ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

Design of Fiber to the Home (FTTH) Access Network and Implementing Online Monitoring to Increase Efficiency

Dr.T.Venkateswarlu[1], R. Renuka[2]

Professor, Department of ECE, SVU College of Engineering, Tirupati, Andhra Pradesh, India[1]

M.Tech, Department of ECE, SVU College of Engineering, Tirupati, Andhra Pradesh, India[2]

ABSTRACT: Fiber-to-the-home (FTTH) is a network technology that deploys optical fiber cable directly to the home to deliver triple-play (data, voice, and video) services with a high speed up to the customer premises.Fiber –To- The-Home currently experiencing higher growth because customers require high bit rate connections for broad band services. This paper deals with the design of Fiber-To-The Home (FTTH) Passive Optical Network (PON) using TDM (Time Division Multiplexing) technology with Point to Multi point (P2MP) architecture. To improve service reliability as well as increasing the efficiency and monitoring capabilities in FTTH-PON network, MATLAB based Online Central Fault Monitoring System (CFDS) is proposed in this paper. CFDS can help any service providers and field engineers to monitor the status and detect the failure line that occurs in the multi-line drop region of tree structured FTTH network downwardly from Central Office (CO). CFDS able to improve the service reliability, reduce the restoration time, maintenance cost and increases overall network efficiency.

KEYWORDS: Fiber-to-the-home (FTTH), Passive Optical Network (PON), Central Fault Monitoring System (CFDS), fiber fault, Efficiency

I. INTRODUCTION

FTTH is a broadband network technology that delivering triple-play (data, voice and video) services with a high speed to the home or business via optical fiber cable[2]. Today, FTTH has been recognized as the ultimate solution for providing various communications and multimedia services, including carrier-class telephony, high-speed Internet access, digital cable television (CATV), and interactive two-way video-based services to the end users. Owing the very high capacity of optical fibers, FTTH can deliver greater capacity as compared to copper-based technologies. FTTH technology using passive optical network (PON) with P2MP configuration or tree topology is the most promising way to provide high quality broadband access. PON has been early described for FTTH as early as 1986[4]. PON are nowadays extensively studied and some commercial deployments are already reported. The PON is commonly deployed as it can offer a cost-efficient and scalable solution to provide huge-capacity optical access.

Since this kind of architecture can accommodate a large number of subscribers, when any fault occurs at one point in an optical fiber line, the access network function will be failed. It leads to affect the whole services transmission [2].A failure due to fiber break in current optical communication system could make the network service providers very difficult to restore the system back to normal. Therefore, the survivability of the whole network has to be examined more seriously.It is important to be able to locate any fiber break after the installation of FTTH access network. Furthermore, a simple and effective monitoring configuration is highly desirable for timely failure detection along the fiber. A good fault surveillance system is essential to identify fiber fault withoutinterrupting the services, while other channels are still in service to maximize the link utilization. Therefore, anoptical line monitoring is essential for failure detection to improve the service reliability and reduce the maintenance costs of FTTH.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

II.LITERATURE REVIEW

In [2] author proposed A new technique for detecting any faulty fiber and identifying the failure location occurring intree-based structured fiber-to-the-home (FTTH) access network with centralized failure detection system (CFDS) based on Visual Basic is proposed and experimentally demonstrated in the paper.They said it is a cost-effective way to detect the failure location within FTTH access network with CFDS to improve the service reliability and reduce the restoration time and maintenance cost. In [3] the mechanism of optical fiber break in Passive Optical Network (PON) is discussed andthe monitoringissues with conventional fiber fault localization technique by using Optical Time Domain Reflectometer (OTDR) is explained. A cost-efficient fully reliable and accurate monitoring solution supporting fault detection, identification, and localization in different fiber access topologies also discussed. They also studied the previous fault. In [4] Afiber-to-the-home (FTTH) network management system named Smart Access Network Testing, Analyzing and Database (SANTAD) for self-protectedand restored against fiber fault based on Visual Basic is proposed. SANTAD is the new upgraded values of recent FTTH technology toward the implementation of smart network, which involved in the centralized monitoring, failure detection, automatic recovery, and increases the survivability and maintainability of FTTH. In [7] author proposed in-service transmission surveillance and fiberfault localization within FTTH with point-to-multipoint (P2MP) configuration downwardly from CO towards customer residential locations based on the graphical user interface (GUI) processing capabilities of MATLAB software.

