RESEARCH ARTICLE OPEN ACCESS

Analysis of Visible Light Communication Based Transceiver through Different Modulation Schemes

Km Shalini Kumari[1], Dharmendra Kumar Singh[2]

[1,2]Department of Electronic &Communication Engineering, Harcourt Butler Technical University, Kanpur
Corresponding author email: gupta.shalini1998@gmail.com[1] and dharmendraaith44@gmail.com[2]

--************************-------------------------------

Abstract:

Visible Light Communication (VLC) are supposed to as a concentrate communication system because of having numerous advantages like low cost, high data rate, more security, low power consumption, it is used not only for brightness devices, but also used for indoor device. This article aims to analysis the result of the different modulation schemes 8-PAM, 64-PAM, BPSK QPSK, D-BPSK, 8-PSK, 16-PSK, 32-PSK. This paper inspects the execution of modulation schemes for VLC, the sort out frame work and fundamental requirement of VLC system are power, bandwidth efficiency. The efficiency and reliability of the communication system are analysed based on tabulated parameters of Visible light communication technology such as data transfer rate, Signal -Noise Ratio (SNR) and Bit Error Rate (BER). In this study, various modulation schemes have been undertaken by numerous researchers and it provides advantage and limitation of modulation schemes. The obtained results contribute a fruitful data for VLC with suitable modulation systems.

Keywords **—Visible Light Communication System, Bandwidth Efficiency, Bit error rate, Signal to noise ratio,LEDs**

--************************-------------------------------

1. INTRODUCTION

The features of visible light communication have transformed the interest of researcher to conduct more research in this area because of having numerous advantages like its wide spectrum, energy efficient low cost, high data rate, more security, low power consumption [1]. LEDs and latest progress in LED technology having higher switching time which is considered in nanoseconds. Conventional radio frequency (RF) could not able to impart higher data rates below 6 GHz [2].VLC is able to entrance the 300 THz of bandwidth, higher data rates could be extend over a short range of communication, to get higher data rate from VLC system, and there is need of apparatus light sources in multiple-input-multiple-output (MIMO) approach [3]. Furthermore, the communication carries through simple LEDs and previously, light

emitting diode (LED) comes out as a new development which is expected to renovate standing illumination technology [4]. LED is studied to be more advantageous than the standing incandescent in periods of long life prediction, low energy consumption, least heat generation lighting, high sufferance to humidity etc [5].

2. MODULATION SCHEMES

With conception of signal loss because of the distance range take place is considered as path-loss, environmental sounds, and ratio of signal-noise (SNR). There are different kinds of modulation systems which are used in Visible Light Communication. Most leading dissimilarity in visible light communication (VLC) and through radio frequency, VLC is encrypted in stage as well as amplitude [3]. This method suggested that stage

---

as well as amplitude encryption is not utilized for visible light communication. In visible light network, encryption was ended with power of light [6].Demodulation expect on detection of receiver. Modulation systems in further categories of transmissions, visible light transmission bring about maximum rates of data with convenes essential for visible light to customers [7].The discussion for modulation schemes is deliberated and used for VLC communication (1) BPSK (2) Pulse System Modulation (3) OOK (4) DPSK (5) QPSK (6) 8-PSK (7) 16-PSK (8)32-PSK [8]. The mentioned above schemes are discussed and simulate through MATLAB.

2.1 On and Off Keying Modulation

On and off keying Modulation stands easiest aspect of amplitude shift modulation (ASM) which defines binary information as existing and non appearance for carrier signal. Existence of carrier with schedule time indicates 1, while for same time It indicates 0 when system is lack [9]. OOK has higher operative than frequency [10]. In absence of LED, light intensity reduced but not totally turned off [11].Main feature of using On-Off Keying modulation is its simplicity and easy deployment. It is usually adopted by the wire line communication system. In latest work, the numbers of investigators were used On-Off keying modulation [12]. The performance can be enhanced through suitable photodiode selection.

2.2 Pulse Amplitude Modulation

Pulse amplitude is type of modulation in which original message signal was encrypted with amplitude of sequence of signal rates [12, 13]. It is an analog pulse modulation type in which carrier pulses amplitude are changed accordance with sample value. Demodulation is bring out by determine the amplitude phase of the carrier.

2.3 Binary Phase Shift Keying (BPSK)

BPSK is easiest type of phase shift model (PSM) [15].This modulation phase is two type in which 0's and 1's in a binary message are defined by two several phase states in signal for binary format 1and binary format 0 [6, 7]. It doesn't individual matter

definitely where the constellation points are stand .Therefore, it hold the greatest noise level before the demodulator extend an inappropriate conclusion [8, 9].Which makes it the toughest of all the PSKs. Thus, it is inappropriate for high data-rate implementation. BPSK is practicable identical to 2-QAM modulation [14].

