IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 5 Issue 2, February 2018
ISSN (Online) 2348 – 7968
www.ijiset.com

# Performance Analysis of Multiplexing Techniques to improve OCDMA

**Priyanka Rani[1], Dr.Lovkesh[2]**

Student[1], Assistant Professor[2] , Department of ECE,

UCoE, Punjabi University, Patiala, Punjab

**Abstract :**In this research, the performance of optical code division multiple access (OCDMA) using differential phase shift keying (DPSK) has been compared with OCDMA using differential quadrature phase shift keying(DQPSK) This comparison took place in terms of bit error rate (BER) and receiver power where data rate 40Gbps,60Gbps and 80Gbps have been used for this analysis. Using of Opti-system 14.2 simulation, comparing eye diagram and optical spectrum alongside with BER and Rx power. It is found that OCDMA-DPSK(NRZ) performs better in comparison to OCDMA-DQPSK(NRZ). The performance analysis also provides parameter for designing and development of an OCDMA system for optical access network using DPSK. . In this paper, comparison the results of the implementation can help to decide the best way to solve the performance issues in OCDMA system.

**Keywords:**
optical code division multiple access
(OCDMA), differential phase shift keying (DPSK), differential quadrature phase shift keying(DQPSK), non return to zero(NRZ), bit error rate (BER).

## 1. Introduction

CDMA is code division multiple Access is one of the most important technology in 3rd Generation GSM. CDMA is a form of spread spectrum broadcast which practices scattering ciphers to spread the signal out over a broader bandwidth then would normally be required [1]. Optical code division multiple access merge the benefits of optical fiber and CDMA to attain high quality connectivity [5]. Due to its improved structure, highly connectivity, secured network, it has been getting more popularity than CDMA. Optical systems are mainly intensity modulated and hence the chips in the O-CDMA system are alternating '1's and '0's instead of '-1's and '1'. Every bit is separated up into n time's periods called chips in OCDMA. A code word is generated by the optical signature sequence by transferring a short optical pulse throughout some chip break but not for others as shown in figure 1.1. In O-CDMA system every user has a single monogram sequence. The encoder of each source signifies each "1" bit by distributing the sign order whereas binary "0" bit is characterized by all zero order [6].

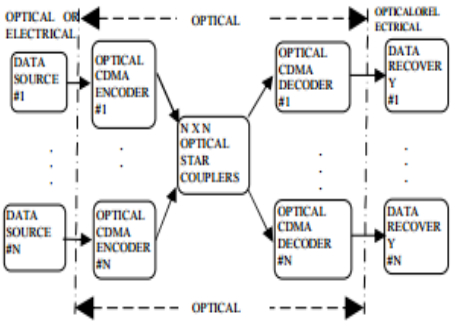


**Figure : 1 Block Diagram of OCDMA**

Meanwhile each bit of the unique indication is signified by a design of lit and unlit chips, the bandwidth of the information stream is augmented [6]. Basically there are three types of OCDMA such as Coherent and Incoherent OCDMA, Synchronous and Asynchronous OCDMA and OCDMA for AON and PON [7]. Intensity-modulation/direct-detection (IM-DD) receivers are used by the coherent OCDMA to identify the control of the optical signal but not the prompt phase dissimilarities of the visual signal. In coherent OCDMA system, the stage information of the optical carrier is vital for the dispreading procedure. It upsurges the difficulty of receiver. In a synchronous OCDMA (S-OCDMA) the bit and chip are synchronized and the receiver observes the correlate output individually at one prompt in the transmission of chips [8]. In the asynchronous OCDMA the bit are not synchronized but the chips

may be communicated synchronously. In AON electrical de-multiplexer are used on the other hand, in PON optical de-multiplexer are active. PON avoid the effect of electromagnetic interference and thunder, economize the cost of operation and maintenance, very good transparency and is suitable for signals with any format and any bit rate, thus provide improved reliable systems [9].

In section 2 and 3 proposed methodology and simulation results are discussed respectively.

## 2. Proposed Methodology

OCDMA is one promising technique other than WDMA, SCMA and TDMA for next-generation broadband multiple access network ascribing to low latency access, full asynchronous transmission as well as soft capacity on demand. But decreased spectral efficiency is one of the main limitations while using the Optical CDMA. Therefore, it is very necessary to optimize its parameters and modulation techniques to take full benefits of the OCDMA technique. Performance parameters can be analyzed using different modulation techniques and data formats. The best way is to apply all the modulation techniques and comparing the performance OCDMA system using this technique. Comparing the results of the implementation can help to decide the best way to solve the performance issues in OCDMA system. The impact of multi-access interference, other performance parameters and attenuation on OCDMA system using different modulation formats have not been investigated. Though the traffic can be managed by the OCDMA systems effectively, still data rate and spectral efficiency need to be improved further. An effective combination of the multiplexing techniques and multiplexing formats implantation in the OCDMA system can help to increase the both factors to a great extent. There is still high need to research on the best combination of multiplexing techniques and samples for improving the performance of OCDMA system.

## 3. Simulation setup

The purpose of the simulation is to compare DPSK with DQPSK for OCDMA system in terms of different parameters (BER, input power, received power). We have used software OptiSystem 14.2 with necessary set up. Figures 2 and 3 show the transmitter part and receiver part respectively. The system has been analyzed for data rates (40,60,80Gbps) and for distances/fiber length 100 km. Three user used for different data transmission at data rate for simulation.

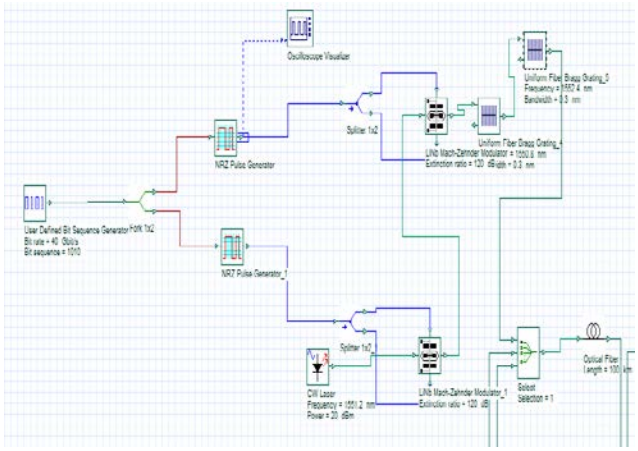

**Figure: 2 Transmitter part**

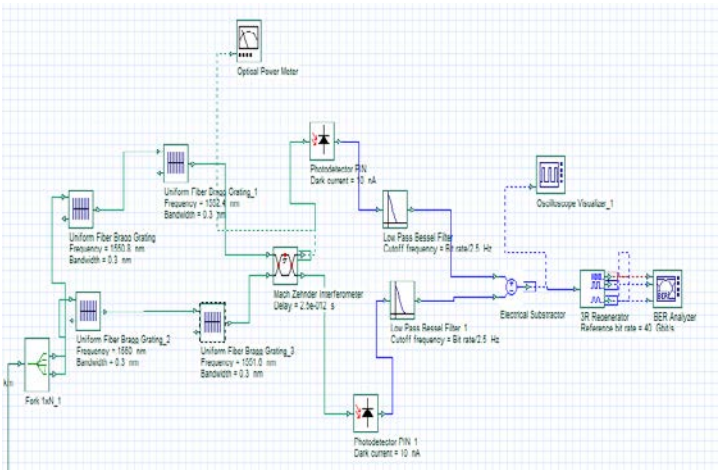

**Figure : 3 Receiver part**

Based on Figures 4 and 5 we can see that different input power affects differently on the BER. The systems are using the same input power (10 dBm to 0 dBm).It is shown that with the increase of data rate the system performance decreases in terms of BER, DPSK provides better power optimization than DQPSK.

In this paper, the main focus is of two powers generator DPSK and DQPSK system. We calculate the results based on two main factors i.e.Non- Return to zero (NRZ) and Return to zero(RZ). Based on these two factors following is the output in the form of graphs that was generated after performing the work. Basically we will discuss NRZ format in this paper.

### 3.1 Results of DPSK based on NRZ

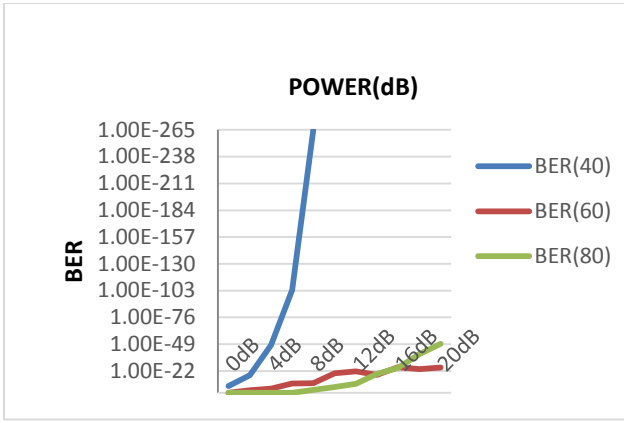


Figure 4: Power vs. BER

In figure 4 depicts, user compares the performance of three different data rate i.e., 40, 60, 80Gbps. Form the graph it is clear that power varies from zero to positive (Form 0 to 20db) and same Behave negative value (Form -13 to -265). From the graph it is seen that in case of low power rate 60 and 80gbps data rate show high Bit error rate but in the case of 40gbps it indicates zero Bit error rate and this remains constant when power is increased. But in the other case after increase power BER of Gbps data fluctuate. In the case of 80Gbps BER was high at power value of 18dB.

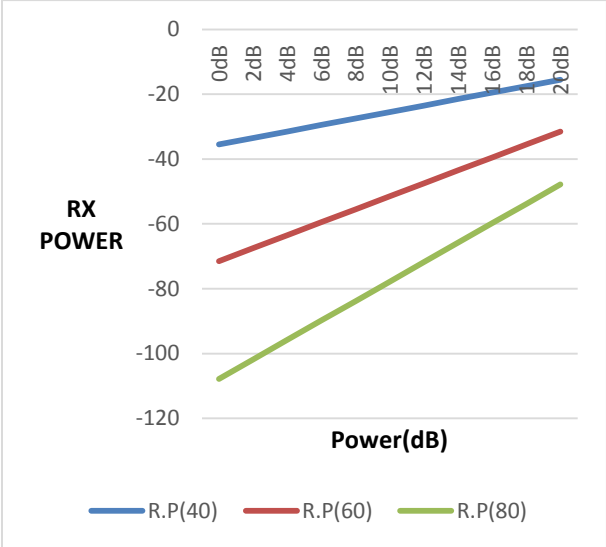


**Figure 5:** Power vs. Received Power

Figure 5,depicts user compare the performance of three different data rate i.e., 40, 60, 80Gbps. Form the graph it is clear that power varies only in positive (Form 0to 20db) and same (Received Power)RX varies only in negative (Form –120to 0). From the graph it is seen that the entire three data rate varies parallel with each other. In the case of 0dB all the three 40, 60 and 80 BER is at -40, -70, and -110 respectively. When the power supply is 20dBall the three 40, 60 and 80 BER is at -20, -35, and -50 respectively.

