CERTAIN INVESTIGATION ON PASSIVE OPTICAL NETWORKS

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Abstract: A Passive optical network is a fiber-optic telecommunications technology for delivering broadband network access to end-users. PON is used to simultaneously transmit signals in both the upstream and downstream directions to and from the user endpoints. The dramatic increase of internet user and development of new high volume internet applications has a profound impact on PON. Today most of available networks are quite busy networks and as the number of nodes increases in the network, the communication over the network also increases. When the data is transferred over the network, there are many causes that is packet loss, such as congestion over the network. The PON resolve the most of the above defined problem. As it provide such a large bandwidth. This paper to investigate the performance of passive optical network in terms of Data rate, BER, Received power, Q factor and Extinction Ratio.

Keywords: GPON. XGPON. NG-PON. BER. FTTx. Q factor,

1. Introduction

Introduction: The great growth in user demand for metric because of today's network applications stir the competition between network carriers to satisfy the user demands. FSAN began studies to assess wants in late 2010, they complete that there is a decent gap between user wants and also the knowledge measure offered by the ten Gbps capable Passive Optical Networks (10G-PON named as XGPON) technologies. A system proposal for Next Generation- Passive Optical Network (NGPON) stage two was commenced in 2011. Among different answers Time and Wavelength – Passive Optical Network (TWDM-PON) technology was suggested at the Apr 2012 meeting as a primary solution to style and implement NG-PON2. The network style achieves main style objectives like out there metric, network reach and price. The demand for bandwidth-consuming services, like HDTV, video editing, online computer and mobile gaming, interactive learning via Internet, telemedicine, 3D television, will ultimately end in an increased use of the bandwidth. Passive optical networks (PONs) are considered as crucial elements of current and future broadband access networks. These systems enable the distribution of data to multiple users through fiber optic cables without requiring active devices or external power sources[1]. These networks make use of various wavelengths for downstream and upstream and have a point-to-multipoint (P2MP) architecture for providing the broadband services. This architecture has remained one in all the foremost popular solutions for fiber to the x (FTTx) deployment among network operators [2, 3]. the large PON deployment has been driven by growing demand in bandwidth, predominantly fueled by high-speed Internet traffic. This evolution drives a necessity for providing higher bandwidth within the downstream. Growing services like cloud computing, online gaming and file sharing will generate more symmetrical traffic within the future. it's thus apparent that within the future, optical access will should evolve toward symmetrical traffic transport. With the aim of provisioning of full services by the largescale deployment of PON architecture worldwide, network operators expect enhanced features from them. a number of these features include improved service support and bandwidth capabilities together with enhanced performance of supportive equipment and access nodes over the present PON architectures [4,5]. The passive optical network (PON) architecture has become the popular fixture for FTTx. Many network operators worldwide have deployed gigabit-class passive optical networks (GPONs) to cater for a rise in demand for higher bandwidth [6]. The PONs are expected to deliver full services which is able to require improved bandwidth and repair support capabilities. within the view of full service access network (FSAN), a PON social group, and ITU-T, a customary organization, the next-generation PONs, i.e., NG-PON, will support full services to users with much higher bandwidth. visible of full service access network (FSAN) and International Telecommunication Union (ITU-T), the evolution of NG-PONs has been divided into two phases termed as NG-PON1 and NG-PON2, respectively. NGPON1 is defined as a midterm solution, and NG-PON2 is taken into account as a long-term upgrade of PON architecture. NG-PON service providers expect improved bandwidth further as service support capabilities over their existing PONs. While NG-PON2 networks is also considered united of the foremost promising solutions, service providers should must accommodate evolving standards. one among the main challenges of NG-PON1 networks remains as their coexistence with the deployed existing GPON systems [7–9]. Optical distribution networks (ODNs) currently account for around 70% of the cost in fitting functional PONs. It is, therefore, imperative that the ODN deployed for GPON is employed for the NG-PON. The enhancement will be dole out within the supportive equipment over their existing PONs. There are several review articles published within the literature addressing the problems of PON and their future trends [7, 8, 10–12]. The evolution of Ethernet based PON (EPON), wavelength division multiplexing (WDM) PON, orthogonal requency division multiplexing (OFDM) PON and NG-PON has been discussed in [10]. In [11], an economical thanks to upgrade the road rate of a PON system from 10 Gbps to 25 Gbps has been proposed. Performance assessment and key features of future optical access networks with wired–wireless convergence have been presented in [12].