III.FTTH NETWORK

PON ARCHITECTURE

The most important aspect of PON architecture is its simplicity. It is shown in the Fig1. The Optical Line Terminal (OLT) is the main element of the network and it is usually placed in the Local Exchange. Optical Network Units (ONUs) serve as an interface to the network and are deployed on a customer's side. ONUs are connected to the OLT by means of optical fiber and no active elements are present in the link. A single ONU can serve as point of access for one (Fiber to the Home) or multiple (Fiber to the Block or Curb) customers and be deployed either at customer's premises (Fiber to the Home or Block) or on the street in a cabinet (Fiber to the Curb).

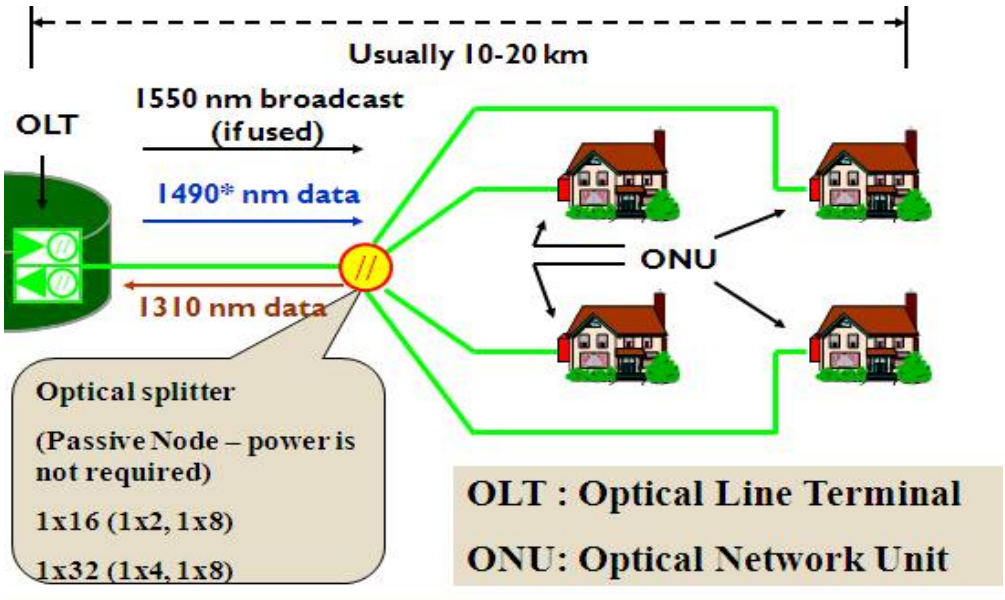


Fig1: PON Architecture

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

Although PONs can exist in three basic configurations (tree, bus and ring), the tree topology is favoured due to smaller variation in the signal power from different end stations. Here we used TDM based PON network as shown in the fig2.

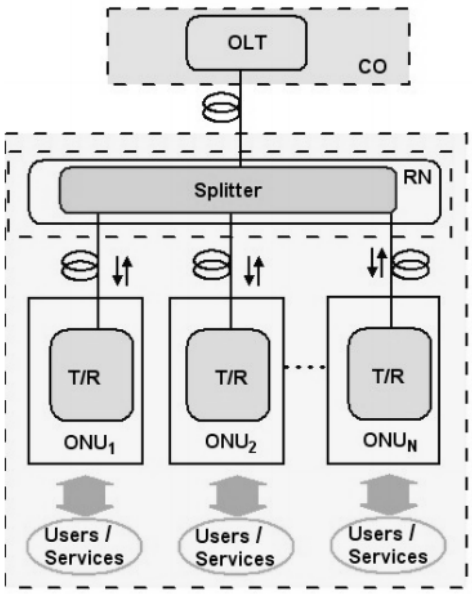


Fig2. TDM PON

CASCADED FILTER APPROACH

A cascaded split configuration results in pushing splitters deeper into the network as shown in fig.3. Passive Optical Networks (PONs) utilise splitter assemblies to increase the number of homes fed from a single fibre. In aCascaded PON, there will be more than one splitter location in the pathway from central office to customer. Currently, standard splitter formats range from 1 x 2, 1 x 4, 1 x 8, 1 x 16 and 1 x 32.

