Journal of Theoretical and Applied Information Technology
15th August 2016. Vol.90. No.1

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

OPTICAL NETWORK TEST AND TROUBLESHOOTING FOR OPTICAL FIBER NETWORK

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ABSTRACT

This paper presents an experimental study for optical fiber network that uses 1550 nm and 1625 nm wavelength band light. We designed the system and network test-bed to measure optical power level or loss of optical power of each type of device or optical components in the Lab Network of ITP by using an Optical Time Domain Reflectometer (OTDR). The prototype of the device is fabricated and which achieves the target characteristics and reliability. In addition, it is confirmed that the prototype could detect fiber fault at 10.5222 km with system loss 18.21 dB within 13 minutes by setting the acquisition parameters in OTDR module.

Keywords: *Fiber Failure, OTDR, Optical Network, Optical Switching, FTTH*

1. INTRODUCTION

Optical diagnosis, characterization and performance monitoring is essential to ensure a high quality operating system for a wavelength band light. An efficient optical network and FTTH networks reliability are highly dependent on test and measurement. Testing is the only way to ensure that all transmission specification is in the construction phase, when the network is ready for the actual test in the field, customers will be supplied with the quality of service (QoS) expected. Testing and diagnosis can ensure that the whole system is operating in an acceptable specification in levels of customer activation. [1]. Testing and diagnosis can ensure that the whole system is operating in an acceptable specification in levels of customer activation. When the circuit is activated and the operation began, QoS must be tested and monitored to meet service level agreements with customers. When problems such as low signal or no signal is detected and diagnosed, problem solving network helps to minimize network time to stop, damage restoration services quickly and efficiently manage network performance [2].

FTTH network troubleshooting involves the detection and identification of the cause of problems in complex optical network topology, which involves a number of devices and components including optical line terminal (OLT), divorcer optics, fiber optics and optical network unit (ONU). Most of the problems are caused by PON network connectors use (dirty, damaged or the connection does not exactly), damage or bend the optical fiber line macro (macro-bend). Such problems will affect service in one, some or all of the user's premises using the same network. Most of these problems can be determined using OPM equipment that measures the amount of optical power at one point or OTDR which displayed a graphic that shows all the elements and components in the circuit under test including connectors, plugs (splice), divorcer, couplers and fiber fault [3, 4]. Since the fiber optic physical layer network has become so branched and complex, monitoring of these fibers as well as the healthy operation of associated systems have become a necessity. A separate wavelength which is out of the normally used band is being identified for this, namely 1625 nm. It has become a practice to use OTDRs at 1625 nm, to monitor the existing optical networks [5, 6].

2. EXPERIMENTAL SETUP

The field trial was performed on a PON-based FTTH network testbed in Institut Teknologi Padang (ITP). The tested fiber cable segments have approximate lengths of 19.2 km, with maximum insertion loss is 8.5 dB. This network contains 9 standard fibers (SMF-28) although not all of them are accessible due to commercial traffic load. A total of 6 fibers were investigated. During the observation, we disconnected the fiber joints between feeder fiber and drop fiber to represent a fiber break scenario at the corresponding position. It visualized the actual break point of an optical line at that distance in a real condition. In this

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study, we proposed and demonstrated an experimental study of FTTH network characterization, it is integrated in a single system, which also includes 1x8 optical switch, optical splitter, OTDR, and personal computer (PC) as illustrated in Figure 1 and Table 1.

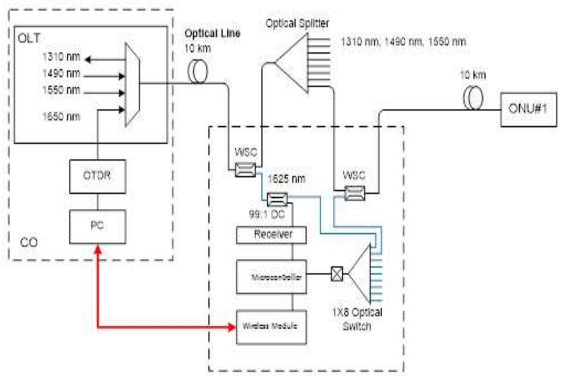

Figure 1: Experimental Setup

Table 1: Insertion loss on optical splitter

	Insertion loss	Data sheet
1550 nm	-6.78 dB	-6.22 dB
1625 nm	-8.56 dB	-6.56 dB

Our system uses 2 event identification method to determine the tested fiber link is either in good or failure condition. In the firstly status checking process, it is firstly divides the measurement result into 2 categories. Reflective event indicates a real reflection located closer to the source. If the measured loss is same or less than reference value, it will consider as good condition, else the exceed value is the degradation loss of measured fiber link. The principle enhancement of our scheme detection is best explained in Figure 2.