PON Technology:

PON consists chiefly of associate optical Line Terminal (OLT), many Optical Network Terminal (ONT) or Optical Network Units (ONTs) and Optical Distribution Network (ODN) that connects OLT and burden The distinction between ONT and ONU is conferred concisely as ONU may be a device that terminates distributed endpoints of ODN and ONT is subscriber device that terminates distributed endpoints of ODN and it's thought-about a special type of ONU.

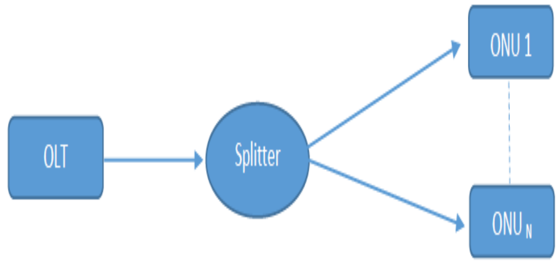

Figure 1: PON architecture

The difference between ONT and ONU is presented briefly as ONU is a device that terminates distributed endpoints of ODN and ONT is subscriber device that terminates distributed endpoints of ODN and it is considered a special form of ONU.

Optical Line Terminal (OLT)

OLT is that the CO aspect device interfaces the backbone network to access network. OLT consists of media access management (MAC) layer protocol, optical transmitter and optical receiver. Optical receiver get and separate the user knowledge from the ODN, then pull up and decrypt the user knowledge and direct it to the back-haul network. OLT controls knowledge flow across the ODN into two directions with completely different wavelength for every to avoid interference between the contents of downlink and transmission channel. In downstream direction, the OLT multiplex voice, knowledge and video traffic victimisation TDM, WDM or each and launch the multiplexed optical signal over the ODN to the user encumbrance. Within the upstream direction, the OLT receives all user traffic returning from encumbrance across ODN and direct it to the backbone network. OLT will support a spread of services on an equivalent fiber with completely different wavelength for every service, as an example for PON The 1490 nm wavelength for downstream voice and knowledge traffic, the 1550 nm wavelength for video distribution and 1310 nm wavelength for upstream voice.

Optical Network Terminal ONT

ONT is that the user aspect device that interfaces optically to optical access network PON at one aspect and electrically to user's instrumentality at user aspect. ONT area unit on the market in several type factors for several services like GPON ONT it will mixture, groom, and transport numerous styles of data traffic from the user and send it over a single-fiber PON infrastructure to OLT.

Optical Splitter

Splitter is that the main component in PON since it's passive power divider that provides Passive Optical Network its name. It is called splitter however it's bifacial device that divide the facility downstream optical signal from OLT to any or all splitter outputs connected to ONTs, it conjointly combines the incoming upstream signals from ONTs to at least one fiber connecting to OLT. The losses thanks to power division limits the quantity of outputs N connecting to ONTs or split quantitative relation. There area unit principally 2 styles of splitters one. Splitters supported placoid technology for split quantitative relation greater than thirty two a pair of. Splitters supported coalesced bi-conical couplers for split quantitative relation less than thirty two.

4.Simulation Design

The simulations for the proposed experiment were carried using an OptiSystem simulator. The OptiSystem enables a user to plan, test and simulate various optical networks. The component library of an OptiSystem is comprised of several components that empowers the user to enter parameters that can be measured from real devices. Simulations have been carried out using five types of single-mode fiber cable which are G654 A, G654 B, G655, G656, G657 and the system can transmit the different data rates. The performance are analysed by Q factor and BER with different data rates.

