3rd International Conference on Recent Development in Engineering Science, Humanities and Management
National Institute of Technical Teachers Training & Research, Chandigarh, India (ESHM-17)
26th March 2017, www.conferenceworld.in ISBN: 978-93-86171-35-1

REVIEW ON WDM AND TDM PON USING DIFFERENT CODING SCHEMES FOR EXTENDED REACH

Pallavi Katna[1], Anu Sheetal [2]

[1,2]Guru Nanak Dev University, Regional Campus, Gurdaspur (Punjab)

ABSTRACT

Telecommunication's technology is exponentially increasing day by day with high speed of reliable data transmission. Optical network play an important role in meeting these demands. The performance of time division multiplexing (TDM) and wavelength division multiplexing (WDM) passive optical networks (PON) using different coding schemes are estimated. For these schemes 16 users are used in the receiver section. So in order to analyze the system performance based on various parameters i.e. BER and Eye pattern. The main purpose is to design a hybrid WDM/TDM PON using reach extender. In this paper, a brief description about the recent challenges and current technology existing in WDM and TDM PON has been reviewed.

Keywords: Passive optical networks (PON), Optical networks unit (ONU), Wavelength division multiplexing (WDM), Time division multiplexing (TDM)

I. INTRODUCTION

Optical fiber has been playing a vital role in communication system. This has led to various applications such as Fiber to the Desk (FTTD), Fiber to the Building (FTTB), and Fiber to the Premises (FTTP) and even Fiber to the Home (FTTH) system largely, because the technology exists, but the cost effectiveness still holds them in abeyance [1-3]. PON are considered to be a method for implementation of FTTH. FTTH provide many services such as peer to peer transmission, video file swapping, internet protocol, video on demand. The PON candidates are Ethernet, WDM and ATM. To fulfill all these demands passive optical networks are required using increase reach, high bandwidth, greater density, security etc. There are different multiplexing schemes such as TDM, WDM and hybrid TDM/WDM [4-5]. The PON delivers the services by means of different multiplexing techniques. Coding techniques are described in section II. Section III describes about the current PON and recent challenges existing in TDM/WDM PON. This is followed by section IV which describes the simulation setup and literature survey and finally section conclusion.

II. CODING TECHNIQUES

1 Non return to zero: Line coding defines the symbols which are arranged in a particular pattern for transmission that represent binary data. NRZ encoding is commonly used in both synchronous and asynchronous transmission. Using NRZ, logic '1' is sent as a high value and logic '0' is sent as a low value.

ISBN: 978-93-86171-35-1

Basically two types of coding is possible. In unipolar NRZ coding '1' is represented by positive voltage (+ve) and '0' is represented by DC line. In bipolar NRZ coding '1' is represented by one physical layer while '0' is represented by another level.

2 Return to zero: In this case '1' is represented by first half of the bit duration. Absence of a pulse represented a binary '0', during the entire bit duration and second half of the level returns to zero. Bandwidth requires for the RZ coding is twice, because for transmission of data it takes only half bit duration and other half returns to zero.

3 Manchester coding: Manchester coding is also known as phase encoding. In this encoding, each bit has one transition either low then high, or high then low of equal time. Manchester code is widely used for various practical applications, because it consumes less bandwidth to achieve the original transmitted data rate.

