DISASTER SURVIVABILITY FOR OPTICAL FIBER NETWORKS

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A project report submitted in partial fulfilment of the
requirements for the award of the degree of
Master of Engineering (Electronic and Telecommunication)

School of Electrical Engineering
Faculty of Engineering
Universiti Teknologi Malaysia

JANUARY 2019

DEDICATION

Special dedicated,

To my beloved family who are always praying for my success,

To my supervisor who always motivate, encourage and give me advise throughout this project,

To all my friend for their support

ACKNOWLEDGEMENT

First of all, thanks to ALLAH S.W.T for his mercy and guidance in giving me full strength to complete this Master Project's report entitled 'Disaster Survivability for Optical Fiber Network' task. Even facing with some difficulties in completing this task, I still managed to complete it.

I would like to thank my project report supervisor Dr. Muhammad Al Farabi Bin Muhammad Iqbal of the School of Electrical Engineering at Universiti Teknologi Malaysia. The door to his office was always open whenever I ran into a trouble spot or had a question about my research or writing. He consistently gave his support and guidance in helping me to finish my project.

Then, I must express my very profound gratitude to my parents and to my siblings for providing me with unfailing support and continuous encouragement throughout my years of study and through the process of researching and writing this project report.

In addition, grateful acknowledgement to all of my friends who never give up in giving their support to me in all aspects of life. This accomplishment would not have been possible without them.

ABSTRACT

The project proposes on developing a simulation tool for studying the impact of circular based disasters towards an optical network topology. The main contribution of the proposed method is to provide important input to the development of network topology to support the efforts to mitigate the effects of regional disasters. The problem is solved by using Waxman random graph for representing the connectivity of optical fibers on a rectangular plane and model probable circular disaster for representing as disaster events. A comprehensive verification using MATLAB is carried out to model the network topology and circular based disaster. In particular, the availability of each optical network is computed by using mathematical formula for quantifying the impact of the disaster events to the network as the outcome of this project.

ABSTRAK

Kajian ini mencadangkan untuk membangunkan alat simulasi untuk mengkaji kesan bencana berasaskan pekeliling ke arah topologi rangkaian optik. Sumbangan utama kaedah yang dicadangkan adalah untuk memberi input penting kepada pembangunan topologi rangkaian untuk menyokong usaha untuk mengurangkan kesan bencana serantau. Permasalahan ini diselesaikan dengan menggunakan graf rawak Waxman untuk mewakili penyambungan gentian optik pada satah segi empat tepat dan memodelkan bencana bulat untuk mewakili sebagai peristiwa bencana. Pengesahan komprehensif menggunakan MATLAB dijalankan untuk memodelkan topologi rangkaian dan bencana berasaskan bulat. Khususnya, ketersediaan setiap rangkaian optik dikira dengan menggunakan formula matematik untuk mengukur kesan peristiwa bencana ke rangkaian sebagai hasil projek ini.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

BER	-	Bit Error Rate
dB	-	decibels
EMI	-	Electromagnetic Interference
Gbps	-	Giga bit per second
ITU	-	International Telcommunication Union
KTM	-	Keretapi Tanah Melayu
LANs	-	Local Area Network
MDT	-	mean downtime
MHz	-	Mega Hertz
MTBF	-	mean time between failure
MTTR	-	mean time to repair
MYREN	-	Malaysia Research and Education Network
OTDR	-	Optical Time Domain Reflect meter
QoS	-	Quality of Service
THz	-	Tera Hertz
TIA	-	Telecommunication Industry Association
WDM	-	Wavelength Division Multiplexer

LIST OF APPENDICES

CHAPTER 1

INTRODUCTION

1.1 Background

Telecommunications has grown rapidly to provide a variety of information at our fingertips. With efficient use of telecommunications, all sectors worldwide will become at least a self-dependent thereby life is being more convenient. There are many types of telecommunication mediums used such as copper, optic network cable or air. Due to the potential of having limitless capabilities of high capacity, optical network has been used primarily in the modern telecommunication infrastructure. Optical network is a type of data communication network developed using optical fiber technology. The optical fiber cable is utilized as the primary communication medium for data conversion and transmission as light pulses between transmitter and receiver nodes. Optical network is less prone to external interfaces also has much lower attenuation and interference, it delivers a multitude of higher bandwidth speed networks across a wide area.