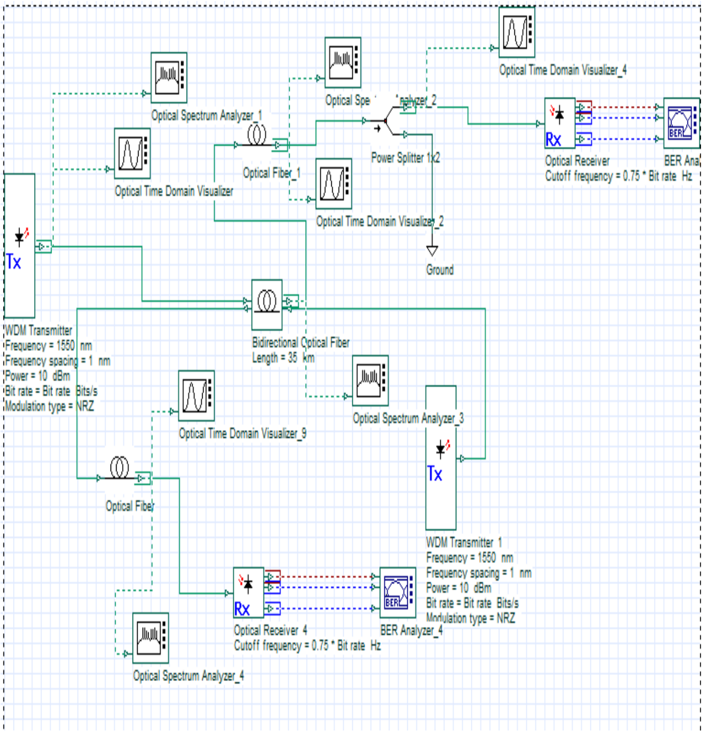

Figure 2: Simulation diagram for 1 user

Simulation diagram can trasmit the different fibers with different data rates. The propagation distance upto 10km. From the optical line terminal to the optical network unit is the downstream and the optical network unit to the optical line terminal is the upstream direction. In each susbsytem have Receiver and BER analyser. Receiver have the low pass filter, 3R genertor, and photodetector. In each subsystem have four users for both upstream and downstream direction. The output of this transmitter is fed to the optical cable which is bidirectional and 10km in length. The OLT is also comprised of a receiving unit that receives the signal coming from the user end.WDM used to separate data streams based on the wavelength of the laser light.One wavelength can be used to transmit downstream data while another is used to carry upstream data. Their function is to split the data coming from the OLT side into 32 outputs and on the other hand transmit the signals from user end to the OLT.

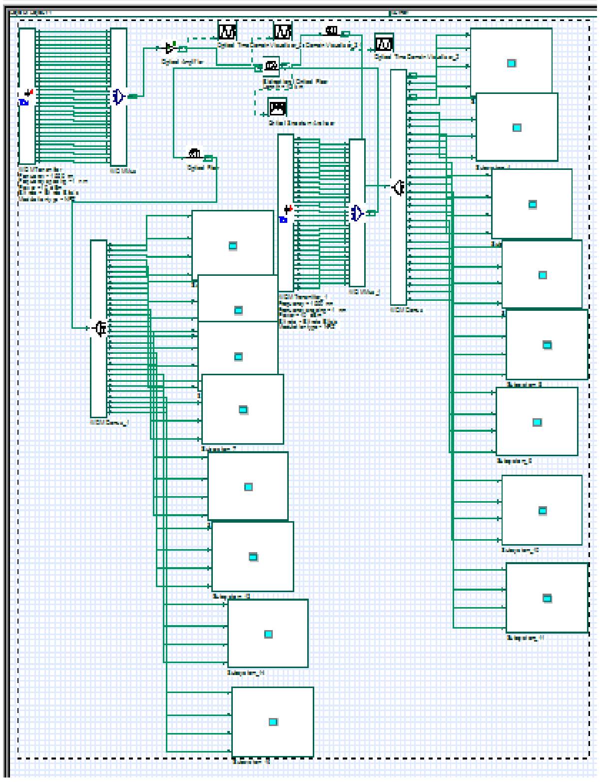

Figure 3: Simulation digram for 32 user

5. Result and Discussion

G654 single-mode optical fiber

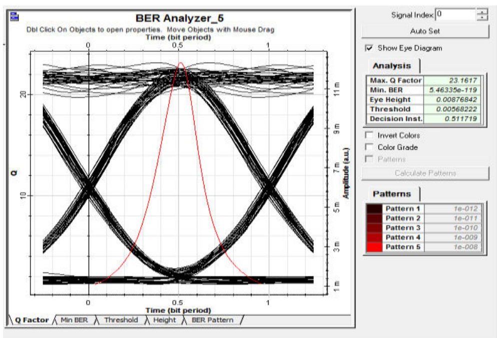

Figure 4: Eye diagram of G654 SMF operating at 10 Gbps with downstream direction and with a link distance of 10km for user 1

