ISSN: 0474-9030

Vol-68-Issue-1-January-2020

Assessment of Rz and Nrz Coders In Free Space Multiplexing System with Reduced Attenuation Effect and Increased Q Factor

R.HelenVedanayagi Anita[1], Dr.G.Karpagarajesh[2], S.SherlinLeela Princy[3], R.Wincy Jenefer[4], M.Martina[5]

[1,3,4,5] PG student, Department of Electronics and Communication Engineering, Government College of Engineering, Tirunelveli, Tamilnadu,India.

[2]Assistant Professor, Department of Electronics and Communication Engineering, Government College of Engineering, Tirunelveli, Tamilnadu,India.

Corresponding Email-Id: rhelenanita@gmail.com

Abstract

Free space optical communication (FSO) is the key technology for connecting systems by means of air as a medium. However signal will lose its strength due to atmospheric losses like rain, fog and other external environmental factors. Wavelength division multiplexing (WDM) approaches are used nowadays which improves signal strength at the receiver. For a perfect communication to happen, the attenuation has to be reduced as much as possible. In this paper, Quality factor (Q) and Bit error rate (BER) of the signal are analysed by simulation models. The line encoding techniques Non- Return-Zero (NRZ) and Return- Zero (RZ) methods were evaluated. The maximum achievable distance is 5kms for power of 40dbm.

Keywords: *Free Space optics, Non- Return to Zero, Return to Zero, Wavelength Division Multiplexing.*

Introduction

The application of WDM is vast in telecommunication industry. Wavelength Division Multiplexing uses different wavelength to multiplex several optical carriers signal. The capacity of users will be increased with this approach. So without the need for multiple optical fibers, WDM technology increases the number of users. The principle behind this is optical- electrical-optical conversions in the transmission network [5]. In this paper, the frequency of operation is taken in C band 1550nm since it falls under optical low loss window [1]. WDM can be used either in single mode or in multi mode optical fibers. The channel of the proposed design is free space and the efficiency of the FSO is highly notable compared to conventional fibers. Selectivity is an additional benefit of the multiplexing systems unlike normal transceivers.

For encoding and decoding the digital messages NZ and NRZ methods are used. In NRZ, the message bits from the communication device will be positive for one’s and negative for zero’s and RZ is exactly the reverse. The energy of NRZ pulses are more than RZ signal pulses. The NRZ coder requires only half the bandwidth for the given data rate. The signal will drops to zero for one’s and it will not drop for zero’s in RZ coder.

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

I. Proposed Methodology

The digital message bits from the WDM transmitter is forwarded to Multiplexer where the signals are multiplexed and carry forward to the free space channel. The modulation coder type of the WDM is analysed with both RZ and NRZ methods. The frequency spacing is 100 GHz. The power consumption of the system is varied from 40 to 45 dbm sweep iterations. The data rate of the modulation is 9bits/s. The capacity of multiplexer is 32 ports. The Bandwidth range is about 80GHz. The attenuation value is varied according to the operating distance range.