Despite to the advantages of optical network, disasters are the huge problem that may give big impact towards the performance of optical network. For example, in areas close to the sea or rivers, floods often occur due to its high vulnerability to such disaster. Due to this matter, many kinds of infrastructure have been destroyed by the disasters. As society heavily depends on optical network, for instance, telecommunications companies used it to transmit cable television signals and telephone signals, much has done to prevent network failure. However, the nodes and link of optical network still fail regularly due to these disasters. As the traffic volume to be transported through the network infrastructure continues to grow, the survivability and availability of the network are becoming the most important issues.

Network operators needs to protect network services against the risk of disasters and recover disrupted network services when disasters occur.

1.2 Motivation

As the Internet traffic is becoming more and more important to the lives of people all over the world, it needs to be highly reliable and readily available at all times. By now, most of the Internet traffic passes through optical network. However, optical network is vulnerable to natural disasters such as tornadoes, floods, earthquakes and hurricanes as well as to physical attacks such as Electromagnetic Pulse attacks, terrorist attacks, bombs and explosions. These disasters occur in a particular geographical location and disrupt a specific part of optical network. The geographical layout of the optical network therefore determines the impact of these events on the connectivity of network.

1.3 Problem Statement

Optical network can be damaged by anything from the biggest offender as well as nature and extreme weather conditions. For example, when floods occurred, an emergency network repair is needed by cable installers under harsh condition in order to avoid additional damage and downtime of optical network. The water can instantly enter a splice enclosure will be frozen then crushing the network strands and leaving with a costly network outage thereby affecting the electronic components in large geographical area. Therefore, the disaster model must be developed towards optical network topology to determine the impact of such disaster events on the network availability. This model also can be used by network operators to provide reliable important service even in the risk of disasters.

1.4 Objectives

Network topology has limitation in its performance when disaster events happened. All the network components within the region may be cut due to the disaster. Therefore, the main objectives of this research are stated below.

a) To develop a simulation tool for studying the impact of modelling the circular based disaster towards an optical network topology.

b) To study the impact of disaster size and strength of disaster impact towards network availability in terms of disrupted optical network connectivity.

1.5 Scope of Research

The scope of this research is to develop a simulation tool of circular based disaster model towards the network topology as an abstraction of an optical network with result of network availability by using MATLAB software. The model also was assumed to affect all the network nodes and optical fiber within the area of effect with certain size of disaster and failure probability. The disaster model was assumed to give an impact to the network topology with constant number of nodes, size of disaster and strength of disaster impact. This research provides an important input to support the efforts to mitigate the impacts of regional disasters.

1.6 Report Organization

The remainder of this project report is organized as follows. Chapter 2 provides an overview of optical fiber with the structural development and the features initially. The general topology and system of optical network is briefly mentioned along with

its advantages and disadvantages. Literature on deployment of optical network and issues regarding to disaster occurred will be also reviewed in this chapter. The model of network topology and disaster model will be highlighted in the case study. Other than that, the survivability and availability of the optical network will be discussed briefly.

Chapter 3 discusses the methodology to implement the research. In this chapter will discuss briefly on the research methodology, designing random network topology using Waxman theory and circular based disaster model. This chapter also discuss the effect of varies size of disaster and strength of disaster impact towards the average of network availability.

Chapter 4 can be divided into two main parts. The first part discusses the effect of disaster sizes towards the average of network availability which the parameter of disaster impact was constant. The second part is to show the result of varies strength of disaster impact towards the average of network availability with constant size of disaster. The mathematical model for disaster also covered. The simulation result is discussed also in this chapter to validate the theoretical results.

Finally, a review of all research system in this dissertation is conducted and the results obtained for the effect of network availability also summarized in the Chapter 5. In addition, the recommendations of the research will be highlighted as well and the future work are discussed in this chapter.

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