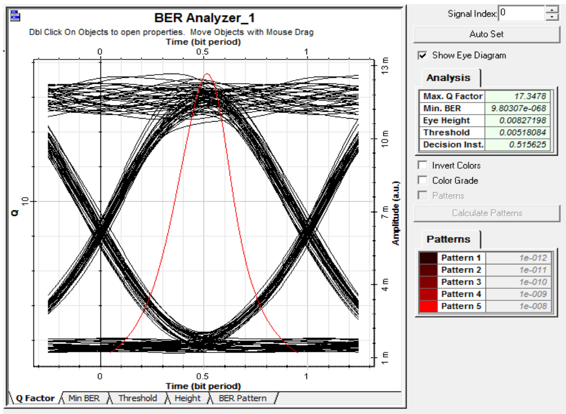

Figure 5: Eye diagram of G654 SMF operating at 12 Gbps with downstream direction and with a link distance of 10km for user 1

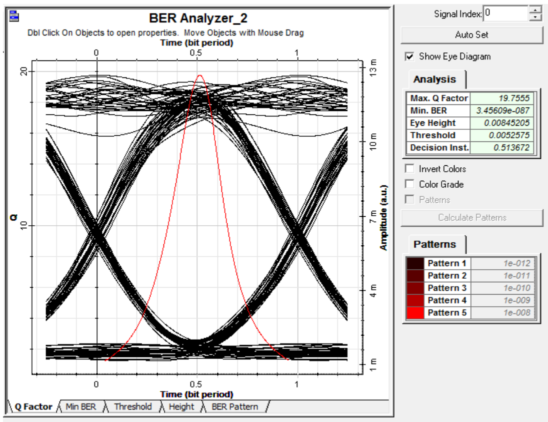

Figure 6: Eye diagram of G654 SMF operating at 15 Gbps with downstream direction and with a link distance of 10km for user

This is the output for 4 user in the downstream direction. the BER and Q factor for G-654 single-mode optical fiber for different fibers and at various data rates. The eye diagram of G-654 SMF operating at 10 Gbps with downstream direction and with a link distance of 10 kms. From the figure, it can be seen that the Q factor is 19.7555 and BER is 3.45609e-087.

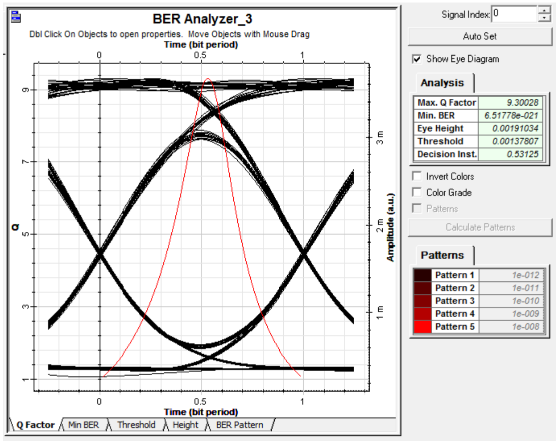

Figure 7: Eye diagram of G654 SMF operating at 10 Gbps with upstream direction and with a link distance of 10km for user 1

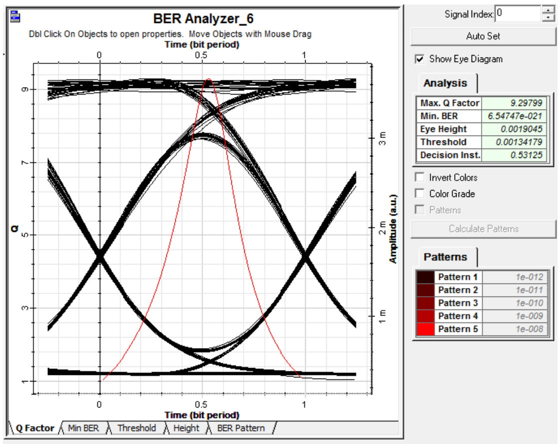

Figure 8: Eye diagram of G654 SMF operating at 12Gbps with upstream direction and with a link distance of 10km

