Performance Evaluation of Fiber to the Home Triple Play Services

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ABSTRACT - This paper evaluates and compares FTTH (Fiber To The Home) PON (Passive Optical Network) link design for multiple subscribers at 100 kms reach at high bitt rate. A splitter is used as a PON (Passive Optical Network) element which creates communication between a Central Office to different users and. An inline amplifier and a boosting amplifier is employed before fiber length which tends to decrease BER and allows more users to lodge. This architecture is investigated for varying values of data rate from a CO (Central Office) to the PON in terms of BER (Bit Error Rate). The simulation work reports BER of 5.5246e−17 at 2.5 Gbit/s systems for the case of 60 users. Similarly in the variation of BER with respect to transmission length, we observe that BER shows an increase in its value as transmission distance enhances. Fiber based access networks can deliver performance that can support the increasing demands for high speed connections.

KEYWORDS: GEAPON, TDMPON, CWDM, OLT, ONT

I. INTRODUCTION

The future generation technology needs to be compatible with today’s bandwidth requirements and also offer bandwidth stretch to support future growth based on network expansion and new application development. Since optical technology has proven to have large bandwidth competence, it appears to be the proper choice to solve the restricted access between backbone and access networks [1]. Fibre to the Home (FTTH) refers to a broadband telecommunication system based on fiber optic cables and associated optical electronics for delivery of multiple advanced services to homes and businesses. [3] FTTH is relatively new and fast growing method of providing very higher bandwidth to consumers and also for businesses, and thereby enabling more robust any kind of services. Figure 1 represents the simple optical distribution network in which many services are provided by FTTH network.

![Fig.1 Simple Optical Distribution Network](image)

Thus, several Fiber-to-the-home (FTTH) or Fiber-To-The-Premises (FTTP) networks have been proposed to provide broadband services to the end user. FTTH is simply the 100% deployment of optical fiber in the access network. Several architectures have been...
proposed of Time Division Multiplexing PON (TDMPON) provides Broadband PON (BPON) with downstream of 622 Mbps, Ethernet PON with 1.25 Gbps downstream, & Gigabit PON (GPON) with 2.5 Gbps downstream. Gigabit-capable passive optical network (GPON) is the basic technology to support the structure of the next-generation FTTH system and supports multispeed rates, full services, robust network, high efficiency and other advantages, and the suggestions of service providers at the same time. GPON is regarded as one of the best choices for broadband access network in the future. [5] Kocher D et al., (2013) in her paper proposed network link design for 56 subscribers at 20 km reach at 2 Gbps bit rate. The simulation work reports BER of 4.5246e−009 at 2 Gbit/s systems for the case of 56 users.[9]

II. SYSTEM DESCRIPTION & MODELING

The block diagram of designed FTTH network is shown in Figure 2. The triple play services (data, voice and video) are transmitted simultaneously and are received at N number of users depending upon the data rate being used.

Fig.2 Block Diagram of Simulation of Fiber to the Home Triple Play Services at different data rates using GE-PON architecture for multiple users.

There are two transmitters viz. One for video and another is for data & VoIP. The communication through the optical fibre path employ the CWDM (Coarse Wavelength Division Multiplexing) technique with data/voice component transmitted at wavelengths in the range of 1480–1500 nm, and video within the 1550-1560 nm range. As shown in block diagram voice, video & data (triple play) is modulated by Laser and transmitted through span of 100km of SMF. At the receiver side passive splitter splits the information equally into 64 numbers of users, where the information is filtered out separately for video and voice/data. CO OLT (Optical Line Terminal) block which is the transmitter block consists of Data/VOIP and Video components. The Data/VOIP transmitter modelled with pseudo-random data generator (PRBS), NRZ modulator driver, direct modulated laser, and booster amplifier. The video component modelled as RF SCM (sub-carrier multiplexed) link with only two tones (channels) for simplicity. RF video transmitter consists of two Electrical Signal Generators, summer, direct-modulated laser, and pre-amplifier. Next, Data/Voice and Video signals are multiplexed at Multiplexer and launched into 100-km fiber span. The signal is then send to passive splitter. A splitter is used to differentiate the particular user. Optical splitter component simulates an “Ideal” optical splitter. It works as a balanced splitter with the same attenuation on each output. Attenuation is set to a default value of 0 dB, so this component implements an ideal splitter without any insertion loss, i.e. a component that perfectly splits the input signals. To measure the spectrum of the voice and data at the user’s end we use spectrum analyzer. We applied an instrument called BER Tester to check the error rate of the simulation. Now at the end of the receiver side every ONU (Optical Network Unit) has a particular receiver for both the reception of the voice and the data.

II. RESULTs & DISCUSSIONs

Data is transmitted at the wavelength of 1490 nm and the video is transmitted at the wavelength of 1550 nm.figure 3 shows the signal power if both voice and video at two wavelengths. Both the wavelengths are selected because these wavelengths window has certain advantage i.e. it is low attenuation window. So each user has separate or slightly different wavelength spectra for video and the data. Figure 5 shows the signal magnitude of both the signals, we can observe that the magnitude of video signal is more as compared to data/voice signals.
As the number of ONUs increases some errors have also occurred so BER is calculated. Figure 5 shows a graph showing the effect the number of users versus BER characteristics.

Also figure shows the comparison of the existing work explained in previous paper and our designed system. As in previous work the designed system was at data rate 2Gbps with 56 users [10], the newly designed system is working at 2.5Gbps with 64 users. As it is observed from the graph that in the designed system the BER improves.

Table 1.1 shows the values of BER for different number of users at 1.25Gbps, 2.5 Gbps and 5Gbps. In this table, as the number of users increases the Bit Error Rate (BER) keeps on increases. Also a boosting amplifier is employed before fiber length which decreases BER and allows more users to accommodate.

![Figure 6: BER vs Distance for 2.5Gbps](image)

Figure 6 shows the BER vs distance graph for 2.5 Gbps with different number users. As it is observed from the graph that the system works fine up to 120 kms above that the BER starts rising.

![Table 1.1: BER for different number of users at 1.25Gbps, 2.5Gbps and 5Gbps](image)
III. CONCLUSION

This accomplishment simulated an optimized GE-PON based FTTH access network to provide residential subscribers with triple play services. We described the requirements of GE-PON access network with considerations of services and PON specific functions. To satisfy those requirements, we simulated an optimized architecture and describe the detailed functions of major elements. Finally, we consider the major technical issues i.e. BER to realize the GE-PON based FTTH access network. The results at 2.5 Gbit/s system between the BER and different number of users illustrate that as the number of users increases beyond 64 users the BER comes to unacceptable level and if further increase data rate of system say 5 Gbps, then we observe a sharp increase in BER. FTTH is a driver for the development of advances optoelectronics technologies, and the great volume in production of optical modules will also accelerate the reduction in cost. We described that by using a boosting amplifier can decrease BER up to a certain extent and hence more users can be accommodated.

IV. REFERENCES: