

A STUDY OF PASSIVE OPTICAL NETWORK AND GIGABIT PASSIVE OPTICAL NETWORK

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Abstract— Nowadays in the fiber-to-the home (FTTH) mechanisms the GPON is the broadly utilized method. Within the carrier's central office and consumer sites the optical access lines are employed in the GPON mechanism is a bi-directional point-to-multipoint system structural design. The GPON mechanism is regarded as the most powerful scheme for the extensive employments comparative to the other mechanisms which are utilized to offer the fiber to the home. On the basis of the time division multiplexing the GPON is occurred as the single downstream wavelength is utilized for the digital and another downstream is utilized for the analog video services. With the help of the GPON encapsulating method (GEM) it can transfer the Ethernet as well as ATM and TDM by having PSTN, ISDN, E1 and E3. This paper offers an overview to the work that has been done many authors.

method (GEM) it can transfer the Ethernet as well as ATM and TDM by having PSTN, ISDN, E1 and E3 [6]. This paper offers an overview to the work that has been done many authors. To the passive optical power splitter only a unique mode optical fiber is linked to the close locations of the customers from the central office. The optical power is alienated into N different routes to the users at this point by the passive splitting component [7]. The several splitting routes may fluctuate from 2 to 64. The unique single-mode fibers are linked to every user such as house, office, etc. from the optical splitter. From the central office to every customer the optical fiber transmission ranges up to 20 km [8].

Index Terms— PON, GPON, FTTH, ONU.

I. INTRODUCTION

The operational mechanisms on the basis of the Optical fiber such as fiber-to-the home, fiber-to-the-building, etc. have identified the gains of minimum loss, large bandwidth and large reach and now it is going to employ globally. In the point-to-point [1] and point-to-multipoint time-multiplexed passive optical network (PON) structural designs the Fiber-to-the-home systems are employed. A three-layered service is delivered to the users like home [2], university and customer principles from the central office (CO) by the usual passive optical network (PON) as illustrated in the figure 1. Among the higher limit of 1550 nm and the lower limit of 1300 nm is monitored by the central office [3] on the receiver section. A couple of key standards for the PONs are the Ethernet PON (EPON) and the gigabits PON (GPON) [4].

Within the carrier's central office and consumer sites the optical access lines are employed in the GPON mechanism is a bi-directional point-to-multipoint system structural design. The GPON mechanism is regarded as the most powerful scheme for the extensive employments comparative to the other mechanisms which are utilized to offer the fiber to the home. On the basis of the time division multiplexing the GPON is occurred as the single downstream [5] wavelength is utilized for the digital and another downstream is utilized for the analog video services. With the help of the GPON encapsulating

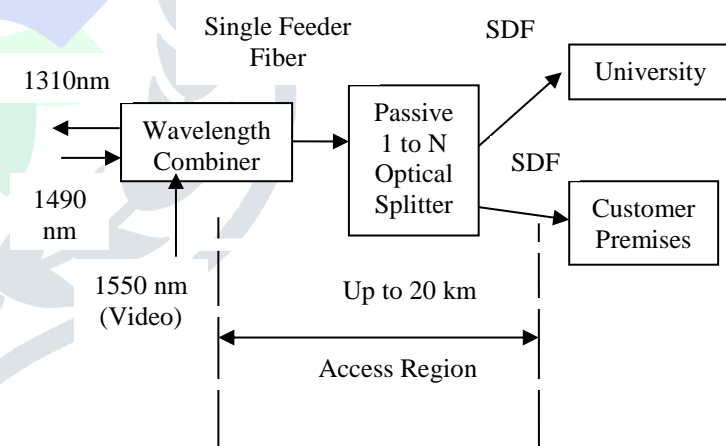


Fig 1 General PON network

II. GPON WORKING

In order to transfer the information bi-directionally (upstream and downstream) on an individual optical fiber the WDM technique is utilized by the GPON method. The broadcast mechanism is utilized by the GPON for the downstream data transfer in order to [9] alienate the transmitter and the receiver signals of several customers on the similar optical fiber. And for the upstream data transmission the TDMA mechanism is utilized. For the triple play service like high-speed Internet, IP telephony, and broadcasting video the GPON is the finest option. To summarize the information on the GPON the GPON Encapsulation Method is utilized. On the basis of the vaguely

enhanced edition of the ITU-T recommendation G.7041 Generic framing procedure this method occurs [10].

