellation points are usually arranged in a square grid with equal vertical and horizontal spacing. The number of points in the grid is usually a power of 2 (2, 4, 8, 16.....). the since QAM is usually square, and the most common forms are 8-QAM, 16-QAM, and 64-QAM schemes. By moving to a higher-order constellation, and it's possible to transmit more bits per symbol. For the mean energy of the constellation is to remain the same (by way of making a fair comparison) and 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 deliver more data less reliably than lower-order QAM.

RESULTS AND DISCUSSION

The system description for the simulation is given in fig 4. The input data are transmitted through the OFDM-QAM system with FEC code .

The system are performance of QAM and OFDM and using AWGN and multiple rician fading channel. Then the calculate error and the system are compare results BER and SNR.

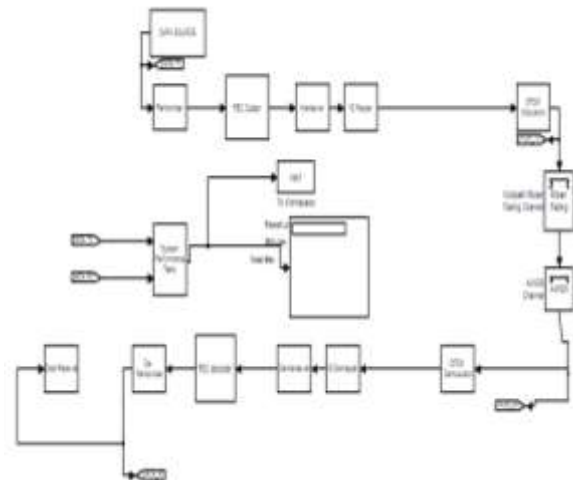


Fig: 5 Simulink block diagram

The simulation model of 16 QAM- OFDM is the input data bits are mapped onto corresponding QAM symbols using grey coding which the Constellation diagram for 16-QAM. The binary words are assigned

to adjacent symbol states and differ by only one digit. In complex modulation scheme are best viewed using a scatter diagram with signals.

THE PERFORMANCE QAM-OFDM WITH RICIAN CHANNEL

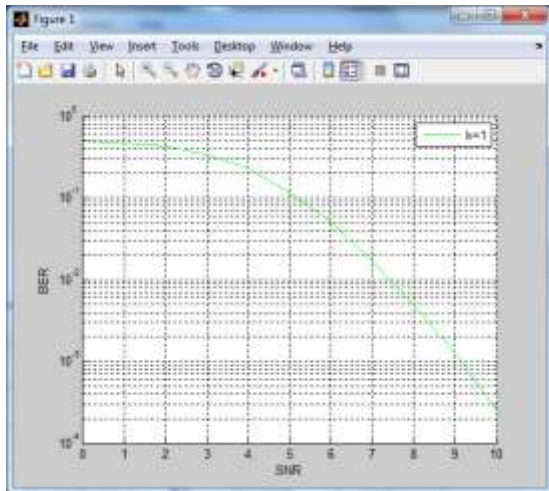


Fig: 5 The Performance of BER vs SNR for the value of k factor (1)

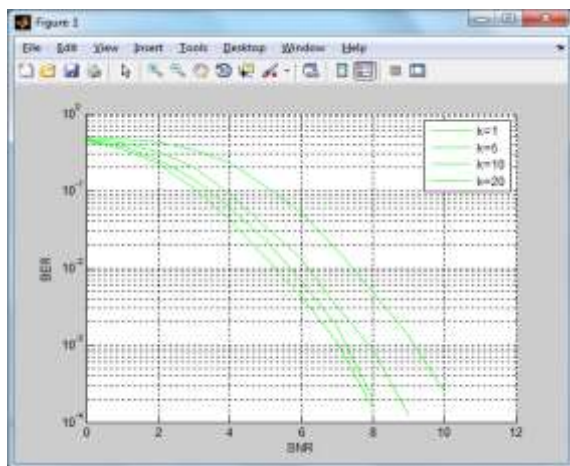


Fig: 6 The Performance of BER Vs SNR

CONCLUSION

The system is modulation technique a using OFDM and QAM. Anyone involved in simulation modeling should use this methodology so that their results can be compared with those of others. It can be concluded that for a certain value of SNR at some signal power the performance in terms of BER is less in QAM system than that of a QPSK system. It is found that with increase of modulation order the capacity enhancement is compare to BER and SNR.

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