International Journal of Advanced Research in Computer Engineering & Technology (IJARCET)
Volume 4 Issue 12, December 2015

Image Transmission Using 64-QAM Modulation Technique in Digital Communication System

Shadbhawana Jain and Shailendra Yadav

***Abstract*—In digital communications, the information is expressed in the form of bits. In recent years, a major transition has occurred from the amplitude modulation, phase modulation and frequency modulation of new digital modulation techniques. In digital communications, the modulation is the process to transmit a message signal. The modulation of a sine curve transforms a message signal in baseband in a signal bandwidth. The input image of origin is applied on the modulation/demodulation techniques such as QPSK, 16-QAM and 64-QAM in the communication system. As a results, the performance of this system is acceptable that, up to a certain level of noise from the critical channel. In other words, if the noise level is raised above this critical level, the performance of the system cannot very quickly. By using 64-QAM modulation technique, which carries higher data rates, this is essential for image transmission. Modulation techniques such as 64-QAM provide better results than the other modulation techniques such as QPSK and 16-QAM.**

***Index Terms*—Quadrature Amplitude Modulation, Fast Fourier Transform, Inverse Fast Fourier Transform, Quadrature Phase Shift Keying, AWGN, Signal to Noise Ratio.**

I. Introduction

In digital communications, the information is expressed in the form of bits. The term refers to a collection of symbols, different sizes, and bits. OFDM data are generated by taking of symbols in the spectral space using the M-PSK, QAM, etc, and convert the spectra of time domain by taking the Inverse Discrete Fourier Transform (IDFT). Since Inverse Fast Fourier Transform (IFFT) is no longer cost effective to implement, it is usually used in place [1]. Once the OFDM data are modulated to time signal, all air carriers transmit in parallel to fill the width of the band of frequencies available. During the modulation, OFDM symbols are generally divided into frames, so that the data will be modulated image by image for that they received signal to be in sync with the receiver [3]. Symbol of long periods reduce the probability of interference inter-symbol, but could not eliminate it.

In recent years, a major transition has occurred from the amplitude modulation as simple analog (AM) and the phase modulation/frequency modulation (PM/FM) of new digital modulation techniques [6]. There is a fundamental compromise in the communication systems. Simple hardware can be used in the transmitters and receivers to communicate information. However, this operation uses a lot of spectrum that limits the number of users. In addition, transmitters and receivers more complex can be used to convey the same information on less bandwidth. The transition toward more and more techniques of effective transmission requires more spectrally and more complex equipment [2]. In digital communications, the modulation is the process to transmit a signal message, for example, a stream of bits, an analog audio and digital signal, to within the further signal that can be actually transmitted. The modulation of sine curve transforms a message signal in base band in a signal bandwidth. The objective of the analog modulation is to transfer a analog base band (or pass band) signal such as a TV signal and an audio signal, on a canal passes-analog band at a different frequency [4-5]. The objective of digital modulation is to transfer a stream of bits over wireless digital communication. To find best suitable digital modulation/demodulation technique will be applied on wireless digital communication system, which improves a degraded image.

Manuscript received Dec, 2015.

***Shadbhawana Jain**, Dept. of E&C Engineering, BTIRT College, Sagar, India.*
***Shailendra Yadav**, Dept. of E&C Engineering, BTIRT College, Sagar, India.*

II. Digital Modulation Techniques

We begin our discussion on the digital modulation by starting with the several types of modulation techniques used. All modulation techniques change from a sinusoidal parameter to describe the data information that we have desire to transmit. A sinusoidal signal has three distinct parties which can be varied [7]. These are the amplitude, phase and frequency.

A. *Amplitude Shift Keying*

Amplitude Shift Keying is a form of a method of digital modulation. Here the carrier wave amplitude is varied based on the signal of digital modulation. And here the frequency and the phase of the signal are kept constant [8]. Consequently this scheme of modulation also called as ON/OFF of the overlay.

$$A(t) = s(t)\sin(2\pi ft)$$

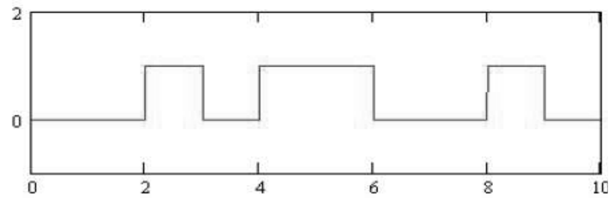


Fig. 1: Amplitude Shift Keying Modulation

B. *Frequency Shift Keying*

In a Frequency Shift Keying modulation, in which the frequency of the sinusoidal carrier signal is varied according to the message level ("0" or "1") while keeping the amplitude and phase constant [11]. Their signal waveform is shown in