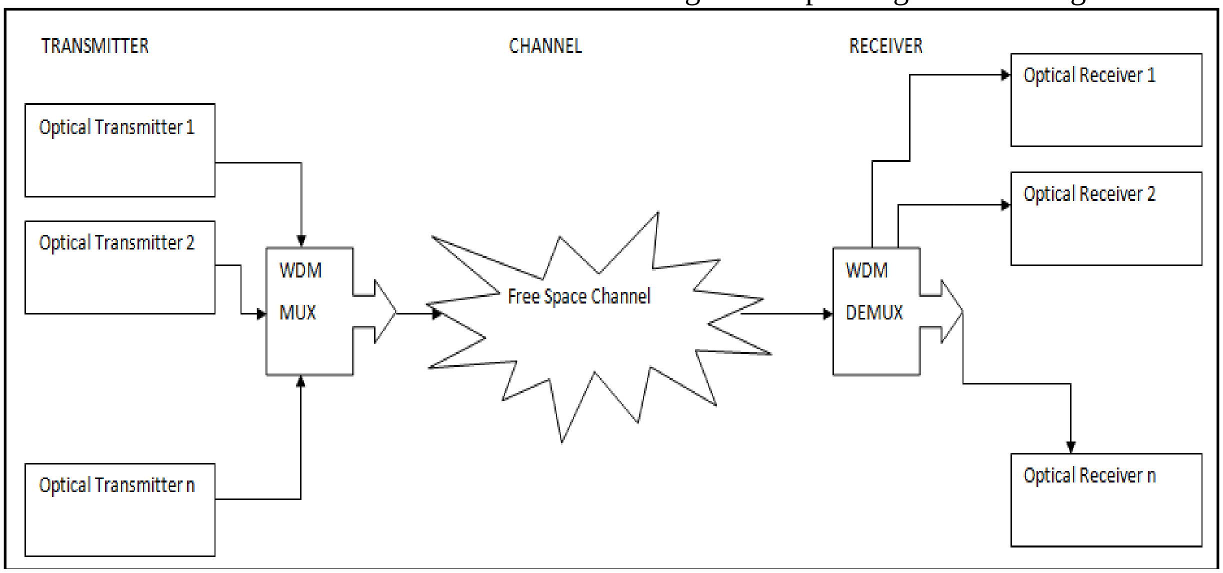


Fig.1. Proposed block diagram of free space WDM system

After the multiplexing, demodulation takes place in which electrical to optical conversion done at the optical receiver shown in Fig.1. The performance metrics will be evaluated by using optical spectrum analyser and BER analyser. The specification for DEMUX is same as the MUX. The software used for the optical simulation is Optisystem v16.1 from Optiwave team. The attenuation effect can be reduced by adjusting the power requirement according to the environmental weather conditions [6].The eye height of the signal reveals the jitter and correct transmission of signal bits throughout the communication. The formula for calculating the cutoff frequency of the receiver is 0.75* symbol rate. The bit rate and symbol rate are inversely proportional to each other. According to the cut off frequency the bandwidth will change [2]. The optical receiver consists of diodes for signal conversion and low pass filter to remove the noise after amplification from the channel.

II. Simulation Results

The obtained simulation results are tabulated below in table 1.and table 2 and the output plots are shown from Fig 2 to Fig.9.

Table 1:WDM modulation Type: RZ Data Rate: 2.5 GbpsPower: 40 to 45 dbm

Attenuation (db/km)	Max. Q	Max. Distance (km)	Min BER

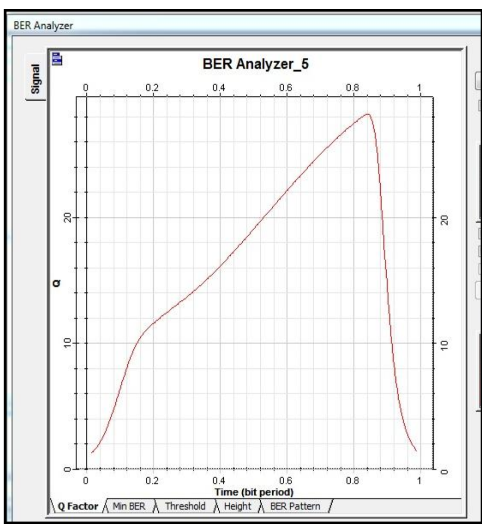
ISSN: 0474-9030

Vol-68-Issue-1-January-2020

0.05	20.2521	1	1.6869e-090
0.08	24.5135	2	5.30e-133
0.25	21.1938	3	5.4056e-100
0.2	20.927	4	1.52185e-097
0.1	28.2218	5	1.57779e-175

Table 2:WDM modulation Type: NRZ Data Rate: 2.5 GbpsPower: 40 to 45 dbm

Attenuation (db/km)	Max. Q	Max. Distance (km)	Min BER
0.05	19.7944	1	1.6633e-087
0.08	19.6834	2	1.4975e-086
0.25	19.5407	3	2.485e-085
0.2	19.8871	4	1.3225e-085
0.1	20.2521	5	1.68965e-091