A. GPON Transmission

1. Downstream GPON Frame format;

In the behavior of the TDM from the OLT the downstream traffic is transmitted to total ONUs. Only frames are considered by each ONU that are encryption ensured. The physical control block downstream, the ATM separation and the GEM separation contained by the downstream frame. For the PON the familiar time reference is offered by the downstream and for the upstream the familiar control signaling is offered [11].

2. Upstream GPON Frame format;

In order to communicate among the OLT every ONU has its individual optical transmitter in the upstream direction. The turns are necessitated to be taken by the ONU to transfer its information to the OLT as there is only single optical receiver at the OLT. For the transmission of the data bursts the variable time length slots are allotted to the entire ONUs by applying the TDMA in the upstream traffic under control on the OLT situated on the central office. The several transmission bursts are contained by the upstream frame. The less Physical Layer Overhead is consisted by every upstream burst [11].

B. Dynamic Bandwidth Allocation (DBA)

The GPON traffic parameters are described in the profile of the DBA and vigorously bound to allot the bandwidth and also enhance the bandwidth use of the upstream. The system presentation is enhanced effectively by the dynamic bandwidth allotment that offers reliability tailoring network responsiveness. A service provider is enabled by the DBA in order to produce high revenue from FFTH systems among no boosting raw bandwidth through enhancing the percentage of suitable on subscription. The OLT is applied in order to influence the DBA that allots bandwidth volume to ONUs. In the downstream direction the traffic is transferred whereas this mechanism operates only in the upstream direction.

C. Transmission Container (T-CONT)

The idea of a variation within the PON transmission convergence and the ATM layer is offered by the T-CONTs. In the system the bandwidth utilized by the unique ONU based on the traffic state at the particular ONU as well as on the traffic pattern on other ONUs in the upstream direction. Some self began broadcast through some ONU in the direction of the upstream could outcome in the clash where the channel is mutual and the presentation is degraded by the retransmission. So, this mutual channel is constructed to act as several point-to-point links within the ONU and the OLT through applying TDMA. On the entire ONUs on the basis of the traffic pattern it contributes the availability to the ONU on the steady slot among the downstream frame. The frame is alienated into several container kinds for the traffic of the upstream. In the GPON there are five kinds illustrated as:

Type-1 TCONT is a steady T-CONT type service and not serviced by DBA. On the basis of the unwanted intermittent consents ensuring steady payload allotment to stable bandwidth necessitations.

Type-2 T-CONT is anticipated for fluctuated bit rate among bounded delay and jitter needs such as video and voice on the IP.

Type-3 TCONT is projected for ensured delay.

Type-4 T-CONT is for the finest exertion traffic.

Type-5 T-CONT is merged for a couple of or more of the other four kinds illustrated over and in this case the unique bandwidth reporting and assignment is completed at the ONU.

D. T-CONT Bandwidth and DBA implementation

T-CONT Type 1 is distinguished through the unchanging bandwidth only. The ensured bandwidth equivalent to the high bandwidth and has the largest precedence.

T-CONT Type 2 is described by ensured bandwidth only that is the provisioned high bandwidth [12].

E. GPON Encapsulation Method Segment

A couple of mechanisms of encapsulation are supported by the GPON that are: the ATM and the GPON encapsulation method (GEM). The entire traffic is plotted across the GPON system among the GEM by applying a variant of SONET/SDH Generic Framing Procedure (GFP). In the mechanism of the GPON a GPON encapsulation method is the shortest service unit. One or more than one kind of service stream is taken by all the GEMs port. Afterward taking the service stream the GEM port should be plotted to the -CONT upstream service scheduling. Among various service kinds the several T-CONTs can be constructed and supported by the entire ONUs. On the basis of the pattern of the customer among single or more than single GEM ports a T-CONT can be bound. Within the OLT and ONU a GEM port is utilized to take service. A native transport of voice, video, and data with no extra ATM or IP encapsulation layer is supported by the GEM. The downstream and upstream rates that are supported by the GEM are 2.5 Gbits/sec and from 155 Mbits/sec to 2.5 Gbits/sec [13].

F. Optical Splitter

An individual fiber is linked from the Optical Line Terminal to several Optical Network Units by the classical PON mechanism. Within the OLT and the several ONUs the point to multipoint link is achieved by applying single or more than single passive branching devices in the route of the fiber. One input and the several outputs are attained in this component. A bi-directional component is the optical splitter. In order to manufacture the splitters there are a couple of mechanisms that are: 1) Fused Biconical Taper (FBT) and 2) Planar Lightwave Circuit (PLC). Through specifically fusing a couple of fibers together the FBT splitter is constructed. A microscopic optical circuit is contained by the PLC splitter that is classically etched in the silicon. The GPON can be utilized because the optical splitter is not the section of the GPON but the capability of the GPON is enhanced as the splitter is utilized in it.

