DECLARATION

I declare that this project entitled "Quality of Service (QoS) Improvement using Traffic Shaping in ADTEC Batu Pahat" is the result of my own research except as cited in the references. The project has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : …….

Name : Siti Rodhiah Binti Mohd Yunus

Date : …….

APPROVAL

I hereby declare that I have read this project and in my opinion this project is sufficient in terms of scope and quality for the award of Master of Computer Science (Internetworking Technology).

Signature : …….

Supervisor Name : …….

Date : …….

DEDICATION

I lovingly dedicate my project to my beloved husband Ashari Bin Kasmin who supported me each me step way

To my precious sons, Muhammad Adli Bin Ashari and Muhammad Ihsan Bin Ashari, who give me passion and strength with their smile.

Last but not least, to my special parent who always be with me. You are my everything.

ABSTRACT

QoS is a requirement for ensuring the implementation of specific standard performance to avoid delays in reaching destinations and decreases number of lost packets. Also the performance of the network can be optimized indirectly. Therefore, to ensure network performance, there are a variety of QoS methods and mechanisms to manage and control packet from lost or delayed and also improve network performance. As a Cisco Networking Academy, Department of Computer and Networking has applied a range of delivery methods to provide the relevant and most effective training solution for students. However, all of these methods can quickly consume bandwidth and make the LAN network is poor or totally down for other classes. This project objective is implement traffic shaping mechanism and analyze the impact of generic traffic shaping and class-based traffic shaping on the network. We separated our experiment into three primary cases. In the first case we investigate the fixed bandwidth of 4 Mbps with no QoS applied. Second case we implement the Generic Traffic Shaping mechanism on outbound interface with three different of mean rate and burst size values. The third case, we configured the sub interface of the router that been classed with different VLANs on the network. The conclusion is that the Class based shaping can lead more efficient and give a good quality of network performance. This is because the class based shaping offered more specific traffic management such as classes the users based on the usage and application used. As from the output the average outgoing packet for sub interface in Traffic Shaping router is 99.93% which indicated a good quality in performance.

.

ABSTRAK

QoS adalah satu keperluan untuk memastikan pelaksanaan prestasi standard khusus untuk mengelakkan kelewatan dalam destinasi mencapai dan mengurangkan beberapa kehilangan paket. Juga prestasi rangkaian boleh dioptimumkan secara tidak langsung. Oleh itu, untuk memastikan prestasi rangkaian, terdapat pelbagai kaedah QoS dan mekanisme untuk mengurus dan paket kawalan dari prestasi rangkaian yang hilang atau lewat dan juga bertambah baik. Sebagai Akademi Perangkaian Cisco, Jabatan Komputer dan Rangkaian telah menggunakan pelbagai kaedah penyampaian untuk menyediakan penyelesaian latihan yang relevan dan paling berkesan untuk pelajar. Walau bagaimanapun, semua kaedah ini boleh dengan cepat mengambil bandwidth dan membuat rangkaian LAN adalah miskin atau sama sekali selama kelas lain. Ini, objektif projek adalah melaksanakan mekanisme membentuk trafik dan menganalisis kesan membentuk trafik generik dan lalu lintas berasaskan kelas membentuk pada rangkaian. Kami belah eksperimen kita kepada tiga kes utama. Dalam kes pertama yang kami siasat jalur lebar tetap 4 Mbps tanpa QoS digunakan. Kes kedua kita melaksanakan mekanisme Generic Trafik Shaping pada antara muka keluar dengan tiga yang berbeza daripada kadar min dan pecah nilai saiz. Kes ketiga, kami dikonfigurasikan antara muka sub router yang telah dikelaskan dengan VLAN yang berbeza pada rangkaian. Kesimpulannya adalah bahawa membentuk Kelas berasaskan boleh membawa lebih cekap dan memberikan kualiti yang baik prestasi rangkaian. Ini kerana pembentukan kelas berdasarkan yang ditawarkan pengurusan trafik yang lebih khusus seperti kelas pengguna berdasarkan penggunaan dan aplikasi yang digunakan. Mulai dari output purata paket keluar untuk antara muka sub dalam Trafik Shaping router adalah 99.93% yang menunjukkan kualiti yang baik dalam prestasi.

ACKNOWLEDGEMENT

In the name of Allah, Most gracious, Most Merciful. All praises belong to Allah. First of all, I would like to thank to Allah Al the Mighty, who made me capable to complete the project throughout those difficult years.

I would like to express my sincere acknowledgment to my supervisor, Dr. Zul Azri bin Muhamad Noh for his excellent supervision, guidance, supporting and encouragement towards in completing my project. May Allah reward him with a reply that much better than what all he has done.

I am in debt and owe great thanks to my beloved husband (Ashari bin Kasmin), my mother, my father, my siblings and my dearest sons (Muhammad Adli and Muhammad Ihsan) for their patience, inspiration, continuous encouragement and thoughtful advice throughout my years as a Master student.

I would like to extend my thanks to my colleagues for their time, guidance and king support during my study. I would also like to thanks to my employer. Last but not least, my special thanks to all my friends especially Mr. Wan Muhammad Hazwan and Mrs Noor Atiqah for their time, understanding, advice and continues moral support.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF ABBREVIATIONS

CBWFQ	Class-Based Weighted Fair Queuing
CIR	Committed Information Rate
DCF	Distributed Coordination Function
DiffServ	Differentiated Services
DSL	Digital Subscriber Line
DSP	Digital Signal Processor
DSCP	Differentiated Services Code Points
FEC	Forward Error Correction
FIFO	First In First Out
GRE	Generic Routing Encapsulation
GSM	Global System for Mobile telecommunications
GTS	Generic Traffic Shaping
ICT	Information and Communication Technology
IETF	Internet Engineering Task Force
IntServ	Integrated Services
IP	Internet Protocol
ISP	Internet Service Provider
LAN	Local Area Network
LLQ	Low Latency Queuing
LTE	Long Term Evolution
MAC	Medium Access Control
MAN	Metropolitan Area Network
NBAR	Network-based Application Recognition
PBX	Private Branch eXchange
PCM	Pulse Code Modulation

PHB	Per-Hop Behavior
PPTP	Point-to-Point Tunnelling Protocol
PSTN	Public Switched Telephone Network
QoS	Quality of Service
RSVP	Resource Reservation Protocol
RTP	Real-Time Transport Protocol
SIP	Session Initiation Protocol
SNMP	Simple Network Management Protocol
SSL	Secure Sockets Layer
TDMA	Time-Division Multiple Access
TS	Traffic Shaping
VoIP	Voice over IP
VPN	Virtual Private Network
WAN	Wide area network
WFQ	Weight Fair Queuing
WLAN	Wireless Local Area Network

CHAPTER 1

INTRODUCTION

1.0 Introduction

ADTEC Batu Pahat is one of the Manpower Department Training Institute (ILJTM) conducted by the Department of Manpower (JTM), Ministry of Human Resources. The main objective is to produce ADTEC skilled workforce that is competent and competitive to meet the needs of the industry. Referring to the objectives, ADTEC Batu Pahat has been credited as an Accredited Center by the Department of Skill Development, Ministry of Human Resources for the Malaysian Skills Diploma program and has been recognized by Malaysia Quality Assurance (MQA) for Diploma of Technology Engineering. This accreditation is an advantage to prepare students to pursue their studies to a higher level. ADTEC Batu Pahat offered Diploma of Engineering Technology in five (5) core technical fields such as Computer Network, Welding, Electronic, Mechatronic and Mechanical Manufacturing.

The Computer and Networking is one of the departments in ADTEC Batu Pahat that offered the program that are in line with the latest technological developments which include system design and development of computer networks in business operations, telecommunications and image processing. Other than that, the program exposes students to skills wiring network systems, network configuration and network management system. Network management covers the work of identifying the problem, repair and maintenance

of network systems. To ensure that students are able to compete in the job market, the Department of Computer and Networking has been recognized as a Cisco Networking Academy and Microsoft IT Academy since 2010, where students have the opportunity to have a professional certification such as Cisco Certified Entry Networking Technician (CCENT) and Cisco Certified Network Associate (CCNA) Routing and Switching.

