ANALYSIS AND MEASUREMENT FIBER OPTIC FAULT BY USING OPTICAL TIME DOMAIN REFLECTROMETER (OTDR)

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DEDICATION

Special dedication to my beloved father and mother, my entire sibling and my kind hearted supervisor Ir. Chairulsyah Wasli and my dearest friends.

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This project would not have been like this if they not given great support and encouragement on me when other academic assignments and test has pressured me. The golden glory for me was during accomplishing this project is when my project successfully completed in the right path.

Most of all, I would like to thank my parents for their unending support, and my brother, whose mere existence keeps me motivated.

ABSTRACT

The purpose of this project was to measure the fiber optic faults by using Optical Time Domain Reflectrometer (OTDR) and at the same time to analyze fiber optic faults. The software which will be used is based on the existing OTDR simulation. The cases of fiber optic faults were learned before upgrade the OTDR simulation. Each case is represented in form of graph for normal condition and abnormal condition. Flash CS3 software was used to create each graph in animation form. Then, the OTDR instrument was learned in detail by applying the instrument in field study. The true result of fiber optic faults was investigated by using the instrument. The result from theoretical and experimental OTDR will be compared to ensure the valid results are obtained. The experimental OTDR is set for students in Opto electronic laboratory. From this experiment, students can easy to understand the operation of OTDR and they can investigate a few of events in fiber optic cable efficiently.

ABSTRAK

Tujuan projek ini ialah untuk mengukur tingkat kerosakan fiber optik dengan menggunakan Optical Time Domain Reflectrometer (OTDR) dan pada masa yang sama untuk menganalisa kerosakannya. Software yang akan digunakan adalah berdasar pada simulasi OTDR yang sedia ada. Kes-kes kerosakan fiber optik dipelajari sebelum menambah baik simulasi OTDR. Setiap kes diwakili dalam bentuk graf untuk keadaan normal dan sebaliknya. Software Flash CS3 digunakan untuk membuat graf dalam bentuk animasi. Kemudian, alat OTDR dipelajari dengan mendalam, dengan menggunakan alat tersebut pada kajian lapangan. Keputusan sebenar kerosakan fiber optik dikaji dengan menggunakan alat tersebut. Keputusan daripada teori dan eksperimen akan dibandingkan untuk memastikan keputusan yang betul diperolehi. Eksperimen OTDR dibuat untuk memudahkan pelajar menjalani eksperimen ini pada masa akan datang. Para pelajar akan dapat memahami bagaimana OTDR ini berfungsi daripada awal hingga akhir selepas mereka melakukan eksperimen ini.

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LIST OF SYMBOL / ACRONYM

ADC	Analog Digital Converter
APD	Avalance Photodiode
DC	Direct Current
GI	Graded Index
LED	Light Emitting Diode
OTDR	Optical time domain reflectrometer
PD	Photo diode
SI	Step Index
I/O	Input and Output
P_i	Input power
P_{in}	Incident power
P_T	Transferring power
P_{ref}	Reflected power
P_o	Output power
a	Attenuation
R	Reflectance
l	Length
L	Loss
d	distance
K @ B (s-1)	Backscattering coefficient
A	Reflection amplitude (in dB), as measured by the OTDR
ΔT	OTDR measurement pulse width (in nanoseconds)
V	Voltage

APPENDIX LIST

CHAPTER I

INTRODUCTION

1.1 PROJECT BACKGROUND

In telecommunication field, fiber optic cable is the main part of transmission of data. So, one of the main maintenance instruments fiber optic cable is optical time-domain reflectrometer (OTDR). This instrument is used to test fiber links by detecting losses and to know what types of faults have occurred on these links, as well as where they are located. Generally, there are a few types of fiber faults likes overload recovery, ghosts and backscatter variability errors.

Before this instrument is used in fiber optic cable plant, we should understand how it works, the function of its buttons and what the types of types of faults. If not, we will face problems of using it. We should have sufficient knowledge of OTDR operation to ensure that the good data can be obtained and it will be used optimally.

This project is targeted to accomplish finish in six months timeline. The ultimate goal is to examine the OTDR in detail and show the examples of good and bad data by using flash CS3 software. Beside this, experimental OTDR is set for optoelectronic laboratory which will be used by students.

