Comparative Analysis of Different Parameters in Digital Schemes

[1]Ritu Namdeo and [2]Dr. Swapnil Nema
[1]Student, [2]Assistant Professor,
[1]Department of Electronics and Communication, [2]Department of Electronics and Communication,
Global Nature Care Sangathan's Group of Institutions, Jabalpur MP, India

Abstract: Free space optical (FSO) communication, is a technology in which information is being transferred from one transmitter to another receiver by propagating light in atmosphere. Its working is similar to that of Optical Fiber Cables (OFC) networks but it does not require any cables. FSO communication is both faster and cost-effective technique as compared to conventional optical fiber communication. When it is combined with the digital modulation scheme, a lot of benefits such as Bandwidth, S/N, cost etc. can be achieved. In the proposed work, On-Off Keying (OOK), and Phase–Shift Keying (PSK) techniques have been compared. The most important parameters we have considered are: Q-factor, Bit Error Rate (BER) and eye opening. We have studied modulation schemes for the fulfillment of three tasks, which are efficiency of a transmission data, resistivity to a non-linearity and ease of implementation.

Keywords: *OOK, PSK, BER, FSO, DPSK, OQPSK, CW, NRZ, RZ, MZ, OSNR.*

I. INTRODUCTION

In telecommunication, our communication system is a collection of individual communication networks, Transmission Systems, really stations, and data terminal equipment (DTE) usually capable of interconnection and interoperation to form an integrated whole. digital system tanks to be less susceptible to waveform distortion, such as crosstalk, nonlinearities, and noise compared to analog systems. the signal to noise performance of the system (energy per bit or spectral noise density) increases linearly in dB with the number of bits used per sample, giving a more efficient noise/bandwidth trade off than FM. digital transmission gives complete freedom to multiplex digital data, voice and video, giving the digital system more flexibility than the analogue system [3].

Orthogonal Frequency division multiplexing (OFDM) is high speed transmission technique widely studied in wireless networks. its potential presents it as an ideal solution for high-speed transmission in optical fiber networks [5]. high speed long haul optical communication links consists of multispan optically amplified systems accumulating ASE noise adding system power penalty, and the receiver performance to ensure you an acceptable signal to noise ratio higher optical signal power is required but it generates a signal crosstalk through such power dependent fiber nonlinear effect. similarly, the higher data rate increases the optical spectral width of the signal to make it more susceptible to chromatic dispersion. although there does not exist a perfect modulation for meat that is immune to all such sources of performance degradation, yet the proper selection of an appropriate optical modulation format does improve the system performance to some extent.

II. MOTIVATION

Taznoon Nisar Khajwal et al [8] published an article in the January 2020, in which he told many advantages of free space optical communication. To use all these terms, it would be very beneficial to include various digital formats with FSO. Additionally, there are some weaknesses in conventional Optical Fiber cables. So, we want to use different digital formats with FSO [8].

III. LITERATURE REVIEW

K. Elayoubi et al [7], optical communication links between satellites and ground stations undergo perturbations thanks to the propagation of the beam through the atmosphere. Although, studies, and experiments have demonstrated the feasibility of such optical links, research remains needed to spot technical solutions adapted to the precise constants imposed to those high-speed links to make sure the specified level of performance [7].

Hanane Alifdal et al [6], optical signal to noise ratio (OSNR) for different chromatic dispersion values. Based on Optical Quadrature Phase Shift Keying (OQPSK) modulation, we proposed a WDM system to advantage from the multi carrier modulation properties. Through MATLAB, and Opti system software simulations we have shown, in one hand, the improvement of BER, and OSNR when the chromatic dispersion coefficient is relatively high. In the other hand, we have outlined the effectiveness of the proposed system in terms of increasing the OSNR, and decreasing the BER [6].

