INTERNATIONAL JOURNAL OF ADVANCE RESEARCH, IDEAS AND INNOVATIONS IN TECHNOLOGY

ISSN: 2454-132X
Impact factor: 4.295
(Volume3, Issue6)
Available online at www.ijariit.com

Design and Implementation of Various Advanced Modulation format over 8-WDM Bidirectional PON

Nisha Rani
Swami Vivekanand Institute of Engineering & Technology, Banur, Rajpura, Punjab
nisha.rani133@gmail.com

Abstract: With the growing demand for users higher speed reliable data transmission become the great need for the users. For the higher bit rate and flexible bandwidth wavelength Division Multiplexing (WDM) network is one of the best solutions. The performance of WDM mainly depends upon factor such as modulation format used in the networks. In this paper comparison of various Advanced Modulation Formats has been carried over the 8 channel Bidirectional WDM PON. Fiber without having amplifier and Dispersion compensating fibers. A network without any amplifier and repeaters reduces the network operation effectively, thus simplifying system configuration and maintenance cost. Hence, the system performance is not increased by using any sort of amplifiers and DCF. The designed system has achieved a maximum transmission distance of 120 km at the power of 0-2 dbm over Bidirectional Multi-mode fiber. This simulation work has done in opt system 14.1 suite Software.

Keyword: PON (Passive Optical Network), DCF (Dispersion Compensation Fiber), MZI (Mach Zehnder Interferometer), OLT (Optical Line Terminal), ONU (Optical Network Unit, WDM (Wavelength Division Multiplexing, MMF (Multimode Fiber).

1. INTRODUCTION

With the advancement of the communication systems, there is a need to send more data at a higher speed that provide higher security, strength, and speed with seamless connectivity [1]. The conventional ways to fulfil this requirement is to form a physical connection between the users in wired communication. In wired communication, the data is transmitted through the medium such as twisted pair cable, Co-axial cable and optical fiber cable [2]. Optical fiber cable is used as it offers a much more promising solution than the other two. It uses the principle of Total Internal Reflection and covers larger distance with larger bandwidth and high data rate [3].Optical cables used for the purpose of computer networking and other uses such as file sharing technology, surfing internet, telecommunication and watching TV etc. [4].

Increasing demands due to rapid population growth has boosted the advance modulation formats to increasing transmission capacity. Higher capacity can be achieved by multiplexing the input signal by multiplexing the input signal but there are certain modulation formats which along with increasing capacity can also improve the signal performance at the output. Some of the advanced modulation formats such as NRZ, RZ, CSRZ, and MDRZ which can be used for bandwidth utilization of fiber. So to achieve this need we have designed 8 Channel Bidirectional WDM PON based system which will be discussed in the next section. Bi-directionality of an optical fiber further increases the network capacity [5].

The Passive Optical Network (PON) is a network, which carries data in the optical domain between the OLT and ONU with a passive transport path of the optical signal. Between the transmitter and receiver, the optical network devices used as non-powered i.e. no electrical devices are used. "The basic principle of PON is to share the central Optical Line Termination (OLT) and fiber over as many Optical Network Units (ONUs) as is practical given cost effective optics [6]."

2. SIMULATION SETUP OF 8 CHANNEL BIDIRECTIONAL WDM PON

Table 2.1 represents the specifications of 8-channel Bidirectional WDM-PON system. The proposed system consists of a laser wavelength of 1550 nm, power 1 dBm, the attenuation factor of 0.2 dB/km and beam divergence of 0.2 mrad. The system consists of transceivers at both the ends i.e. Transmitter as well as receiver end. All channels are multiplexed by wavelength division multiplexing and every channel is transmitting its own information without interfering the other channel. In this way, it reduces the interference effect and aliasing effect [7].