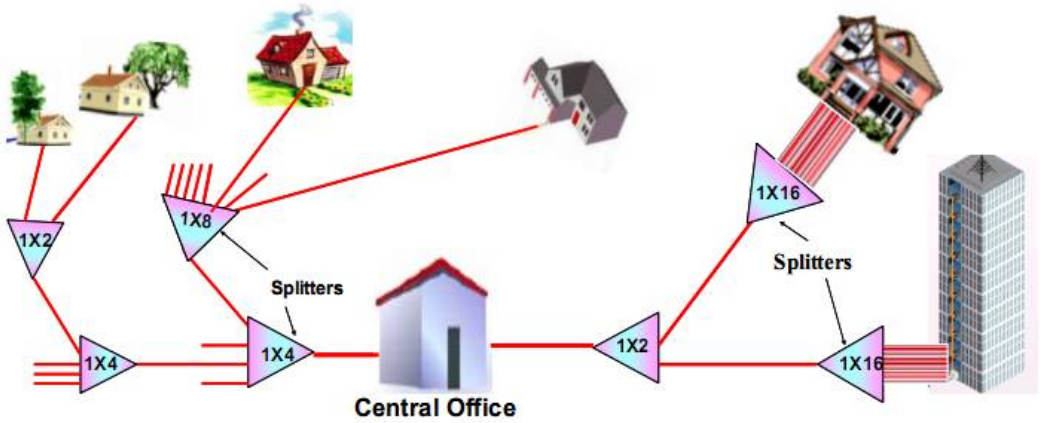


Fig.3 Cascaded Filter Approach

ADVANTAGES OF PON:

- PON allows longer distances between CO and customer: 20 km for PON vs. 5.5 km for DSL
- PON provides higher bandwidth.
- Allows downstream continuous broadcasting (video)
- Eliminates electronic devices in the middle of the network.
- Allows easy upgrades to higher bit rates or additional wavelengths

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

IV.IMPLEMENTATION

Theimplementation of FTTH-PON technology in simulation is done by the software named Opti-system developed by Optiwave. This tool allows us to design, plan and test our optical network for different elements. This tool has variety of devices of about twenty testing instruments, twenty two Lasers for input to the system, more than 50 modulation techniques. Based on our requirement of the optical network design we can make avail of the devices from the software. It is the comprehensive design software suite allows us to design, plan, and test and simulate modern optical network in transmission layer of the network. The design of Passive Optical network can be made effective by observing the parameters like Bit Error rate, latency, throughput, reliability. We use the test instrument tools like BER analyzer, WDM analyzer, Power meter, Spectrum Analyzer for our design. The power meter is used to measure the average power of the optical signal transmitted. The spectrum analyzer is used to plot the wave of magnitude of the input signal and frequency. The WDM analyzer used to measure the values like Signal to noise ratio, Signal power and noise power.

Graphical User interface for online monitoring is developed using MATLAB software to specify a faulty fiber and failure location among a number of optical fiber lines in FTTH access network.

V.DESIGN

The FTTH Passive optical network with tree topology is designed with 1:4 splitter and combiner in the form of cascading. The figure.4 shows 3 lambda (1310nm, 1490nm and 1550nm)PON network. The design goal is to achieve the transmission power at 0 dB loss and receive power of about -27 dB. The design has three sections, first is the Optical Light Terminating Unit (OLTE), Splitting and combining part and Optical network Unit (ONU). The Optical splitter used to enable single optical fiber to serve multiple premises. In our design we used 1:4 Splitter. Splitter is placed in between OLTE and ONU. The communication is through the optical fiber with the maximum length of 20Km.

