International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-2, July 2019

Performance Analysis of Radio over Fiber Simulation Model using DPSK Modulation Technique

Shivam Modgil, Davinder Prakash

***Abstract**: In this paper, performance analysis of radio over fiber (ROF) system has been proposed to analyze the performance of the system using differential phase shift keying method. RoF Systems exhibits the unique characteristic of combining the featuring of fiber optic link and free space radio path which brings many advantages and challenges to new mobile networks. RoF systems has the provision of large bandwidth and has fewer losses for the transmission that make the ROF suitable for the future wireless broadband services and fulfill demands of high data rate. The proposed simulation model helps in improving the system capacity and their effects on the output in terms of Q factor, minimum BER is analyzed by using optisystem software.*

Keywords: Radio Over Fiber, Differential Phase Shift Keying, Radio Frequency.

I. INTRODUCTION

The augmentation needs for high capacity and transmission speed to fulfill the requirements of data-intensive multimedia and real-time applications which is applicable for both cellular and fixed wireless communication system. This put huge pressure on the conventional microwave base of the wireless networks which finally will not be capable to survive with the total traffic which reduces the growth of broadband wireless access networks. An optical fiber system has minimum transmission loss with huge bandwidth and is a unique way to substitute the microwave base for the passage of future high- density traffic from entire remote antenna base-stations. ROF technique will be equivalent hybrid method of both microwave and optical communication system [1]. ROF is a technique where incoming light is modulated with (RF) signal and transferred through optical fiber for wireless applications. ROF offers a combination of wired & wireless networks in an efficient way to increase the bandwidth demand of the future communications system. ROF is an efficient way of providing economic benefits due to the expanding requirement for signal strength and also for wide bandwidth and low attenuation characteristics [2]. The main advantages of ROF system are dynamic resource allocation, reducing an expenditure of total power, low attenuation, numerous operator and multi-service operation, large bandwidth, etc. The rapid developments of radio over fiber communication systems have aroused much interest in the research of optical communication as presented in [1-9].

ROF is a technology which used the optical link to transfer RF signal from one station to another station (central station to remote antenna unit). ROF is mostly analog optical link which used to transmit modified RF signal. In ROF, RF signal is transmitted from downlink channel to uplink channel from centre station (CS) to base station (BS). Primary condition for ROF connection is duplexing which is applicable for both (downlink & uplink), appropriate length and high achievement of optical component [3]. Configuration of ROF link as shown in figure. The system made up of CS and RAU join by single mode fiber (SMF). Fig. 1 represents the basic function of ROF system [4].

In case of downlink transmission, the RF signal is directly modulated through laser diode and we obtain intensity modulated optical signal in CS. Then resulting modified optical signal are transfer through optical fiber cable. At BS the signal is demodulated by photodiode to obtain RF signal and the radiated through antenna. In case of uplink transmission, the RF signal coming from antenna is directly modulated through laser diode at BS and resulting signal is transmitted by optical fiber cable to CS. In CS the signal coming from BS are demodulated by photodiode and recover the original RF signal. After that signal is amplified and then further processed [4].

Revised Manuscript Received on 30 July 2019.
***** Correspondence Author

Shivam Modgil*, Department of Electronics and Communication Engineering, Chandigarh University, Mohali, Punjab, India. Email: modgilelectx@gmail.com

Davinder Parkash, Department of Electronics and Communication Engineering, Chandigarh University, Mohali, Punjab, India. Email: davinder.e6047@cumail.in

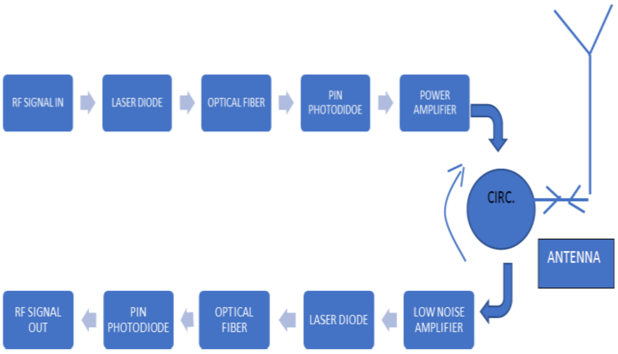

Fig. 1 Basic ROF System [4]