### 3.2 Results of DQPSK based on NRZ

In this result we are getting output of power vs. BER

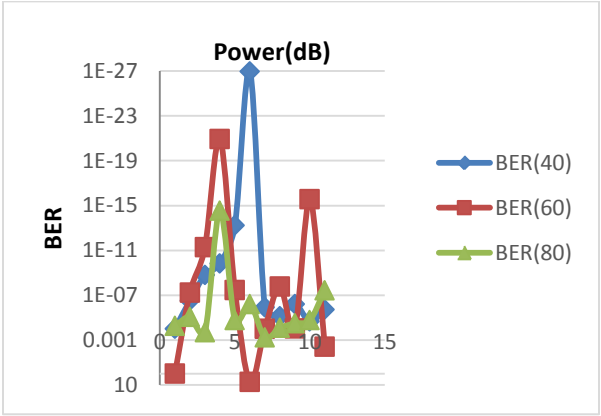


Figure 6: Power vs. BER

In figure 6, user compare the performance of three different data rate i.e., 40, 60, 80Gbps. Form the graph it is clear that BER varies from negative to positive (Form 1 to -27db) and same Power varies from 2to 12. From the graph it is seen that in case of low power rate 60 and 80gbps data rate show low Bit error rate i.e. zero at each value of power. But in the case of 40gbps it indicates zero at the -5 power supply. It shows pyramid shape by first increasing the value of BER till -27 at 6 powers and after that sudden decrease in BER value.

IJISET - International Journal of Innovative Science, Engineering & Technology, Vol. 5 Issue 2, February 2018
ISSN (Online) 2348 – 7968
www.ijiset.com

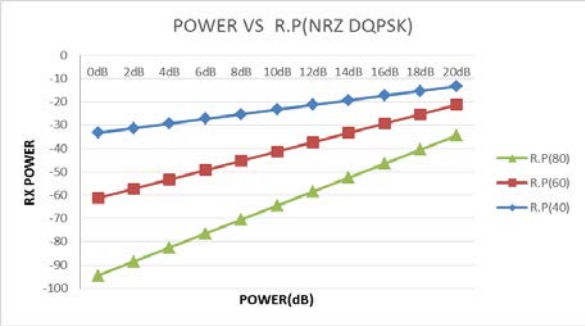


**Figure 7:** Powers vs. Received power

In figure 7, user compare the performance of three different data rate i.e., 40, 60, 80Gbps. Form the graph it is clear that power varies only in positive (Form 0to 20db) and same (Received Power)RX varies only in negative (Form 0to -100). From the graph it is seen that the entire three data rate varies parallel with each other. In the case of zero power all the data indicates -35, -60, -85 RX respectively. When the power supply is higher i.e 20dB all indicated -10, -20, -35RP respectively.

We can also verify the same concept with eye diagram. Now eye diagram is discussed for DPSK and DQPSK based on NRZ.

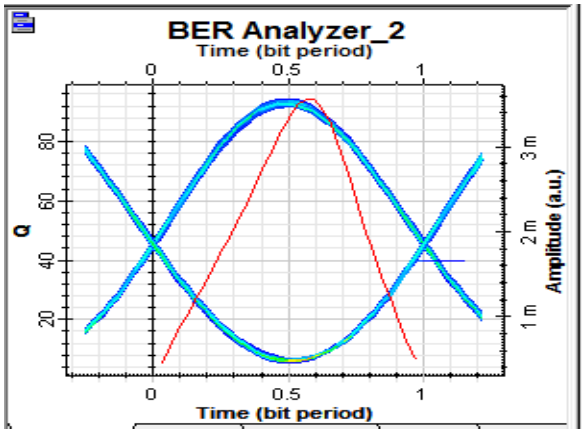


Figure 8(a):Eye diagram analysis for 40Gbps DPSK-NRZ at user-3. In this eye diagram it shows the quality factor of DPSK 40Gbps.