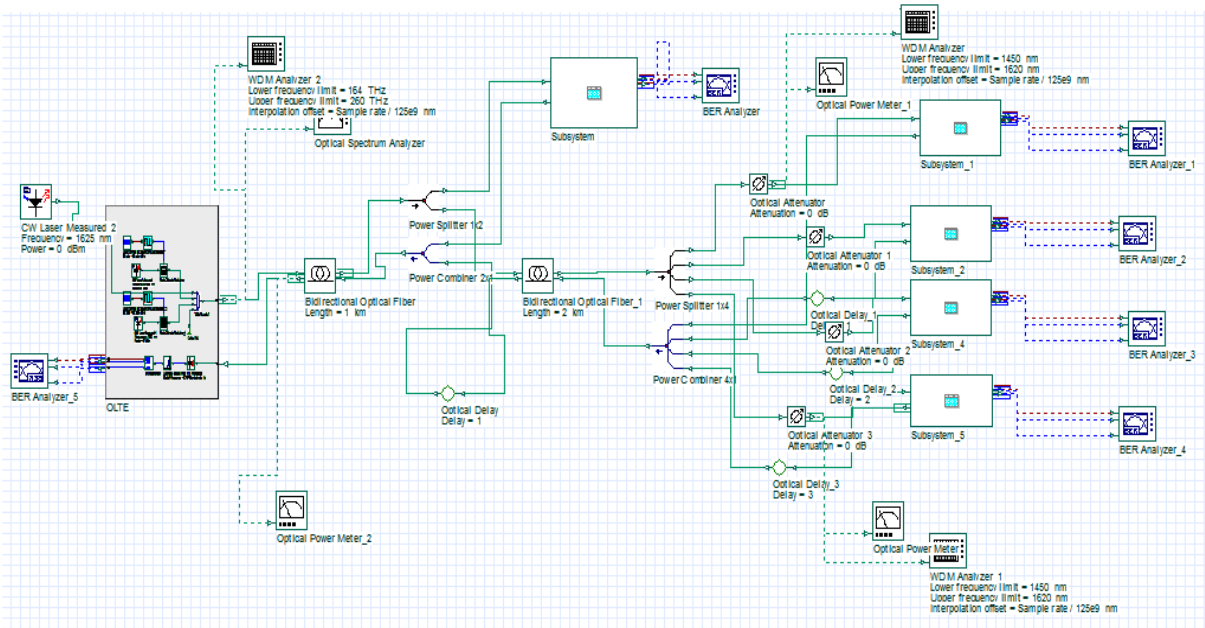


Fig4: Design of 3 lambdasPON Network

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

Performance is decided by the quality of the signal. Parameters are used to measure the quality of the signal is Bit Error Rate (BER) and Optical Signal to Noise Ratio (OSNR). Zitter is another parameter used to introduce the delay or interrupt in the arrival of the packet to avoid signal interference with in the network.

VI.RESULTS AND DISCUSSION

A. PASSIVE OPTICAL NETWORK (PON)

The output of 3 lambdas FTTH-PON network in BER analysis displays the quality of the signal should be less than 10^{-6} is good and less than 10^{-9} is excellent quality of signal as shown in the following fig 5.

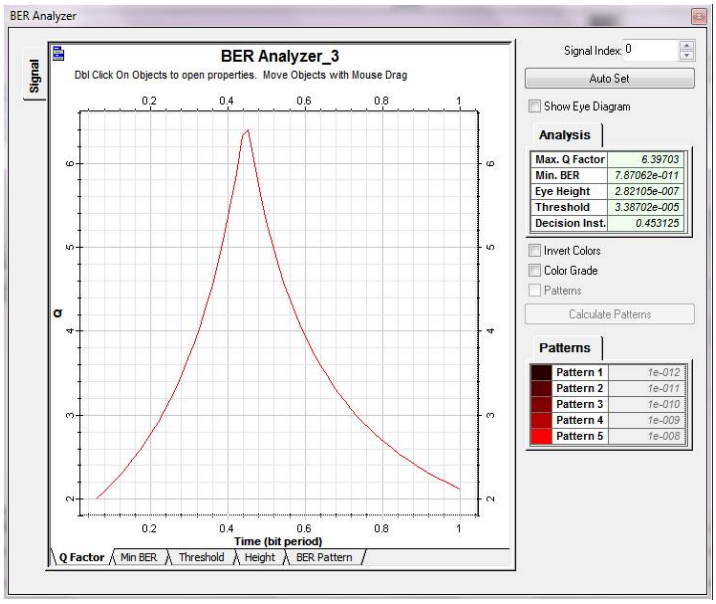


Fig5: BER Analyser

The output of 3 lambdas FTTH-PONin WDM analyzer, OSNR values should be greater than 40db as shown in fig6.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

