TESIS^ APPROVAL STATUS FORM

JUDUL: An Efficient Traffic and Bandwidth Prioritization Using Network Quality of Service (QOS)

SESI PENGAJIAN: 2004/2005

Saya YAP LHEE SUNG

(HURUF BESAR)

mengaku membenarkan tesis (PSM/Sarjana/Doktor Falsafah) ini disimpan di Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dengan syarat-syarat kegunaan seperti berikut:

1. Tesis adalah hakmilik Kolej Universiti Teknikal Kebangsaan Malaysia.
2. Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dibenarkan membuat salinan untuk tujuan pengajian sahaja.
3. Perpustakaan Fakulti Teknologi Maklumat dan Komunikasi dibenarkan membuat salinan tesis ini sebagai bahan pertukaran antara institusi pengajian tinggi.
4. ** Sila tandakan (/)

_____ SULIT (Mengandungi maklumat yang berdarjah keselamatan atau kepentingan Malaysia seperti yang termaktub di dalam AKTA RAHSIA RASMI 1972)

_____ TERHAD (Mengandungi maklumat TERHAD yang telah ditentukan oleh organisasi/badan di mana penyelidikan dijalankan)

_____ TIDAK TERHAD

(TANDATANGAN PENULIS)

Alamat tetap : No 9, Jln Lee Kim Sui, 48000 Rawang, Selangor.

Tarikh : 18/10/2004

(TANDATANGAN PENYELIA)

PROF. MADYA DR. SHAHRIN B. SAHIB @ SAHIBUDDIN
Timbalan Dekan (Akademik)
Fakulti Teknologi Maklumat & Komunikasi
Kolej Universiti Teknikal Kebangsaan Malaysia
Karung Berkunci 1752
75450 Ayer Keroh, Melaka

Nama Penyelia

Tarikh : 18/10/2004

CATATAN: ** Jika tesis ini SULIT atau TERHAD, sila lampirkan surat daripada pihak berkuasa.
^ Tesis dimaksudkan sebagai Laporan Projek Sarjana Muda (PSM)

AN EFFICIENT TRAFFIC AND BANDWIDTH PRIORITIZATION USING NETWORK QUALITY OF SERVICE (QOS)

YAP CHEE SUNG

This report is submitted in partial fulfillment of the requirements for the Bachelor of Information and Communication Technology (Computer Network).

FACULTY OF INFORMATION AND COMMUNICATION TECHNOLOGY
KOLEJ UNIVERSITI TEKNIKAL KEBANGSAAN MALAYSIA
2004

ADMISSION

I admitted that this project title name of

AN EFFICIENT TRAFFIC AND BANDWIDTH PRIORITIZATION USING NETWORK QUALITY OF SERVICE (QOS)

is written by me and is my own effort and that no part has been plagiarized without citations.

STUDENT : _____ Date : 18/10/2004
(YAP CHEE SUNG)

SUPERVISOR: _____ Date : 18/10/2004
(PROF. MADYA DR. SHAHRIN SAHIB)

ACKNOWLEDGEMENT

I would like to owe my gratitude and sincere thanks to the Faculty of Information Technology and Communication (FTMK) for having this special semester to us, and giving us the opportunity to perform the Bachelor Project (PSM). I extend my gratitude to FTMK for making my training period memorable fulfilling and enriching experience. I have learned a lot during this PSM period. I have exposed myself to the new knowledge and prepared myself for the challenge of my future working days.

Firstly, I would like to express my deepest thank to Assoc. Prof. Dr. Shahrin Sahib, my supervisor of the PSM, for his effort to make my PSM a memorable experience, and his kindness of giving me advice and guides me throughout the project. I would like to thank for his valuable idea for the project that I need to accomplish; the project might not be accomplish in time without his help. His kindness, morale support and help will always in my memory.

Besides that, I would like to express my appreciation to the lecturers, to name a few as Miss Azah Kamilah Muda, Mr. Suhaimi Basrah and Mr. Othman Mohd for their patient and kindness to brief and guide me for the PSM. Their help to me during the PSM is much appreciated. The information that they provided to me is useful. I really learn a lot from them.