Serge Roland Sanou et al [5], presents the OFDM modulation associated with offset quadrature phase shift keying (OQPSK) filter using a filter banks for an optical transmission at the rate of 10 Gbps over 1600 kilometer in a single mode fiber (SMF). The simulations are performed in the VPI photonics software environment. The results show that the filtered OFDM/OQPSK provides better transmission performance than the classical OFDM/OQPSK firstly because it doesn't require equalization to certain distances; secondly distances are greater than those achieved with the traditional OFDM in similar studies. during this study, the bandwidth it's maximized because we don't use the cyclic prefix. Moreover, the complexity of transmitters and receivers are reduced, which shows it as an effective solution to combat the effect of the chromatic dispersion, the polarization mode dispersion, the inter symbol interference, and nonlinearities [5].

IV. ADVANCED MODULATION FORMATS

An OOK transmitter made up with an intensity modulated driven by the electrical data signal. This link is shown as an intensity modulation with direct detection, and the receiver includes a pre-amplification section based on an Erbium Doped Fiber Amplifier (EDFA) [7].

A. Differential Phase Shift Keying (DPSK)

In DPSK, the face of the modulated signal is shifted relative to the previous signal element for low voltage. After generating the PRBS sequence, and due to the absence of an optical phase reference, a differential encoder is used to provide a DPSK waveform: the operation principle is that the face reference has to be provided by the signal itself. The receiver used to decode a DPSK modulation contain an Optical Delay Line Interferometer, and a Balance Photo Receiver [7].

DPSK Electrical

First the DPSK signal generated electrically and then it is sent via electrical channel. Here, we use bit rate 30.375 Mbps with sample rate 19.4 Gigahertz. The sequence length kept is 256 bits. 64 samples are taken per bit. Quadrature Detector is operated in 550 Megahertz with the gain 2 dB.

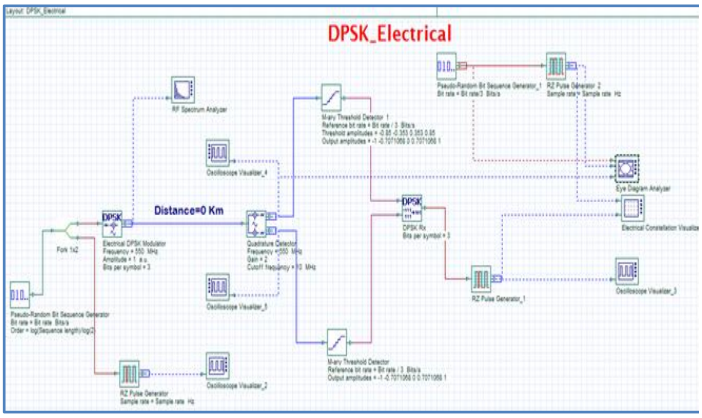

Figure 1: DPSK Electrical Modulation using Opti system

DPSK Optical

In this method, the signal is optically modulated DPSK format, and then transmitted via Optical fiber cable. Here, we use bit rate 40 Gbps with sample rate 193 THz. The sequence length kept is 128 bits. 32 samples are taken per bit. CW LASERs are used with 4 milli what. Optical loops used here is 6. Low Pass Filter is operated at 0.8* bitrate. The output is measured at 60 Km away from the Transmitter. Total 4096 samples are transmitted through optical link.