II. ROF SIMULATION MODEL

The proposed ROF simulation model is classified into three number of parts named as transmitters Tx, transmission link and receivers Rx as shown in Fig. 2. Transmitter consist of data source, DPSK modulator, low pass Bessel filter, MZM modulators and CW laser. The data source is a pseudo-random binary source generator, which delivers a chain of bits which is a combination of 1's (ON) and 0's (OFF). The simulation model has PRBS generator which produced information at data rate of 1 Gbps and light is regulated by utilizing Mach Zehnder Modulator (MZM). DPSK is applicable for the digital modulation which in non-colorant method of Phase Shift Keying At the receiver side it eliminates the requirement of coherent reference signal. Then the modified signal is transfer through band pass filter which eliminate the undesired frequency component. Then the modified data is modulated and carrier of the optical source-based laser diode at 193.1 THz frequency, which is frequency using the Mach Zehnder modulator (MZM), an external device for modulation Then output of MZM is transmitted through optical fiber cable and amplifying by optical amplifier.

The optical transmission link is containing mono mode optical fiber (SMF) and optical amplifier. Then MZM modulator signal transfer from single mode fiber (SMF) and then it can be amplified by using optical amplifier. Optical amplifier is used for boosting of optical signal. Semiconductor optical amplifier (SOA), Raman amplifier, etc. are the examples of optical amplifier.

Then the output of optical amplifier goes to power splitter which split the one input signal into two output signals [7]. After that the output of power splitter goes to Bessel optical filter having frequencies 193.119 THz and 193.120 THz and bandwidth is 1.5* Bit rate Hz. Then the filter signal is passing through photodetector which will replace the optical signal directly into base band signal. The photodiode is used to demodulate the optical signal then we use the low pass Bessel filter which reject the high frequency. At the receiver side we use BER Analyzer and Eye Diagram Analyzer to observe the output.

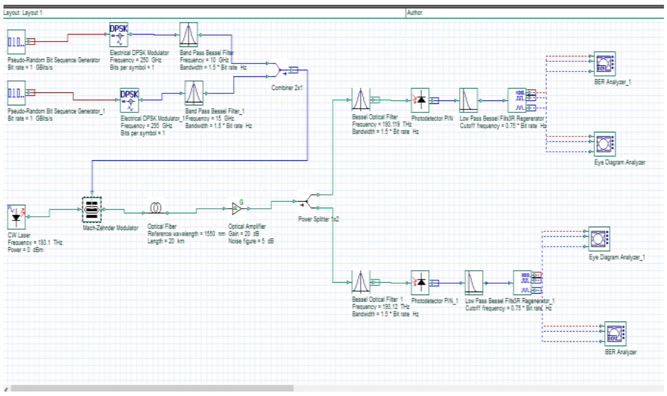

Fig. 2 Simulation Design of ROF using DPSK

III. SIMULATION RESULTS AND DISCUSSION

This section represents execution of DPSK based ROF technique is analyzed in the form of various parameters that are BER, Q-factor and eye-diagram etc. Figure 3(a) & 3(b) shows output of the BER Analyzer and outputs shows the Q factor, BER and eye height of ROF system applying DPSK technique. The Q factor measures the selectivity of this structure. If higher the Q factor and lower the bandwidth then there is possibility to increase traffic. By study it can be observed that DPSK method is best for ROF system design because high Q factor and minimum BER can be achieved. Figure 3 (a) shows BER analyzer output of ROF system using DPSK technique value of 5.2× 10^{-71}, Q-factor of 17.77 and eye height of 0.00084. Figure 3(c) shows BER analyzer 1 output of ROF system using DPSK technique value 1.794×10^{-82}, Q-factor of 19.19 and eye height of 0.000825. And figure 3(b), 3(d) represents the eye diagram of ROF system using DPSK technique.

