NETWORK PERFORMANCE EVALUATION OF IPv4 AND IPv6 IN NETWORK LAYER PROTOCOL

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ABSTRACT

Nowadays, Internet technologies are growing drastically. These Internet technologies vary from very complicated tasks to very simple tasks. Therefore, there are needs to connect to the Internet resources. Without Internet, many works are not possible. Having realized the importances of Internet, any issues that are related to the Internet are given serious attentions. These attentions are varied from many levels of users. With millions of users that are increasing drastically, Internet becomes a very complicated network. Since Internet Protocol (IP) is one of the important elements in computer network, many researches have been conducted which aim to improve the service quality. Without IPs, Internet is not functioning well. Current IP, namely IPv4, cannot support the increasing number of network devices. IPv6 (Internet Protocol Version 6) is the solution in overcoming the shortage of IP addresses. In a short duration, IPv6 becomes very popular and it is spread around the world. Since the former IP structure is not appropriate to support the fast development of Internet network, this often results in the degradation of service quality.

This thesis aims to evaluate the performance of TCP and UDP data transmission in current IP network (IPv4) and IPv6 network. The matrics of evaluation are based on throughput, loss rate and round-trip time. All the testing are conducted in 6iNet testbed. Transmitted TCP and UDP packets are generated using Netperf, which is the performance tool. The experiments consist of the investigation of TCP and UDP performances, which are analyzed in different networks. At the same time, the results of the experiments provide new knowledge to the next generation of IP implementation in term of TCP and UDP transmission. This also provides new experiences to the researchers. The finding from this study is able to provide the network administrators the knowledge to configure new IPv6 architecture especially in campus network. This thesis also provides an extensive survey of the literature of performance measurement. The performance measurement provides useful resources for researchers who are interested in this field.

ABSTRAK

Pada masa kini, teknologi Internet berkembang dengan begitu pesat sekali. Tugas-tugas yang sangat kompleks hinggalah kepada tugas-tugas yang paling ringkas memerlukan sambungan kepada sumber Internet. Tanpa Internet, banyak kerja tidak dapat dilakukan. Menyedari kepentingan Internet, sebarang isu yang berkaitan dengannya diambil perhatian yang serius dari pelbagai peringkat pengguna. Dengan jutaan pengguna dan pertambahan pengguna yang menggunakan Internet, Internet menjadi satu rangkaian yang sangat komplek. Protokol Internet (IP) adalah salah satu elemen yang paling penting dalam rangkaian komputer. Tanpa IP, Internet tidak akan dapat berfungsi dengan baik. IP semasa yang dikenali juga sebagai IPv4, tidak dapat menampung pertambahan peranti rangkaian. IPv6 (Protokol Internet versi Ke-enam) adalah penyelesaian kepada masalah kekurangan IP ini. Dalam masa yang singkat, IPv6 menjadi begitu terkenal dan tersebar ke serata dunia memandangkan IP semasa yang digunakan sekarang tidak begitu sesuai untuk menampung perkembangan Internet yang begitu pantas. Kekurangan IP ini juga mengakibatkan penurunan dalam kualiti perkhidmatan Internet.

Tesis ini berkenaan dengan prestasi penghantaran data menggunakan TCP dan UDP dalam rangkaian semasa (IPv4) dan rangkaian IPv6. Penilaian ini berdasarkan jumlah data digital yang dihantar (throughput), kadar kehilangan data (loss rate) serta kadar penghantaran dan penerimaan (round-trip time). Semua ujian ini dijalankan di 6iNet sebagai tapak ujian. Paket TCP dan UDP yang dihantar dihasilkan menggunakan perisian Netperf. Eksperimen ini mencakupi penilaian prestasi TCP dan UDP yang dianalisa dalam rangkaian yang berbeza. Pada masa yang sama, keputusan eksperimen ini menyumbang kepada pengetahuan baru dalam implimentasi IP generasi baru terutamanya dalam penghantaran data TCP dan UDP. Ia juga menghasilkan pengalaman baru kepada para penyelidik. Hasil daripada kajian ini memberi pendedahan kepada pentadbir rangkaian untuk mendirikan senibina IPv6 dalam persekitaran kampus. Tesis ini menghasilkan kajian mendalam literatur tentang pengukuran prestasi. Pengukuran prestasi memberikan sumber yang berguna kepada penyelidik yang berminat dalam lapangan ini.

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TABLE OF CONTENTS

List of Figures

List of Tables

ABBREVIATIONS

6iNet	Sintok IPv6 Network
ATM	Asynchronous Transfer Mode
CPU	Central Processing Unit
DF	Don't Fragment
DHCP	Dynamic Host Configuration Protocol
DHCPv6	Dynamic Host Configuration Protocol
DNS	Domain Name System
DSTM	Dual Stack Transition Mechanism
FIT	Faculty of Information Technology
FTP	File Transfer Protocol
ICMP	Internet Control Message Protocol
ICMPv4	Internet Control Message Protocol Version 4
ICMPv6	Internet Control Message Protocol Version 6
IETF	Internet Engineering Task Force
IHL	Internet header length IP Internet Protocol
IPSec	Internet Protocol Security
IPv4	Internet Protocol Version 4 IPv6 Internet Protocol Version 6
ISATAP	Intra-Site Automatic Tunnel Addressing Protocol

ISLAN	Integrated Sintok Local Area Network
LAN	Local Area Network MANIS Malaysian Advanced Network Integrated System
Mbps	Mega bits per second
MF	More Fragment
MPLS	Multilevel Label Switching
MSc(IT)	Master Science Information Technology
NAT	Network Address Translations
ND	Neighbor Discovery
PDU	Protocol Data Unit
QoS	Quality Of Service
RFC	Request For Comment
RPCv6	Remote Procedure Call
RSVP	Resource Reservation Protocol
RTT	Round Trip Time
SSH	Secure Shell
TCP	Transmission Control Protocol
TOS	Type of Service
TTL	Time-to-Live
UDP	User Datagram Protocol
UUM	Universiti Utara Malaysia

Chapter 1

Introduction

In these recent years, the Internet is growing rapidly. The ability of Internet has been utilised by organization. It has been utilised not just in academic research but it also has been widely used in daily life. The growth of Internet has produced various impacts to end users. Even unexpected devices (refrigerator, toaster, car and many other) need Internet connection to make these devices operate properly without any problems. These extended devices, which are connected to our network, were caused new problems. One of the problems is the shortage of Internet Protocol (IP) addresses. When a device needs to communicate over the Internet with each other, it needs a unique IP address. IPv4 is running out of IP addresses. Moreover, the process of segmentation and reassembly (in IPv4 network) at each router are inefficient [60]. Having realized the issue of IP shortage to allocate all devices, the next generation IP has been introduced, namely IPv6. These experiences that have been learned through IPv4 protocol, have been incorporated into IPv6 network.

IPv6 stands for Internet protocol version 6. This protocol was introduced to eventu-

The contents of the thesis is for internal user only

- Does we need firewall in end host? Is it that IPsec function is enough in IPv6 header? The process of IPv6 maturity takes long time.

Lots of works and conformance testing in various aspects need to be carried out to provide a stable network. It is important to raise the confident level of users to switch to IPv6, especially for those who feel comfortable enough with IPv4. All of the results in Chapter 5 were obtained from analyzing the TCP and UDP in IPv4/IPv6 networks. It would be interesting to do further research in this area. Analyzing the performance of both protocols in different environments, such as in wide area network and measuring the performance of IPv6 in global network, are topics that are interesting to be conducted as a topic of research.

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