



Faculty of Information and Communication Technology

**A NETWORK DESIGN OPTIMIZATION FOR SMALL SIZED
INSTITUTE OF HIGHER LEARNING - A FEASIBILITY STUDY AT
COSMOPOINT COLLEGE, MELAKA**

Siti Ramah binti Desa

Master of Computer Science (Internetworking Technology)

2017

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SITI RAMAH BINTI DESA

**A dissertation submitted
in fulfillment of the requirements for the degree of Master of Computer Science
(Internetworking Technology)**

Faculty of Information and Communication Technology

UNIVERSITI TEKNIKAL MALAYSIA MELAKA

2017

DECLARATION

I hereby declare that this dissertation titled “A Network Design optimization for small sized Institute of Higher Learning - a feasibility study at Cosmopoint College, Melaka” is the outcome of my own study except for as quoted in the references. The dissertation has not been recognized for any degree and is not synchronously submitted in application of any other degree.

Signature :

Name : Siti Ramah binti Desa

Date :

APPROVAL

I hereby proclaim that I have read this dissertation and in my judgement this dissertation is tremendously satisfactory in terms of scope and quality as a partial fulfilment of Master of Computer Science (Internetworking Technology).

Signature :.....

Supervisor Name : PM Dr Abdul Samad Bin Shibghatullah

Date :.....

DEDICATION

I dedicate my dissertation to my beloved husband Ku Mohd Idham bin Ku Mansor who supported me each step way

To my precious kids, Ku Muhammad Hamizan, Ku Hazimah Husna, Ku Hamizah Husna, who give me passion, encourage and strength with their smile.

Never being forgotten, all my friends in the MITI (offshore) class, Nalizawati, Zalifah, Rohaizah, Teck Guan, Yan, Rashid, Kamal, brother Tamri, Sis Rasuan, Nasran, Khairul, Hairul, Mynn, Man, Haffiz and Ain who always supported me.

ABSTRACT

This project is intended to address research to find the network design optimization for small sized category Institute of Higher Learning (IHL). The IHLs in Malaysia is categorized based on the number of student that actively registered. The Ministry Of Higher Education (MOHE) through its MyQuest evaluation standard state that the small sized Institute of Higher Learning (IHL) is refer to IHL that consist the number of student below 600 (MOHE, 2015). Most private IHL and some of Polytechnic College come under this category. When referring to the network design for this category of IHL, most of the network implementation or computer network setup for these IHLs was done by vendors and all information on network design blueprint is not kept by the college or the institution itself which arise problem or a hard work when any expansion and maintenance needed.

The research depicts from the idea that small IHL need a guidance in optimizing and developing the best suited network design in order to improve the network performance. Generally, Network manager faces plenty of challenges in the form of retaining raised availability, excellent performance, and protection. Present educational institution give a lot more consideration to information technology facilities to improve their students learning experience. Student is an asset to education work of area.

Performance Analysis in the network have many metrics such as throughput, delay, and bandwidth. The throughput, network failure, delay and latency is measure on current network and survey is taken to find any weakness relative to the network. The analysis is made to current network layout to find foe any improvement. Once the layout is redesign, the test for the same variable is made to find an enhancement and to ascertain that current network layout need an optimization for the performance to increase.

ABSTRAK

Projek ini pada asasnya cuba menjurus kepada kajian dalam mencari pengoptimuman rekabentuk rangkaian kepada Institut Pengajian Tinggi (IPT) yang bersaiz kecil. Kategori IPT ini didasarkan kepada bilangan atau jumlah pelajar. Kementerian Pengajian Tinggi dalam penilaian MyQuest meletakkan kategori IPT bersaiz kecil berdasarkan kepada bilangan pelajar seramai 600 dan ke bawah (MOHE, 2015). Kebanyakan IPT swasta dan sebahagian Kolej Politeknik berada di bawah kategori ini. Apabila melihat kepada rekabentuk rangkaian pada IPT dalam kategori ini, kebanyakan pelaksanaan dan pengurusan rangkaian computer diuruskan oleh vendor. Setiap maklumat berkaitan rangkaian dan 'blueprint' tidak disimpan dalam entiti kolej. Ini akan menimbulkan kerumitan dan kerja keras apabila wujud masalah atau apabila tiba masa untuk penambahan dan penyelenggaraan.

