

The Significance of IPv6 Research Lab Activity in Enhancing Teaching and Learning of IPv6 Deployment

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IPv6 is the next generation of Internet Protocol for the network. Introduced in early 1990 by Engineering Task Force Internet (EITF), IPv6 will become the alternative solution for the current Internet protocol (IPv4) addressing limitation problems. After the era of IPv4, IPv6 will be fully implemented as the addressing internet protocol. Even though the need on IPv6 is very demanding, it still not widely implemented in Malaysia. This is due to the lack of promotion and personnel to implement IPv6. The responsibility has now fallen upon the university to develop and train experts for IPv6 implementation. In order to effectively train experts there is needs to develop working laboratories that enable students to learn IPv6 with a systematic approach. Due to that reason this paper presents a study on the need of an IPv6 lab, namely IPv6RG lab in Universiti Teknikal Malaysia Melaka (UTeM). This lab will act as the training center for students to experience the latest tools and software in designing, developing and testing the implementation of IPv6

Keywords: IPv6; work laboratory; learning

1. Introduction

Internet has growth rapidly and become a need in our daily life, it has been used not just for sharing information online but it has been used for online banking, online shopping, market trading, online bussiness and many more. However, not many user realize that the protocol use to support the addressing of the host connected on internet is becoming exhausted. First introduced in 1969 the Internet Protocol or known as IPv4 has support the internet connectivity for such a long time. During it development it is believe that the number of address its suppose to provide to the host connected to the internet is 4 billion or 2^{32} but at the late 80's as the Internet is booming there is a need to replace the protocol with a new generation to support larger users. Addressing scheme is used on the Internet to indicate the unique address of the host same the number, the street name and the postcode of a resident.

IPv4 address report found at <http://www.potaroo.net/tools/ipv4/index.html> is expecting the IPv4 addresses scheme will be totally exhausted at the end of 2011 and for that reason in the early 90's , *Internet Engineering Task Force* (EITF) has introduced a new alternative to overcome the exhaustion of IPv4 which is *Internet Protocol version 6* (IPv6). IPv6 have a larger address pool compare to IPv4, its have 128 bit addressing scheme which can support up to 2^{128} or

3.4×10^{38} addresses. IPv6 also has improve some of the features of IPv6 that going to make internet is easier to manage, more secure and more reliable.

The development of IPv6 in the whole world indirectly give an impact to our society especially all the network users in Malaysia which include

Universiti Teknikal Malaysia Melaka. Base on this reason a special research survey has been done on Fakulti Teknologi Maklumat & Komunikasi (FTMK), UTeM to study on the significance of IPv6 research lab activity in enhancing teaching and learning. In general the study is to:-

- (i) Study The needs of IPv6
- (ii) Study the current knowledge and usage of IPv6 among community
- (iii) Method of IPv6 Research Lab in enhancing teaching & learning

2. Background

2.1 The needs of IPv6

In 1981, Internet Engineering Task Force (IETF) has published a memorandum called request for comment (RFC 791) has explained the usage of

Internet Protocol (IP) and since then IP does not have any major change. At that time the IP was carefully design with careful plan and consideration. However in recent years people start noticing that the current IP or called IPv4 have some weaknesses and there is a need to change to a new generation of IP. For this reason, IETF has issued another Request For Comments (RFC) 1752 [2] entitled "The Recommendation for the IP Next Generation Protocol" in 1994, to developed a suite of protocol and standard to cater the exhaustion of address and the security issue of IPv4. The new IP is called the next generation IP or known nowadays as IPv6.

The most important features of IPv6 is it larger address space compare to IPv4; IPv4 only provide 32 bit of addressing scheme while IPv6 provide 128 bit addressing scheme in which its can give 5×10^{28} unique address for each of the 6.5 billion people in the world today. This can be used to replace the IPv4 that is expected to give up all its addresses in a few years. The issue of IPv4 address exhaustion has been discussed for several year, APNIC director, Paul Winson has expected the addresses will be depleted by 2023 based on the current demand of internet usage. In september 2005, Cisco system, the leading network hardware manufacturer reported that the IPv4 addresses will finish up in another 4 to 5 years which will be around 2010 or 2011.