III. RELATED WORK

SanjeevVerma et al. [1], In this paper, a system that can provide an error free communication from single point to multipoint network had been discussed. In this proposed system the fiber Bragg's grating (FBG) technique had been used to reduce the errors due to inter symbol interference for both point to point (P2P) communication and for the HSDR. In fiber communication link, the optical meter was used at transmission side to get polarization for various lengths of optical fibers. For the length of optical fibre (L) = 40 km, the maximum value of Q-factor obtained is 7.79338. The initial point of polarization was 185THz and ending point was 200 THz, Here the value of vertical linear polarization is (VLP 1, 0, 0) and the value horizontal linear polarization is (HLP 1, 0, 0), $S1$ was 1dBm and $S0$ was -6.71496dBm respectively.

IvicaCale et al. [2], In this paper, demand of high bandwidths by the customers due to introduction of new techniques had been discussed like Television (IPTV) and Video on demand (VoD) over internet in addition to High Speed Internet access (HIS). Ca help in satisfying demands related to high bandwidths but it has limitation related to distance. May be there is only one solution to fulfill the demands related to high bandwidth and the solution is usage of optical fiber cables. Passive Optical Network (PON) is one of the ways to get high bandwidth. In European countries and in USA Gigabit passive optical network is primarily used, whereas in Asia while use EPON/GePON is widely used. This paper had provided review on Gigabit PON and network architecture to analyze this technique, transmission system and idea related to the power consumption of GPON systems.

Naresh Kumar. [3], This paper had described Gigabit PON that can provide error free long distance communication by using distributed Raman amplification and it had resulted in improved communication technique by using square root module for the distance of 60 km at the rate of data transmission 2.5 Gbps. It had been also observed that quality factor (that is Q) had been improved with the usage of square root module, which further helped to increase the length of GPON.

Marilet De Andrade et al. [4], This paper had discussed about the importance of using optical network in various segments of a global communication networks and it was also highlighted that PONs are very important in the access network as well as in supporting different communication network techniques. Finally, it was analyzed after discussing the gigabit PONs that these can be used for broader bandwidth and longer distance communication.

Marino Rodrigues et al. [5], As the demand for bandwidth is increasing it becomes a serious challenge for telecom service providers to meet the required demands of user like businessmen. In this paper, solution for above mentioned problem had been discussed. Optical fiber is the only solution to meet the high bandwidth demands. So, optical fiber became a part of access networks. With the help of optical fiber rate high transmission rate can be achieved that is not possible with the help of optical fibers, coaxial cables and wireless communication network. Optical fibers can be manufacture from different materials, so on the basis of this, it was classified as: glass optical fiber (GOF) and plastic optical fiber (POF). This paper aimed to study the usage of POF in various communication networks with the help of simulation software. This study had been done in two steps:

First step was realization of a Gigabit Passive Optical Network (GPON) by using different types of optical fibers glass optical fibers and plastic optical fibers. After this the second step was analyzing the characteristics of POF in an optical distribution network where GPON and 10G-PON exist simultaneously. Finally, after analyzing the performance of POF it was concluded that it can be used in access networks but the optical distribution network (ODN) attenuation should be around 15 db.

D. Verhulst et al. [6], In this paper the high performance of 1.25 Gbit/s GPON burst-mode uplink had been demonstrated which had exceeded the ITU-T G.984 recommendation and it had also supported the power leveling mechanism (PLM). The sensitivity of -31.6 dbm had been achieved by burst mode receiver with the 21.9 dB dynamic range .

Lukas Malina. [7], This paper had dealt with the study of authenticity and security of Gigabit Passive Optical Networks (GPON) and an efficient security solution had been proposed. The solution provided for security of network was creating mutual authentication and key generation of key between the Optical Line Termination (OLT) unit and end units (ONUs) in Optical Distribution Network (ODN) as per described by the ITU-T G.984 series of standards. New coding and cryptographic techniques had been used for generation of key so that data transmitted should be secured. The parameters used in coding techniques were transmitted by the PLOAM (Physical Layer Operations, Administration and Maintenance) messages. Here, in this solution the signal propagation values had been used to characterize the output between OLT and ONU, it provides more secured form of data transmission. Finally, the efficiency of proposed had been analyzed and had shown better results.