As a Cisco Networking Academy, Department of Computer and Networking has applied a range of delivery methods to provide the relevant and most effective training solution for students such as Classroom Learning, Self-Paced Study, E-Learning, Training Workshops, Online Learning and Online Exam. However, all of these methods can quickly consume bandwidth and make the LAN network is poor or totally down for other classes. This department has own network with link speed of 4Mbps and has never been implemented any QOS mechanism in traffic management. They use a best effort service in all applications. The network usage can be shown in Figure 1.1 that has been capture on 4-5 August 2015. The peak usage is nearly hit the maximum bandwidth. In design a network this issue may affect the performance of the network.

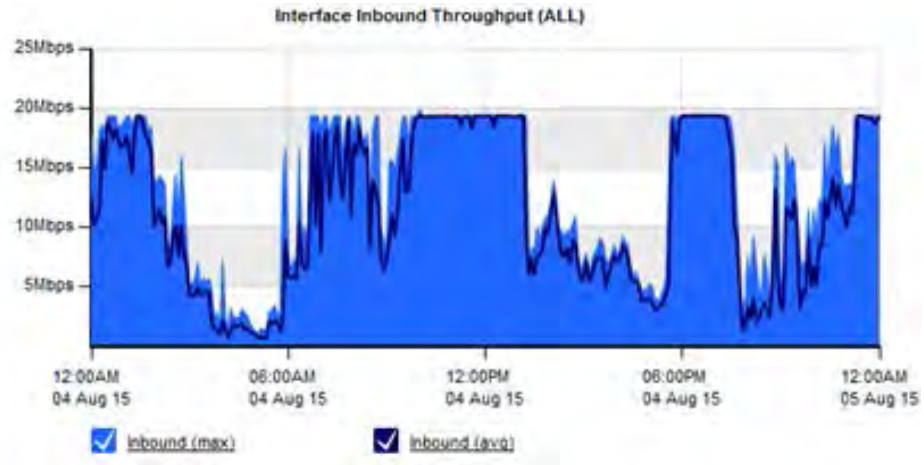

Figure 1.1: Bandwidth Usage Recoded on 4-5 August 2015

This study investigates the network performance metric that influence the network performance at Department of Computer and Networking, ADTEC Batu Pahat that cause traffic congestion in the network. Based on investigation of network flow, the real time implementation of traffic shaping is conducted with Generic Traffic Shaping and Class-based Shaping Mechanisms. Finally, to analyze the significance on the packet delay due to packet shaper and also the packet loss we perform a comparison for each Generic and Class-based.

1.1 Research Background

Recent advances usage of network technology in the corporate, home and academic communities, especially in training center that has a various training delivery has brought about consuming large bandwidth along with widespread internet access through high-speed connections. The measure of system performance shows one of the fundamental appraisal characters of a successful network solution or a network service.

Basically, quality has two approaches to determining, scaling and evaluating that comply the specification. In network prospect, measuring the performance is known as the Quality of Service (QoS) and relates several of QoS mechanisms that are resolved the desired standard in the network. Normally, QoS parameter includes network performance metrics such as availability, packet loss, packet delay and utilization. On the other hand, the measure of end user experience or satisfaction performance is known as the Quality of Experience (QoE). While the QoS is rather a quantitative and objective approach to assessing network performance, the QoE is qualitative and subjective, measured on an end user basis, and involves human-related satisfaction and experiences with the network service.

A network usually contain of a lot of communication devices such as server, switch and routes between them (Kozačinski and Knežević, 2014). The packet is travel through the network. A transmitter is a node that sends the packet, and the other guests are having the packet known as a receiver. They are not physically linked up each other, but in most instances there are other nodes and paths between them. Because of that, it has a possibility that not all packets are sent through the same route and error might occur within the transmission such as:

i) Packets arriving out of order per various routes.
ii) Jitter occurs when packets arrive at the destination in the wrong order, improper queue or error in configuration that caused by network congestion. Also known as packet delay variation.
iii) Transferring error. Packets can be failed to reach the destination while travel because of traffic congested that can cause delays and decline the network performance.

1.2 Problem Statement

Designing the network that met the technical goals is a major task, especially the network availability, network performance and user expectations. In reality situations, the receiver is usually moderate in responding. Hence, all senders cannot get the response immediately from a receiver simultaneous and required to wait. This can cause issues in network performance such as slower transfer, packet delay and possible packet loss. However, there are several QoS mechanisms that can enhance the poor network performance such as classification and marking, policing and metering, traffic shaping, queuing and scheduling, and dropping.

Traffic shaping is a fraction of QoS mechanism that can reduce the packet loss, jitter and packet delay. To date a number of studies have investigated the effects of the QoS mechanism, especially traffic shaping in various field and service such as packet-switch network, cellular network, wireless mesh network and internet (Daniel-Simion, 2011; Davis and Navet, 2012). They had come with the conclusion that inclusive all studies that traffic shaping is a fraction of QoS mechanism that can reduce the packet loss, jitter and packet delay. However, in a local institute, especially ADTEC Batu Pahat has never been implementing this mechanism in traffic management. They use a best effort service in all applications. So that, in this study the traffic shaping will be implemented in order to apply for improvement traffic management in ADTEC Batu Pahat and to reduce network problem issues in this institute such as network congestion and peak network usage especially in teaching and learning (T&L) process.

1.3 Research Objective

This project embarks on the following objectives:

i) To investigate the network traffic in ADTEC Batu Pahat

ii) To implement traffic shaping mechanism in LAN ADTEC Batu Pahat

iii) To analyze the impact of generic traffic shaping (GTS) and class-based traffic shaping on the network.

1.4 Research Methodology

We use Wireshark to monitor and analyse the collected LAN network traffic Department of Computer and Networking. The records consist of traffic flow and bandwidth usage within LAN. The monitoring records were compiled during a 1-week

period of training in the Department of Computer Network. Throughout this investigation, factors that influence the network performance will be determined.

Based on investigation, the real time implementation of traffic shaping is conducted with Traffic Shaping Mechanisms using Generic Traffic Shaping and Class based Shaping. The router will be configured for outbound traffic flow per-interface and specify peak rate traffic shaping for permitting more data to be sent if the bandwidth is available. And for Class based Shaping the router is configured for outbound traffic per-sub interface. The use of sub interface is to divided the user by implementing the Vlan on a network. After that, the network analyzer will be run in the same time manner to analyze the effectiveness by implementing traffic shaping in avoidance congestion in traffic flow and enhanced the network performance.

Finally, for monitoring the impact and the effectiveness of this three cases, mainly we used Wireshark along with Cacti. Wireshark is for monitoring client traffic analyser while Cacti is for monitoring traffic ingoing and outgoing on a router.

1.5 Expected Outcomes

The main outcome of this study is the improving of the network performance and after traffic shaping is implemented on a network. Traffic shaping is a fraction of QoS mechanism that can reduce the packet loss, jitter and packet delay. The importance of this study is to determine the network performance optimization by using traffic shaping with appropriate packet size, transmission rate, number of resources and the length of buffer can be chosen to obtain the excellent outcome.

1.6 Conclusion

In this chapter, it specified about the research in QoS improvement using traffic shaping. QoS is a method to ensure network performance in line with the network standard. Network performance matrix has a strong relationship with the network performance. Precise evaluation permits us to discover outcomes of traffic shaping which can be associated to throughput and end-to-end delay. This chapter is an overview that illustrates the information about the research. In introduction chapter, the essential points clarify about a research literature, specific problem, the objectives, research design, expected outcome and conclusion. In the following chapter, we will discuss about more about literature review related to the QoS, network performance and traffic shaping.

CHAPTER 2

LITERITURE REVIEW

2.0 Introduction

In this chapter, the focal point is a study, reviews and examines the QoS mechanism especially traffic shaping in a way to improve the network performance by determine the network performance matrix and characteristic. It started with the review the background of the research problem and verifies that none of the researchers has study this topic. By doing this, we can find the gap in this knowledge defined in Chapter 1. Then, it continues by discussing the related work on QoS. Finally, the last section will summarise the traffic shaping techniques which are going to be implemented in this study.

2.1 Research Problem

Designing a network that comply all the need and requirement standard is hard to achieve. On one hand, users require the network to sustain very high availability, little or no congestion, and thus little or no queueing delay, especially to the technical institute that has money constraint that can cause a very limited bandwidth capability but yet still has to occupy the network technology growth. A network must be constructed to sustain the availability when there are failures or disturbances in the network. A failure tends to make the connection loss, which can take several seconds to recover from, and is too lag for real-time applications such as video streaming, gaming or voice that cause jitter.