In addition, I would like to thank the technicians of FTMK, for their patient to show me their technical knowledge and experience. I really learn a lot of hands-on experience from them.

Lastly but not least, I would also like to thanks my friends, for their help and kindness. Thanks for giving me some guideline during the PSM period.

Thank you all for making my PSM period a great and treasured experience. I wish you all the best in the future undertakings.

ABSTRAK

Projek sarjana muda ini adalah berkaitan dengan pengurusan trafik rangkaian, dengan menekankan dalam kajian servis qualiti rangkaian (QOS). Sejak beberapa tahun yang lepas, trafik rangkaian, sama ada trafik LAN atau trafik WAN, telah mengalami pertumbuhan yang pesat disebabkan oleh kemunculan pelbagai jenis aplikasi multimedia yang memerlukan kapasiti rangkaian yang tinggi. Dalam rangkaian IP, semua trafik akan dilayan dengan sama rata. Dengan ini, apabila rangkaian telah padat dengan trafik yang kurang kritikal, aplikasi kritikal akan mengalami kesukaran untuk melaksanakan transaksinya. Dalam hal ini, implementasi QOS adalah penting supaya trafik-trafik bagi applikasi kritikal dapat dilayan and dihantar terlebih dahulu berbanding dengan trafik-trafik yang kurang kritikal. Projek sarjana muda ini dilaksanakan dengan menggunakan metologi FAST yang terdiri daripada tujuh fasa seperti fasa penilaian konsep, fasa pengajian masalah, fasa pengajian keperluan, fasa pengajian tindakan, fasa rekabentuk, fasa implementasi dan fasa pengujian. Setiap fasa mempunyai aktiviti-aktiviti yang tersendiri yang perlu diselesaikan sebelum melangkah ke fasa yang seterusnya. Simulasi rangkaian QOS ini yang dibangunkan mengabungkan teknologi QOS dalam Windows dan CISCO. Secara umumnya, projek sarjana muda ini telah banyak memberi pendedahan kepada konsep dan teknologi QOS. Ini memang merupakan satu peluang yang baik bagi saya untuk meneroka ilmu baru dalam bidang teknologi QOS.

ABSTRACT

Generally, this bachelor project will research in network traffic and bandwidth prioritization, by using the QOS solution to setup a simulation QOS-enabled network. Within the past few years, there has been a rapid growth of network (LAN and WAN) traffic, due to the new applications, particularly multimedia applications, have placed increasing demands on networks. In the IP network, everything is best-effort delivery and all the applications have the equal value. Therefore, when the network is crowded with the less critical traffic (e.g., non-critical Web browsing, large FTP file transfers, and P2P uploading / downloading of digital music files), the mission-critical application can not get their way to complete the transaction. In this instance, network quality of service (QOS) is significant to provide guaranteed bandwidth and prioritized traffic to the critical application. E-Business, Enterprise Resource Planning (ERP) and streaming applications like video conferencing and VoIP require performance guarantees to ensure that they do not suffer from bandwidth contention from less critical applications and Internet traffic. The bachelor project was developed under the Framework for the Application of System Techniques (FAST) methodology, which consists of seven phases (concept evaluation phase, problem analysis phase, requirement analysis phase, decision analysis phase, design phase, construction phase and implementation phase). All the activities that are defined in the pervious phase need to be completed first before proceeding to the next phase. The simulation QOS-enabled network was setup by interoperating the Windows-based and Cisco-based QOS technology. Both of the LAN traffic and WAN traffic can be prioritized in the simulation QOS-enabled network. As a conclusion, the bachelor project has given many revelations in the QOS concept and technology. It has placed a great chance for me to equip myself with new skills and additional knowledge in QOS technology.