Table 2.1 Specifications of WDM PON system

Pulse generator	PRBS
LASER Wavelength	1550 nm
Power (in mw)	0 dBm–2 dBm
Attenuation	0.2 dB/km
Transmitter aperture diameter	50 mm
Beam divergence	0.2 mrad
Responsivity	1A/W
Dark Current	10Na
Multiplexing Technique	WDM
Number of users	8
Optical fiber Used	Bidirectional MMF
Amplifier Used	None
Dispersion compensation fiber	None

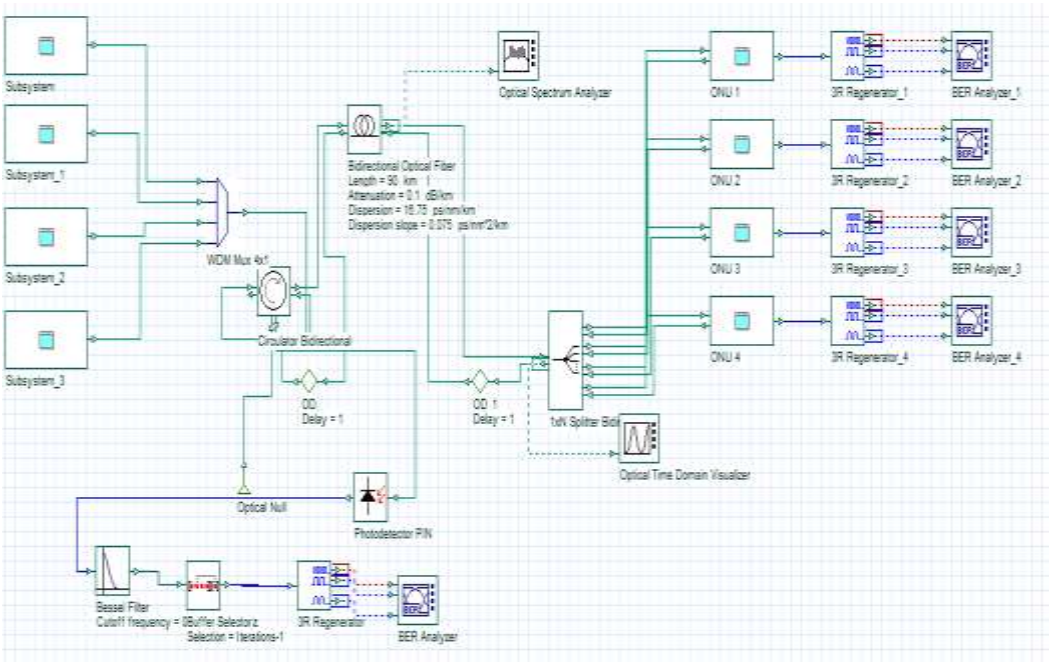

Figure 2.2 Design of 8 Channel Bidirectional Link

Figure 2.2 shows the implementation of 8 channels WDM PON over bidirectional link .the system consists of transceivers at both the ends. For transmitting part i.e. OLT, different modulation formats have been used like RZ, NRZ, CSRZ, and MDRZ, which can also be called as RZ family. For receiving the signal at ONU, Photo Detectors (PD) has been used with filters for filtering the signal and 3R Regenerator, regenerating the electrical signal. In this system, an OLT also acts as an ONU and vice versa. Also, the fiber used is Bidirectional multimode fiber. When the signal propagates from the channel then it is easily affected by the atmospheric effects so in order to remove high frequency components signal passes through the Bessel filter which removes non-linear and high frequency components along with certain harmonic components and at last, signal is analyzed by the BER analyzer followed by 3R regenerator. This 3R regenerator helps in providing the 3 inputs to BER analyzer system contains subsystem at both the ends. The prototype model is analyzed by varying its power, distance, and channel spacing.

3. ENHANCE SYSTEM PERFORMANCE BY USING ADVANCE MODULATION FORMAT

System Performance Can be enhanced by using Advance Modulation Format such as NRZ(Non-Return to Zero), RZ(Return to Zero), CSRZ(Carrier Supressed Return to Zero), MDRZ(Modified Duo Binary Return to Zero).

