UNIVERSITI TEKNOLOGI MARA

DESIGN AND PERFORMANCE ANALYSIS OF TIME AND WAVELENGTH DIVISION MULTIPLEXED PASSIVE OPTICAL NETWORK (TWDM-PON)

FAZRYDA BINTI ZAKARIA

Dissertation submitted in partial fulfillment of the requirement
for the degree of
Master of Science
(Telecommunication and Information Engineering)

Faculty of Electrical Engineering

July 2017

ACKNOWLEDGEMENT

In the name of Allah, The Most Loving and The Most Compassionate'

Alhamdulillah, the highest thank to Allah S.W.T because of His Willingness I am possible to complete this project. I also would like to take this opportunity to extend my deepest gratitude to the following persons who helped me a lot in this project.

I would like to express my sincere appreciation to my supervisor, Dr Nani Fadzlina Naim for her encouragement, trust, critics, constant attention and guidance towards finishing my project. Thank for your guidance and without your guidance this project cannot be started and will not well organized.

I am also grateful to express my appreciation towards my beloved family members for their moral supports, patience and courage to me to complete this project. Finally, credits are also given to all my friends as they have been very supportive and always assist me in various occasions directly or indirectly influential and supportive in helping me to finished this project. Thanks to all of you for everything.

ABSTRACT

Recent years, enormous deployment of Passive Optical Network (PON) happened worldwide due to high demand of network operators to serve their customer's requirements. Operators are hoping for an improvement and capability in terms of bandwidths and service support. In addition, they required an enhanced performance of access nodes and supportive equipment connected to their current PON networks. The direction of PON evolution is a main key problem for the telecommunication commerce. In April 2012, The Full Service Access Network (FSAN) announce Time and Wavelength Division Multiplexing (TWDM) became one of superlative resolutions NG-PON2 implementation. Network operators deliberate TWDM-PON to have more advantages than other methods because it is not much of risk and troublemaking and more cheaper system as it reuses current components and technologies. In this project, a design of TWDM that meet the requirement of NG-PON2 constructed on International Telecommunication Union/ Telecommunication Standardization Sector (ITU-T) was proposed. The design achieves the minimum requirements of standard ITU-T G.989 and was simulated using Optisystem Simulation Software. This project implements NG-PON2 systems at 4x10Gbps using four different wavelengths range 1596 – 1603 nm, fiber link of 40 km and varied the value of power optical splitter from 1:2, 1:4, 1:8, 1:16 and 1:32. The results indicate that the suitable number of customers that can be served for this TWDM network is 60 based on simulation result for received power is -27.5 dBm, excess power margin of 12 dB and maximum fiber span of 100 km.

TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

1.1 INTRODUCTION

Passive Optical Networks (PON) evolution passed since first ATM/Broadband PON (APON/BPON) [1, 2] to Gigabit-PON (GPON) and Next Generation GPON (XG-PON) with data rates for both Upstream (US) and Downstream (DS) route progressively increasing from 155Mbps to 10Gbps. For current marketing of PON, the main point is to encounter demand by reducing cost and bandwidth per subscriber. Likewise, another revolution of PON have improved from the original requirement split ratio of 1:16 and 1:32 to current split of 1:64 along with maximum 20 km fiber distance [3]. However, due to unceasing demand of high data rates presented by Telecommunication's Service Providers to their subscribers, it is necessarily needed to increase data rates and split ratio.

In 2011, consider of above specified requirements from NG-PON, FSAN proposed NG-PON2 as the following evolution which empower a capacity of 10Gbps [4]. Amongst the requirements is higher capability equipped or larger than 40Gbps at 40 km range and split ratio of 1:64 and not more than 1Gbps access rate per customer [4, 5]. NG-PON2 systems necessitate elasticity to balance a compromise in data speed, fiber range, and power splitter ratio for numerous applications. The contestant technology possibility for NG-PON2 included Wavelength Division Multiplexed PON (WDM-PON), Time Division Multiplexed PON (TDM-PON), Time and Wavelength Division Multiplexed PON (TWDM-PON), Code Division Multiplexed PON (CDM-PON) and Orthogonal Frequency Division Multiplexed PON (OFDM-PON). In 2012,