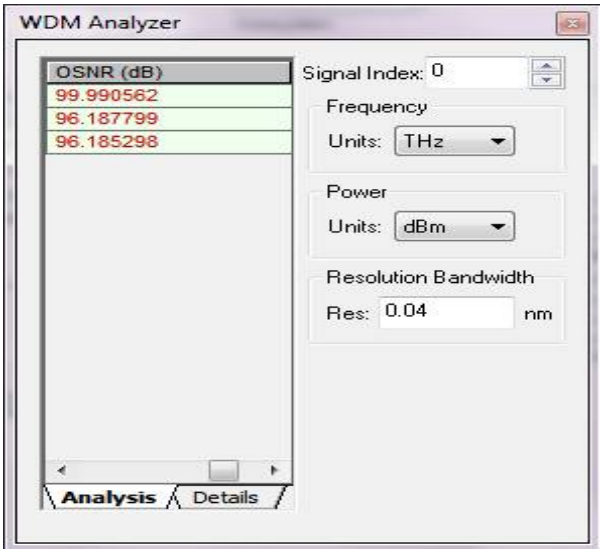


Fig6: WDM Analyser

B.CENTRALIZED FAULT DETECTION SYSTEM (CFDS)

One of the basic functionalities of CFDS is to detect failure in FTTH access network. The CFDS consists in: i) plotting optical signal level (dB) versus distance (km) graph, ii) checking the status of each optical fiber line, and iii) displaying line details.OTDR (Optical Time Domain Reflectometer)is an instrument that is used to measure the fiber attenuation, locate fault, measure splice loss and fiberattenuation coefficient throughout the installed fiber length. The 1625nm wavelength signal is used as a test signal from the OTDR to find the fault in the network without affecting the service in online. The measurement results are recorded in the OTDR and then transferred to PC.The program will identify and present the parameters of optical line such as the line's status either in working or non-working condition, magnitude of decreasing as well as the location, failure location. The analysis result will be sent to field engineer or serviceprovider for prompt action.

All OTDR measurement into a single computer screen for advanced data analysing. A failure message is in a fault line in exact location from CO is displayed. A failure location was identified by a drop of optical signal level. To obtain further details on the performance of specific line in the network system, every measurement results obtained from the network testing are analysed in the Line detail form.

CFDS is interfaced with the OTDRto display eight results on a single computer screen in a time as shown in the fig7 and also the further information when click on each individual line.