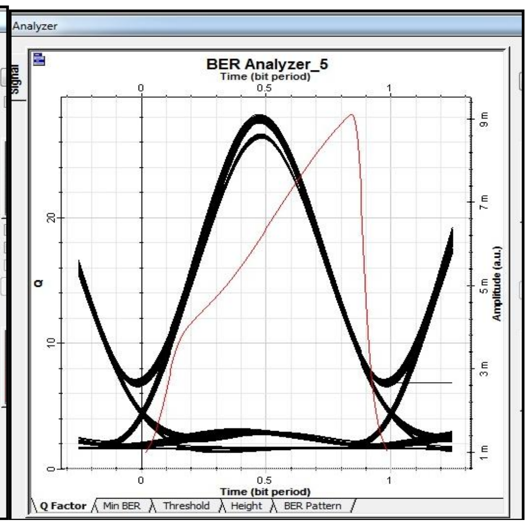


Fig2. RZ modulation Max Q factor 28.2218 Fig3. RZ modulation Eye plot

The BER analyser analyses the Q factor and receiver threshold of the transmission design. The maximum threshold is attained in case of RZ line coder. The power and bandwidth requirement of the design is necessary for the cost efficient system. The bandwidth in WDM system enhances the signal reachability. Severe attenuation leads to reduction in distance as the signal get lossed in transmission. But in our case, the distance is increased as much as possible without disturbing the Quality factor.

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

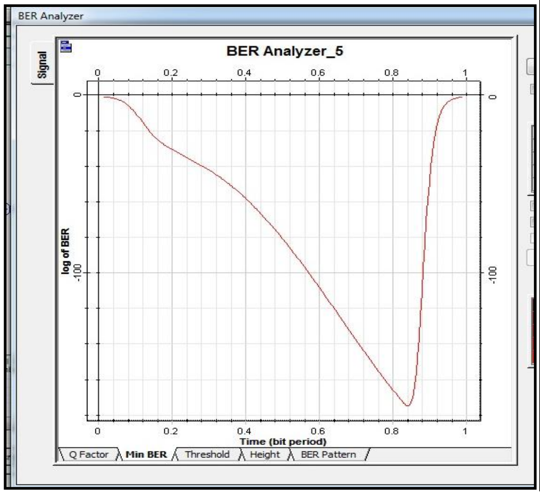


Fig. 4 RZ Min BER 1.52185e-0970

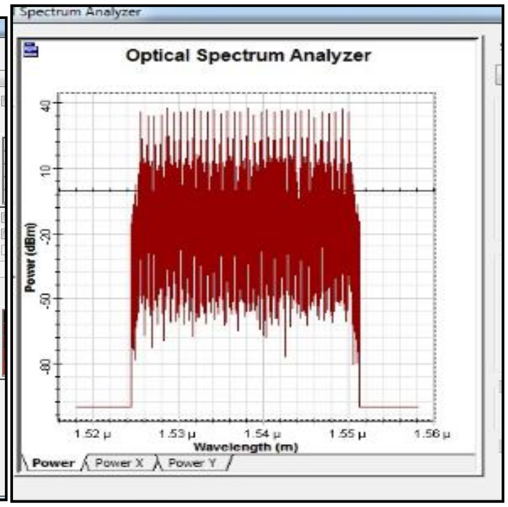


Fig.5 RZ spectrum result

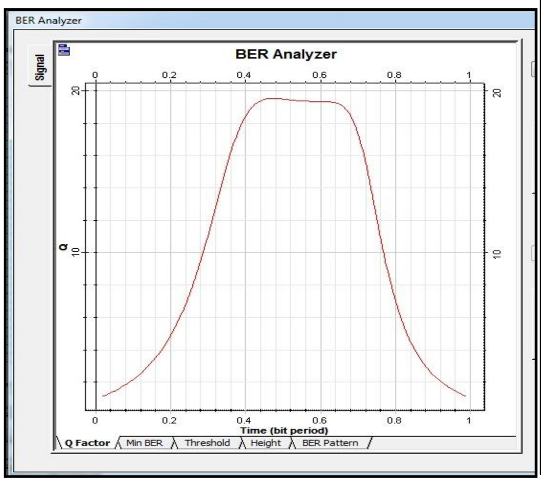


Fig.6 NRZ Max Q 20.2521

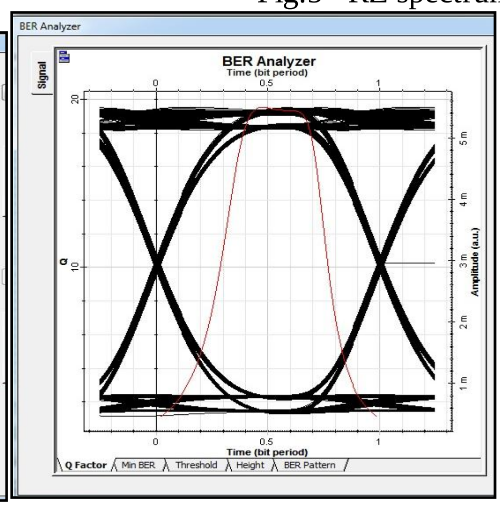
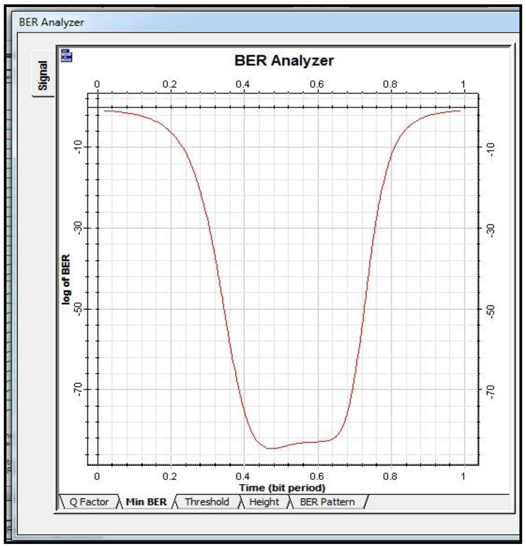


Fig.7. NRZ Eye plot

ISSN: 0474-9030

Vol-68-Issue-1-January-2020



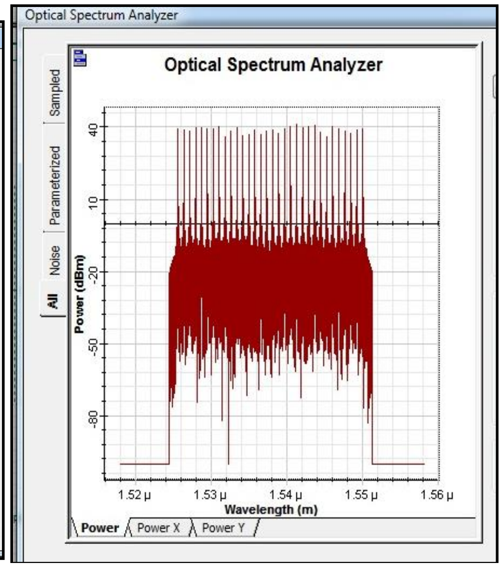


Fig.8 NRZ Min BER 1.3225e-085 Fig.9 NRZ spectrum result

Conclusion

By the overall performance analysis, the Quality factor of RZ is maximum than NRZ. But in terms of Bit error rate, NRZ is better. Communication via free space provides maximum efficient distance of 1km with attenuation of 0.1dB/km. Using WDM method in free space channel, the capacity of transmitter and receiver is increased. The maximum achievable distance of 5kms in RZ modulation type attained 28.2218 Q factor whereas NRZ modulator has 20.2521 Q factor. By comparing the results from RZ and NRZ modulation, it is found that RZ holds good for Q factor but it has more Bit error durations than NRZ. Non Return to Zero being level sensitive, it has minimum BER compared to RZ.