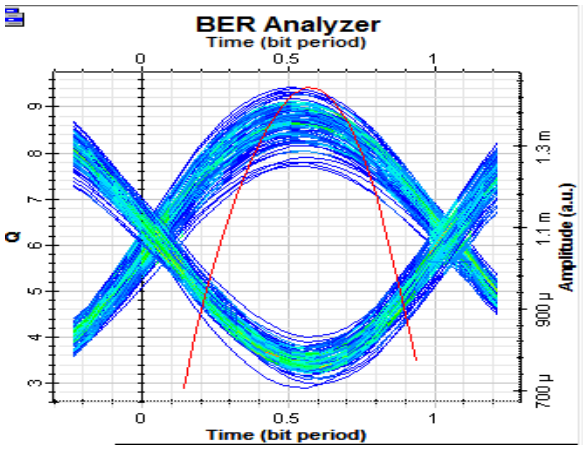


Figure8(b):Eye diagram analysis for 60Gbps DPSK-NRZ at user-1

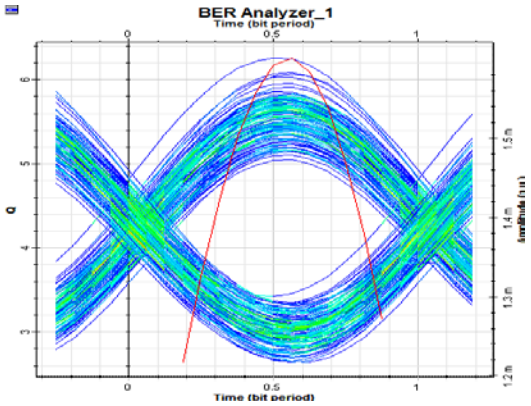


**Figure 8(c):** Eye diagram analysis for 80Gbps DPSK-NRZ at user-2

ISSN (Online) 2348 – 7968
www.ijiset.com

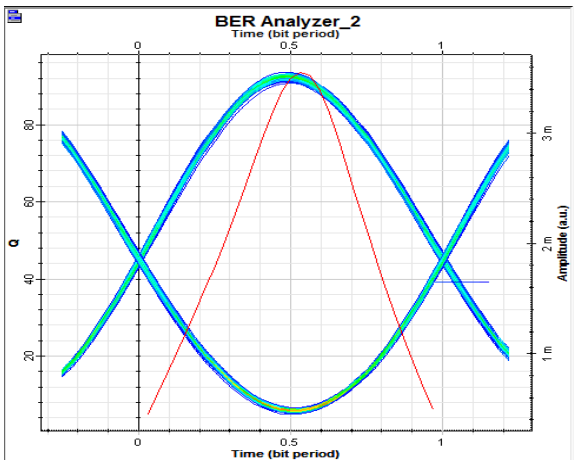


Figure9 (a): Eye diagram analysis for 40Gbps DPSK-NRZ at user-3

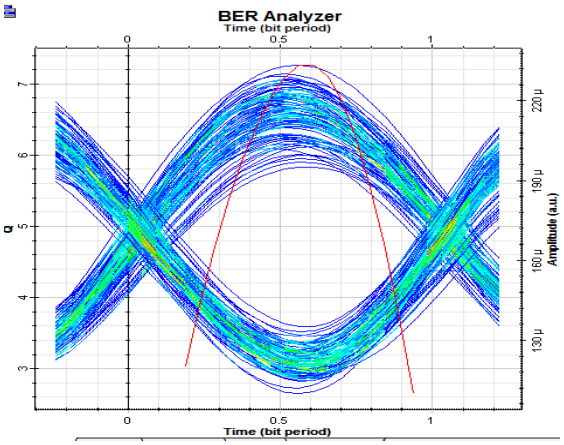


Figure9 (b): Eye diagram analysis for 60Gbps DPSK-NRZ at user-1

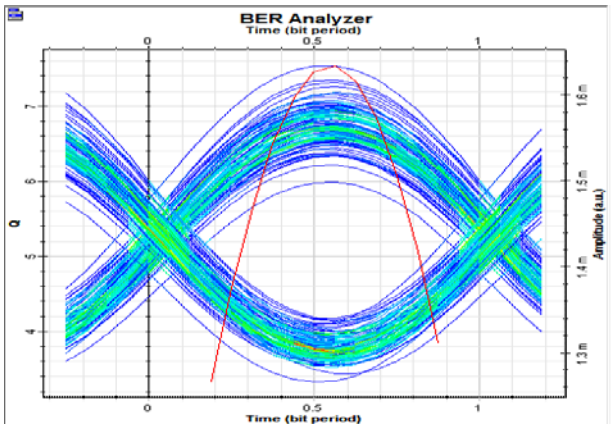


**Figure 9(c):** Eye diagram analysis for 80Gbps DPSK-NRZ at user-3

## Conclusion

Comparing to conventional DQPSK-OCDMA with other advance modulation techniques such as DPSK for OCDMA system represents advantages of improved quality factor. Further research and analysis can be conducted to achieve for multiple user and longer distance system. Finally, we conclude from this analysis that this system transmits signal at 100 km on data rate 40,60,80Gbps respectively .An effective combination of the multiplexing techniques and multiplexing formats implantation in the OCDMA system can help to increase the both factors to a great extent. There is still high need to research on the best combination of multiplexing techniques and samples for improving the performance of OCDMA system. In this paper, comparison is done with the modulation techniques getting output of two factor i.e. power and line width on three different parameters such as Quality, Bit error rate (BER) and Receivedl Power (Rx power).

## References

1. Akhoundi, Farhad, Jawad A. Salehi, and Arvin Tashakori. "Cellular underwater wireless optical CDMA network: Performance analysis and implementation concepts." *IEEE Transactions on Communications* 63.3 (2015): 882-891.
2. S. Singh, S. Singh, Performance Analysis of Spectrally Encoded Hybrid WDM-OCDMA Network Employing Optical Orthogonal Modulation Format against Eavesdropper, International Journal of Electronics and Communications (2017),
3. Gonzalez, O., et al. "Cyclic code-shift extension keying for multi-user optical wireless communications." *Electronics Letters* 51.11 (2015): 847-849.