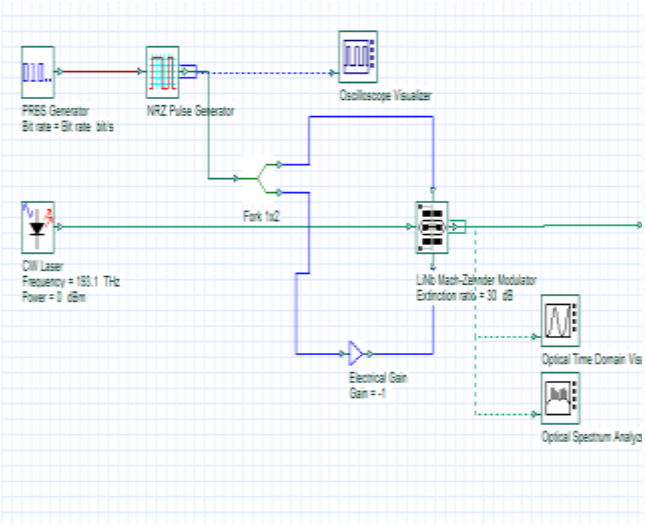

Figure 3.1(a) Design of Subsystem of NRZ Modulator

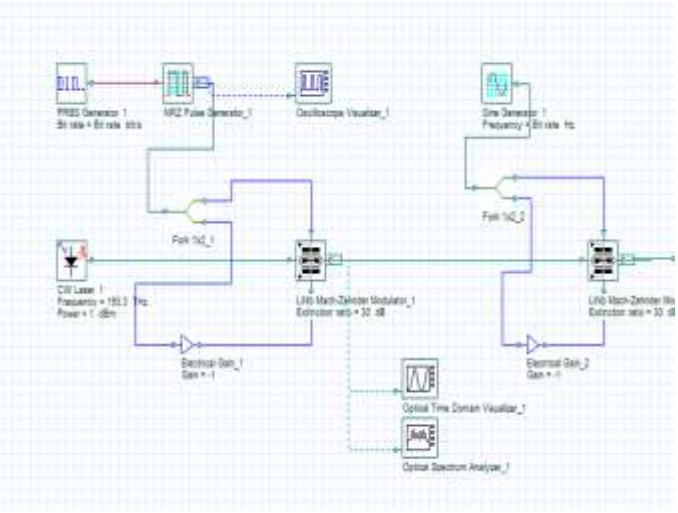

Figure 3.1(b) Design a Subsystem of RZ Modulator

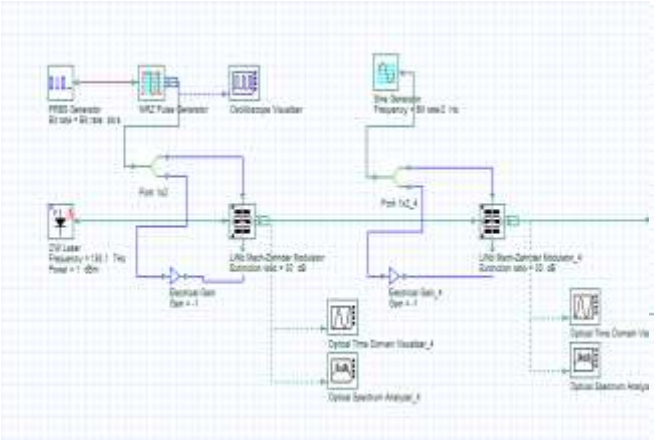

Figure 3.1(c) Design a Subsystem of CSRZ Modulator

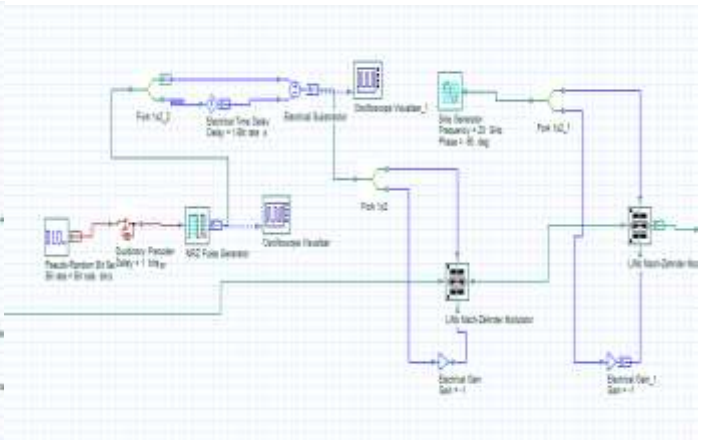

Figure 3.1(d) Design a Subsystem of MDRZ Modulator

4. RESULT AND DISCUSSION

The above system was simulated using various Advanced Modulation Formats by varying different parameters like Power and Distance. Following are the results that are obtained by simulation in Optisystem 14.1.

4.1 ANALYSIS OF VARIOUS MODULATION FORMATS WITH DIFFERENT PARAMETERS

Parameters that are varied are as under

1) Distance
2) Power

For each parameter varied, other two parameters were kept constant.