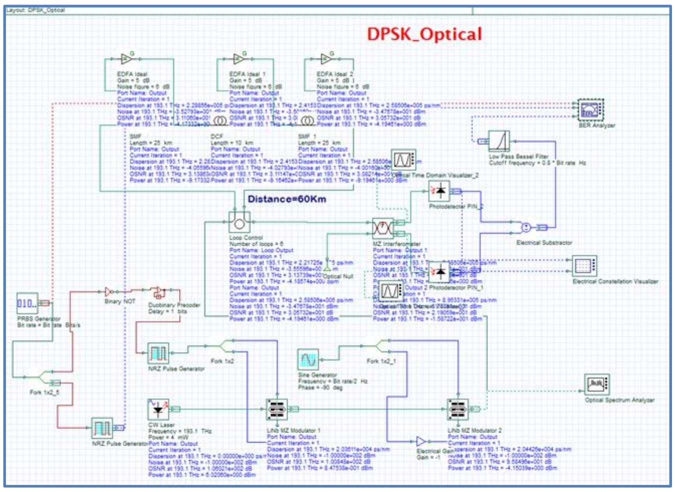

Figure 2: DPSK Optical Modulation using Opti system

B. Offset QPSK

If two or more beds are combined in a symbol, then the signal frequency f_b is reduced. this will reduce the transmission bandwidth. In QPSK, two successive bits are combined and make a group. This combination of two bits creates four symbols. When the symbol is changed to next symbol the phase of the carrier is changed by π/2 radian or 90^o. Low-power modulators are most efficient for wireless communication; the conventional of QPSK modulator consumes more power and area [1]. The data sequence is converted into two parallel bits and encoded. These in-phase and quadrature bit streams are combined with sine and cosine waves generators.

OQPSK Electrical

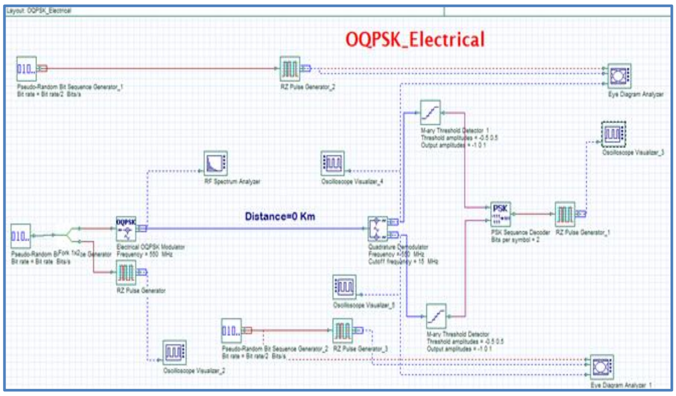

Figure 3: OQPSK Electrical Modulation in Opti system

First OQPSK signal is generated electrically and then it is sent via electrical channel. Here, we use bit rate 30.375 Mbps with sample rate 19.4 Gigahertz. The sequence length kept is 256 bits. 64 samples are taken per bit. Quadrature Detector is operated in 550 Megahertz with the gain 2 dB.

OQPSK Optical

In this method, the signal is optically modulated OQPSK format, and then transmitted via Optical fiber cable. Here, we use bit rate 40 Gbps with sample rate 193 THz. The sequence length kept is 256 bits. 32 samples are taken per bit. CW LASERs are used with 4 milli what. The output is measured at 10 kilometers away from the Transmitter. Total 8192 samples are transmitted through optical link.

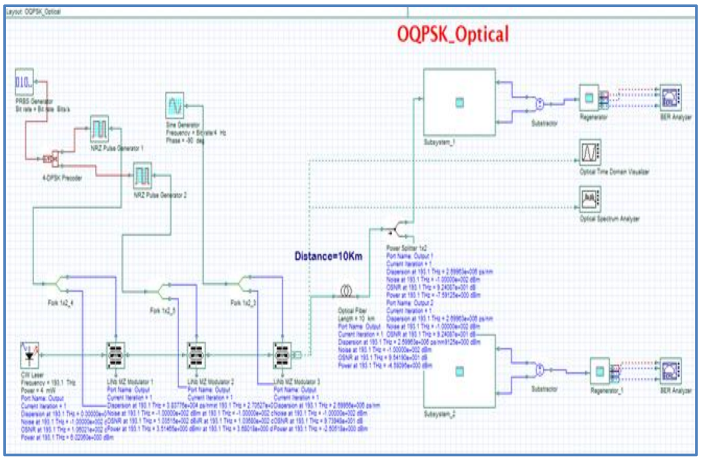

Figure 4: OQPSK Optical Modulation in Opti system

V. Result and Comparisons

The result of the localization process given by Bhavin V. Kakani is 96.7% whereas the character recognition technique is 92.2% Accuracy for ANN using Feature extraction [3]. The complete Automatic Number Plate Recognition System Gives the Accuracy given byRZ-DPSK format proves to perform better than DPSK and NRZ-OOK formats, partially due to the inter symbol interference reduction when RZ pulses are used

[7]. The main objective of this work is to analyze different approaches to mitigate the FSO channel impairments influencing the transmission limitations in optical communication. Now, we will make a detailed comparison between DPSK and an OQPSK. Table 1 displays the measured parameters for both DPSK and OQPSK modulation techniques. In general; a minimum acceptable BER is about 10^{-9} [2].