ISSN: 2278 – 1323

fig. 2.

$$s(t) = \sin(2\pi f_1 t) \text{ For bit 1}$$
$$s(t) = \sin(2\pi f_2 t) \text{ For bit 0}$$

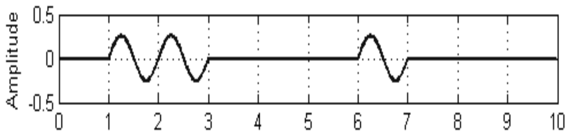


Fig. 2: Frequency Shift Keying Modulation

C. Phase Shift Keying

We can alter the sinusoidal carrier phase to point out the information. When the sinusoidal signal starts, the phase in this circumstance is the beginning angle. When the phase of a sinusoidal signal is moving 180 degrees, it transmits 0. Phase offset describes change of the information in this state [10]. The most generally and widely used are binary Phase Shift Keying (BPSK) and Quadrature Phase Shift Keying (QPSK).

$$S(t) = \sin(2\pi f t) \text{ For bit 1}$$
$$S(t) = \sin(2\pi f t + \pi) \text{ For bit 0}$$

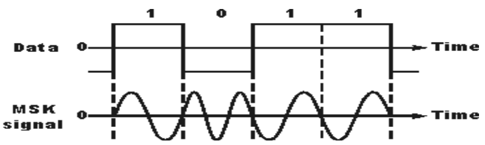


Fig. 3: Phase Shift Keying Modulation

D. Binary Phase Shift Keying

The technique of digital modulation BPSK is devoted to as the most easy to PSK and in this method, the phase of the carrier do not represent that two members of the phase [10].

As any form of modulation by phase shift, there is the definition of the states or the points that are used for data bits of signaling. One of the main methods for PSK is BPSK. A digital signal change between 1 and -1 (or 1 and 0) will create the inversions in phase, i.e. the phase shifts to 180 degrees as the data shifts state. This operation is also called to two levels PSK as it uses two phases separated by 180º to represent binary digits. The principle equation is,

$$S(t) = A\cos(2\pi f_c t) \text{ For binary 1,}$$
$$S(t) = A\cos(2\pi f_c t + \pi) \text{ For binary 0,}$$
$$S(t) = A\cos(2\pi f_c t) \text{ For binary 1,}$$
$$S(t) = -A\cos(2\pi f_c t) \text{ For binary 0,}$$

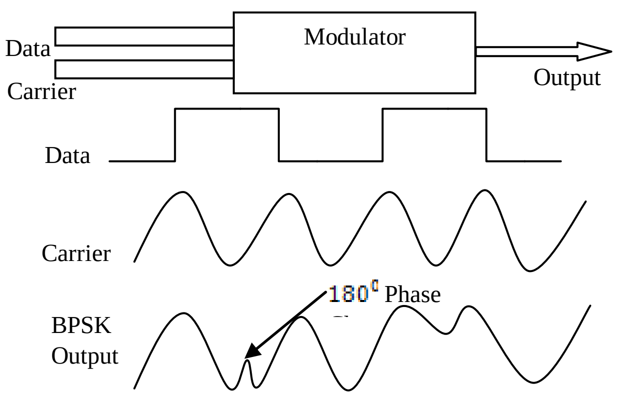


Fig. 4: Block Diagram of BPSK Modulation

E. Quadrature Phase Shift Keying

This operation is also called to four levels of PSK where each element represents more of a bit. Each symbol contains two-bit and it uses the phase shift of $\pi/2$, Means 90º instead of the phase change 180º. The principle of this technique lies in the equation:

$$S(t) = A\cos(2\pi f_c t + \pi/4) \text{ For 11,}$$
$$S(t) = A\cos(2\pi f_c t + 3\pi/4) \text{ For 01,}$$
$$S(t) = A\cos(2\pi f_c t - 3\pi/4) \text{ For 00,}$$
$$S(t) = A\cos(2\pi f_c t - \pi/4) \text{ For 10}$$

In this mechanism, the constellation consists of four points, but the decision is always made in two bits. This mechanism can ensure the efficient use of the bandwidth and the spectral efficiency high.