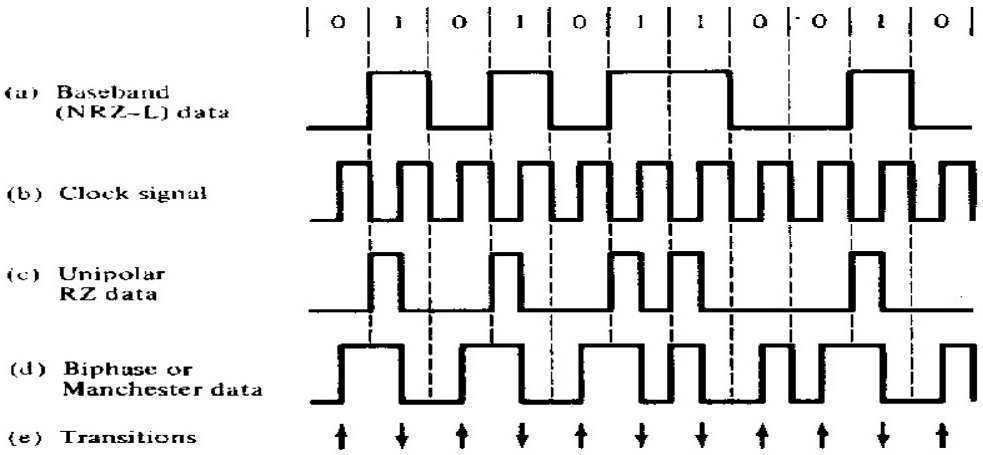

Fig. 1 Various coding techniques

III. OPTICAL ACCESS NETWORKS

PON were developed during the year 1980's. It is a cheapest way to implement. PON architecture use only passive components since it is a point to multipoint transport network which reduces the cost and maintenance. PON has several advantages; no need for installing multiplexer and de-multiplexer in the splitter, longer distance between central office and customers, easy upgrades to higher bit rates. PON consists of a Optical line termination (OLT), Optical network unit (ONU), Optical distribution network (ODN) etc. An OLT is a central office node that is connected to a backbone networks. In case of ONUs or ONTs multiple users are present that connects to the OLT by a single channel, and the fibers and splitters between them, called the ODN. There are various architectures of PON using different modulation schemes like Hybrid TDM/WDM, TDM and WDM.

1 TDM PON: Fig.2 shows the tree topology of TDM PON network [2]. At the Central Office the Optical Line Termination transmits the data in the downstream traffic. An optical fiber connects the OLT to the multiple ONU users which is connected through an optical Combiner/ Splitter which combines or divides the signal from OLT to ONU. The TDM PON is a single point to multipoint architecture. In the downstream direction the data were transmit by the OLT to ONU. It is passed through a 1: N splitter and it is extracted by the ONU. In the form of packets the data is transmitted and each user transmits packets after a particular time delay.

ISBN: 978-93-86171-35-1

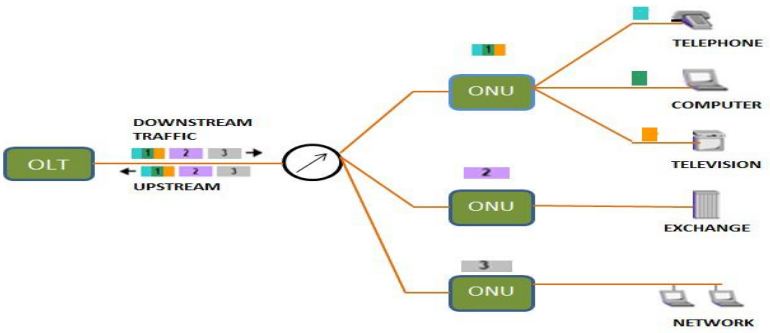

Fig. 2 TDM PON Model

2 WDM PON: WDM PON uses multiple wavelengths in a single fiber to enhance the capacity without increasing the data rate. Fig 3 represents WDM-PON architecture [3]. The OLT housed in Central Office has a set of tunable or fixed wavelength laser sources which is used to transmit the downstream traffic to ONU. Each user at the transmitter side has been assigned a frequency at which it operates. The frequency allotment can be based on the requirement of bandwidth demanded or it can be permanent. The data is sent to a multiplexer that combines all the data together and transfer it through the optical fiber of lengths varying from 20 km to 100km.

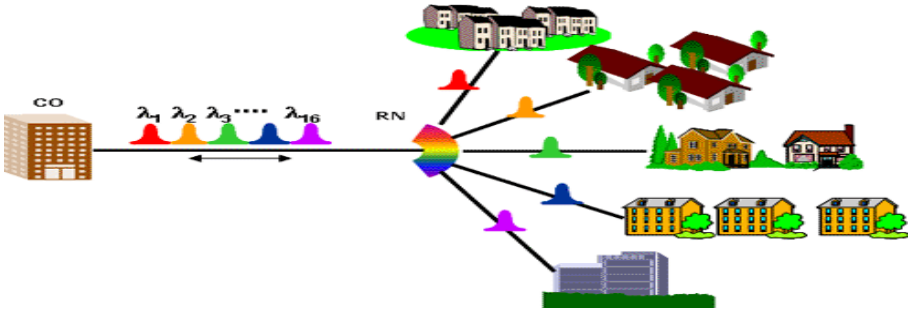

Fig. 3 WDM PON Model

IV. LITERATURE REVIEW

U. Ibrahim, Hassan Abbas *et al.* (2010) Compares performance gains achieved by using PIN and APD at the ONU side in a 32 users WDM-PON. By Simulation performance gains of around 5Gbps in terms of data carrying capacity and 15km in terms of system reach is attained if Avalanche Photo Diode is used at the ONU in downstream direction.

