A Review: Modelling and Performance of OFDM System using QAM

Balajee Sharma[1], Rashmi Pandey[2]

[1]*M. Tech (DC) VIT Bhopal*
[2]*Professer and Head ECE deptt., VIT Bhopal*

Abstract—this review paper based on the Performance analysis of OAM-OFDM system in AWGN Channel. In Digital communication system with multi carrier modulation technique can play very important role in all phase of designing and engineering. In this paper we discuss about the performance analysis of 16QAM- OFDM system. We compare the performance analysis of different technique used in the 16 QAM OFDM and discuss the BER vs SNR Ratio.

Keywords—QAM-OFDM, DAB, FFT.

I. INTRODUCTION

Orthogonal Frequency Division Multiplexing is based on the principal of transmitting data by dividing the stream into several parallel bit streams of multi-carrier transmission. In an OFDM scheme, a large number of orthogonal, overlapping, narrow band sub-channels or subcarriers, transmitted in parallel, divide the available transmission bandwidth. This avoids the need to have non-overlapping subcarrier channels to eliminate inter-carrier interference. OFDM is being used in a number of wired and wireless voice and data application due to its flexible system architecture. Some examples of OFDM applications are Digital Audio broadcasting (DAB), and High Rate Digital Subscribers Line (HDSL), and very high rate digital subscriber line (VHDSL) systems, which operate over twisted pair channels.

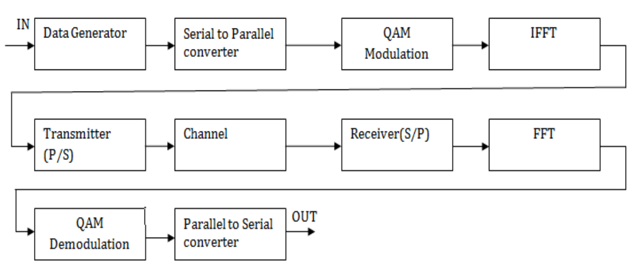

Fig 1. The Basic Model of OFDM System

The basic idea behind multi-tone modulation is to replace one wideband signal with many simultaneously transmitted narrowband signals with the same overall bandwidth as the original signal. In principle, the two schemes are equivalent in an AWGN channel. To implement OFDM transmitters and receivers in discrete time, Inverse fast Fourier transform (IFFT) and Fast Fourier transform (FFT) are used respectively. OFDM transmits symbols that have long time duration, which is less or equal to the maximum delay spread. To eliminate ISI, guard intervals are used between OFDM symbols.

II. METHODOLOGY

OFDM is of great interest by researchers and research laboratories all over the world. it is expected to be used for wireless broadband multimedia communications. OFDM can be seen as either a modulation technique or a multiplexing technique. One of the main reasons to use OFDM is to increase the robustness against frequency selective fading or narrowband interference. In a single carrier system, a single fade or interferer can cause the entire link to fail, but in a multicarrier system, only a small percentage of the subcarriers will be affected. Error correction coding can then be used to correct for the few erroneous subcarriers. The concept of using parallel data transmission and frequency division multiplexing was published in the mid-1960s. Some early development is traced back to the 1950s. A U.S. patent was filed and issued in January 1970.

In a classical parallel data system, the total signal frequency band is divided into N no overlapping frequency sub channels. Each sub channel is modulated with a separate symbol and then the N sub channels are frequency-multiplexed. It seems good to avoid spectral overlap of channels to eliminate inter-channel interference. However, this leads to inefficient use of the available spectrum. To cope with the inefficiency, the ideas proposed from the mid-1960s were to use parallel data and FDM with overlapping sub-channels, in which, each carrying a signaling rate b is spaced b apart in frequency to avoid the use of high-speed equalization and to combat impulsive noise and multipath distortion, as well as to fully use the available bandwidth.

To realize the overlapping multicarrier technique, however we need to reduce crosstalk between subcarriers, which means that we want orthogonality between the different modulated carriers. The word orthogonal indicates that there is a precise mathematical relationship between the frequencies of the carriers in the system. In a normal frequency-division multiplex system, many carriers are spaced apart in such a way that the signals can be received using conventional filters and demodulators. In such receivers, guard bands are introduced between the different carriers and in the frequency domain, which results in a lowering of spectrum efficiency. It is possible, however, to arrange the carriers in an OFDM signal so that the sidebands of the individual carriers overlap and the signals are still received without adjacent carrier interference. To do this, the carriers must be mathematically orthogonal. The receiver acts as a bank of demodulators, translating each carrier down to DC, with the resulting signal integrated over a symbol period to recover the raw data. If the other carriers all beat down the frequencies that, in the time domain, have a whole number of cycles in the symbol period T, then the integration process results in zero contribution from all these other carriers. Thus, the carriers are linearly independent (i.e., orthogonal) if the carrier spacing is a multiple of 1/T.