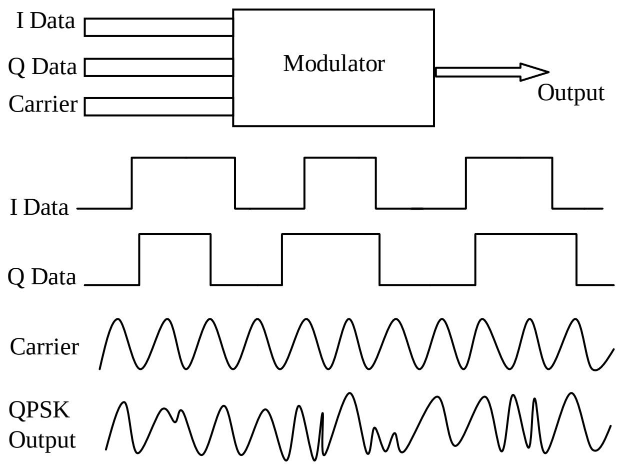


Fig. 5: Block Diagram QPSK Modulation

F. Quadrature Amplitude Modulation

In the QAM signal, in which the two carriers offset are in phase with 90 degrees, are modulated and the output results have consists together phase and amplitude variations. Because both phase and amplitude variations are introduce, it has also involved as a combination of both phase and amplitude modulation. The digital formats of Quadrature Amplitude Modulation are frequently denoted to as "quantified QAM" and that they are used more and more for the communication of data in radio communications systems.

III. Digital Communication System And Proposed Method

The model is a simple model of a wireless digital communications system. The model is broken into its constituents of functions or modules, and each of these in turn is described in terms of its impact on the data and the system. Since this model includes the whole of the system, both the source code and the equalization of the channel are briefly described. Modulation/de-modulation and IFFT/FFT are the main blocks of this wireless digital communications system simplified [9]. The Digital Communication systems, by description, are of communication systems that utilize such a numeric sequence as an interface involving the input channel and the source.

Fig. 6 shows the model of digital communication on basis the first three blocks of the diagram (source encoder,

ISSN: 2278 – 1323

modulator and channel encoder) together form the transmitter. The Source represents the message to transmit that includes the voice, video, and the image or text data among others. If the information has been acquired in analog form, it must be converted to digital format to make our communication easier. This conversion to analog to digital (ADC) is accomplished in the block of encoder source. Position a binary interface linked with the channel and source. The source encoder converts the output of the source of a binary sequence and the channel coder (often called a modulator) treats the binary sequence for the transmission on the channel.

The last three blocks consisting of detector/Demodulator, a decoder channel, and source of the receiver of form decoder. The destination represents the client waiting for the information.

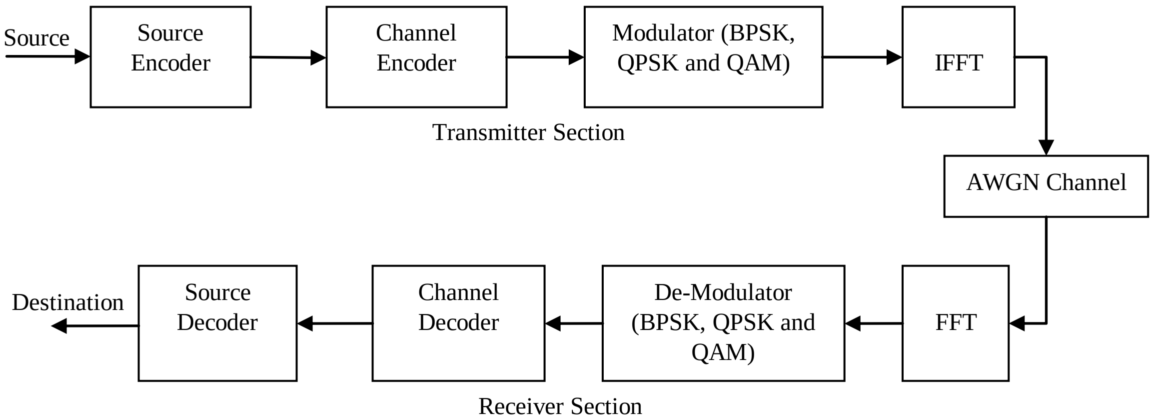


Fig. 6: Digital Communication System Model

It may be a human or a storage device or to another station of treatment. In all cases, the source of the liability of the decoder is to recover the information of the channel decoder and to transform it into an appropriate format for the destination. This transformation includes the digital to analog conversion (DAC) if the destination is a human being waiting to hem or view the information or if it is a storage device analog. If the destination is a storage device digital, the information will be retained in its digital state without a controller. The channel decoder (demodulator) creates the binary sequence entering (hopefully) reliable manner, and the source decoder creates the source output.