Table showing output using DPSK Modulation Technique

PARAMETER	OUTPUT USING DPSK MODULATION TECHNIQUE	
Q-FECTOR	17.77	19.19
BER	5.2× 10^{-71}	1.794×10^{-82}
EYE HEIGHT	0.00084	0.000825

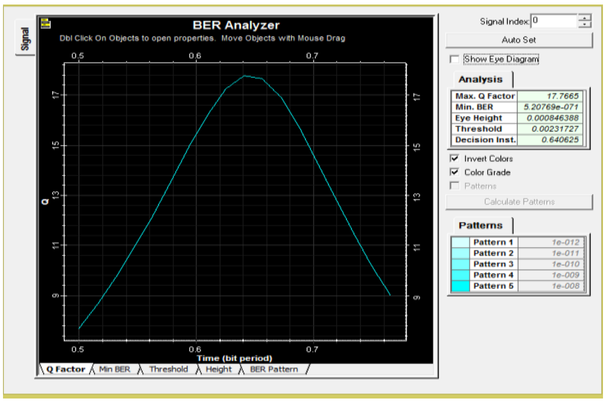

Fig 3(a) Output of BER analyzer

International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878 (Online), Volume-8 Issue-2, July 2019

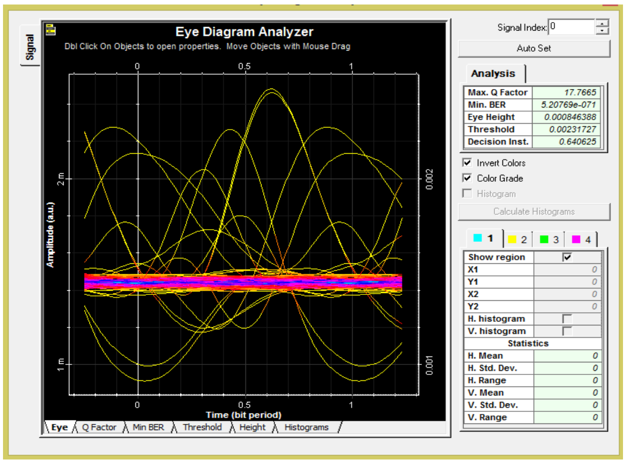

Fig 3(b) Output of Eye Diagram Analyzer

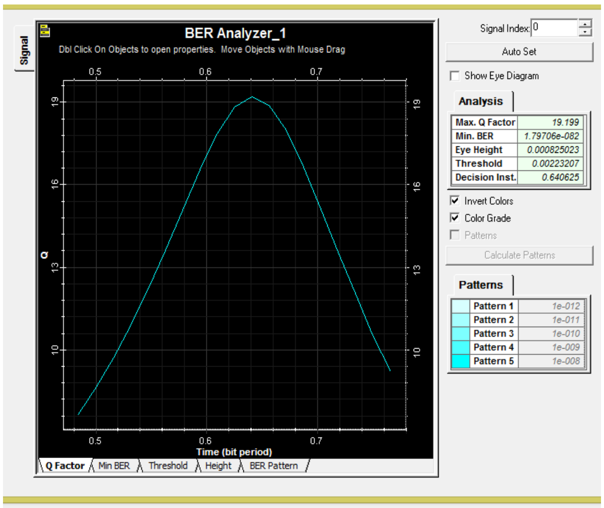

Fig 3(c) Output of BER analyzer 1

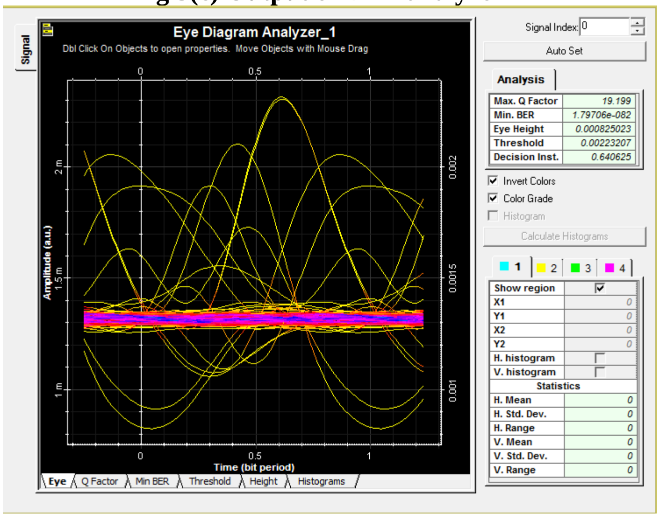

Fig. 3(d) Output of Eye Diagram Analyzer

IV. CONCLUSION

The proposed ROF system has been simulated and analyzed using DPSK modulation techniques. The proposed system is used to examine the performance of the system with respect to Q-factor, BER, and eye diagram. It has been concluded that the ROF system using DPSK modulation provides high Q-factor and minimum BER and provides an efficient link for the transmission of higher data rates. At a frequency of 193.1 THz a minimum value of BER i.e. 5.2×10^{-71} and high-quality factor of 17.77 is achieved. High quality factor makes the system more robust against noise and more efficient system.

REFERENCES

1. A Christina Lim, Ampalavanapillai Nirmalathas, Yizhuo Yang, Dalma Novak, Rod Waterhouse, “Radio-over-Fiber Systems,” International Conference on Optical Transmission Systems, Switching, and Subsystems VII, Proc. of SPIE-OSA-IEEE/ Vol. 7632 76321S-2.
2. Hamim Nasoha and Sevia M. Idrus, "Modeling and Performance Analysis of WCDMA Radio over Fiber System", Asia Pacific Conference on Applied Electromagnetics Proceedings, Photonics Technology Center, Malaysia, 2007.
3. H.A. Mohammad , Performance evaluation of DWDM for Radio over Fiber system with Dispersion Compensation and EDFA , *International Journal of Computer Applications, Vol.72, No.10*,June 2013.
4. H. Al Raweshidi, S. Komaki, "Radio Over Fiber Technologies for Mobile Communication Network", Artech House, London, eds. 2002
5. Jincy Johny et al, “Design and Simulation of a Radio Over Fiber System and its Performance Analysis”, IEEE explore, 2012
6. A.M. Zin , S.M. Idrus , “The characterization of Radio over Fiber Employed GPON Architecture for Wireless Distribution Network” , *International Journal of Machine Learning and Computing, Vol.1, No.5* , December 2011.