References

1. *Li, G., Bai, N., Zhao, N. and Xia, C., 2014. Space-division multiplexing: the next frontier in optical communication. Advances in Optics and Photonics, 6(4), pp.413-487.*
2. *P. Venkateswari, E. JebithaSteffy, Dr. N. Muthukumaran, 'License Plate cognizance by Ocular Character Perception', International Research Journal of Engineering and Technology, Vol. 5, No. 2, pp. 536-542, February 2018.*
3. *N. Muthukumaran, Mrs R.Sonya, Dr. Rajashekhara and V. Chitra, 'Computation of Optimum ATC Using Generator Participation Factor in Deregulated System', International Journal of Advanced Research Trends in Engineering and Technology, Vol. 4, No. 1, pp. 8-11, January 2017.*
4. *B. Renuka, B. Sivaranjani, A. Maha Lakshmi,Dr. N. Muthukumaran, 'Automatic Enemy Detecting Defense Robot by using Face Detection Technique', Asian Journal of Applied Science and Technology, Vol. 2, No. 2, pp. 495-501, April 2018.*
5. *N. Muthukumaran, 'Analyzing Throughput of MANET with Reduced Packet Loss', Wireless Personal Communications, Vol. 97, No. 1, pp. 565-578, November 2017.*
6. *R. Sudhashree, N. Muthukumaran, 'Analysis of Low Complexity Memory Footprint Reduction for Delay and Area Efficient Realization of 2D FIR Filters', International Journal of Applied Engineering Research, Vol. 10, No. 20, pp. 16101-16105, 2015.*

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

7. F.M.AiyshaFarzana, HameedhulArshadh. A, Ganesan. J, Dr. N. Muthukumaran, 'High Performance VLSI Architecture for Advanced QPSK Modems', Asian Journal of Applied Science and Technology, Vol. 3, No. 1, pp. 45-49, January 2019.
8. A.Srinithi, E.Sumathi, K.Sushmithawathi, M.Vaishnavi, Dr. N. Muthukumaran, 'An Embedded Based Integrated Flood Forecasting through HAM Communication', Asian Journal of Applied Science and Technology, Vol. 3, No. 1, pp. 63-67, January 2019.
9. N. Muthukumaran and R. Ravi, 'Hardware Implementation of Architecture Techniques for Fast Efficient loss less Image Compression System', Wireless Personal Communications, Volume. 90, No. 3, pp. 1291-1315, October 2016.
10. F.M. AiyshaFarzana, HameedhulArshadh. A, Sara Safreen. M, Dr. N. Muthukumaran, 'Design and Analysis for Removing Salt and Pepper Noise in Image Processing', Indo-Iranian Journal of Scientific Research, Vol. 3, No. 1, pp. 42-47, January 2019.
11. Anil Lamba, "Uses Of Cluster Computing Techniques To Perform Big Data Analytics For Smart Grid Automation System", International Journal for Technological Research in Engineering, Volume 1 Issue 7, pp.5804-5808, 2014.
12. Anil Lamba, "Uses Of Different Cyber Security Service To Prevent Attack On Smart Home Infrastructure", International Journal for Technological Research in Engineering, Volume 1, Issue 11, pp.5809-5813, 2014.
13. Anil Lamba, "A Role Of Data Mining Analysis To Identify Suspicious Activity Alert System", International Journal for Technological Research in Engineering, Volume 2 Issue 3, pp.5814-5825, 2014.
14. Anil Lamba, "To Classify Cyber-Security Threats In Automotive Doming Using Different Assessment Methodologies", International Journal for Technological Research in Engineering, Volume 3, Issue 3, pp.5831-5836, 2015.
15. Anil Lamba, "A Study Paper On Security Related Issue Before Adopting Cloud Computing Service Model", International Journal for Technological Research in Engineering, Volume 3, Issue 4, pp.5837-5840, 2015.
16. J. Keziah, N. Muthukumaran, 'Design of K Band Transmitting Antenna for Harbor Surveillance Radar Application', International Journal on Applications in Electrical and Electronics Engineering, Vol. 2, No. 5, pp. 16-20, May 2016.
17. Dr. N. Muthukumaran, Dr. R. Joshua Samuel Raj, Arumugathammal. E, Karthika. N, Karthika. S, Sangeetha. M, 'Design of Underground Mine Detecting Robot using Sensor Network', International Journal of Emerging Technology and Innovative Engineering, Volume 5, Issue 7, pp. 519-524, July 2019.
18. Boselin Prabhu S. R. and Balakumar N., "Functionalities and Recent Real World Applications of Biosensors", International Journal of Computer Science & Communication Networks, Vol 6 Issue 5, pp. 211-216.
19. Boselin Prabhu S. R. and Balakumar N., "A Research on Efficient Processor Design Structure with Reduced Memory Gap", International Journal of Research in Electronics and Computer Engineering, Vol. 4, Issue 4, Oct-Dec 2016, pp. 158-164.
20. Boselin Prabhu S.R., Rajeswari P. and Dinesh Kumar A., "An Analytical Review of Fiber-Optic Sensors and Biosensors, Journal of Engineering, Scientific Research and Applications, Volume 2, Issue 1, 2016, pp. 58-61.
21. Boselin Prabhu S.R., Balakumar N., Rajeswari P. and Dinesh Kumar A., "Wireless Electricity Transfer Methodologies Using Embedded System Technology", Journal of Engineering, Scientific Research and Applications, Volume 2, Issue 1, 2016, pp. 81-89.
22. Boselin Prabhu S.R., Rajeswari P. and Dinesh Kumar A., "Analysis of Decentralized Clustering Hierarchy for Highly Distributed WSN", Journal of Engineering, Scientific Research and Applications, Volume 2, Issue 1, 2016, pp. 45-49.
23. Boselin Prabhu S. R., "Reliable Security Approach for Wireless Embedded Systems", International Journal of Emerging Technology and Innovative Engineering, Vol. 2, Issue 11, November 2016, pp. 402-406.
24. Boselin Prabhu S. R., "An Elaborative Literature of Hierarchical Clustering Methodologies for Dense WSNs", SK International Journal of Multidisciplinary Research Hub, Volume 3, Issue 11, November 2016, pp. 15-19.