1.2 SCOPES OF WORK

The scopes of work for the project include the following areas:

i. The study and understanding of OTDR the cases of fiber optic faults.
ii. Build the animation for fiber faults cases by using Flash CS3.
iii. Find the a few types of OTDR simulation and investigate them.
iv. Find the true result of OTDR cases and compare with theoretical animation.
v. The analysis of the fiber optic faults from the OTDR instrument.

Other scopes of work include:

1. Maintain good log book record
2. Prepare the necessary documents
3. Publishing final report
4. Project Presentation

1.3 PROBLEM STATEMENTS

Today, fiber optic cable is used widely for communication system which is used for transmitting the signal or data. Therefore, the maintenance of fiber optic cable should be done frequently to ensure the best serves are obtained by subscribers. There are many equipments are used for the maintenance of fiber optic cable such as OTDR. Generally, OTDR is used to identify optical cable fault. There are some reasons to analysis and measurement fiber optic faults by OTDR. One of the reasons is OTDR set is very expensive. The problem statement in this project is to show the simulation of an OTDR where it is will be used for knowing better OTDR. So, the function of the OTDR will be utilized maximally.

1.4 PROJECT OBJECTIVES

Due to the problem statement stated above, it's cleared that the objectives of the project are:

i. To know the function of OTDR.
ii. To make the OTDR animation
iii. To analysis the OTDR from theoretical and measurement aspect.
iv. To find out the advantage and disadvantages of OTDR.

1.5 PROJECT'S METHODOLOGY

Phase1:-

Meet and discuss with my supervisors Ir. Chairulsyah Bin Abdul Wasli and Dr Abdul Samad Bin Shibghatullah. Show the project progress to them. Get the more information about OTDR from supervisor, internet, books, journal, thesis, and so on. Firstly, try to understand the concept & desired result for this OTDR cases.

Phase2:-

For this phase, discuss with my second supervisor Dr Abdul Samad Bin Shibghatullah and do surveys on animation software for find the best method. Find the chosen software and learn it from supervisor, internet and books for showing the best result of OTDR cases animation.

Phase3:-

For this phase, prove a few of fiber optic fault cases by representing them in graphs and block diagram. Design the animation of OTDR cases by using FlashCS3 software. Show the design of animation to supervisors and make correction of the design.

Phase4:-

For this phase, set the experimental OTDR for lab optoelectronic which will be used by students. Finally, submit the thesis of this project. Figure 1.1 shows the project flowchart.

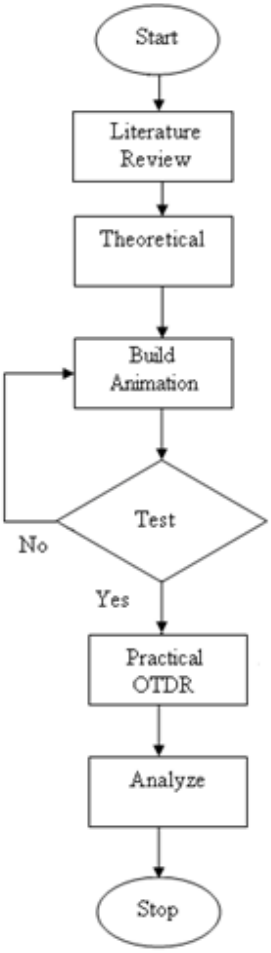

Figure 1.1 Project Flowchart

1.6 REPORT STRUCTURE

This report is organized in five chapters. The first chapter gives the brief introduction of analysis and measurement of fiber optic fault by OTDR. The objectives and scope of the project is also explained in this chapter as follows:

Chapter I : Covers the introduction

Chapter II : Covers the literature review

Chapter III : Covers the design methodology

Chapter IV : Cover the result for the project and expected result

Chapter V : Conclusion and discussion

CHAPTER II

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter will look into the various aspects and the methods on research methodology on project. This chapter will show the concept of the actual fiber optic cable and the various related analysis. Furthermore, this chapter will show the necessary enhancement that will make this equipment, OTDR (Optical time Domain Reflectrometer) much more efficient equipment. Literature Review is important in each project as a base for gathering information necessary to complete the project. All information is gathered from various sources such as:-

1. Journal
2. Books
3. Conference Transcript
4. Thesis
5. Patent
6. Website

After searching through all this various material, all information will be filtered to be related to OTDR. All this information will be compiled to be included in the report.

