www.ijecs.in
International Journal Of Engineering And Computer Science ISSN:2319-7242
Volume 4 Issue 6 June 2015, Page No. 12270-12272

Performance Analysis of OTDM System at the Different Data Rate

Akriti Gupta[1] Jyotsana[2] and Himali[3]

[1]*Department of Electronics and Communication Engg.,GNDU Regional Campus, Jal., Pb.,India*
guptaakrity@ymail.com

[2]*Department of Electronics and Communication Engg.,GNDU Regional Campus, Jal., Pb.,India*

[3]*Department of Electronics and Communication Engg.,GNDU Regional Campus, Jal., Pb.,India*

Abstract: ***OTDM is an updating technique to TDM that provides high speed data generation. It is a technique which overcomes the bandwidth limitation of electronics. The basic principle of this technology is to multiplex number of low bit rate optical channels in time domain. In this paper, the performance of OTDM system is analysed at different data rates i.e.40 Gbps, 80 Gbps and 160 Gbps respectively. The single mode fiber with dispersion 17.65 ps/ nm-km is used. The maximum transmission length achieved is 145km for 40Gbps OTDM system with Q-factor of 29.22 and BER of*** 10^{-88}.

Keywords: OTDM, Data rate, SMF, Q-factor.

1. Introduction

As technology is advanced time to time, OTDM (optical time domain multiplexing) system is still a challenge to implement for high data transmission. Various technologies have been used to satisfy the performance characteristics of OTDM. It is a method of generating high speed data upto 1Tb/s beyond bandwidth limit. To overcome the limitations of TDM and WDM,OTDM systems are developed. The main difference between OTDM and WDM is different wavelengths of laser is used in WDM while a single central wavelength is used in OTDM system[1].As the technology changes WDM systems are still not sufficient to overcome the challenges that are required for high data rates. Thus to develop a technology for high data rates, OTDM systems are used. OTDM systems overcome disadvantages of WDM systems as it provides non overlapping of channels in time domain and there is no need for the optical filter at the receiver side .OTDM systems decrease the receiver complexity and also decreases the power consumption [5].In OTDM background various simulation setups are implemented using various fibers. Using these characteristics OTDM system have designed with acceptable bit error rate $2.39x10^{-9}$[2].The simulation setup can be implemented using different formats for 40-160Gbps data rate with acceptable BER [4].The performance of OTDM system has been measured on the basis of Q-factor and BER[6].The BER is basically the ratio of number of bit errors to the total number of transmitted bits. The Q-factor determines the opening of the eye. More the eye opening more the Q-factor and better is the signal strength [7].

2. System Description

The block diagram for OTDM is shown in Fig.1.The simulation is done using Optisystem v11.0. The system is designed at different data rates: 40Gbps, 80Gbps and 160Gbps. The transmitter of OTDM consists of pseudo random generator, amplitude modulator, pulse generator and time delay. The CW Laser converts the electrical signal to optical signal. This optical signal is then modulated with signal generated by the pulse generator. This modulated signal is then time delayed .The time delays used are 0ns, 0.25ns, 0.50ns, 0.75ns.

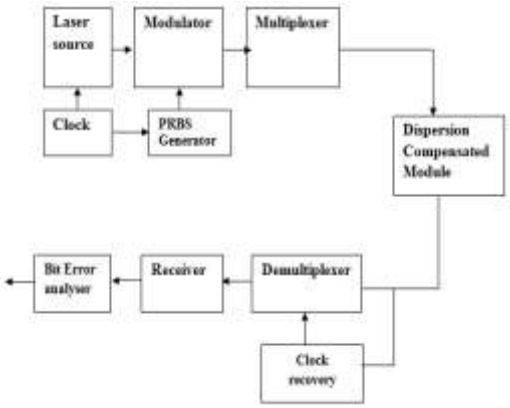

Figure 1: Block Diagram of OTDM system

This time delayed signal is then multiplexed to travel through the optical fiber. The multiplexed signal then travel through the dispersion compensated module. The dispersion compensated module consists of optical amplifier, optical fiber and dispersion compensated fiber. At the receiver side eye diagram analyzer is used to know the Q-factor and BER. The signal is then demultiplexed at the receiver side. At receiver side all the operations that are performed are reverse to functions performed at the transmitter side. Clock recovery is used at the receiver side. The Dispersion compensated fiber used has dispersion of -80ps/nm-km and

the optical fiber used have a dispersion of 16.75ps/nm-km.