Kajian cuba untuk memberi idea atau cabaran bahawa IPT bersaiz kecil memerlukan satu panduan dalam mengoptimumkan dan membangunkan rekabentuk rangkaian yang bersesuaian dan mampu mempertingkatkan prestasi rangkaian. Secara umumnya, pengurus rangkaian akan menghadapi pelbagai cabaran dalam pada mengekalkan kadar kebolehcapaian yang meningkat, kecemerlangan prestasi dan dalam masa yang sama selamat. IPT masa kini memberi banyak penekanan ini dan kemudahan teknologi maklumat bagi meningkatkan pengalaman pembelajaran pelajar mereka, dimana pelajar bagi IPT adalah aset dalam bidang penawaran pendidikan.

Analisa Prestasi dalam rangkaian mempunyai pelbagai metric termasuklah Performance Analysis in the network have many metrics such as kadar kendalian (throughput), kelewatan atau penangguhan (delay), dan jalurlebar (bandwidth). Kadar kendalian, kegagalan rangkaian dan latensi (latency) diukur pada rangkaian sedia ada dan kajiselidik dilakukan untuk mengenalpasti kelemahan yang berkaitan dengan rangkaian. Analisa dibuat bagi mencari penambahbaikan. Apabila rangkaian direkabentuk semula, ujian menggunakan parameter yang sama dilakukan untuk mencari pencapaian dan peningkatan dalam menjurus kepada pengoptimuman prestasi rangkaian.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Malaysia has reached a gross higher education admission rate of 48% in 2012. This denotes a 70% increase in enrolment over the last span to reach 1.2 million students in public and private IHLs covering public universities, polytechnics, community colleges, private universities, private university colleges, and private colleges (Summary 2012). Nowadays, Institute of Higher Learning (IHL) in Malaysia wants to improve the way of teaching and learning methods and provide an excellent Information Technology (IT) environment, to provide student with online resource material such as audio visual material, online communication, create a portal for student so that the student can interact with the university or college to get his or her result and others announcement anywhere they are located.

This intention is comply with one of 10 shifts in Malaysia Education Blueprint 2015 - 2025 (Higher Education) which is Globalized Online Learning. As 97% Internet penetration, puts Malaysia in a good position to hitch the power of online learning to widen access to good quality content, enhance the quality of teaching and learning, lower the cost of delivery, and bring Malaysian expertise to the global community. (Summary 2012)

Providing excellent learning environments by embarking on building reliable campus network, give researchers and educator to go beyond the limitations of space and time to acquire desirable applications services and information. To this end, the need for cost-

effective high-availability network is therefore of utmost importance in an educational system.

To design a networks that met user's requirements for functionality, performance, availability, scalability, affordability, security, and manageability will need a full effort of network designer. Designing the network not only considering the routers, switch, hub and connect the dot in the network. Any design that proposed by network professional must ensure to fulfil the business requirement and solve typical business problem. Characterizing the network, including the architecture and performance of major network segments and devices, to analyse network traffic, including traffic flow and load, protocol behaviour, and any quality of service (QoS) are the first task that must done in analysing the current or existing network layout.

Generally, when the time goes by, computer network faces plenty of issues in the course of elevated availability, excellent performance, perfect infrastructure, and security. Present IHL pay more attention to IT to improve their students learning experience. Maintaining the network infrastructure and analysing the current performance of the network is required as for the objective of IHL as stated. Modern networks need to develop more solid in many ways beyond the network topology and devices themselves to meet the needs of the present social media atmosphere. Network failures due to any circumstances is not acceptable which may lead to stability issues that impact an incredible number of customers. Cosmopoint College is Cosmopoint Group's largest subsidiary that was recognised in 1992 to provide students with the essential knowledge and skills to face with the current challenges in the industry, and help graduates achieve the highest levels of success in their professional career.