7. S.M.J Alam , M.R. Alam , “Bit Error Rate Optimization in Fiber Optic Communications” , *International Journal of Machine Learning and Computing, Vol.1, No.5,* December 2011.
8. C.K. Wing ,Y. Min, “Radio-Over-Fiber 16-QAM , 100 km Transmission at 5Gb/s Using DSB-SC Transmitter and Remote Heterodyne Detection”, *Journal of Lightwave technology, Vol.26, No.6,* March 15 ,2008.
9. Pooja *et al*, “ Advantages and Limitation of Radio over Fiber System”, International Journal of Computer Science and Mobile Computing, Vol.4, Issue.5, May- 2015, pg. 506-511

AUTHORS PROFILE

Shivam Modgil is a Master degree student in Electronics and Communication Engineering at Chandigarh University, Gharuan, Punjab, India. He has carried out his research work in Optical Fiber Communication. His research interest includes study of optical fiber losses, optical amplifier, FSO and Radio over fiber etc

Dr. Davinder Parkash was born in Haryana, India in 1976. He received B.Tech. and M.Tech. degree from the Deptt. of Electronics and Communication Engineering at Kurukshetra University, Kurukshetra and NIT, Kurukshetra in 1999 and 2007, respectively. He received a PhD. degree at Thapar University, Patiala in 2015. He is currently working as Professor, ME and PhD Coordinator in Department of ECE at Chandigarh University, Ghauran (India). He worked as HOD and M.Tech. Coordinator at HCTM, Kaithal. He has more than 18 years of Teaching & Research experience. He received the ‘**Young Scientist Award’** from **Governor of Punjab (India)** for his research work. He has published more than 65 papers in national and international journals/conferences. Life member of International Association of Computer Science and Information Technology (IACSIT), Singapore [LM.No.-80344601], Life member of Punjab Academy of Sciences, Patiala (LM-929), International Association of Engineers (IAENG), Hong Kong (L.No.- 106649) and. His main research interest includes the design and analysis of microstrip antenna, multiband antennas, and Wireless Communication. His main research interest also includes study of optical fiber losses, optical amplifier, EDFA and Raman amplifier, WDM, FSO and Radio over fiber etc..

.