2.2 FIBER OPTIC LINK

The simple fiber optic data link is the main part in fiber optic which should be considered for the premises environment. The link of fiber optic data communication should be learned to know how the data is transferred from source to user. The model of simple fiber optic data link is shown in Figure 2.1. The principle of an optical communications system is to transmit a signal through an optical signal through an optical fiber to a distant receiver. The electrical signal is converted into the optical domain at the transmitter and is converted back into the original electrical signal at the receiver.[4]

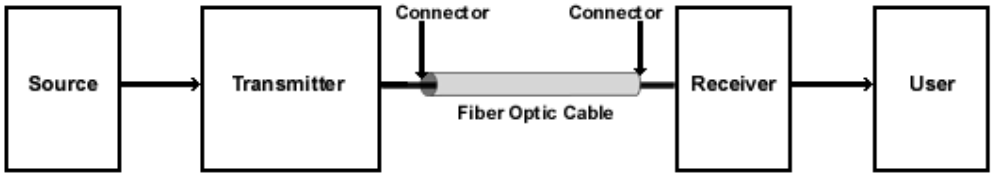

Figure 2.1 Model of "simple" fiber optic data link

There are three main parts in a model of simple fiber optic which are known as source-user pair, transmitter and receiver. Refer to Figure 2.1 above, the fiber optic cable establishing the Transmission Medium with the connectors that provide the interface of the Transmitter to the Transmission Medium and the Transmission Medium to the Receiver.

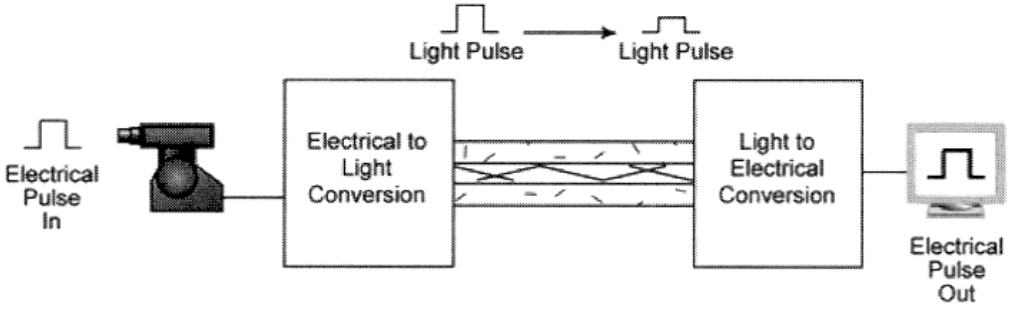

Figure 2.2 Process of transmission light in fiber optic cable

Fiber optic cable functions as a "light guide," guiding the light introduced at one end of the cable through to the other end. The light source can either be a light-emitting diode (LED)) or a laser. The light source is pulsed on and off, and a light-sensitive receiver on the other end of the cable converts the pulses back into the digital ones and zeros of the original signals.

Even laser light shining through a fiber optic cable is subject to loss of strength, primarily through dispersion and scattering of the light, within the cable itself. When the faster laser is applied, the dispersion of light is greater. Light strengtheners, called repeaters, may be necessary to refresh the signal in certain applications.

2.3 OPTICAL FIBER CABLE

In an optical fiber cable, it contains one or more optical fibers. The optical fiber elements are typically individually coated with plastic layers and it also contained in a protective tube suitable for the environment where the cable will be installed. The actual fiber portion of an optical is generally considered to include both the fiber core and its cladding.

Figure 2.3 below illustrates the fiber optic cable structure. The core is the transparent glass (or plastic) component of the cable. Light shines through it from one end to the other. The cladding, which is a glass sheath that surrounds the core, is a key component. Like a mirror, it reflects light back into the core. As light passes through the cable, its rays bounce off the cladding in different ways.

The loose buffer consists of plastic tube, which is over twice the fiber diameter in size and serves as a shield from stresses and temperature changes. As the fiber experiences bending, pressure, or extreme temperatures, the buffer protects the fiber and leaves room for movement and expansion. The tight buffer consists of a plastic buffer deposited directly on the fiber coating. While differences in thermal expansion between fiber and buffer may cause microbends, this configuration