Table 1: Simulation Parameters

Parameters	*Specifications*
C W Laser wavelength	1552.52nm
Input Power	5 mW
Gain of optical Amplifier	10 dB

Table 2: Fiber Parameters

Parameters	*SMF*	*DCF*
Attenuation(dB/km)	0.25	0.2
Effective area(μm^2)	80	63
Dispersion(ps/nm km)	17.65	-80

3. Results And Discussions

3.1 For 40 Gbps OTDM

The simulation results for 40 Gbps OTDM system is shown in fig.6 at channel 1. The BER is measured as 10^{-88} , 10^{-65} , 10^{-41} and 10^{-87} for channel 1,2,3 and 4 respectively. Q-factor is 29.22, 27.33, 13.47 and 29.12 for channel 1,2,3 and 4 respectively. Figure 3 shows optical spectrum analyzer for 40 Gbps system.

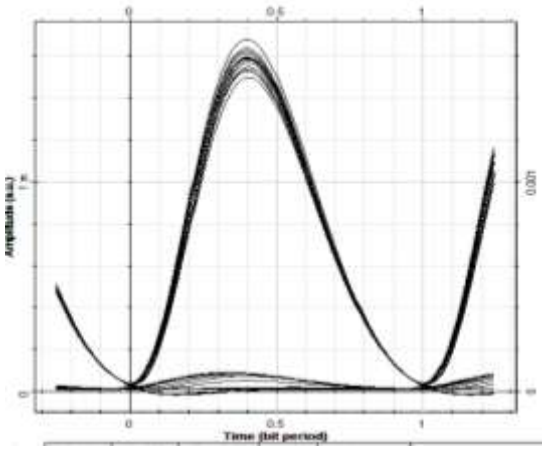

Figure 2: Eye diagram for Channel 1

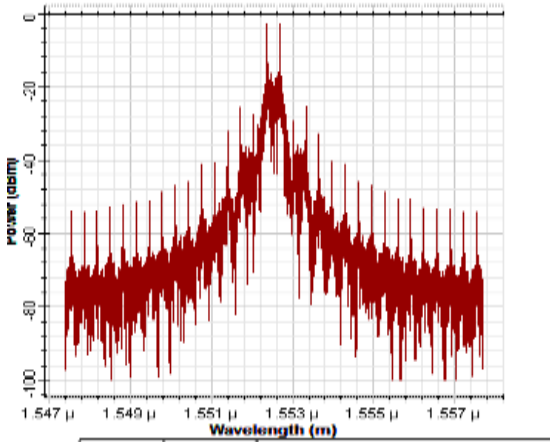

Figure 3: Optical Spectrum Analyzer for Channel1

3.2 For 80 Gbps OTDM

The simulation results for 80 Gbps OTDM system is shown in fig.6 at channel 1. The BER is measured as 10^{-10} , 10^{-9} , 10^{-9} and 10^{-12} for channel 1,2,3 and 4 respectively. Q-factor is 6.35, 5.99, 5.92 and 6.83 for channel 1, 2, 3 and 4 respectively. Figure 5 shows optical spectrum analyzer for 80 Gbps system.