A. Proposed Method

This is the technique of modulation, it is most popular and used in various standards of wireless connection. It combined with install and PSK which has two different signals sent simultaneously on the same carrier frequency but it must be shifted from 90º to the respect of the other signal. At the end of the receiver, the signals are demodulated and the results are combined to obtain the binary input transmitted [8]. The principle equation is:

$$S(t) = d_1(t)\cos(2\pi f_c t) + d_2(t)\cos(2\pi f_c t)$$

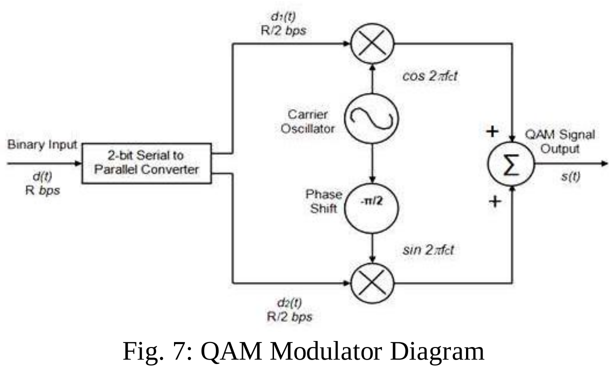


Fig. 7: QAM Modulator Diagram

This is identical to the 16-QAM except that it has 64 States where each symbol represents 6 bits (2^6= 64). It is one of the techniques of complex modulation but with greater efficiency [16]. The total bandwidth increases as a function of the increase in the number of states for each symbol.

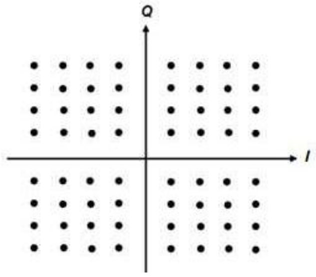


Fig. 8: 64-QAM Constellation Diagram

IV. Simulation Results

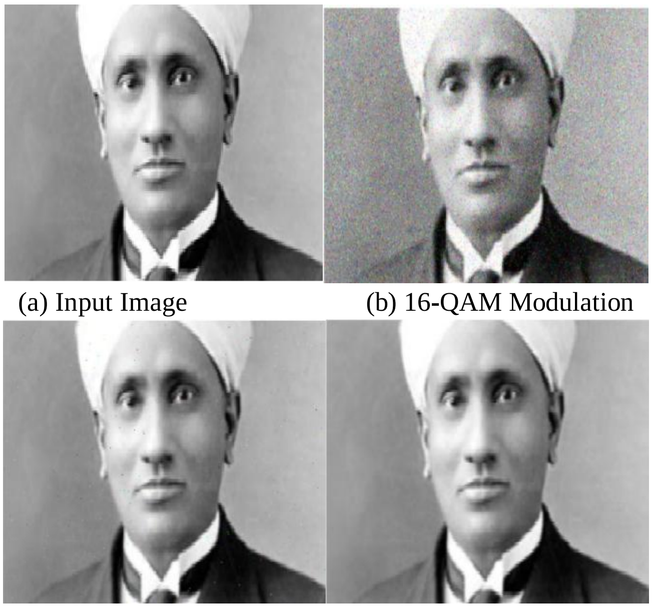
The initial phase before the wireless transmission is to transmit the message generated, where this message could be either randomly generated binary values, its audio or image digitally processed. Simulation of this part uses the numbers of pseudo-random distributed evenly, using the "rand(m,n)" which produces a Function 1 by 2500 values pseudo-random, where 2500 represent the number of bits. In order to produce the binary values random, the products previously the values should be rounded to the nearest whole number value. This is achieved by the use of function "round", which product 1 by 2500 bits (ones and zeros).

The kernel of the wireless transmitter is the Modulator, which allows you to modulate the Input data stream image by image. The data are divided into images based on the variable symbol by frame, which corresponds to the number of symbols by image by carrier. If the total number of symbols in a stream of data to be transmitted is less than the total number of symbols per frame, the data would not be divided into frames and would be modulated all at once.

Modulation/ De-Modulation ".m" must be executed while other M-Files will be invoked accordingly. The data source

ISSN: 2278 – 1323

for this simulation is taken from an 8-bit grayscale (256 levels of gray) bitmap image file (*.bmp) based on the choice of the user. The image data will then be converted to the size of the symbol (bits/symbol) determined by the choice of QPSK of four variations provided by this simulation. The converted data will then be separated into multiple frames by the wireless transmitter. The modulator 64-QAM allows you to modulate the data image by image. Before the output of the transmitter, the time signal modulated in cascade with the protections of the chassis inserted between as well as a pair of identical headers added at the beginning and at the end of the data stream. The communication channel is modelled by the addition of Gaussian white noise and amplitude clipping effect.