TABLE OF CONTENTS

DESIGN

IMPLEMENTATION

TESTING

LIST OF TABLES

LIST OF FIGURES

LIST OF ACROYMNS

ACROYMN	DESCRIPTION
[A]	
AAL	ATM Adaptation Layer
AD	Active Directory
ABR	Available Bit Rate
ACL	Access Control List
ACS	Admission Control Services
AIM	Advanced Integration Module
API	Application Programming Interface
ATM	Asynchronous Transfer Mode
[C]	
CBR	Constant Bit Rate
CMS	Cluster Management Suite
COP	Common Open Policy Service Protocol
CQ	Custom Queuing
CRM	Customer Relationship Management
[D]	
Diffserv	Differentiated Services
DNS	Domain Name Service
DSCP	Differentiated Services Code Point
[E]	
ERP	Enterprise Resource Planning
[F]	
FAST	Framework for the Application of System Techniques
FIFO	First In First Out
FTP	File Transmission Protocol
[G]	
GPRS	General Packets Radio Services

[H]

HRT	Human Response Time

[I]

IEEE	Institute of Electrical and Electronics Engineers
IETF	Internet Engineering Task Force
IOS	Internetworking Operating System
IP	Internet Protocol
IPX	Internet Packet Exchange
ISO	International Organization for Standardization
ITU	International Telecommunication Union

[K]

Kbps	Kilo bit per second

[L]

LAN	Local Area Network
LDAP	Directory Access Protocol

[M]

MAC	Media Access Control
Mbps	Mega bit per second
MDD	Model-Driven Development Route/Technique
MRSVP	Mobile Resource Reservation Protocol
MTA	Module Test Application

[N]

NDS	Novell Directory Service
NIC	Network Interface Controller

[P]

PSM	Bachelor Project
PATH	RSVP message that contains the reservation request
PQ	Priority Queuing

[Q]

QOS	Quality of Service

[R]

RAM	Random Access Memory
RESV	RSVP message that confirms the reservation request

RFC	Request for Comments
RSVP	Resource Reservation Protocol
[S]	
SBM	Subnet Bandwidth Management
SMTP	Simple Mail Transfer Protocol
SNA	System Network Architecture
SOW	Statement of Work
SQL	Structure Query Language
[T]	
TCP	Transmission Control Protocol
TFTP	Trivial File Transfer Protocol
TOS	Type of Service
[U]	
UBR	Unspecified Bit Rate
UDP	User Data Protocol
[V]	
VBR-nrt	Variable Bit Rate (non real time)
VBR-rt	Variable Bit Rate (real time)
VLAN	Virtual Local Area Network
VoIP	Voice over IP
VPN	Virtual Private Network
[W]	
WAN	Wide Area Network
WBS	Work Breakdown Structure
WFQ	Weight Fair Queuing
WINS	Windows Internet Name Service
WWW	World Wide Web

LIST OF APPENDIXES

CHAPTER I

INTRODUCTION

1.1 Overview

Generally, within the past few years, there has been a rapid growth in network traffic. New applications, particularly multimedia applications, have placed increasing demands on networks, straining their ability to provide customers with a satisfactory experience. To answer this situation, numerous mechanisms have surfaced for providing Quality of Services (QOS) networks. The ultimate goal of these mechanisms is to provide improved network service to the applications at the edges of the network.

QOS operates across the network and allocates resources, such as bandwidth, to applications. This allocation is determined by giving some applications priority over other kinds of applications. QOS gives network administrators control over the networks, and, consequently, the ability to provide better service to the end users. Hence, a mission-critical application can be guaranteed the resources to complete its transactions within an acceptable period.

In this instance, a simulated QOS-enabled network will be established in this bachelor project (PSM). The main purpose of the project is to test the functionality of the service prioritization in a crowded network, so that the critical services or applications will not be compromised although on the peak traffic time.

The Framework for the Application of System Techniques (FAST) methodology, with an emphasis in Model-driven development (MDD)

route/technique, will be followed during the development of the project. A detailed description for the FAST methodology will be touched in Chapter III.

1.2 Problem Statements

Today, there has been a rapid growth in network traffic, and with that growth, competition for limited network resources. The performance of mission-critical applications, such as SQL Database, and time-sensitive applications, such as NetMeeting video conferencing, can drown in a flood of less important network traffic such as a PointCast Web newscast. As a result, systems administrators end up facing network crowd, slow response, and packet-dropping problems.

For example, UDP simply transports packets. Applications that favor UDP, such as multimedia applications, can quickly overwhelm a network and this has caused the critical application cannot complete its transactions within an acceptable period.

Besides that, some regular and non-critical services such as like file copy, long printing spools, and e-mails with heavy attachments, also may substrate the available bandwidth and may cause delay and network congestion.

1.3 Objectives

There are several objectives that need to be archived through this bachelor project (PSM), as listed below:

a) to setup a simulated QOS-enabled network environment.
b) to increase the performance of the mission-critical application such as e-commerce, and the time-sensitive application such as NetMeeting video conferencing in a slow link.
c) to reserve resources (network bandwidth) for entitled users.
d) to prioritize access to resources (network bandwidth) based on users and applications.
e) to prevent non-adaptive protocols (such as UDP) from abusing network resources
f) to efficient use of existing resources (network bandwidth), which can delay the need for expansion
g) to prove and verify the concept of QOS.

1.4 Scopes

Project's Activities

Project 1 (PSM 1) will give more attention in doing the project documentation, such as literature research, project plan, problem analysis and project design. All the implementation only will be performed in Project 2 (PSM 2).

Project's Result

The performance of the bachelor project (PSM) is not going to setup the complete QOS-enabled network environment. On the contrary, only a simulated

QOS-enabled network will be setup so that the functionality of QOS can be proven, tested and verified

Platform

The simulated QOS-enabled network only contains the Windows 2000 or Windows 98 hosts, other hosts such as Linux and UNIX will not be included.

Network Devices

The simulated QOS-enabled network involves not only the layer 2 network devices (switches), but also the layer 3 network devices (routers) to make it works efficiently.

Network Bandwidth Reservation

In the simulated QOS-enabled network, both of the Intranet access bandwidth (LAN traffic) and the Internet access bandwidth (WAN traffic) can be reserved and prioritized based on the users and the applications.

1.5 Contributions

For personal important, bachelor project (PSM) is very important for every KUTKM students because in order for a student to finish the bachelor program, it is compulsory for the student to pass the bachelor project (PSM) before being awarded the degree.

Practically, this project is important to show that QOS is another alternate solution to improve the network and critical application performance. Previously,

many people think that increasing network bandwidth is the best solution for solving the network congestion and slow response problems; increased network bandwidth means increased network performance.

However, simply throwing more bandwidth at the network is not the ultimate solution to these problems, because people cannot foresee what new bandwidth-hungry applications will be in use in several months (refer Figure 1.1) [30]. An ill-behaved application can easily bring the network down. In this situation, it is more suitable for the network administrators to incorporate the QOS than increasing the network bandwidth (which is an expensive and limited resource).

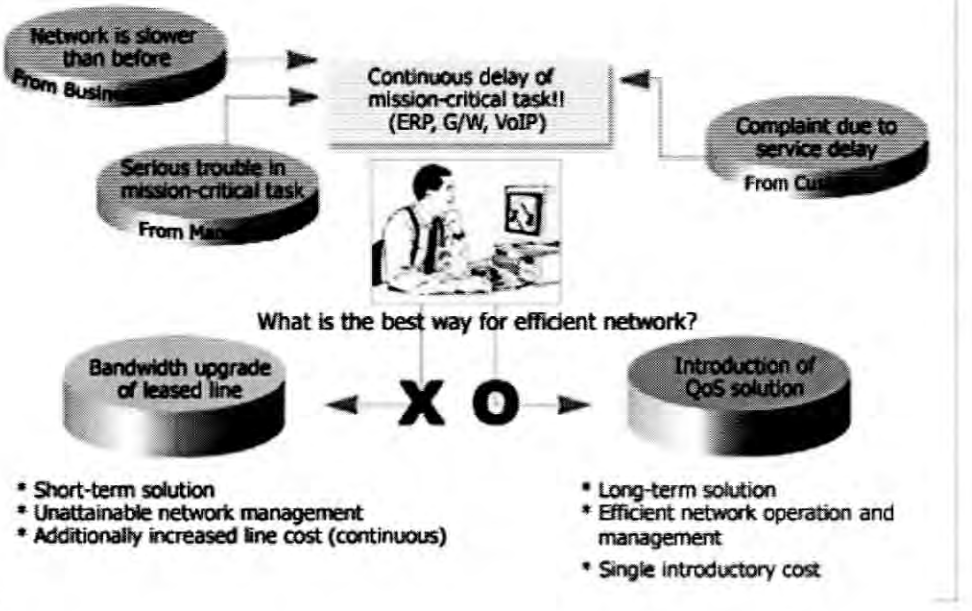

Figure 1.1: Comparison of QOS Solution and Bandwidth Upgrade Solution

With QOS, network administrators can achieve a better management and use of the limited bandwidth resources by using the traffic prioritization schemes and the network bandwidth can be guaranteed for the essential services during high congestion periods.

For example, users making purchases or consults in the organization's portal could and should receive a special treatment and a bigger bandwidth than other people that are downloading a song from Kazaa or just simply surfing the net for adult sites. The representing, senior executives and strategic mobile personal in remote locations, should have guaranteed a minimal required bandwidth in order to execute transactions without troubles and unnecessary waste of time.

In bigger organizations with remote offices, the WAN traffic prioritization is important. The WAN links are very expensive and very limited in bandwidth. Many critical applications like voice over IP, remote application servers, critic information consults, etc., require defined and guaranteed bandwidth. Without a service prioritization and a right bandwidth distribution, this services collapse and the out of order times are more frequently and endless.

Besides that, some regular use services like e-mails with heavy attachments, long printing spools, backup traffic, and file copy, movement and transfer, can substrate the available bandwidth and may cause delay and network congestion. In consequence, critical applications like organization's SQL Database may collapse.

Therefore, the service prioritization is fundamental, just because the critical applications access can be minimized or even completely deactivated by non - critical applications; personal down/up loading heavy files using www or ftp, or watching multimedia application through Internet. This is especially critic for the organization's outdoor offices where the bandwidth is expensive and limited.

As a conclusion, QOS provides the following advantages:

a) Ability prioritizes network traffic flow.
b) Ability allocates network bandwidth and resources.
c) Gives administrators control over their networks.

d) Efficiently use of existing resources, which can delay the need for expansion.
e) Provide policy enforcement.
f) Improve user satisfaction.

1.6 Expected Output

In today's network, the emerging of the bandwidth hungry applications have brought to the rapid growth of the network traffic. In this instance, the traffic of non-critical application has crowd the network capacity and slows down the critical application response.

Therefore, research on how to prioritize the critical traffic (QOS) is the main objective of this project. In this project, a simulated QOS-enabled network will be setup, to test the functionally of the QOS concept.

At the last stage of the project, it is hoped that the simulated QOS-enabled network environment can provide a better management and use of the limited bandwidth resources by using the traffic prioritization schemes and the network bandwidth can be guaranteed for the essential services during high congestion periods.

CHAPTER II

LITERATURE REVIEW

2.1 Introduction

Actually, the concept of QOS had been voiced out at the early of 1997. IP supports QOS in the IP header. Asynchronous transfer mode (ATM) natively provides QOS in its virtual circuits and various bit-rate controls. Recently, the Internet Engineering Task Force (IETF) developed Resource Reservation Setup Protocol (RSVP) as a QOS standard for TCP/IP networks and the Internet. The Institute of Electrical and Electronics Engineers (IEEE) defined the 802.1p standard for QOS in all IEEE 802-type networks, such as Ethernet-standard networks.

Besides that, major network vendors, including 3Com, Bay Networks, and Cisco, also have developed road maps to QOS implementation and started to deliver QOS-enabled network equipment and management tools. Therefore, network administrators' dream of a tool that can give us a better control of the network traffic can become a reality.

Before I propose this project, I have got some information from the pervious QOS research (source: books and Internet) so that I have a briefly know about the QOS service, such as what is QOS, how does QOS works, QOS requirement and the benefit of QOS. That particular information is very important and useful for me to start my project because at least I know that I am not doing something that is impossible.