The obligation to student achievement and schooling a lifelong love of learning is the core of Cosmopoint's mission. The commitment is shown by employees and academic members who identify the reputation of providing students with the prospect to learn from the best. Cosmopoint has grown into a trustworthy educational institution in Malaysia and is constantly strengthening its position at the forefront of education in the country. It features:

- The institution offers educational opportunities through a networked of 11 branches strategically located in all main town midpoints throughout Malaysia including Sabah and Sarawak. This means students can have entree to reasonable quality education without travelling far.
- Cosmopoint has a status for providing courses that is affordable and career-oriented to full-time and part-time students. The course offered include Information Technology & Engineering, Art & Design, Business & Management, Hospitality & Tourism, Health Sciences, Built Environment, Languages & Communication and Media Studies.

Cosmopoint College (CC) Melaka is one of the Institute of Higher Learning that trying to go aboard the goal and vision in providing excellent online resource materials and creating the learning environment of ICT experience. The current infrastructure and facility of communication network that was implemented since its establishment many years ago has demanding of enhanced performance. The layout of current network is based on Local Area Network (LAN) architecture with star topology. The increasing number of wireless user and the use of latest online application and learning software that have high memory usage increase the demand for higher throughput. Nevertheless the high number of users that use the internet in a time bring to slow response and delay. Network failure is also an issue in CC Melaka. This demand and the increasing of network failure rate in the current network

has spark the initial step of this research. The study is to identify whether by optimizing and redesigning the network will create the difference of the issue stated and improve the performance of the metrics. An experimental investigation is conducted to explore the availability and vulnerability of current network design and its need to improve the design for better performance.

1.2 Research Background

Computers and information networks either small or large network are critical issue to the triumph of businesses, both large and small organization. Computer network and internet link connect people, support applications and services, and run access to the resources that keep the businesses on the go. To come across the daily requirements of businesses, networks and internet themselves are becoming quite complex. A reliable communication networks do not happen by coincidence, not just plug in the wire and they goes around the world. It was a crucial task of network designer and technicians. They need to identify in which shape should the network to develop. The reliable network is the outcome of hard work of these network designers and technicians, who have to identify network requirements and give the best solutions that are concurrent to the requirements of a business environment.

Developing and establishing a network are much more on concerning the requirements of business and technical goals where:

- The network should maintain a vigil all the time, even though in the occasion of failed connection, hardware failure, and overloaded circumstances.
- The network should without fail deliver applications, web services and be responsible for balanced response times from any host to any host.

- The internet connection nevertheless must not be a scare place with a hacker, virus, worms that can harm the businesses. It should guard the data that is communicated over it and data stored on the devices that connect to it.
- The network should be hassle free upon modification and to be adapted in addition to become accustomed to network growth and all-purpose business changes.
- Because failures occasionally occur, troubleshooting should be stress-free. Finding and fixing a problem should not be too timewasting.

(Cisco Press 2014) in booklet CCNA4 wrote that the process of designing a noble network requires intensive hard work by network designers and technicians, who recognise network requirements in area of business and select the fit solutions to fulfil the needs of a business. There are four essential technical basic requirement that should be factors of good network which are availability, manageability, security and scalability. The designer must well acknowledge of these four fundamental technical basic requirements. The book also concern on design goals such as throughput, filtering, managing traffic flow, bottleneck and so forth.

The most common types of network that need to be concern before designing it to meet the business goals are Local Area Network, Metropolitan Area Network, Campus Area Network and Wide Area Network.

Local Area Network (LAN) is a design of connected computers arrayed in a small terrestrial area such as an office, a building, or a campus within the context of this project. A LAN include groups of computers and devices that shares mutual communications links and share the resources on the same network. LAN usually never exceed two building or else it is should stand for Campus Area Network. LAN is mostly using Ethernet technology and apply a star topology, which is at times called a hub-and-spoke topology.