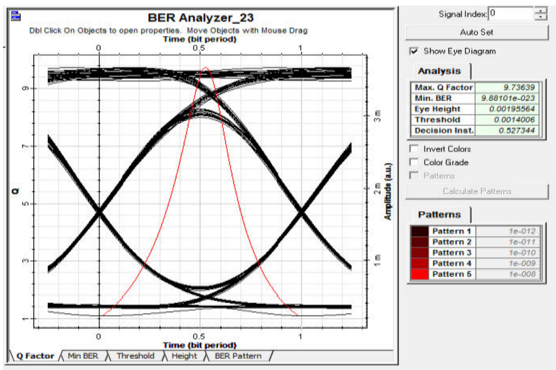

Figure 9: Eye diagram of G654 SMF operating at 15Gbps with upstream direction and with a link distance of 10km

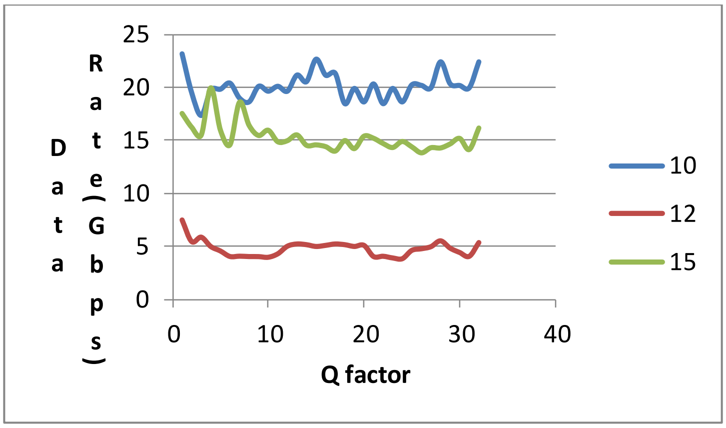

Figure:10 Data rate versus Q factor for G654A SMF in the downstream

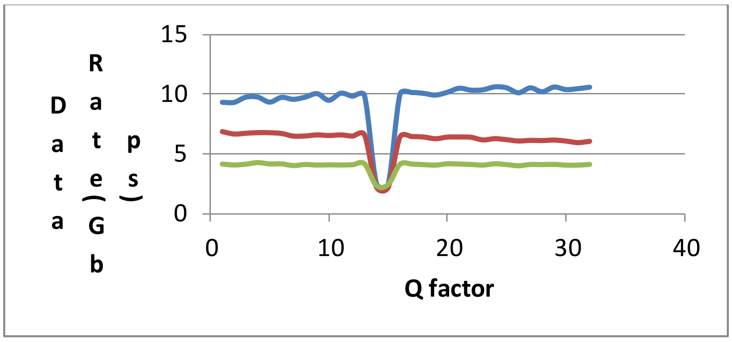

Figure:11 Data rate versus Q factor for G654A SMF in the upstream

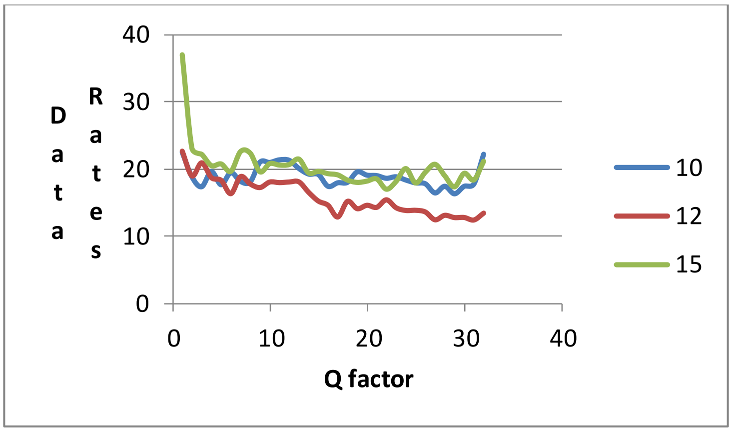

Figure:12 Data rate versus Q factor for G654B SMF in the downstream

Graph Analysis

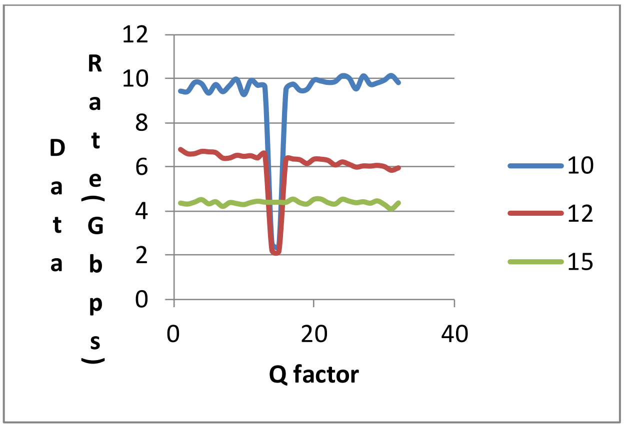

Figure:13 Data rate versus Q factor for G654B SMF in the upstream

