Performance Analysis and Quality of Service Passive Optical Networks using Gaussian pulse

Gebrekiros Gebreyesus Gebremariam (M.Tech)
Department of Electronics and Communication Engineering
Punjabi Unversity, Patiala, Punjab, India

ABSTRACT

When the data is transferred over the network, a performance and quality of service is one of basic requirement of both user and network but there are many major causes that can result packet loss, such as Congestion over the network. Because of this there is requirement of some methodology that can enhance the performance and quality of service for data transmission over the network. In this paper, the proposed work is representing the solution of the same problem as the major Hypothesis. The Proposed system is the advancement of existing PON- technology with the inclusion of quality of service and performance by utilizing the bandwidth in an effective way. This work investigates the capacity of the passive optical network via the performance and quality of service by modelling the optical signal in the fiber link transmission channel.

Keywords: - Quality of Service; Fiber Link, Passive Optical Network; Gaussian pulse; Optical Signal Transportation.

1. INTRODUCTION

Fiber optics uses light signals to transmit data. As this data moves across a fiber, there needs to be a way to separate it so that it gets to the proper destination. A passive optical network does not include electrically powered switching equipment and instead uses optical splitters to separate and collect optical signals as they move through the network. A passive optical network shares fiber optic strands for portions of the network. Powered equipment is required only at the source and receiving ends of the signal. Optical Splitters are used to divide the incoming light beam from a single fiber into two or more fiber channels.

2 RELATED WORKS

In this paper, it was briefly review the related work on analysis of passive optical network. Passive Optical Network (PON) is one of the most widely deployed access networks due to its unique benefits, including signal format as well as high data rates and reliability. Since the optical networks offers a wide bandwidth in metropolitan and wide area networks (WANs), there still exists a bottleneck between local area networks (LANs) and the networks service providers. Thus by using fiber optic networks access bandwidth gap can overcome [3].

The performance of a PON system presented in this paper is analyzed how the BER, Q-Factor and Optical power changes as wavelength and attenuation are for better communication. The System simulated using Optisystem7.0 software has beenused [14].

The proposed system is designed with Gaussian pulse parameters to enhance the performance and quality of service of the system with the same base line parameters.

3. System Design

In this paper investigates network for the analysis of performance analysis of passive optical networks over the link, one is based on the point to point link for reducing the power loss when data is transmitted from the transmitter section to the receiver section for increase capacity over the network. Optisystem 7.0 is used for simulation purposes.

Table 1: Simulation parameters		
Parameters	Base line Value	Unit
Bit Rate	10	Gbps
Power	32.68	dBm
Pulse Width	13.2	P_s
Dispersion	17	P_s/nm/Km
Wave Length	1490	nm
Length	21	Km
Attenuation	0.2	dB/Km
β_2	-20	ps^2/Km
Effective Area	60	μm^2
n_2	$2.6 * e^{-20}$	m^2/W

4. SIMULATION RESULTS AND DISCUSSION

The simulation model of PON was done in two sections with and without Gaussian pulse parameters using OptiSystem software. The model was designed for a ‘single user’ scenario. It consist of user defined bit sequence generator, NRZ pulse generator, continuous wave laser source, Mach-Zehender modulator, It also has an ONT receiver should have photodiode, 3R generator, BER analyzer, Bessel optical fiber filter and Gaussian pulse generator. The link, sometimes called channel, is consists of 21 Km of single mode fiber and optical attenuator with and without Gaussian pulse parameters.