2.3.1 Bit Error Rate

Bit error rate for binary phase shift keying can be calculated from equation (1)

$$P_e = 1/2 \, erfc \, (E_b/N0)^{1/2} \quad …….(1)$$

Where

Pe = Probability of error

Erfc = Error function

Be/No = Signal to noise ratio

2.4 Differential Phase Shift Keying

Differential phase modulation has customary variety of stage modulation which transfer signal through interchange wave phase. In Differential phase keying modulation the phase of the modulation signal is move corresponding to the above signal element. As indicated in binary phase shift keying and quadrature phase shift keying there are opacity of phase signal if its constellation is movable by means of some kind of influence in transmission system by which the signal transfer. To resolve this complication we can used to change the information rather than set the phase. It is a simplest form of phase modulation which is used in analog modems [11].

2.5 Quadrature Phase Shift Keying (QPSK)

It is also familiar with phase PSK, 4-QAM or 4-PSK.The QPSK is the variation of binary phase shift keying. It is besides twice side band restrained carrier modulation which forward doubles bits of digital data with same time which is called bigits [6]. It operates four steps on constellation illustration, equally space in circle with four phases [13].

2.6 Phase Shift Keying (PSK)

Phase modulation is used for transmitting of transmission signals [3].Message signal is encrypted as alternative in the fast phase. Phase modulation has one of the two first principal which is an angle system modulation cooperatively with frequency system modulation [7].

In this modulation, amplitude in original message signal is modifies accordance with the carrier signal holding its amplitude and frequency constant [9].

The carrier signal amplitude is formulated accordance with the improving the stage of signal (amplitude) of original message signal. Phase modulation is mostly used for communicating radio waves, satellite television [3, 5].

3. Simulation on MATLAB

MATLAB is the most extensively used platform for programming and calculating mathematical problems (algorithms) [2]. It is a fourth generation tool, it is a matrix-based language which is used to solve the computational mathematic programming and coding. Matlab is used to identify the data, execute algorithms, and through Matlab we can conceptualize the data and also it can be used to develop user interface so that the user can prospect his model [14]. Through Matlab, we can transform our algorithms into C/C++ language to implant it into embedded systems. With the help of MATLAB platform we implement our model and simulate to determine the results and also analyses the model to check the effect. Here we determine the ratios for SNR and BER of various modulation systems to identify performance of the model and obtain results are analyzed.

4. RESULT AND DISCUSSION

4.1 8-PAM Modulation

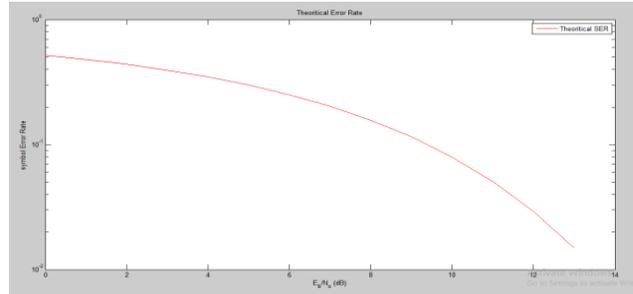Fig.1 shows the 8-PAM modulation, As increases Eb/No (signal strength), Symbol error rate is also increases.

Fig. 1 8-PAM Modulation Scheme.

4.2 64-PAM Modulation

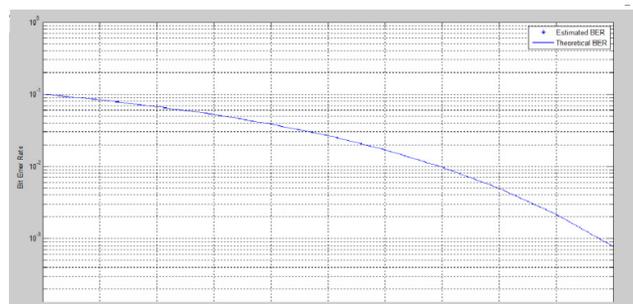Fig.2shows, as increases the signal strength (Eb/No) dB, Bit Error rate is decreases.

Fig. 2 64-PAMmodulation (Symbol error rate vs. Eb/N0)

4.3 Binary Phase Shift Modulation (BPSK)

Its result is obtained through MATLAB which is shown in fig. 3. Which could be concluded that when strength of the signal is increases bit error rate is decrease.
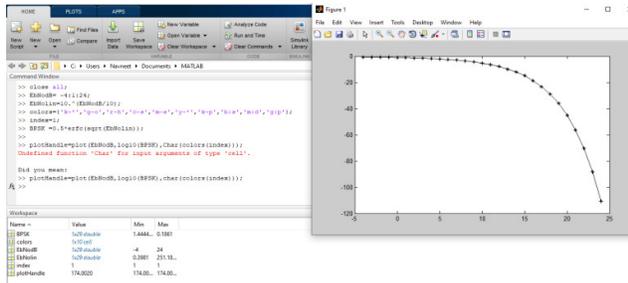
Fig. 3 SNR Vs. BER.

4.4 Comparison between Simulation and Analytical Method

Fig. 4indicates BER versus SNR by using different modulation schemes. We can distinguish that the trends between two types of the graph are in the equivalently. Thus here, we can come to an ending which simulation technique is more reliable. Differential binary phase shift (DBPSK) is within downward of the enactment on comparing with equal level of error rate of bit.
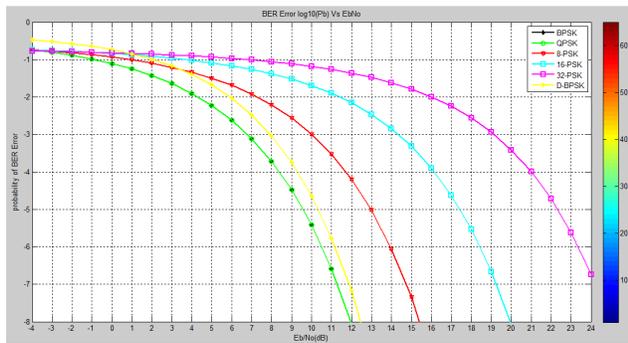

Fig.4 BER Vs. SNR of BPSK, QPSK, D-BPSK, 8-PSK,16-PSK,32-PSK.

4.5 Comparison between Different Modulation Schemes

For the comparison between simulation and analytical we used coding method to with different kind of modulation as the fundamental concept as shown in table 1. According to latest review, different types of major factors are to be considered. Comparison between different modulation schemes is presented in table 1.

TABLE 1

COMPARISON OFDIFFERENT MODULATION SCHEMES.

Modulation Schemes	BER	SNR (Eb/No) dB
BPSK	-0.7	12
QPSK	-0.7	12
8-PSK	-0.7	15.4
16-PSK	-0.7	20
32-PSK	-0.7	~24
D- BPSK	-0.5	12.4

5. CONCLUSION

In this article, Comparison between simulation and analytical method are analyzed and also comparison table for different modulation schemes were proposed. Here we can see the difference between SNR and Eb/No for different modulation. Therefore, we can understand that the simulation method is precise. Even so, there are various types of factors which are required to take outcome for best systematic/efficient modulation system.

REFERENCES

[1] P. K. Das and J. Sengupta, "Design and Evaluation of Wireless Transceiver for Visible Light Communication," 2018 9th International Conference on Computing, Communication and Networking Technologies (ICCCNT), 2018, pp. 1-4.

[2] Ahmed Faisal., Jawaid M.,"A Review of Modulation schemes for Visible light communication" IJCSNS International Journal of Computer Science and Network Security, VOL.18 No.2, February 2018.

[3] L.U.Khan, "Visible communication: Applications, architecture, standardization and research challenges, "Digital Communications and Networks (2016).

[4] Angga Pradana, NurAhmadi, Trio Adiono, "Design and Implementation of Visible Light Communication System Using Pulse Width Modulation," The 5th International Conference on Electrical Engineering and Informatics 2015 August 10-11, 2015, Bali, Indonesia.

[5] Kwonhyung Lee and Hyuncheol Park, Channel Model and Modulation Schemes for Visible Light Communications, Circuits and Systems (MWSCAS), 2011 IEEE 54th International Midwest Symposium 2011.

[6] Ek-am0rn shinwasusin,Chalie charoenlarpnopparut," Modulation performance for visible light communication"(2015)6th International Conference of Information and communication Technology for Embedded system (IC-ICTES).

[7] N. Fujimoto and H. Mochizuki, "477 Mbit/s visible light transmission based on OOK-NRZ modulation using a single commercially available visible LED and a practical LED driver with a pre-emphasis circuit," presented at the Optical Fiber Communication Conf./Nat. Fiber Optic Engineers Conf., Anaheim, CA, USA, Mar. 17–21, 2013.

[8] J. Vucic et al., "230 Mbit/s via a wireless visible-light link based on OOK modulation of phosphorescent white LEDs," in Proc. Conf. OFC/NFOEC, Mar. 2010, pp. 1–3.

[9] Haruyama, Shinichiro,"Visible light communication using sustainable LED lights", 2013 Proceedings of ITU Kaleidoscope: Building Sustainable Communities,pp.1– 6,2013.

[10] Rajagopal, Sridhar and Roberts, Richard D and Lim, Sang-Kyu,"IEEE 802.15. 7 visible light communication: modulation schemes and dimming support",IEEE Communications Magazine,vol.50,no.3,pp.72–82,2012.

[11] Wang, Chao and Zhang, Zhidan and Zhang, Minglun and Zhu, Hetian,"Visible light communication application scenarios based on Android smart devices LED lamp",Photonic Network Communications,vol.32,no.2,pp.174–178,2016.

[12] Cilean,Alin-Mihai and Dimian,Mihai,"Current challenges for visible light communications usage in vehicle applications: A survey",IEEE Communications Surveys& Tutorials,vol.19,no.4,pp.2682–2703,2017.

[13] Elgala H, Mesleh R, Hass H, Indoor broadcasting via white LEDs and OFDM IEEE Consumer Electronics 2009 55(3);1127-1134.

[14] Modulation scheme for high-speed wireless data visible light communications," J. Lightw. Technol., vol. 32, no. 14, pp. 2582–2592, Jul. 2014.

[15] Communication: Modulation schemes & dimming support," IEEE Commun. Mag., vol. 50, no. 3, pp. 72–82, Mar. 2012.