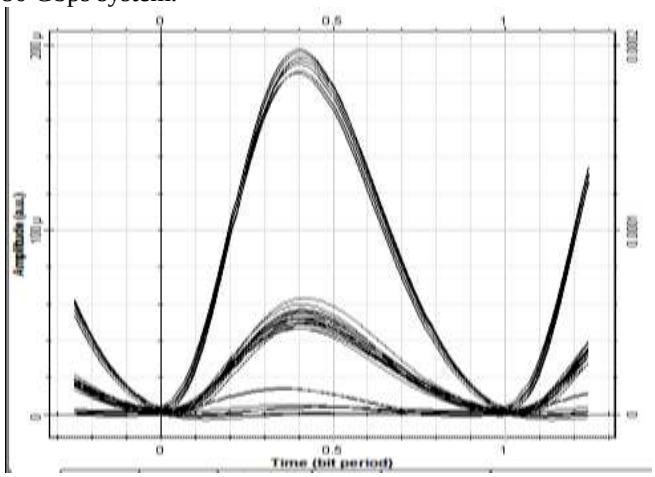

Figure 4: Eye diagram at Channel 1

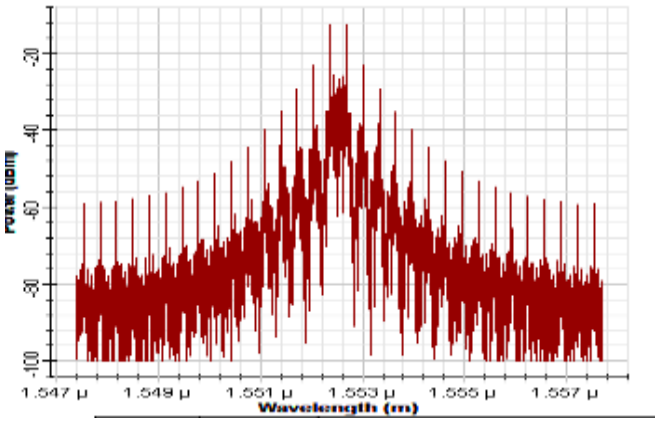

Figure 5: Optical Spectrum Analyzer for Channel1

3.3 For 160 Gbps OTDM

The simulation results for 160 Gbps OTDM system is shown in fig.6 at channel 1. The BER is measured as 10^{-10} , 10^{-11} , 10^{-9} and 10^{-10} for channel 1,2,3 and 4 respectively. Q-factor is 6.11, 6.40, 5.94 and 6.17 for channel 1, 2, 3 and 4 respectively. Figure 7 shows optical spectrum analyzer for 160 Gbps system.