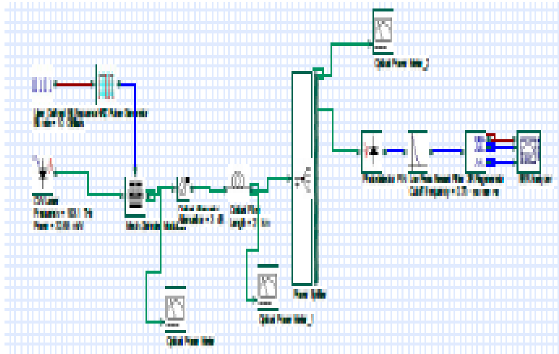

Fig.1 Singles channel using laser source

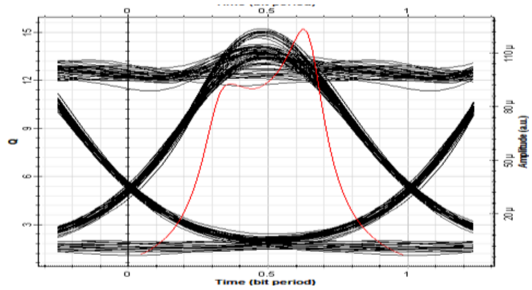

Fig.2 Q-factor of Singles channel using laser source

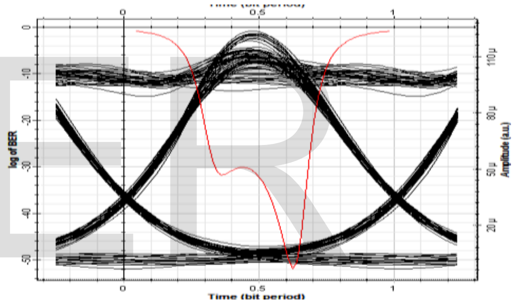

Fig.3 Min. BER of single channel using laser source

Table 2 :Analysis of the BER analyzer diagram Using laser source at 21 Km.	
Parameter	Value of output
Max. Q factor	15.2182
Min. BER	1.33605e-052
Eye Height	7.93214e-005
Threshold	4.41396e-005
Decision Inst	0.625

As shown from the above table and the graphs ,for the system without Gaussian pulse parameters. The max.Q-factor is 15.2182 dB with Min. BER of 1.33605e-052. The eye opening of the BER analyzer is 0.0000793214.

International Journal of Scientific & Engineering Research Volume 9, Issue 2, February-2018
ISSN 2229-5518

Table 3 Q- factor for a number of users with varying distance

Distance (Km)	Number of users				
	24	34	44	54	64
6	49.62	47.82	45.79	43.64	41.44
11	26.02	25.48	24.88	24.20	23.48
21	16.06	15.94	15.76	15.51	15.21
31	10.24	10.14	10.01	9.84	9.65

Form table 3 the quality of service decrease with increase the number of users and increasing the distance.

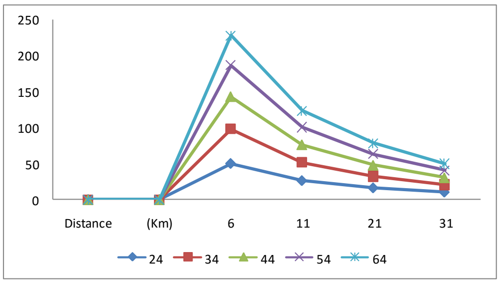

Fig. 4 Q-factor with increasing number of users

As shown in fig 4 the Q-factor decreases with the number of users and the transmission distance.

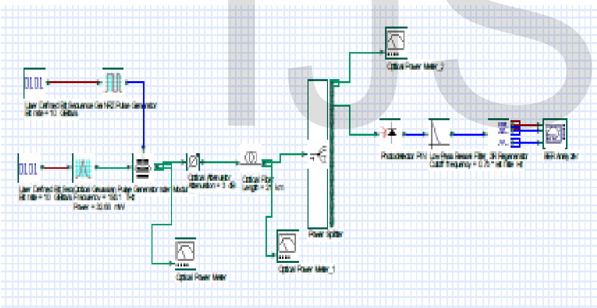

Fig.5 Single channel with Gaussian pulse parameter

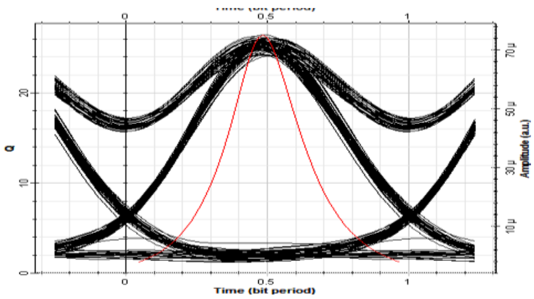

Fig.6: Q-factor of a single user using laser source.

