Giga Passive Optical Network

Competition for the provision of high-bandwidth multi-play services (video, voice, data) is growing. Enhanced service delivery requires increased end-user Bandwidth over large Giga Passive Optical Network Technologies (GPON) use PONs for triple-play services, including subscribers to TV, VoIP, and Internet services. The benefit is much higher data rates, which are essential for video distribution and other Internet services. In which study of the GPON technology we discuss. Broadband access networks and PON (DSL, cable modem TDM, WDM,). PON architecture (FTTx, optical transmission system, power splitting techniques in a TDM PONs), optical technologies in passive optical access networks. APON, BPON, EPON, GPON, WDM PON. It addresses the opportunities and challenges that service providers face as they offer their customers new GPON technology capabilities and analyze standards for performance, physical properties, implementation, and testing requirements. It also discusses the development pathways for each standard and the challenges to such development. The final chapter contains the conclusions, some final thoughts, suggestions and recommendations for the implementation of new projects.

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Fiber to the Home, often acquainted with FTTH, is defined as a technology for access networks that distributes the highest possible speed of internet connections via fiber that goes directly to the city, the building or the office. The fiber optic communication path is terminated within the subscriber's homes for the purpose of carrying communication services to a single subscriber. FTTH is unique because it removes all bottlenecks that delay the performance of other types of networks. With FTTH, possible download files are at least ten times faster than, for example, ADSL networks.

Why FTTH is needed

Because it is the only type of finely tuned line access network solution that is authentically protected against all future developments and eventualities, ergo it is the only one where it makes sense to invest when a starting network is used. FTTH offers significantly higher bandwidth and better access to novice accommodation types than other access options, and is the only network option that is capable of spreading the future economic expansion that has led the information for economies and communities. It is also more reliable and more economical to use than alternatives. The following figure shows the estimates of the required bandwidth in the world until 2030.

There are several advantages associated with FTTH that are highlighted

- FTTH features local battery backup and low power consumption.
- FTTH is reliable, scalable and secure.
- The FTTH networks are a future proof architecture.
- Signals peregrinate a long distance inside fiber cable without degradation up to 20 Kms or more under some circumstances.

GPON Architecture

FTTH are divided over two main architectures. In particular, the two commonly used architectures for FTTH implementation are active and passive. AON architecture (Active Optical Networks) is also called Point-Point architecture (P2P) and the architecture of the passive optical network (PON) is called Point to Multi Point (P2M). The loss of active or passive architectures for deployment depends on the type of accommodation to be distributed, the costs of the infrastructure, the current infrastructure and future plans for migration to the starting technologies.

Objective of GPON

- Multiservice convey: TDM voice, synchronous convey SONET/SDH, Ethernet (10/100 Base T), ATM, etc.
- Multi rate: Support for multiple bitrate with the same protocol, including symmetrical speeds of 622Mbps, 1.25Gbps, 2,5Gbps, 10Gbps and asymmetric of 155Mbps/1.25Gbps, 622Mbps/1.25Gbps, 155Mbps/2.5Gbps, 622Mbps/2.5Gbps and 1.25Gbps/2.5Gbps respectively in upstream and downstream.
- Maximum range of 20 km, albeit the standard has been prepared to get up to 60 km.
- OAM (Operation, Administration and Management) end to culminate.
- The maximum number of users that can hang from the same fiber is 64,but the system is yare to give up to 128 users.

Giga Passive Optical Network (GPON) System

GPON Networks are State of Art Next Generation Network that can provide Voice, Data & Video (Triple Play services) on the same Fiber (Hammadi et al, Aug 2017). GPON technology consists of the following equipment’s

Optical Line Terminal Equipment (OLT)

The OLT switch, as shown in Figure 5, is installed in the control panel office. The 7342 P-OLT is selected as the core of the GPON system (Alcatel Lucent 7342 ISAM FTTU, data sheet). The OLT switch provides the ability to terminate multiple passive optical networks to ONT and control them for user connectivity and aircraft traffic to the operator's network to the CO over Ethernet. OLT is equipped with a service network card, which is connected to various systems such as data servers, soft switches, gateways and so on. The downlink transfer rate from OLT to ONT is 2.5 GB / s and the uplink transfer rate is 1.2 GB / s at each GPON port. In the case where the downstream wavelength of 1480-1500 nm is used in the upstream 1260-1360 nm (Keizer, 2006), the network design is based on distributed fission with a split ratio of 32 fibers per PON port. With this design consideration, the total number of subscribers that can be served by an OLT sub-rack for bid triple play services is 1024 subscribers. The guaranteed minimum price, which can be delivered to any GPON subscriber with 2.5 GB / s Downstream, must not be less than 78.125 Mb / s per subscriber. Higher downstream speeds would result in higher user percentages, while higher splitting ratios would result in a lower user rate. By way of illustration, the exchange ratio between split ratios and subscriber rate at the lower assigned user percentages again indicates 10Gb / s GPON technology subscribed to, examining different loads with different split ratios.

Optical Network Terminal (ONT)

ONT will be installed in each of the subscriber's homes and an ONT as shown in Figure 5 can offer 4 telephone lines, 2 data ethernet ports and IP TV. There are different types of ONT for medium and large companies and several buildings that vary in the number of ports. Examples of these ONTs are the SOHO which can support 8 telephone lines and the Multi-Dwelling Unit (MDU) which consists of three units and can provide 24 telephone wires and 12 high-speed data connections. In this project, the selected ONT is the 7342 Single Family Unit ONT (GSFU-A) that can provide triple play services. The GSFU-A unit is equipped with: a) 2 x 10/100 Base T Ethernet interface b) 4 POTS lines for voice (VOIP) c) IPTV support d) H.248 for VOIP signaling.

Design and Implementation of GPON

GPON provides two interfaces, GEM and ATM. ATM interface could be used to transport telephony service which could be realized through the use of VoATM to convert from ATM channel to RJ-11 interface. GEM interface could be used to transport internet service. This requires conversion from Ethernet to GEM which is standardized and can be presented as an Ethernet interface to the user. EPON could be implemented in a similar manner as GPON. Except that the Enhancement band is not specified for EPON although it can be implemented same as in GPON. At the ONU level EPON provides an Ethernet interface which can be used directly as a user interface without any conversion. In fact this is one of the major differences between EPON and GPON. For telephony, VolP protocol could be used since the IP is the available interface and since it is easier to encapsulate VolP into Ethernet than encapsulating VoATM into Ethernet. Finally, television service is realized in the same way as in GPON through the use of an extra wavelength.

FTTH projects are amongst such projects where they involve a mixer of civil and technical works. Project implementation planning saves time, efforts and cost. Therefore, a careful consideration is given to this issue. Special consideration is given to FO testing at the end of each step. Two methods are adopted in this project to determine the exact location of broken optical fiber in an installed optical fiber cable when the cable jacket is not visibly damaged. These are OTDR testing and laser source/power meter set. Optical Time Domain Reflector meter OTDR is used for attenuation monitoring and fault location in the feeder network while laser source/power meter is used for the other tests.

In order to keep pace with the high-demand in services and applications, PONs are continuing to evolve and considerable research efforts are being made to address the various challenges observed. In this article, we promoted the deployment of PONs in access network to replace conventional copper and wireless based technologies. The work covered a literature review on PONs evolution over the last two decades, world status on FTTx deployment, technologies, equipment, network cable design, loss and power budget consideration. We have shown a study to analyze the worse committed rate for different split ratios per PON with respect to different network load. We have also demonstrated and justified the limitation of transmission distance specification of a PON link to not exceed 20km. a guideline for designers is also provided through numerical calculation for the selection of transmitter and receivers with special emphasis on the minimum output power required and the lowest detection sensitivity, respectively. The work has also demonstrated conceptual design, acceptance test procedure,

and analysis of OTDR test results to verify compliance with given specifications and standards.

When implementing a new project support for the most common services should be taken into account. From the end user point of view an ONU hardware equipped with an Ethernet interface should be most convenient to provide these services. Such system implementation that requires less protocol conversion or encapsulation would be an EPON based system. Since the Internet protocol has been there for a while and lots of services are born in this environment. The migration of these services to a PON network using the same protocol has its advantages. GPON on the other hand has its advantages as well; it provides more direct service interfaces. but the main question remains would an average user really needs those different services. At the user level if the same service could be viable using Ethernet, ATM support becomes extra. Since the user equipment is standardized to Ethernet, ATM is no must, extra conversion like Ethernet to GEM and vise versa are then overkill. At the network operator level the advantage of EPON is the relative cheap equipment needed for EPON networks. A general recommendation to any new project is to consider the required services and the available protocols that support these services taking into consideration the techno-economic factors behind the implementation of any of the two standards in a PON environment.

It is clear by now that any emerging standard should take into consideration legacy systems and should offer coexistence and smooth migration to the next generation PONs. Although current standards describe a more or less complete paN network based on EPON and GPON there are still unsolved issues. What happens when the 10Gbitls systems exist side by side with the legacy 1.2 I 2.4 Gbitls systems? The 10Gbitls rates are available for active optical networks now, but are they suitable for PONs? Are the devices then still easy to manufacture? Or more constraints need to be implemented pushing the price even higher? These questions can only be answered and analyzed when the standards are available. IEEE 802.3av 10Gitls EPON standard answered some of these questions while network operators still wait for ITU-T 10G bitls GPON standard which is expected to come out on or before 2012. Another question that is unanswered to any new project. what if more wavelengths are going to be used in a standard? Each standard describes a fixed band-plan to use but can this bandplan be extended with other wavelengths?