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

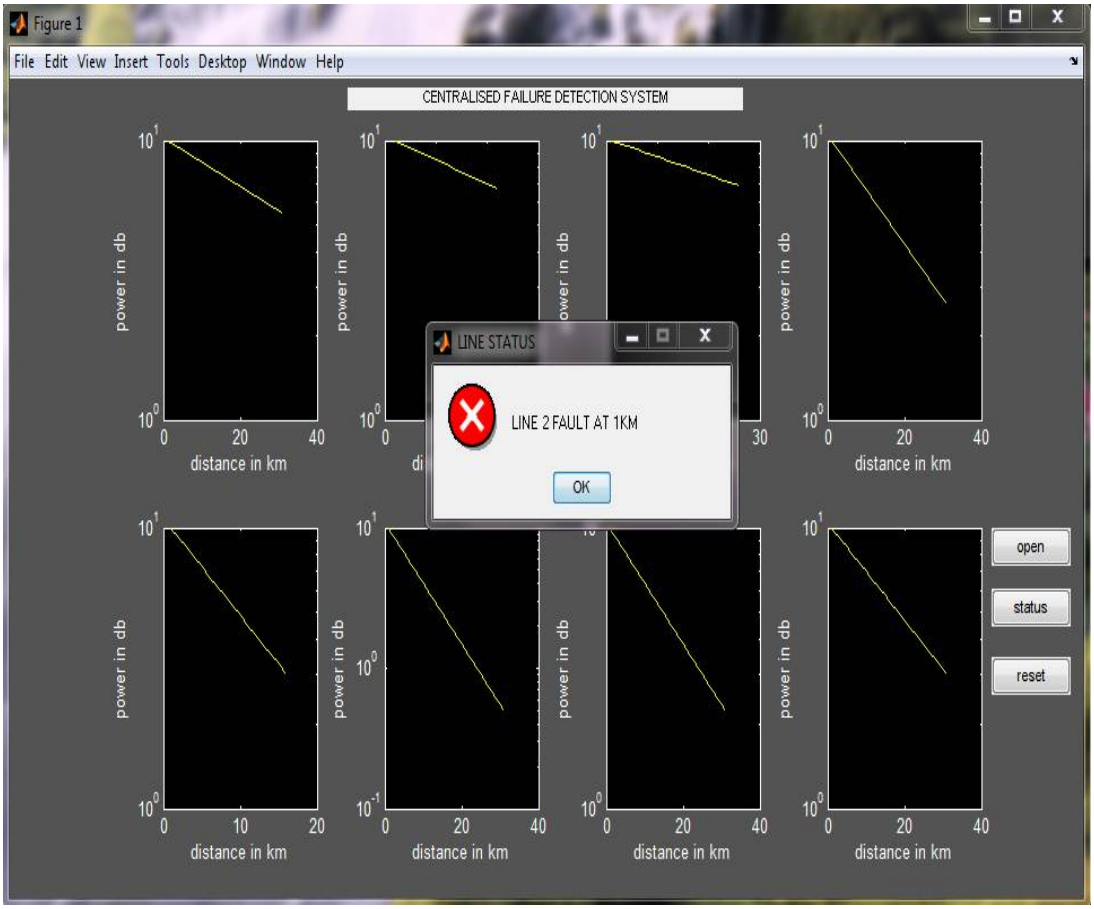


Fig7:Eight graphs are displayed in the Line Status form. A failure message is displayed to show the faulty line and failure location in FTTH access network

CFDS is able to identify and present the parameters of each optical line such as the line's status, magnitude of decreasing at each point, failure location and other details as shown in the fig8.

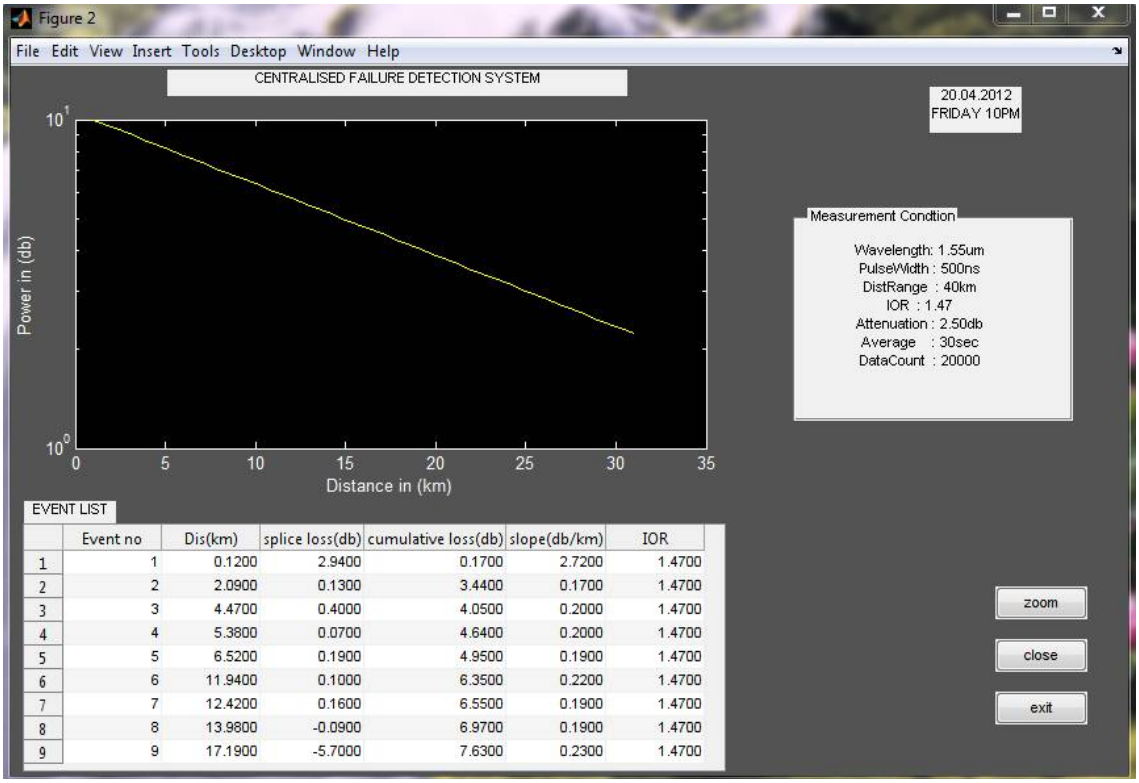
ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017