Metropolitan Area Network (MAN) is a link that expand throughout the town covering an area of a few city blocks to the area of an entire city. It is also used to be understood as the interconnection of several local area networks by joining them with backbone lines.

Campus Area Network or Campus Network is a kindly a communication network that cover through a range of building blocks. A campus area network (CAN) is a network of several interconnected local area networks (LAN) in a partial geographical area. A CAN is smaller than a wide area network (WAN) or metropolitan area network (MAN).

The prime type of network is Wide Area Network (WAN). A wide area network (WAN) is a network system that exists over a extensive geographical area. A WAN connects diverse type of smaller networks, including local area networks (LAN), campus area network (CAN) and metropolitan area networks (MAN). Computers and users in one site can interconnect with computers and users in other locations over the WAN network. WAN implementation is successfully can be through either with the help of the public transmission system or a private network.

Designing a computer network for ideal performance and trying to fulfil all the need and meeting the requirements for all the users in an organization is very important decision. Before purchasing a brand new technology and arranging the equipment, it is advantageous if the network can be simulated quickly with ease and without much expense(Ayyoub 2014).

The study case presents the redesign and implementation process of various components of the “Lucian Blaga” University of Sibiu network, especially the most important part: the central core. This redesign is done on a physical, as well as a logical level, the objective being a network providing optimal performance, availability and scalability to transparently integrate new services and facilities(Eduard n.d.).

1.3 Problem Statement

Nowadays, academic institution wants to improve the way of teaching and learning and provide an excellent IT environment, to provide student with online resource material such as audio visual material, online communication, create portal for student so that the student can interact with the university to get his or her result and others announcement anywhere they are located. Providing excellent learning environments by embarking on building reliable campus network give researchers and educator to go beyond the limitations of space and time to acquire desirable applications services and information. To this end, the need for cost-effective high-availability network is therefore of utmost importance in an educational systems.

Cosmopoint College (CC) Melaka is one of the Institute of Higher Learning that trying to embark that aim and vision. An experimental investigation was conducted to explore the availability and vulnerability of current network design and its need to optimize the design for better performance. The current network was implemented many years ago and there is an increasing demand of better performance. The high usage of internet and the increasing number of user especially student and lecturer in their learning and teaching environment has impact the network performance.

Slow response and network failure is a major complain received from the internet user of Cosmopoint College (CC) Melaka. This arising issues of network performance in current network, which contra to reliability, affecting the business environment which rely on network availability. All routine in Cosmopoint Melaka from more than 200 users regarding enrolment, administrative task, communication, teaching and learning are depending to internet availability and speed.

This study will be using a throughput metric as parameter in performance measure. Referring to records and officer incharge, the number of complain for network failure receive in average of once in two days. This will give a bad influence to the company as a Institution of Higher Learning that apply day to day internet use.

The figure 1 below showing the download speed and the upload speed for the current situation at CC Melaka.

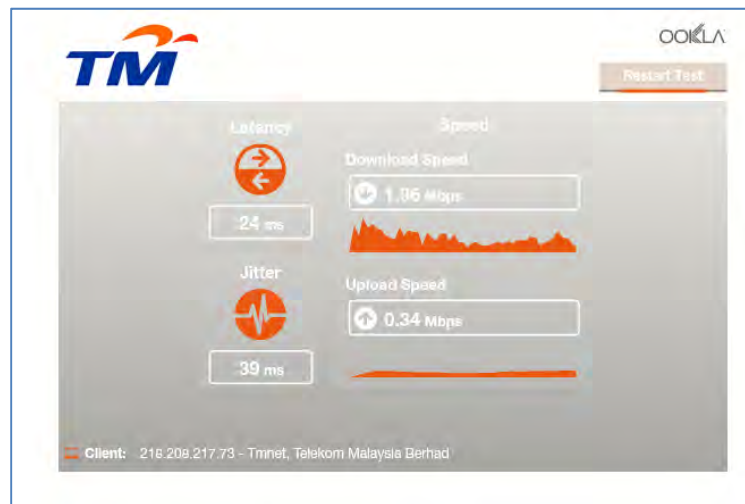


Figure 0-1: Example of Speed Test

The paper also try to compare with other colleges that in the same category. One college in Negeri Sembilan deploy a network that similar to cc melaka but.