J. H. Lee, et al.(2010) [1] Colorless Gb hybrid WDM/TDM PON using a protocol terminator is experimentally demonstrated. It consists of a legacy TDM-PON, reflective semiconductor optical amplifier based on WDM-PON, combined with a efficient and simple node structure in order to provide high-speed FTTH service to a large area with a high population density. This system can support 512 subscribers with a single fiber. The performance of the system was analyzed by transmitting Gb/s data including Rayleigh backscattering and 20 km attenuation.

C.Michie et al. (2009) [2] EDFA have a limited use in PONs because the wavelengths typically include 1.3 μm. SOA offer a cost-effective solution. Theoretical treatments analyze operational requirements and verify this analysis through the experiment of the amplified system. The analysis considers for the dc offset that is

ISBN: 978-93-86171-35-1

proposed into the receiver section as a result the filter widths are 20 nm or greater for the amplified spontaneous emission powers which was present in amplified PONs.

H.Song *et al.* (2009) .Reviews the evolutionary path of optical access networks and shows the perspectives for high bandwidth and low cost. This paper discuss the requisites for optical technique sources, and optical amplifier when used in networks with large power attenuation, high transmission rate and the topological structures that allow for physical protection (tree-and-branch). Then, demonstrations of Long-Reach OAN developed worldwide by research institutes. Finally, DBA algorithms that allow to modify the effect of the increased control-plane delay in an extended-reach network.

J.Zhang, N, Ansari (2009) Describes the capacity of WDM PON and Introduces the definition of achievable rate region by analyzes the achievable rate region for a network architecture from the wavelength. Finally comparison of various WDM PON architectures and design an access control scheme.

V. METHODOLOGY

The performance is analyzed using the simulation done in the OptiSystem.7 simulation tool of Opti-Wave software. To compare the performance of various networks various factor are analyzed fiber length, different data rates and BER performance, The PON support 16 users with the main objective to determine the BER and Q factor .It is attain at different data rates and different fiber lengths. Then next step is to compare the BER with the distinct SMF lengths. In case of TDM-PON simulation 16 transmitters, a CW laser with a particular frequency of 193.1 Hz and a time delay circuit for each transmitter at the OLT side.

VI. CONCLUSION

TDM/WDM-PON architecture was designed using 16 users has been successfully evaluated in this paper. Results simulated using Opti-system software has confirmed that WDM PON network performance is superior architecture. This has been estimated for different coding for both TDM and WDM PON. When compared with RZ and NRZ coding techniques simulation Manchester coding shows better performance through Max Q factor, Min BER, and Eye Diagram. Data rates are compared using 1Gbps, 2.5Gbps, 4Gpbs and 10Gbps in the long reach enhanced system. It is also estimated that if power consumption is increased at the OLT, it can transmit high data rates with min BER, and it also shows that if power consumption is lowered in the CO, it works for lower data rates with optimum BER.

REFERENCES

[1] J. H. Lee, et al., “First Commercial Deployment of a Colorless Gigabit WDM/TDM Hybrid PON System Using Remote Protocol Terminator,” J. Light wave Technol. 28, 344-351 (2010).

[2] C.Michie, J. McGeough, S.karagiannopopulos, and I. Andonovis, “optically amplified passive optical networks: A power budget analysis,’J.opt. Netw.8,370-382(2009).

ISBN: 978-93-86171-35-1

[3] H.Song, B.W.Kim, and Mukherjee, " Long- Reach Optical Access Networks: A survey of research Challenges ,Demonstrations, and bandwidth, Assignment Mechanisms", IEEE Communications Survey and Tutorials, accepted, 2009.

[4] K.Tanaka, A Agatan, and Y. Horiuchi, IEEE 802.3av 10G-EPON standardization and its Research and Development Status," J.lightwave Tech. 28, 651-661(2010).

[5] U. Ibrahim, Hassan Abbas, Raja faizan, S. F. Shaukat "Performance Evaluation of Photo Receivers in WDM Passive Optical Networks" IEEE JOURNAL 2010.

[6] A. Sierra and S. V. Kartalopoulos, "Evaluation of two prevalent EPON networks using simulation methods," in Proceedings of the Advanced International Conference on Telecommunications and International Conference on Internet and Web Applications and Services.

[7] U. Ibrahim, S. Nazir, S F Shaukat, M. I. Shehzad, and M. Faisal, "Monte Carlo Analysis of Broadband Passive Optical Networks", unpublished Jingjing Zhang and Nirwan Ansari, New Jersey Institute of Technology Yuanqiu Luo, Frank Effenberger, and Fei Ye.