Table 1: Parameters of different Digital Formats

Modulation Format	DPSK		OQPSK			
Parameters	Electrical	Optical	Electrical		Optical	
			I	Q	I	Q
Bit rate (bps)	30.375 Mbps	40 Gbps	30.375 Mbps		40 Gbps	
Sample Rate (Hz)	19.44 GHz	1280 GHz	19.44 GHz		1280 GHz	
Sequence length (bits)	256 bits	128 bits	256 bits		256 bits	
Samples/bit	64	32	64		32	
Number of samples	16384	4096	16384		8192	
frequency (Hz)	550 MHz	193 THz	550 MHz		193 THz	
Gain (dB)	2 dB	5 dB	2 dB		5 dB	
distance (KM)	0 km	60 km	0 km		10 km	
Bits per symbol	32	32	32		32	
Cutoff Frequency (Hz)	10 MHz	10 MHz	10 MHz		10 MHz	
Input power (W)	4mW	4mW			4mW	
wavelength (nm)	…………	1550 nm	…………		1550 nm	
Q- Factor	0	36.01	0	0	44.12	43.86
Eye Height (a.u.)	0	0.005	0	0	0.0013	0.002
Bit Error Rate	1	4.95 to 324	1	1	0	0

CONCLUSION

In this work, we have compared DPSK and OQPSK systems. Several measurements were performed including Bit Error Rate curves for optimum reception, eye diagram with the variation of input signal and distance of medium for each of the systems. Low-power modulators are more efficient. Conventional or QPSK modulator is consume more power and more area [1]. If the power factor is more important, then we should give priority to DPSK because OQPSK is more power consumer. Abu Bakr Muhammad et al [4] told that, free space optical communication links can provide importance of solution to the last mile problem in many scenarios, taking advantage of its flexibility, BER and high data rate. Free space optical communication is a method by which one transmits a modulated beam at visible or infrared light through the atmosphere for broadband applications.

References

[1] S. M. Usha and H. B. Mahesh, Low Power and Area Optimized Architecture for OQPSK Modulator, IEEE Transaction, (2019), 123-126.

[2] Shaina and A. Gupta. “Comparative Analysis of Free Space Optical Communication System for Various Optical Transmission Windows under Adverse Weather Conditions.” Procedia Computer Science 89 (2016): 99-106.

[3] Available from: https://www.ukessays.com/essays/information-technology/advantages-of-digital-communication-system-information-technology-essay.php

[4] Abu Bakar Mohammad, Optimization of FSO System in Tropical Weather using Multiple Beams, Proc. of 2014 IEEE 5th International Conference on Photonics (ICP), Volume 5 (2014), 109-112.

[5] Serge Roland Sanou, François Zougmore and Zacharie Koalaga, Performances of OFDM/OQPSK Modulation for Optical High-Speed Transmission in Long Haul Fiber over 1600 Km, Global Journal of Researches in Engineering: General Engineering, Volume 14 Issue 2 Version 1.0 (2014), 9-14.

[6] Hanane Alifdal, Farid Abdi and Fouad Mohammed Abbou, Performance Analysis of an 80Gb/s WDM System using OQPSK Modulation under FWM Effect and Chromatic Dispersion, IEEE Transaction, (2017).

[7] K. Elayoubi, A. issons, J. Lacan, L. Saint Antonin, M. Sotom and A.Le Kernec, RZ-DPSK Optical Modulation for Free Space Optical Communication by Satellites, IEEE Transaction, (2017).

[8] Taznoon Nisar Khajwal, Performance Analysis of FSO-SISO and FSOWDM Systems under Different Atmospheric Conditions, 7th International Conference on Signal Processing and Integrated Networks (SPIN), (2020), 312-316.