ISSN: 0474-9030

Vol-68-Issue-1-January-2020

25. VP. Anubala, N. Muthukumaran and R. Nikitha, 'Performance Analysis of Hookworm Detection using Deep Convolutional Neural Network', 2018 International Conference on Smart Systems and Inventive Technology (ICSSIT), pp. 348-354, 2018, doi: 10.1109/ICSSIT.2018.8748645.
26. N. Muthukumaran and R. Ravi, 'The Performance Analysis of Fast Efficient Lossless Satellite Image Compression and Decompression for Wavelet Based Algorithm', Wireless Personal Communications, Volume. 81, No. 2, pp. 839-859, March 2015.
27. Anil Lamba, "Uses Of Artificial Intelligent Techniques To Build Accurate Models For Intrusion Detection System", International Journal for Technological Research in Engineering, Volume 2, Issue 12, pp.5826-5830, 2015.
28. Anil Lamba, "Mitigating Zero-Day Attacks In IOT Using A Strategic Framework", International Journal for Technological Research in Engineering, Volume 4, Issue 1, pp.5711-5714, 2016.
29. Anil Lamba, "Identifying & Mitigating Cyber Security Threats In Vehicular Technologies", International Journal for Technological Research in Engineering, Volume 3, Issue 7, pp.5703-5706, 2016.
30. Anil Lamba, "S4: A Novel & Secure Method For Enforcing Privacy In Cloud Data Warehouses", International Journal for Technological Research in Engineering, Volume 3, Issue 8, pp.5707-5710, 2016.
31. Anil Lamba, "Analysing Sanitization Technique of Reverse Proxy Framework for Enhancing Database-Security", International Journal of Information and Computing Science, Volume 1, Issue 1, pp.30-44, 2014.
32. Jayaraman.G, Dr. N. Muthukumaran,Vanaja.A, Santhamariammal.R, 'Design and Analysis the Fire Fighting Robot', International Journal of Emerging Technology and Innovative Engineering, Volume 5, Issue 9, pp. 690-695, September 2019.
33. R. Joshua Samuel Raj, T.Sudarson Rama Perumal, N.Muthukumaran, 'Road Accident Data Analytics Using Map – Reduce Concept', International Journal of Innovative Technology and Exploring Engineering, Volume-8, Issue-11, pp. 1032- 1037, September 2019.
34. Banumathi.A, Banupriya.A, Niranjana.R, Jayaraman.G, Dr. N. Muthukumaran, 'Advanced Illumination Measurement System in Highways', Asian Journal of Applied Science and Technology, Vol. 3, No. 1, pp. 39-44, January 2019.
35. Mrs. S. Murine Sharmili, Dr. N. Muthukumaran, 'Performance Analysis of Elevation & Building Contours Image using K-Mean Clustering with Mathematical Morphology and SVM', Asian Journal of Applied Science and Technology, Vol. 2, No. 2, pp. 80-85, April 2018.