G655 single-mode optical fiber

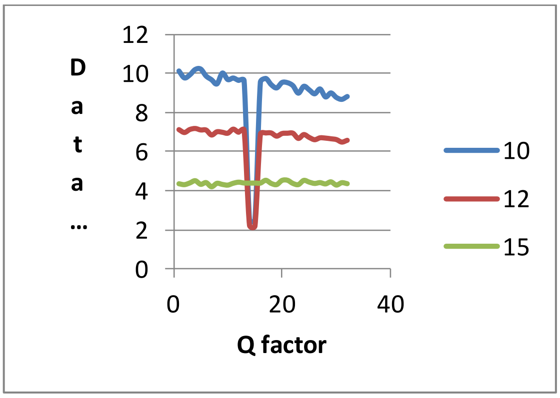

Figure:14 Data rate versus Q factor for G655 SMF in the upstream

G656 single-mode optical fiber

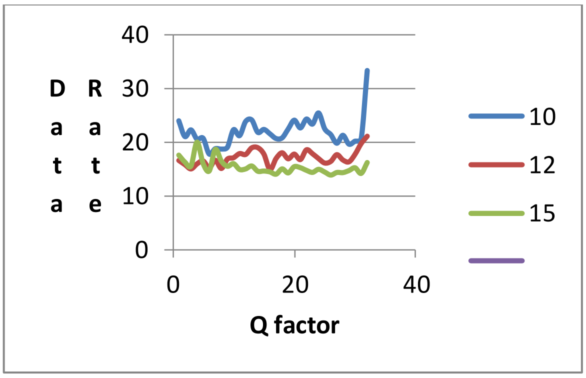

Figure: 15 Data rate versus Q factor for G656 SMF in the downstream

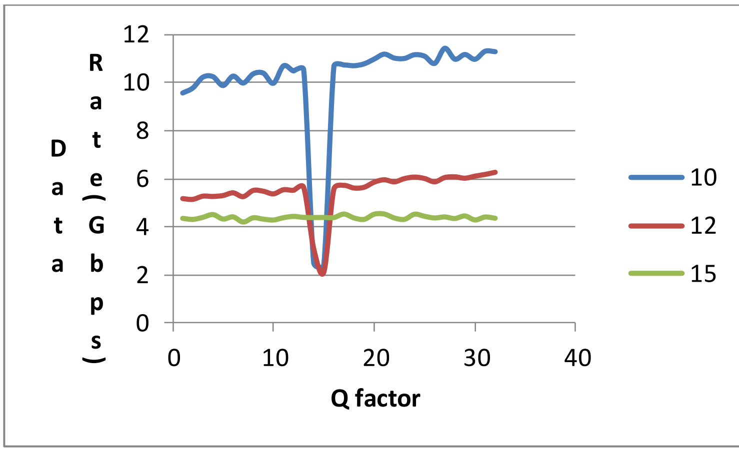

Figure: 16 Data rate versus Q factor for G656 SMF in the upstream

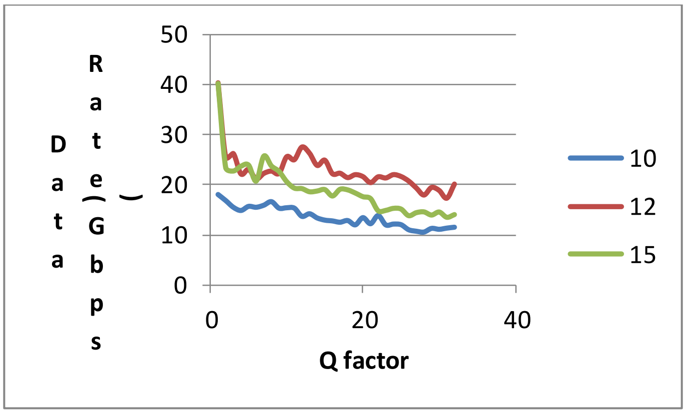

Figure: 17 Data rate versus Q factor for G657 SMF in the downstream

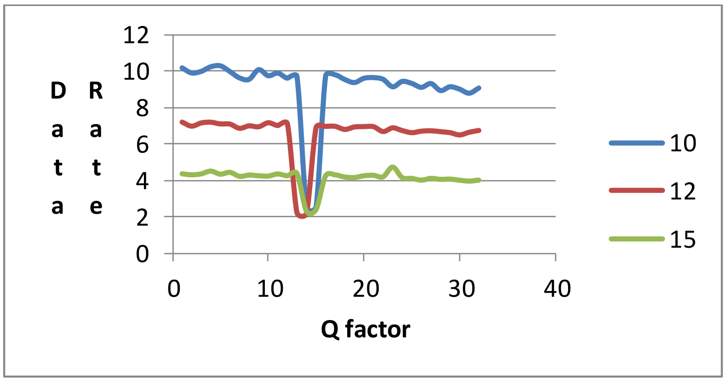

Figure:18 Data rate versus Q factor for G657 SMF in the upstream

Power analysis