	Event no	Dis(km)	splice loss(db)	cumulative loss(db)	slope(db/km)	IOR
1	1	0.1200	2.9400	0.1700	2.7200	1.4700
2	2	2.0900	0.1300	3.4400	0.1700	1.4700
3	3	4.4700	0.4000	4.0500	0.2000	1.4700
4	4	5.3800	0.0700	4.6400	0.2000	1.4700
5	5	6.5200	0.1900	4.9500	0.1900	1.4700
6	6	11.9400	0.1000	6.3500	0.2200	1.4700
7	7	12.4200	0.1600	6.5500	0.1900	1.4700
8	8	13.9800	-0.0900	6.9700	0.1900	1.4700
9	9	17.1900	-5.7000	7.6300	0.2300	1.4700

Fig8:An Example of working line in Line's detail form fora specific line in the network

VII.CONCLUSION

This paper gives the brief discussion about the FTTH network, its components and design with efficient transmission of power. The bit error ratio is also analysed. Since there is a need for huge data rate, FTTH can deliver greater capacity as compared to copper-based technologies. FTTH technology using passive optical network (PON) with P2MP configuration or tree topology is the most promising way to provide high quality broadband access. Also locating a fiber fault within the FTTH-PON network becomes more significant due to the increasing demand for reliable service delivery. CFDS can help any service providers and field engineers to monitor the status and detect the failure line that occurs in the multi-line drop region of tree structured FTTH access network downwardly from CO. CFDS able to improve the service reliability and reduce the restoration time and maintenance cost. With CFDS no more cost and time misspending due to the troubleshooting mechanism is done downwardly.

VIII. ACKNOWLEDGEMENT

The authors would like to thank *Mr.A.Vetrivel, S.D.E., BSNL Regional Telecom Training Center,Chennai*for providing the permission and technical assistance.

REFERENCES

1. Fiber Communication Systems by 'Govind P Agrawal', 3rd edition.
2. Mohammad syuhaimi ab-rahman*, boon chuan ng, kasmiranjumari 'Detecting faulty fiber with centralized failure detection system (CFDS) in fiber-to-the-home (FTTH) access network' OpticaApplicata, Vol. XXXIX, No. 2, 2009
3. V.Sangeetha1, G. Gayathri , B. Hindhuja, S. Jegatheeswari, M. Kalaivani 'OPTICAL FIBER CABLE FAULT LOCALIZATION IN FTTH NETWORK USING OTDR' INTERNATIONAL JOURNAL OF RESEARCH IN COMPUTER APPLICATIONS AND ROBOTICS Vol.3 Issue.3, Pg.: 205-212 March 2015

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Website: www.ijircce.com

Vol. 5, Issue 2, February 2017

4. Mohammad Syuhaimi Ab-Rahman, Boonchuan Ng and KasmiranJumari 'Visual Basic Software Tool for FTTH Network Management System: SANTAD 'IJCSNS International Journal of Computer Science and Network Security, VOL.9 No.2, February 2009
5. https://en.wikipedia.org/wiki/passive optical network
6. G. Keiser, Optical Fiber Communication, j,d ed., McGraw-Hill, New York,USA2000.
7. M.S.A. Rahman and B.C. Ng, "MATLAB-based graphical user interface development for Centralized Failure Detection System (CFDS) in SCAN Network," J. of Opt. Commun., vol. 29, no. 3, pp. 152-156, 2008.
8.]I. Sankawa, S.I. Furukawa, Y. Koyamada, and H. Izumita, "Fault location technique for in-service branched optical fiber networks," IEEE Photon. Technol. Lett., vol. 2, pp. 766-768, 1990.
9. A.A.A. Bakar, M.Z. Jamaludin, F. Abdullah, M.H. Yaacob, M.A. Mahdi, and M.K. Abdullah, "A new technique of real-time monitoring of fiber optic cable networks transmission," Optics and Lasers in Engineering,vol. 45, pp. 126-130, 2007.
10. YEH C.H., SHIH F.Y., CHANG G.K, CHI S., Reliable tree-type passive optical networks with self--restorable apparatus, Optics Express 16(7), 2008, pp. 4494–4498.