4.1.1 Analysis over varied power

For this kept all the parameters constant such as the range in beamwidth and channel spacing respectively output was taken for different values of Power varied from 0 dBm to 25 dBm as in table 4.1.1(a). For this, all the values of Power were put in sweep mode in Optisystem 14.1 keeping other parameters constant. First of all, bidirectional fiber distance is fixed at 90 km by changing its parameters than LASER parameters are fixed. The output is seen at channel 2 and 4. It is due to the fact that outermost channels are always affected most by the interference of other signals travelling along. Therefore, channel 2 shows a better value of Q-Factor and BER than showed by channel 4. Power is an input parameter which is changed after each iteration at 0 dBm to 25 dBm.

Table 4.1.1(a) Comparison Analysis On The Basis Of Q Factor and Ber

Power (in dbm)	Channel 2							
	NRZ		RZ		CSRZ		MDRZ	
	Q-Factor	BER	Q-Factor	BER	Q-Factor	BER	Q-Factor	BER
0	8.96598	1.071717 *10^{-116}	7.98646	6.9387* 10^{-116}	8.14774	1.85353* 10^{-016}	10.9532	3.18298* 10^{-28}
5	27.4745	1.77222* 10^{-116}	22.6206	1.35608 *10^{-113}	27.6601	1.0536*1 0^{-168}	32.8277	1.16859* 10^{-236}
15	218.26	0	191.055	0	193.007	0	105.385	1.15652* 10^{-158}
25	8.62727	2.76558* 10^{-18}	1343.03	0	1328.49	0	0	0

4.1.2. Analysis over varied Distance

For this kept all the parameters constant such as power and channel spacing respectively and output was taken by varying Distance from 90 km to 120 km. Modulation formats is used to give output at 90 km to 120 km without using any amplifiers in the network. The table 4.1.2(a), shows the analysis between quality factor and BER by varying distance of signal. More the distance and more the dispersion which reduces the quality factor and increases the BER. The output is seen at channel 2 and 4. Channel 2 shows a better value of Q-Factor and BER than showed by channel 4. Distance is an input parameter which is changed after each iteration at 90 km to 120 km.

Table 4.1.2(a) Comparison analysis on the basis of Q factor and BER

Distance (in Kms)	Channel 2							
	NRZ		RZ		CSRZ		MDRZ	
	Q-Factor	BER	Q-Factor	BER	Q-Factor	BER	Q-Factor	BER
90	9.76234	8.14251 *10^{-23}	9.75466	8.75492* 10^{-23}	14.0439	4.19287* 10^{-045}		2.01857* 10^{-5}
100	7.58961	1.60402 *10^{-14}	7.90872	1.29908* 10^{-15}	14.3691	4.412*10 $^{-047}$		2.05965* 10^{-5}
110	6.04271	7.56998 *10^{-10}	6.00397	9.62336* 10^{-10}	14.0208	5.8046*1 0^{-045}		2.03647* 10^{-5}
120	4.81015	7.52461 *10^{-7}	4.91783	4.35021* 10^{-7}	13.1045	1.54281* 10^{-039}		2.1853* 10^{-5}

The results of the designed system proved that Bidirectional 8 channel WDM-PON works best with MDRZ modulation format upto a distance of 120 km.

The system gives the best result when the opening of the eye is maximum. So according to the height result has been analyzed. At the 90 km eye height is $2.01857*10^{-5}$ as per the fig 4.1.3 at 100 km eye height is $2.05965*10^{-5}$ according to the fig 4.1.4 at 110 km eye height is $2.03647*10^{-5}$ as shown the fig 4.1.5 and at 120 km eye height is $2.1853*10^{-5}$ as shown the fig 4.1.6.

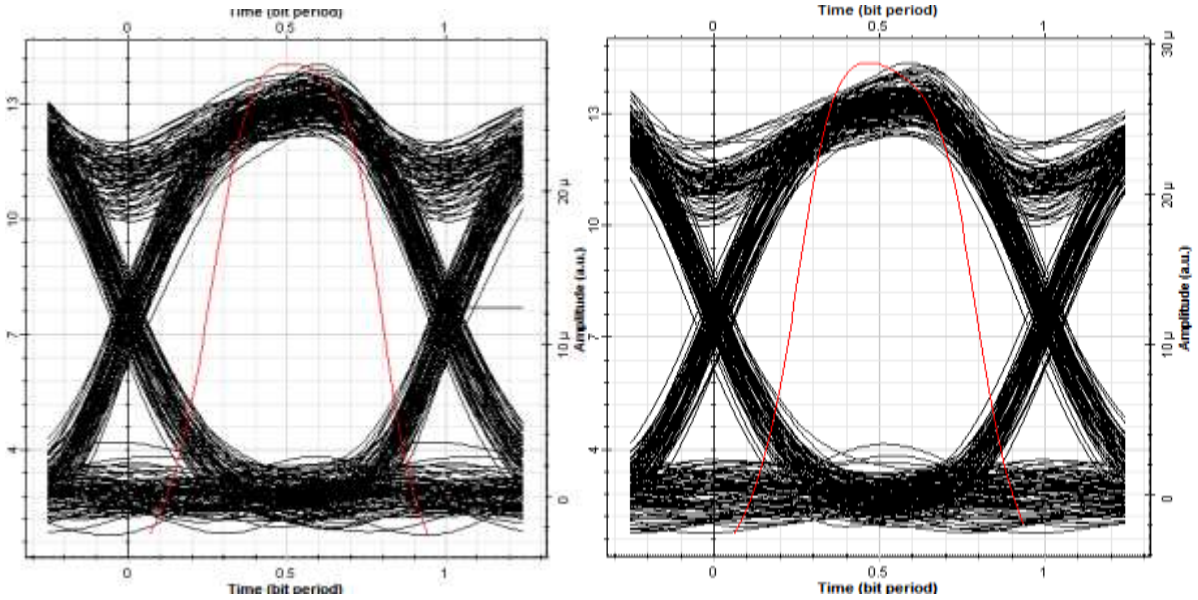

Figure 4.1.3 Eye diagram of MDRZ 90 km Figure 4.1.4 Eye diagram of MDRZ 100 km

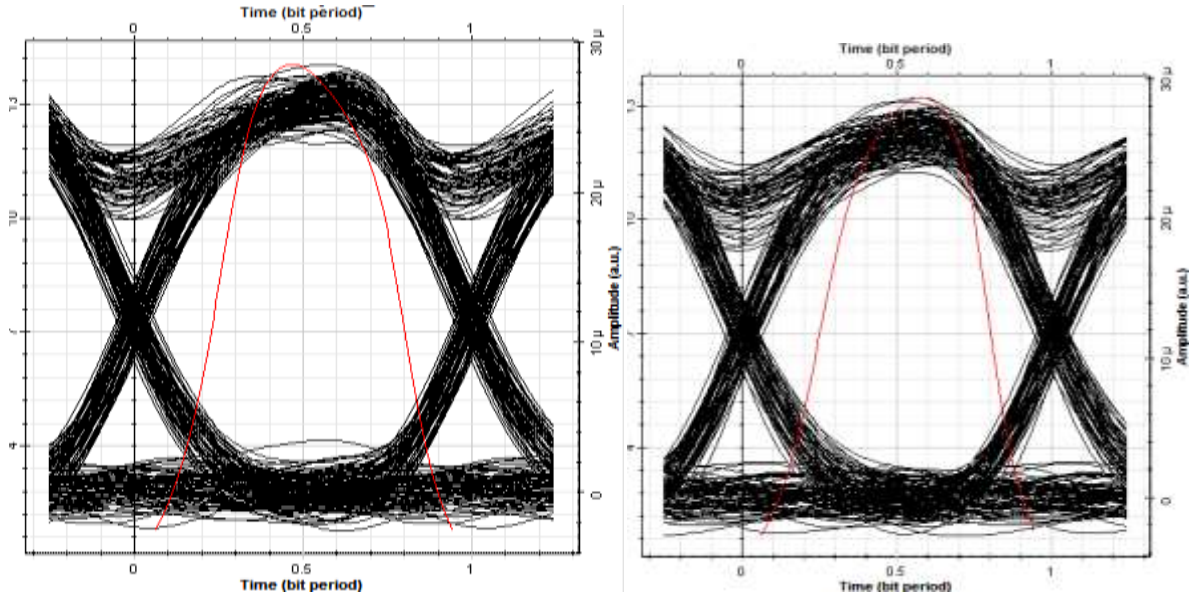

Figure 4.1.5 Eye diagram of MDRZ 110km Figure 4.1.6 Eye diagram of MDRZ 120km

CONCLUSION

In this research, a Bidirectional WDM-PON system is designed, implemented having different Advanced Modulation Formats and tested using optisystem 14.1. The results of the designed system proved that Bidirectional 8 channel WDM-PON works best with MDRZ modulation format upto a distance of 120 km, power 1dBm and channel spacing 200 GHz, without using any amplifiers, DCF and repeaters.