Passive optical network are analysed by different input power with output power. The input powers are 0dBm,

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2dBm, 4dBm, 6dBm, 8dBm and the corresponding output power are analysed.

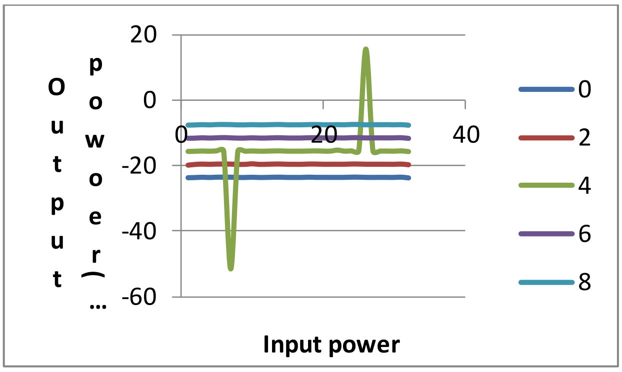

Figure: 19 Input power versus output power for photodetector APD in downstream direction

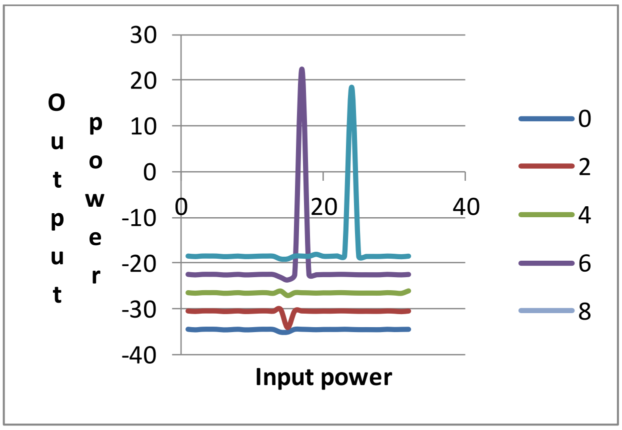

Figure: 20 Input power versus Output power for photodetector APD in Upstream direction

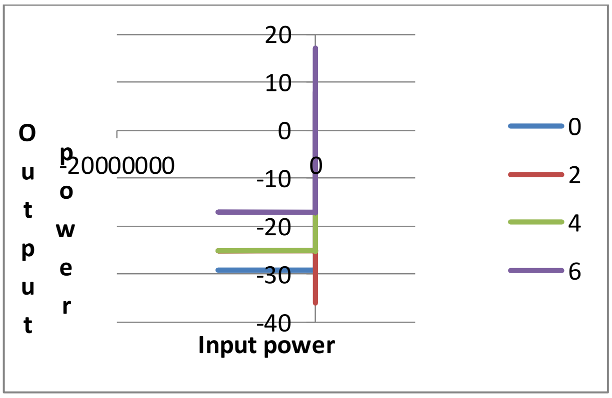

Figure: 21 Input power versus output power for photodetector PIN in downstream direction