(a) Input Image (b) 16-QAM Modulation

(c) QPSK Modulation (d) 64-QAM Modulation

Fig. 9: Shows the Image Transmission Using Various Digital Modulation Techniques

The receiver detects the beginning and the end of each frame in the signal received by an envelope detector. Each temporal signal detected is then demodulated in useful data. The modulated data are then converted into a size of 8 bit word data used to generate an image file output of the simulation.

From the fig. 9, the first image in the left column is the input image of origin, the image of a gray scale is the image to which the modulation/demodulation techniques such as QPSK, 16-QAM and 64-QAM in the communication system will be applied. If the noise level is raised above this critical level, the performance of the system cannot very quickly. The advantage of the currently designed system is that, when the channel is under a condition of high noise, the system generates a quality of image worse rather than completely lose the transmitted image. By using 64-QAM modulation technique, which carries higher data rates, this is essential for image transmission. Modulation techniques such as 64-QAM provide better results than the other modulation techniques such as QPSK and 16-QAM.

V. Conclusion

The aim of this thesis was image transmission over wireless digital communication and examines various digital modulation techniques such as QPSK, 16-QAM and 64-QAM using Additive White Gaussian Noise (AWGN) channel and know the best suitable modulation technique for image transmission over wireless digital communication system.

The image transmission over communication system using digital modulation techniques are performed and the results are obtained through a high level technical language called MATLAB was introduce for designing and implementing wireless digital communication system. Like many of the other wireless digital communication systems, the performance of this system is acceptable that, up to a certain level of noise from the critical channel. In other words, if the noise level is raised above this critical level, the performance of the system cannot very rapidly. The advantage of the currently designed system is that, when the channel is under a condition of high noise, the system generates a quality of image worse rather than completely lose the transmitted image. The simulation results are performed, when SNR value is 10 dB. By using 64-QAM modulation technique, which carries higher data rates, this is essential for image transmission. Modulation techniques such as 64-QAM provide better results than the other modulation techniques such as QPSK and 16-QAM.

REFERENCES

[1] G. Avril, M. Tlich, F. Moulin, A. Zeddam, and F. Nouvel, “Time/Frequency Analysis of Impulsive Noise on Power line Channels,” International Symposium on Power Line Communications (ISPLC), pp.14 –150, 2010.

[2] Lawrence E Larson, “RF and Microwave Circuit Design for Wireless Communications; Artech House,” ISBN 0-89006-818-6, 1996.

[3] F. R. P. Cavalcanti and S. Andersson, “Optimizing Wireless Communication Systems,” Springer Science. pp. 353-356, 2009.

[4] De Buda, R., “A Comparison of Two Digital Modulation Techniques,” IEEE Trans. on Communications, vol.1, pp 429-335, 1996.

[5] Feher, “Applications of Digital Wireless Technologies to Global Wireless Communications,” Prentice Hill, ISBN 0-13-214272-4, 1997.

[6] H. Nikookar and R. Prasad, “On the Sensitivity of Multicarrier Transmission over Multipath Channels to Phase Noise and Frequency Offset,” In Proceedings of IEEE International Symposium on Personal, Indoor, and Mobile Radio Communications, pp. 68–72, 2010.

[7] Rohan D Jahagirdar and Aditya Narendra Ukey, “Study of Digital Modulation Techniques,” IEEE Transactions on Communications, vol. 8, pp. 312-322, 2010.

[8] Rajesh R. Bhambare and Rajeshree D. Raut, “A Survey on Digital Modulation Techniques for Software Defined Radio Applications,” International Journal of Computer Networks and Wireless Communications, vol. 3, no. 3, 2013.

[9] Sonal Agrahari, Shravan Kumar Sable and Rita Jain, “A Survey of Designing an Efficient Digital Communication System Using Different Modulation Schemes,” International Journal of Emerging Technology and Advanced Engineering, vol. 4, no. 6, 2014.

[10] Reeta Charde, “Image Performance over AWGN Channel Using BPSK System,” International Journal of Engineering and Innovative Technology (IJEIT), vol. 2, no. 1, 2012.

[11] R. Pandey, K. Pandey, “An Introduction of Analog and Digital Modulation Techniques in Communication System,” Journal of Innovative Trends in Science Pharmacy & Technology, vol. 1, 2014.

Shadbhawana Jain was born in Bhelsi (Tikamgarh) India on 17nd Nov 1991. She received her B.E. from BTIRT Sagar. At present she is pursuing M.Tech in Digital Communication from BTIRT Sagar on the topic of Image Noise Mitigation Using Efficient Modulation Techniques. Her research interests are Digital Communication System, Modulation Techniques, single mode and multimode Optical Fiber Communication system.

ISSN: 2278 – 1323