We have analyzed the prototype model on the optiwave software. In which system performance has been analyzed over varied power, distance and channel spacing. On the basis of analyses, we conclude that with the increase in power laser intensity increases it cover more distance but at high power, the nonlinear effects increase so we can increase the power up to particular level. On the other hand distance of 120 km and channel spacing, 200 GHz becomes increase up to a particular level than the system is affected by errors most of the part of light scattered in the system and cause the noisy spectrum at the output.

SCOPE FOR FUTURE WORK

As mentioned, analysis has done with a bidirectional system with 8 channels for various parameters like Distance, Power and Channel spacing. Further, the number of channels used can be increased to 16 or 32 with additional parameters varied like Line width etc. WDM-PON enhances the system capacity but in order to enhance more capacity Hybrid WDM TDM combination can be used.

REFERENCES

[1] Agrawal Govind P. 2006," Fiber-Optic Communications Systems", Third Edition.

[2] K Djafar. Lowell L Mynbaev. Scheiner, 2008, "Fiber-optic communications technology", Science publishing company, Bejing, Third Edition.

[3] 2001, Kaiser G., 1991, "Optical Fiber Communication", Second Edition, McGraw-Hill International.

[4] Gowar J, "Optical Communication Systems", Second Edition, Prentice Hall of India.

[5] Inna Kurbastka, Alseveska Anita, George Lilita, and Bobrovs Vjacceslavs, 2016, "Comparison of Modulation Formats for Use in the Next Generation Passive Optical Networks'', pp. 3783-3787.

[6] Inna Kurbastka, Sandis Spolitis, Girts Ivanovs and Vjaceslaves Bobrovs, 2016 "Investigation On Optimal Transmission Parameters for Different Modulation Formats in 10Gbit/s WDM-PONSystems", *IEEE*, pp. 1-5.

[7] Singh Harmanjot, Singh Gagandeep, Kaur Chamanjot, 2016, "Comparative Analysis of Advance Modulation Formats Over 8 Channel Bidirectional WDM-PON,'' *IIJETT*, Vol.-38, pp. 205-209.

[8] Kaiser G., 1991, "Optical Fiber Communication", Second Edition, McGraw-Hill International. Rachata Maneekut, Theera Sakchaichanchon, Varaporn Ket-Urai and Pasu Kaewplung, 2012, " Recent Progress of the Next Generation 40Gbps Signal Transmission Over Passive Optical Network using the Advance Modulation Formats," *IEEE*, pp. 1--4.

[9] Isaac I. Kim, Bruce McArthur, and Eric Korevaar, 2011, "Comparison of laser beam propagation at 785 nm and 1550 nm in fog and haze for optical wireless communications" *Jounal of Applied Optics, vol. 38, pp. 424-431.*

[10] Bo-ning HU, Wang Jing, Wang Wei, Rui-mei Zhao, 2010, "Analysis on Dispersion Compensation With DCF based on Opt-system", *IEEE*, pp. 40-43.

[11] Marek Hajduczenia and Henrique J. A. da Silva, 2009, "Next Generation PON Systems – Current Status", In proc. *International Conference on Transparent Optical Networks (ICTON).*

[12] Choudhary Manish and Kumar Bipin, 2009, "Analysis of Next Generation PON Architecture for Optical Broadband Access Networks" optical Fiber Communication, Tech Dig, vol. 9, pp. 607-608.

[13] Jung-Hyung Moon, Ki-Man Choi and Sil-Gu Mun, 2009, "An Automatic Wavelength Control Method of a Tunable Laser for a WDM-PON", *IEEE*, pp. 56-64.

[14] Ryohei Urata, Cedric Lam, and Hong Liu, 2009, "High Performance, Low Cost, Colorless ONU for WDM-PON", in proc. *European Conference on Optical communication (ECOC)*, pp. 3115-3123.

[15] Klaus Dieter Langer and Jelena Grubor, 2007, "Recent Developments in Optical Wireless Communications Using Infrared and Visible Light", *IEEE*, pp.146-150.

[16] Chang Hee Lee, Wayne Sorin, and Rui-mei Zhao, 2006, "Fiber to the Home Using a PON Infrastructure", *Journal of Light wave Technology*, pp**.** 4538-4545.