Much of the research focuses on the high efficient multicarrier transmission scheme based on "orthogonal frequency" carriers. In 1971, Weinstein and Ebert applied the discrete Fourier transform (DFT) to parallel data transmission systems as part of the modulation and demodulation process. Therefore, if we use DFT at the receiver and calculate correlation values with the center of frequency of each subcarrier, we recover the transmitted data with no crosstalk. In addition, using the DFT-based multicarrier technique, frequency-division multiplex is achieved not by band pass filtering but by baseband processing. Moreover, to eliminate the banks of subcarrier oscillators and coherent demodulators required by frequency-division multiplex, completely digital implementations could be built around special-purpose hardware performing the fast Fourier transform (FFT), which is an efficient implementation of the DFT. Recent advances in very-large-scale integration (VLSI) technology make high-speed, large-size FFT chips commercially affordable. Using this method, both transmitter and receiver are implemented using efficient FFT techniques that reduce the number of operations from N2 in DFT down to N log N. In the 1980s, OFDM was studied for high-speed modems, digital mobile Communications and high-density recording. One of the systems realized the OFDM techniques for multiplexed QAM using DFT and by using pilot tone, stabilizing carrier and clock frequency control and implementing trellis coding are also implemented. Moreover, various-speed modems were developed for telephone networks. In the 1990s, OFDM was exploited for wideband data communications over mobile radio FM channels, high-bit-rate digital subscriber lines (HDSL; 1.6 Mbps), asymmetric digital subscriber lines (ADSL; up to 6 Mbps), very-high-speed digital subscriber lines (VDSL; 100 Mbps), digital audio broadcasting (DAB), and high-definition television (HDTV) terrestrial broadcasting.

The OFDM transmission scheme has the following key advantages:

- Makes efficient use of the spectrum by allowing overlap
- By dividing the channel into narrowband flat fading sub channels, OFDM is more Resistant to frequency selective fading than single carrier systems are.
- Eliminates ISI and IFI through use of a cyclic prefix.
- Using adequate channel coding and interleaving one can recover symbols lost due to the frequency selectivity of the channel.
- Channel equalization becomes simpler than by using adaptive equalization techniques with single carrier systems.
- It is possible to use maximum likelihood decoding with reasonable complexity, as discussed in OFDM is computationally efficient by using FFT techniques to implement the modulation and demodulation functions.
- In conjunction with differential modulation there is no need to implement a channel estimator.
- Is less sensitive to sample timing offsets than single carrier systems are.
- Provides good protection against co channel interference and impulsive parasitic noise.

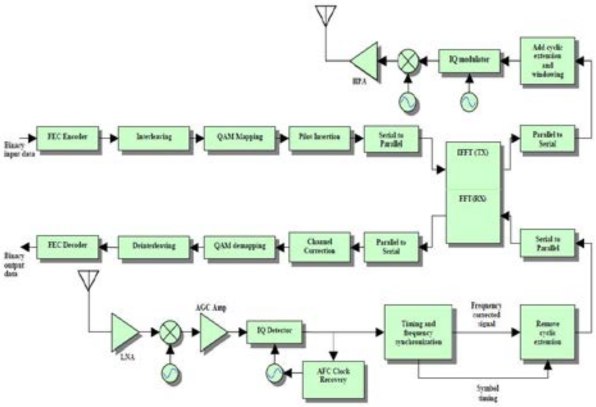

Fig 2. Block Diagram of an OFDM Transreciever:

III. PREVIOUS WORK

1. In 2011, T.P. surekha [1] , T. Ananthapadmanabha [2] , C. Puttamadappa [3] Members, IEEE, "Modeling and Performance Analysis of QAM-OFDM System with AWGN Channel" a simulink based simulation system is implemented using the AWGN channel and analysis the graph of BER vs SNR .the system is implemented for 192 subcarriers, 256 point IFFT. The effect of noise can be calculated for only 16 QAM. The The BER ratio 10^{-2} at 15 db SNR.

2. In 2013, Swati M. Kshirsagar1, A. N. Jadhav2 "Performance Evaluation of Coded Adaptive OFDM System Over AWGN Channel" the simulink based system is implemented using the AWGN channel for 64 sub carriers the noise level is about is 17 dB The The BER ratio 10^{-2} at 15 db SNR.

3. In Dec 2012, *Indu Maurya* "Determining the Positioning Algorithm for Fingerprinting Using WLAN" the simulink based system is implemented using for AWGN channel and analysis the graph of BER vs SNR. The noise level of AWGN channel is 15 dB. The system is implemented for 16 QAM. The BER ratio 10^{-3} at 15 db SNR

4. In 2005 Jae-Min Kwak[1], Sung-Chul Lee[1], Ji-Woong-Kim[2], Gi-Sik Park[3], Sung- Eon Cho[4], and Hyo-Chang Pang[5], " The Performance analysis of OFDM system using Hierarchical 16 QAM on Multipath Fading channel" a simulink based simulation system is implemented using the AWGN channel for 64 sub carriers the noise level is about is 40 dB. The BER ratio 10^{-3} at 15 db SNR.

5. In May 2012, Vineet Sharma *, Anuraj Shrivastav ** , Anjana Jain*** , Alok Panday**** "BER performance of OFDM-BPSK,-QPSK,- QAM over AWGN channel using forward Error correcting code" the system is implemented 192 carriers and noise of channel is 20dB . The BER ratio 10^{-3} at 18 db SNR.

IV. CONCLUSION AND FUTURE SCOPE

In the previous work which was discuss in literature review shows that there is need to improvement in system in terms of Noise level. If Noise level will the BER should be reduced so that in higher level QAM will be implemented at higher noise level such as 32 QAM, 64 QAM as so on.

The recent advancement have improve the bit error rate some extant but the system that analysed for more no of carriers that reduced the ISI and ISF using deferent technique.

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