Even though there are new technology that can saved IPv4 such as Subnetting, Classless Inter-Domain Routing (CIDR), Dynamic Host Configuration Protocol (DHCP) and Network Address Translation (NAT), all this techniques only slow down the depletion process and not solving the problem of the addresses exhaustion. This reason has stimulated the needs of IPv6 to solve the IPv4 problem. The other features that IPv6 have improved compare to IPv4 are routing efficiency, header format, auto-configuration, Quality-of-Service (QoS), security and mobility.

2.2 Knowledge and usage of IPv6 among community

IPv6 has been implemented phase by phase around the world, this are the initial step before IPv6 is fully implemented and replacing the IPv4 infrastructure. In the develop countries such as United State, Japan, China, France, United Kingdom, Australia and Neatherland, the migration to IPv6 is rapidly in progress. For the purpose of this paper, we are focussing more towards the development of IPv6 in China, United state and Malaysia.

China.

China has been setting up the pace with the development of IPv6 projects, project such as China IPv6 Standard, China IPv6 academic Test-

bed, IPv6 Commercial Test-bed (1), IPv6 Commercial Test-bed (2), and China IPv6 Suppliers Test-bed. Projects of national character has been successfully stimulate the progress of IPv6 implementation in China. China has shown a larger IPv6 implementation during the organization of the Beijing 2008 Olympic Games.

United State.

IPv6 is toward full implementation in the U.S. which is done through the North-America IPv6 Task Force (NAv6TF). Awareness campaigns on the importance of IPv6 has help boost the usability of IPv6 in US. Government of the United States also has set set all networks backbones to the federal agency should be upgraded to IPv6 compatible by the end of June 2008. In May 2003 United States Department of Defense also has announced that IPv6 compatible is one of the requirements for any acquisition. All manufacturers of hardware and software products required to include elements of IPv6 in the latest version of their products. Decisions and actions of the United States should be an example for the whole world to move towards IPv6 migration.

Malaysia.

According to the Malaysia Communications and Multimedia Commission; IPv6 is one of the niche areas listed in the 9th Malaysia Plan. The government of Malaysia aims to be IPv6-enabled nation by 2010. They Targeted all the service providers in Malaysia to began providing IPv6 connectivity in 2006 whereas E-government network is planned to be IPv6 compatible by 2008. To ensure the country IPv6 driven plans is properly accomplish the government has established the NAV6 as a center for research and development of IPv6.

3. The Implementation

Faculty of Information and Communications Technology, UTeM has implemented some specific plans in the implementation of IPv6 Research Lab to stimulate teaching and learning. This activity is designed to expose and to ensure students can conduct learning activities regarding IPv6 more clearly. The activities are:

3.1 Providing IPv6 Course and Workshop

IPv6 Research Lab held two series of courses and workshops related to IPv6 aims to expose students to IPv6. Courses and workshops held are as follows:

- Course "The Needs of IPv6"

The Needs of IPv6 is a basic course that reveals the theory of IPv6, IPv6 development and the need for IPv6 for ensuring the future of Internet. This course also introduces students to the basic features of IPv6 addressing and the benefits of IPv6.

- IPv6 Basic Workshop

IPv6 Basic Workshop seeks to expose students to the basic technical infrastructure to develop IPv6. Students are taught, and presented the opportunity to develop basic laboratory by simulating IPv6 (using network simulation software) and practical (with hardware).

3.2 Upgrading Facilities for IPv6 Learning

Most existing network hardware and computer systems in FTMK UTeM is not supporting IPv6. IPv6 Research Lab take this responsibility to update the network hardware such as routers and third-layer switches with IPv6 Internet Operating System (IOS). Students are also involved in the process to update IOS of routers which has been included in their project in the subject Workshop II.