3. RESULT AND DISCUSSION

Insertion loss of each line optical splitter 1xN measured using two units of the FOT-600 Loss Test Set from EXFO Inc., in which one is used as the light source and the other as the OPM (Optical Power Meter) to measure levels (loss) power optical and ORL (Optical Return Loss). Any loss is measured at the first hole (in the inlet port) and the N (at the outlet port) optical splitter 1xN as shown in Table 2, then listed and compared with the loss specifications derived from data sheet.

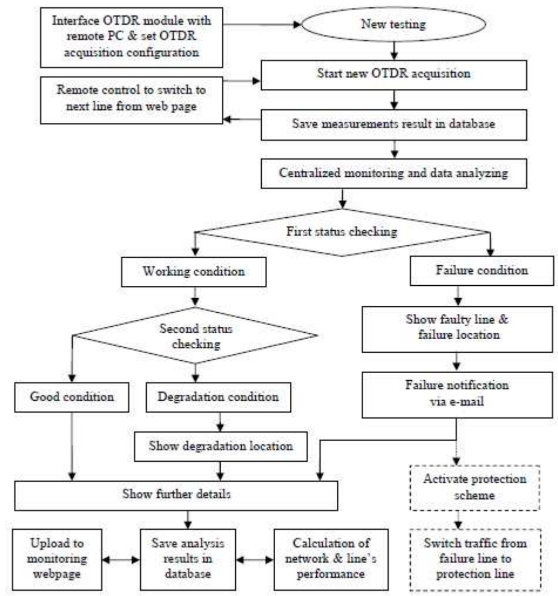

Figure 2: Systems flow for failure detection in PON-based FTTH

Table 2: Optical loss for each fiber link

Link loss	In good condition	In experimental implementation
1550 nm	-6.99 dBm	-6.29 dBm
1625 nm	-8.79 dBm	-7.97 dBm

Figure 3 and 4, it clearly displays the reflective events at every fiber joint location. It is successfully detecting a fault occurred in the drop fiber region at distance 10.5222 km from CO in failure line within 13 minutes by setting the acquisition parameters in OTDR module with 1625 nm operating wavelength and 1 µs pulse width. This method provides a distance deviation of 0 m (minimum) to 63.7 m (maximum) from the exact failure location in real scenario with total system loss 18.21 dB.

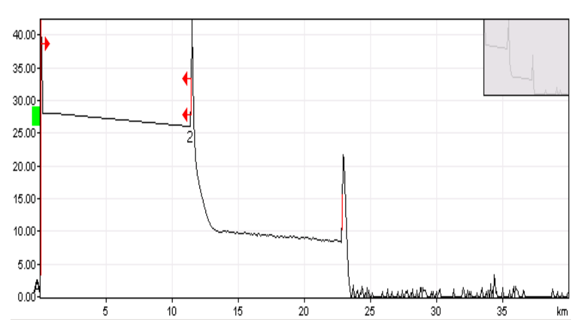

Figure 3: 1625 nm Wavelength Band Light

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Type	No.	Loc.	Loss	Refl.	Att.	Cumul.
	1	0.0000	- - -	>-25.3	@33.9dB	0.000
	(7.9755)		1.452		0.182	1.452
	2	7.9755	8.796	>-21.4		10.249
	(7.9781)		1.882		0.236	12.131
	3	15.9536	0.247	-28.9		12.378

Figure 4: Fiber Characterization

4. CONCLUSION

We have presented our novel optical test solution to monitoring and management system tool, which has been exclusively developed for the study of PON-based FTTH. The flexibility of our program has been highlighted through a series of experiments that exhibit its performance. From the results of these experiments, it concluded that this scheme is able to assists NSPs in centralized failure detection and troubleshooting PON-based FTTH network system by studying the loss value of reflective event.

ACKNOWLEDGEMENTS

This work is sponsored by High Education General Director (Dikti) through the Hibah Bersaing

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