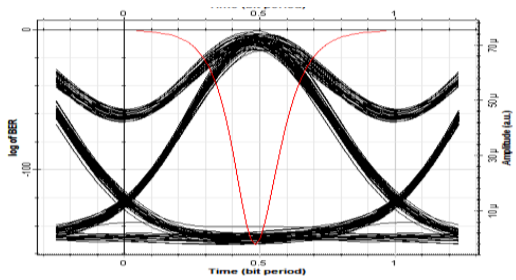

Fig.7: Min. BER of a single user without Gaussian pulse parameter.

Table 4 :Analysis of the BER analyzer diagram With Gaussian pulse parameter at 21 Km.

Parameter	Value of output
Max. Q factor	26.2443
Min. BER	3.59136e-154
Eye Height	6.3203e-005
Threshold	3.26135
Decision Inst	0.484375

Here, a Q-factor of 26.2443 *dB* is achieved for the system with a minimum BER of 3.59136e-154. The greater Q-factor indicates the higher performance of the passive optical network. The same parameters are used for both the Gaussian pulse and non Gaussian pulse s systems. The eye opening is greater that is 6.3203e-005.

Table 5:Q-factor with and without Gaussian pulse

Parameter	6 Km	11 Km	21 Km	31 Km
Laser source	41.4161	23.2223	15.2182	9.6532
Gaussian pulse	48.4814	40.4633	26.4243	16.0759

From the above table 4 the maximum value of Q-factor is obtained when the Gaussian pulse is used. The Q-factor is best optimized and analyzed by using the Gaussian pulse for better quality of service and system performance.

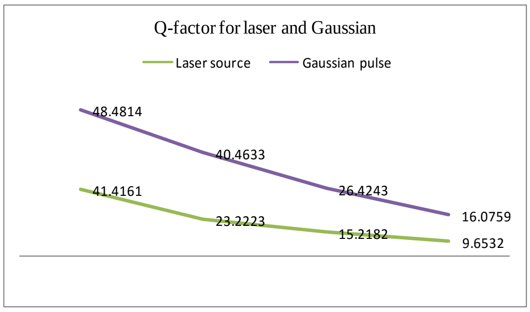

Fig.8 Q-factor of laser source and Gaussian pulse

As shown from the graph the performance and quality of the system is greater for the system with Gaussian pulse with variation of the distance with a given fiber length and input power.

Table 6 Q-factor with increasing distance and No. of users using Gaussian pulse					
Distance (Km)	Number of users				
	24	34	44	54	64
6	69.73	63.93	58.28	53.10	48.48
11	83.30	66.96	55.34	46.84	40.46
21	53.29	43.04	35.76	30.43	26.42
31	29.66	24.86	21.10	18.24	16.08

The Q-factor is more improved by using the Gaussian pulse parameter. This can be more illustrated by using the graph as shown below.

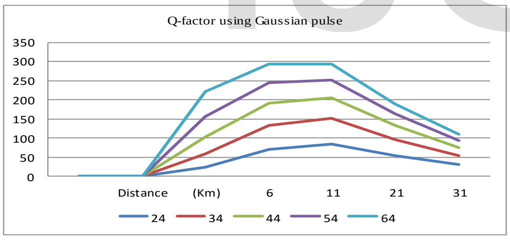

Fig. 9 Q-factor graphs using Gaussian pulse with varying number of users and distance

5. CONCLUSION

The performance analysis of transmissions and quality of service for the passive optical network is evaluated with and without the Gaussian parameters. From the analysis the Bit Error increases with increasing the transmission distance and number of users. The graph of Q-factor vs. number of users is shown in fig. 4 and fig. 9 at bit rate of 10 Gbps with varying distance. As the number of users increase, Q factor decreases due to non linearity and dispersion induced in fiber which degrades the transmission quality.

The Q factor is high and its sharp graph indicates low loss. Also the BER is less. The optical power at the end of the fiber through which the signal has been transmitted with 24 users at 21 Km fiber length has reduced from 12.70 dBm to -8.29 dBm without Gaussian pulse parameter and 10.11 dBm to 10.89 dBm with Gaussian pulse parameter. The simulation results indicate that greater value of Q-factor and less Min. BER value indicates good quality of service and performance.