Sumanpreet et al. [8], This paper had reviewed the performance of Gigabit passive optical network for high rate data networks. Present world demands for High Speed access to internet, Video on demand (VoD) etc. which cannot be achieved by Asymmetric digital subscriber line (ADSL) technology. In ADSL copper wires are used as media for transmission of data. With the help of copper wire higher data rate cannot be achieved. The only way to meet the increasing demand of bandwidth is implementation of optical fiber in access networks. Gigabit passive optical network technology is one of the ways to implement fiber in optical distribution network. In broadband networks in which data transmitted from point to many points, in these type of networks GPON technology is one of the best choices..

Debasmitha Hazra et al. [9], In this paper, GPON downstream link with data 1.25 Gb/s had been studied. In the proposed model of GPON optical network had been implemented and the capability of downlink physical media had been analyzed. Limitation involving in the designing of this model like optical fiber span analysis, power consumption etc. had been considered with worst case while designing this model. The quality factor i.e. Q and bit error rate, these two values were used to determine the efficiency and quality of proposed network. For class A number of users are two, similarly for class B the number of users are 8 and for class C it can support 15 users.

Sanjeev Dewra et al. [10], In this paper, Fiber Bragg Grating had been studied and described. Various applications, properties, manufacturing and Fiber Bragg grating designing had been discussed. Formation of FBG's are very easy, they are small in size, low in cost and perform well even under electromagnetic radiations. The necessary techniques for manufacturing of fiber Bragg grating had been described. This paper had shown the complete and organized overview of fiber Bragg grating technology.

Sanjeev Verma et al. [11], Upcoming generation demanding high speed data in various fields and applications. The data can be transmitted by different types of medium copper wire, coaxial cable, wireless medium or by using optical fiber. Performance of optical fiber network can be measured through various parameters like Q-factor (it should have maximum value for good performance of network), BER or bit error rate (it should be minimum), Eye height and Threshold. Optical fiber network can be used in different type of application like high speed internet, video on demand, video on internet etc. as it can provide high speed data transmission. This paper was

primarily focused on increment in Q- factor and decrement in bit error rate BER by varying the distance and transmitted bit sequence in uniform Bragg grating based optical fiber communication system. "OPTISYSTEM" software was used to check the performance of proposed system. By taking bit sequence 1010101010 as input and transmitted at distance of 70km the maximum Q-factor obtained was 13.9572 and minimum BER was $1.21174e-044$.

Lin Qi et al. [12], In the field of optical fiber communication various technologies are used to compensate the depression. The compensation technologies that were invented earlier, suitable for only single optical signal and some aren't suitable for optical fiber communication. To overcome this problem the Uniform Fiber Bragg Grating (UBFG) coupling theory in the surrounding of its reflection band gap had shown effective results. In this paper, a new dispersion compensator had been introduced. This new dispersion compensator can be used to reduce the dispersion of various optical signals in WDM system. The simulation had been done by using OPTISIM and the results had shown that the proposed system is valid.

Christi K. Madsen et al. [13], In this paper, new and unique design of optical filter had been proposed that could help in more data transmission from optical fibers. In present scenario of communication network, optical filters are very important for advanced working of optical communication network. This paper had presented new digital processing methods for designing of optical filters. These new optical filter designs would help researchers to keep in pace with this quickly evolving technology. This approach was completely focused on filter characteristics and it also help to deal with complex filters. Various theoretical and experimental results with their various applications in variety of systems-including the new wavelength division multiplexing (WDM) technology had been discussed in this paper.

Nguyen Dong-Nhat et al. [13], In this paper, performance of absolute added correlative coding (AACC) had been studied and analyzed. (AACC) coding technique had been analyzed with the help of two types of signals that are: non-return-to-zero (NRZ) and return-to-zero (RZ) by using binary intensity modulation receiver in 40 Gb/s optical metro-access networks that was working at 1550 nm. After that the two signals (RZ and NRZ) transmitted by using AACC technique had been compared and results had shown that NRZ impulse shaping is superior as compare to the RZ in terms of spectral efficiency, residual dispersion and self-phase modulation (SPM) tolerance. Though, RZ-AACC had experienced advantage of ~1–2 dB in receiver sensitivity as compare to NRZ-AACC for 300-km single-mode fiber delivery.

IV. CONCLUSION

For the transporting Ethernet and IP traffic the GPON determined the requirement to include PON to be a Gigabit able resolution. Now-a-days the GPON is the much enhanced PON mechanism in the industry. Comparative to the ATM and Ethernet based PON mechanism the GPON is provided a huge effectiveness. Distant broadcasting and the greater bandwidth is offered by the GPON. For the broadband access systems the GPON is the finest point to multipoint method. Comparative to the PON protocols the speed of the GPON is very high surveyed by the author from the literature.

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