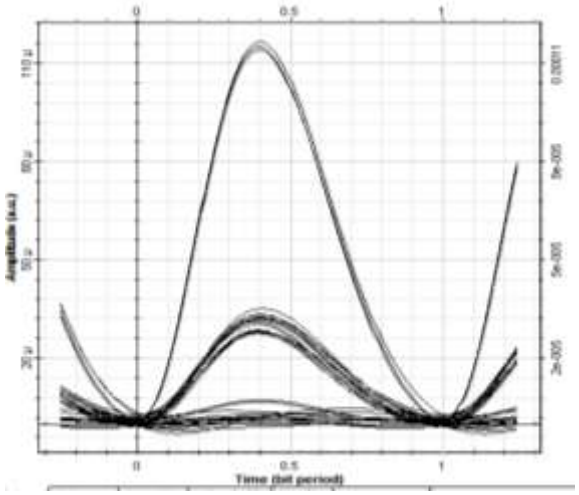

Figure 6: Eye diagram at Channel 1

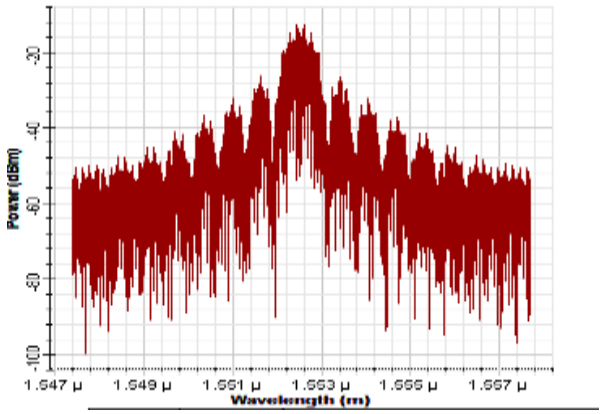

Figure 7: Optical Spectrum Analyzer at Channel 1

Table 3: Effect on transmission distance at different rates

Parameters	*Data Rate (Gbps)*		
	40	80	160
Q-factor	29.22	6.35	6.11
BER	10^{-88}	10^{-10}	10^{-10}
Transmission distance (km)	145	108	96

4. Conclusion

The performance comparison of OTDM system at different data rates has been done. Firstly OTDM system at 40Gbps is done with maximum transmission length 145 km with Q-factor 29.22 and BER 10^{-88}. Furthur data rate is increased to 80Gbps and maximum transmission distance is 108km with Q-factor 6.35and BER 10^{-10}.Then the performance is checked at 160Gbps which travels maximum transmission distance of 96km and Q-factor 6.11 and BER 10^{-10}. It has been concluded that the transmission distance decreases as the data rate is increased. The 40Gbps OTDM system has achieved maximum transmission distance of 145km as compared to others with Q-factor 29.22.

References

[1] X. Yang, R. J. Manning, A. K. Mishra, R. P. Webb, A. D. Ellis, and D. Cotter, "Application of semiconductor optical amplifiers in high-speed all-optical NRZ to RZ format conversion," in Proc. International Conference on Transparent Optical Networks (ICTON), (2007), pp. 228–231.

[2] S Kaur, R.S Kaler "Performance of RZ and NRZ modulation format in 40-160 gbps OTDM system demultiplexing" Optik 124, pp 1100-1104,February 2013 .

[3] S.H. Lee, K.K Chow, C.Shu" All Optical RZ to NRZ Data Format Conversion using Spectral Broadening effect in Dispersion Shifted Fibre" Optic Communication, Vol 263, pp 152-155, June 2006

[4] W. Yang; M. Zhang "Analysis of 160 all optical NRZ to RZ data conversion using quantum dot SOA MZI" Optics communication, Vol 282,pp 1744-1750,January 2011.

[5] Z. Quiang Hui, J. Gong, M. Liang "Demonstration of All Optical RZ to NRZ Format Conversion Self Phase Modulation in Dispersion Flattened Highly Non-Linear Photonic Crystal Fibre" Optics and Laser Technology Vol 54, pp7-14, May 2013.

[6] W. Yu, L. Huo, D. LU, C. Lou"A Novel Optical Pico-second NRZ to RZ format Converter with Simulataneous wavelength Multicasting Using a Single Stage Mach Zehnder Modulator" Optic Communication, Vol 285, pp 4302-4306, July 2102.

[7] L. Wang, Y. Dai, G.K.P. Lei, J. Du, C. Shu, All-optical RZ-to-NRZ and NRZ-to-PRZ format conversions based on delay-asymmetric nonlinear loop mirror, IEEE Photon. Technol. Lett. 23(6) (2011).

[8] M.I. Hayee, A.E. Willner" NRZ versus RZ in 10–40-Gb/s dispersion-managed WDM transmission systems" IEEE Photon. Technol Lett. 11 (8) (1999) 991–993.

[9] Y.Xie,J.Zhang,W.Wang "All optical RZ to NRZ format conversion using single SOA by the optical bandpass filter"IEEE Photon. Vol25, pp 2051-2053,Sep 2008.

[10] Jyotsana, R Kaur, R Singh "Simulative Comparison of 40 OTDM Transmission System operating at S-band and C-band over ITU G.653" Vol 2 issue 8, August 2013,pp 3091-3093.