Table 7. Q-factor and Min. BER with increasing No. of users using Gaussian pulse at 21 Km					
parameter	Number of users				
	24	34	44	54	64
Q-factor	53.29	43.04	35.76	30.43	26.42
Min. BER	0	0	2.64e-280	9.54e-204	3.60e-154

6. ACKNOWLEDGEMENT

First of all, I would like to say thanks to GOD for blessing me with the spirit's ability, courage and strength to prepare this work. I would like also to express my deepest gratitude thanks to my Supervisor, **Dr MANJIT SINGH, Professor**, department of Electronics and Communication Engineering, Punjabi University, Patiala, for his valuable continuous guidance. He is constant source of energy to me

7. REFERENCE

[1] R. Nagesh, R. Rajesh Mohan, and R. S. Asha, "A Survey on Dispersion Management Using Optical Solitons in Optical Communication System," *Procedia Technol.*, vol. 25, no. Raerest, pp. 552–559, 2016.

[2] G. P. Agrawal, *Fiber-Optic Communications Systems, Third Edition.*, vol. 6. 2002.

[3] R. Malhotra, "Performance analysis in Passive Optical Networks (PONs)," vol. 1, no. 4, pp. 263–267, 2012.

[4] S. Dewra, "Performance Analysis of Gigabit Passive Optical Network Using 2Gbit / Sec Downstream Transmission," pp. 743–748, 2015.

[5] J. Chen, "Design , Analysis and Simulation of Optical Access and Wide-area Networks," *Communication*, 2009.

[6] C. C. K. Chan, *Optical Performance Monitoring*. 2010.

[7] D. B. Payne, *Fibre Optic Communication*, vol. 161. 2012.

[8] S. K. H. Sadon, S. M. Mitani, T. Kanesan, M. Hizamel, and R. Mohamed, "Quality of Service (QoS) Analysis for Decentralized Passive Optical Network (PON) Intelligent Algorithm," vol. 15, pp. 202–205, 2016.

[9] A. Dixit, B. Lannoo, G. Das, D. Colle, M. Pickavet, and P. Demeester, "Dynamic Bandwidth Allocation With SLA Awareness for QoS in Ethernet Passive Optical Networks," *J. Opt. Commun. Netw.*, vol. 5, no. 3, pp. 240–253, 2013.

[10] L. G. T. Zulai, F. R. Durand, and T. Abrão, "Energy-efficient next-generation passive optical networks based on sleep mode and heuristic optimization," *Fiber Integr. Opt.*, vol. 34, no. 3, pp. 117–137, 2015.

[11] V. Chhabra and M. Dhiman, "Method and Modelling for Allocating Wavelength in WDM Passive Optical Networks," no. 10, pp. 99–108, 2014.

[12] J. M. Senior and M. Y. Jamro, *Optical Fiber Communications: Principles and Practice*. 2009.

[13] J. Li, Y. Fan, and M. Zhou, "Performance modelling and analysis of workflow," *IEEE Trans. Syst. Man Cybern. Part A*, vol. 34, no. 2, pp. 229–242, 2004.

[14] I. Engineering, "Performance Analysis of 2 . 5 Gbps GPON," *Perform. Anal. 2.5 Gbps GPON*, vol. 3, no. 6, pp. 10148–10155, 2014.

[15] O. Infrastructures, "Henrik Wessing," 2006.

[16] M. R. Radivojević and P. S. Matavulj, "Implementation of Intra-ONU Scheduling for Quality of Service Support in Ethernet Passive Optical Networks," *J. Light. Technol.*, vol. 27, no. 18, pp. 4055–4062, 2009.

[17] N. Naim, "Real-Time Monitoring in Passive Optical Networks Using a Superluminescent LED With Uniform and Phase-Shifted Fiber Bragg Gratings," *J. Opt. ...*, vol. 5, no. 12, pp. 1425–1430, 2013.

[18] M. Fayyaz, K. Aziz, and G. Mujtaba, "Performance analysis of optical interconnects' architectures for data center networks," *Cluster Comput.*, vol. 19, no. 3, pp. 1139–1161, 2016.

[19] G. Luke, C. P. Larsen, A. Ehrhardt, and H. Jansen, "Optical Commuinications," *Teletronikk*, vol. 101.2, 2005.

[20] A. Srivastava, "A Detailed Literature Review on Cloud Computing," *Asian J. Technol. Manag. Res.*, vol. 4, pp. 2249–892, 2014.