4. Chen, Fu-Jun, et al. "Modified decoding and detection scheme for spectral amplitude coding optical CDMA systems." Electronics Letters 51.10 (2015): 773-775.
5. Norazimah, M. Z., et al. "Performance of different SAC-OCDMA detection schemes with NRZ and RZ data formats." Industrial Electronics and Applications (ISIEA), 2013 IEEE Symposium on. IEEE, 2013.
6. Glesk, Ivan, Tolulope B. Osadola, and Wing C. Kwong. "Towards higher scalability of hybrid optical CDMA network." *Optical and Quantum Electronics*49.8 (2017): 267.
7. Peng, Chen. "Novel Methods for Extending Optical Code Set for Coherent OCDMA." *Computer, Informatics, Cybernetics and Applications*. Springer, Dordrecht, 2012. 11-18.
8. Durand, Fábio Renan, MoanirStábileFilho, and TaufikAbrão. "The effects of power control on the

optical CDMA random access protocol." *Optical Switching and Networking* 9.1 (2012): 52-60.

9. Min, Seong-sik, and Yong Hyub Won. "Optical CDMA system with the least multiple access interference under arbitrary restrictions." *Optics communications* 228.4 (2003): 309-318.
10. Ashour, Isaac AM, et al. "Optical code-division multiple-access and wavelength division multiplexing: Hybrid scheme review." *Journal of Computer Science* 8.10 (2012): 1718-1729.
11. Sahuguede, Stephanie, Anne Julien-Vergonjanne, and Jean-Pierre Cances. "Error Probability Bound Considering Beat Noise in 2-D OCDMA Systems." (2007): 266-274.
12. Jazayerifar, Mahmoud, and Jawad A. Salehi. "Atmospheric optical CDMA communication systems via optical orthogonal codes." *IEEE transactions on communications* 54.9 (2006): 1614-1623.
13. Beyranvand, Hamzeh, and Jawad A. Salehi. "Multirate and multi-quality-of-service passive optical network based on hybrid WDM/OCDM system." *IEEE Communications Magazine* 49.2 (2011).
14. Shalaby, Hossam MH. "Closed-form expression for the bit-error rate of spectral-amplitude-coding optical CDMA systems." *IEEE Photonics Technology Letters* 24.15 (2012): 1285-1287.
15. Norazimah, M. Z., et al. "Performance of different SAC-OCDMA detection schemes with NRZ and RZ data formats." *Industrial Electronics and Applications (ISIEA), 2013 IEEE Symposium on*. IEEE, 2013.