1.4 Research Question

The questions arise on the matter are:

1. Does the network design that had been developed years ago create problems regarding performance?
2. What are major problems arise?
3. Does the problems will be influenced once the network is redesigned and does it optimizing the current network in Cosmopoint College Melaka?

4. Does the throughput will increase and the network failure will reduce after the optimization?

1.5 Research Objective

The objective of this research is to propose an optimization of the network design, which will be recommended for the Cosmopoint College, Melaka, and which will adapt to the specific requirement stated by the institute and also recommend a network infrastructure which can bring characteristic like scalability and performance, to the new design. Network optimization is a balance between network performance and network costs.

Network performance can be extremely enhanced. With a good track of monitoring, it is possible to alter your devices and protocols to accomplish the best possible performance.(Umeh et al. 2015)

There are three objectives in this research:

1. To identify the current design of the network in Cosmopoint Melaka.
2. To proposed a network optimization.
3. To reduce the problem arise with current network.

1.6 Research Methodology

This section review the research methodology that will be used in the project. The investigative experimental technique is the method of research that test hypothesis regarding cause-effect connection. The details of research methodology will be expand in Chapter 3. The steps of the method will be used in this project paper summarized as below:

1.6.1 Defining the current network

The current network design in term of its' physical design, will be defined an experimental variable to be manipulated. The network physical design will be the main cause in the finding of the study. Currently the CC Melaka network design apply the LAN network design that is approachable for office building and number of user is below 200. In addition the number of user and types of applications that being used in the network coverage are also will be defined.

Analysing the current system in term of equipment, size of the campus, number of student in the entire campus is very important that will help the designer to make a choice on what equipment is needed The manipulation which the redesign of network will observes the effect of other dependant variables. In this study, the dependant variable is used that are throughput, network delay and network failure.

1.6.2 The variable will be analysed based on the current network

The most collective metric evident in the network study is throughput. Throughput is defined as the rate at which substance data transmissions can be transferred from one point to another through a appropriately long time period.(Narayan et al., 2009). The analysis on throughput is will be done before and after the proposed network redesign.

Next, the network failure analysis for current design will be run. Network failure is the whole or fractional failure of a element or components of a network because of glitch or natural or human-caused disasters. In reaching high availability amidst numerous failure factors such as hardware, software, and human errors, the focus is on fitting the most unreliable devices and communication links in the network.

The engineers of computer networks have had to struggle with frequent failures such as link failures, router failures, and interface failures and so on, years after the first networks were constructed. Much effort has gone into helping operators detect and understand network failures.

In the network, link failure will root the network to not work correctly and what a designer must do to optimize the network when there are link failure amid point to point, which was the research conducted by Kerivin, Nace and Pham, 2012 to solve that they proposed to create redundancy of the network by making multi path link.

Improving long term network availability requires measuring failures and adapting strategies to suit circumstances. Unfortunately, such analysis is hardly performed in practice. This lack of analysis is because common means of assessing network failures at fine granularity presuppose measurement mechanisms that incur significant capital and operational expense.

The other variable will be put in concern is network delay. Packet delay is considered as being encompassed of packet access delay, propagation delay and processing delays. The average delay was processed as expressed in equation.

The analysis on vulnerability of network infrastructure also will be done simultaneously with throughput analysis phase.

1.6.3 The propose network optimization will be designed using Top Down Approach.

In the phase user requirement and analysis are the core finding in spite of the latest technology in network device.

There are six phase in the top down design approach but for this study, the design approach will end at stage 4. The Top Down Approach involve Analyse Requirement, Develop