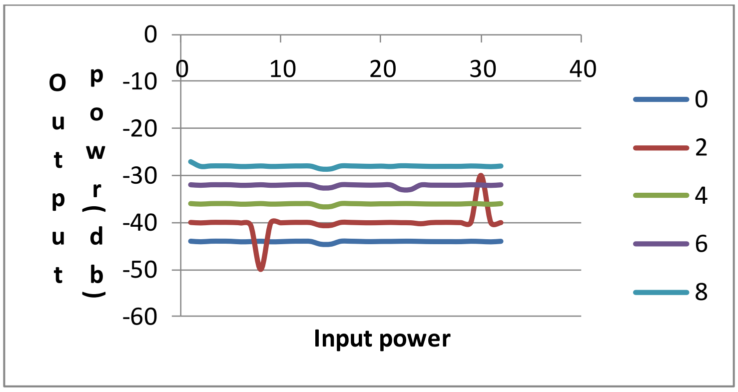

Figure: 22 Input power versus output power for photodetector PIN in upstream direction

Extinction Ratio analysis

Passive optical network are analysed by different extinction ratio. That are 10dBm, 15dBm, 20dBm, 25dBm, 30dBm.

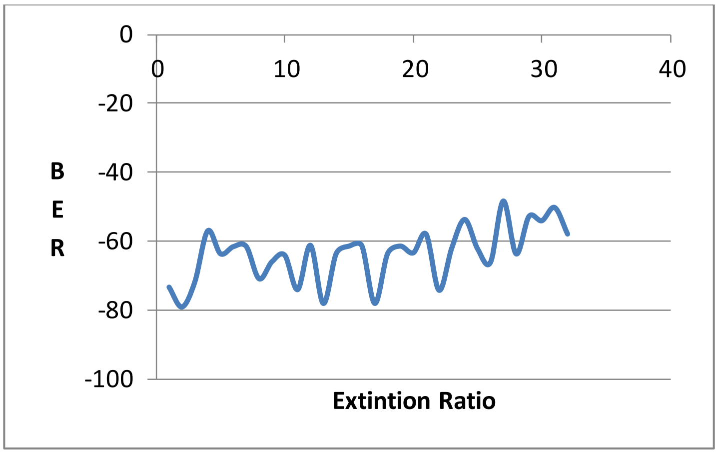

Figure: 23 Extinction ratio versus BER for downstream direction

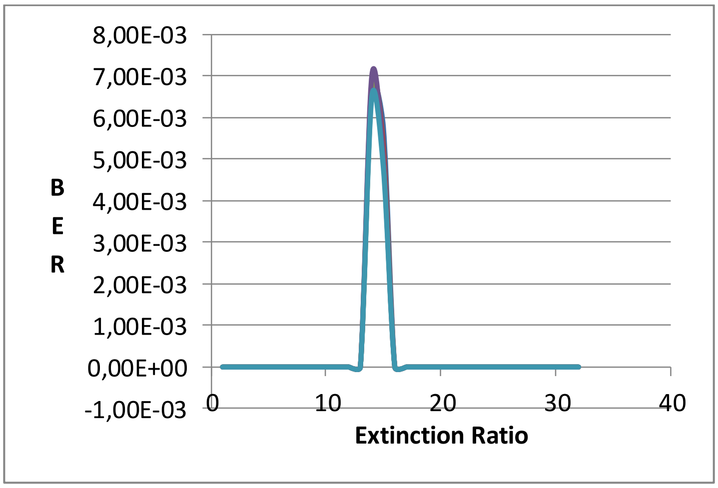

Figure: 24 Extinction ratio versus BER for upstream direction

Conclusion

PON is a very effective fiber optics access technology. It has gained much interest in today's networking due to its flexibility, high bandwidth and low cost passive connection. For instance, PON technology has been successfully deployed in Fiber-to-the-Home (FTTH) that support Triple Play services that combine the internet data, telephony and video to the home through shared cable. The Simulation was performed on Optisystem-Optiwave version 7.0 software. The analysis of simulation results was based on BER, Q factor and eye pattern obtained for various scenarios. The system was analyzed using different fibers with different data rates both downstream and upstream directions. The existing PON architecture based on G-654A, G-654B, G-655, G-656, G657 fibers considering and different data rates for upgradation to PON. And also the system was analysed by power and extinction ratio. It has been found that, the more effective parameter in the performance was by increasing the power source of OLT in both downstream and upstream scenarios. It has also been found that OLT power source controls the upstream.

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