3.3 Providing Laboratory & Facilities for Student Project

IPv6 Research Lab set the opportunities to the development of IPv6 infrastructure in the student Final Year Project and Workshop II subjects.

Under Graduate

Since the establishment of IPv6 Research Lab in 2009, there was a total of 14 students who made the Final Year Project related to IPv6. The existence of IPv6 Research Lab also allows the scope of subjects of Workshop II applied with the development of IPv6 elements such as Tunneling IPv6, DNS Server, and Web Server

Post Graduate

Research IPv6 Lab also provides a platform and facilities for PhD students where there are two PhD students are conducting research related to IPv6 at this moment.

4. Methodology

This section focuses on the study of two basic things::

- The extent of IPv6 research lab to help teaching and learning

Student performance in the Final Year Project and Workshop II

Methodology for the study consists of three main parts: data collection methods and sampling, methods of measurement data (analysis data) and finally the selection of respondents.

4.1 *Methods of Data Collection*

Data obtained by the following sources:

Questionnaire

In general, the questionnaire was divided into sections:

- Personal details
- Knowledge of IPv6
- The extent on how much IPv6 Research Lab activities emerge the teaching and learning

Interviews

The extent on how much IPv6 Research Lab activities emerge student performance in Final Year Project and Workshop II.

4.2 *Respondent and Sampling*

Questionnaire

In total there are 64 students have been selected to serve as respondents. A total of 64 questionnaires were distributed to students and each student is given a period of 15 minutes to complete the surveys.

Of the total questionnaires distributed, only 83% could only form used for analysis. Some forms can not be used because it is not due to be completed or used answer does not meet the requirements of the question.

Interviews

In total, there are 37 students have been selected to be responden. Students were asked seven questions related to how much IPv6 Research Lab activities emerge student performance in Final Year Project and Workshop II.

5. Analysis

The result obtained from the analysis stage should show the impact of IPv6 Research Lab in:

- i) Helping teaching and learning of IPv6
- ii) Enhancing student performance in the Final Year Project and Workshop II

5.1 Questionnaire Highlights

The survey shows 69% from the 63 respondent agreed that the facility used for the teaching and learning is in good condition, the result is illustrated in figure 1. The survey also shows none of the respondent disagree that the IPv6 research lab not helping them in teaching and learning IPv6.

Figure 2 shows 85% (sila rujuk Rajah 2) or 54 respondent from the 63 students realize the workshop on 'The Needs of IPv6' is helping them in having an excellent understanding on the concept of IPv6 Whereas another 14% realize the workshop only help them in getting good understanding in IPv6.



Figure 1 : The needs of IPv6 Research Lab facility in teaching and learning IPv6.



Figure 2 : The understanding of IPv6 concept from The Needs of IPv6 workshop.



Figure 3 : level of understanding in configuring IPv6 devices from the IPv6 Basic Workshop.

The next survey shows the level of understanding on configuring the equipment of IPv6 through the workshop of Basic IPv6. As shown in figure 3, 86% or 55 of the respondent agreed the Basic IPv6 workshop really help them to have an excellent understanding in configuring IPv6 device meanwhile 6 respondent or 10% only have a good level of understanding and only 2% of the respondent only have moderate understanding from the said workshop.

5.2 Interviews

The Interview session is done after analyzing the respond from the survey, only 37 respondent is choose for the interview session. The purpose of the interview session is to find out whether the research lab activity has:

- i) Helping teaching and learning of IPv6
- ii) Enhancing student performance in the Final Year Project and Workshop II

For item (i) most of the respondent which is 73%, acknowledge the IPv6 research lab activities are helping them in understanding IPv6 while 83% of the interviewed respondent agreed that the activities influences their achievement in doing the Bengkel II subject and the final year project. Table 2. Shows the summary of the interview.

Table 1: Interview analysis

73% respondents agreed that the activities of IPv6 Research Lab helps them in learning IPv6.

83% respondents agreed IPv6 Research Lab activities affect their performance in Final Year Project and Workshop II

6. Conclusion

Internet Protocol version 6 (IPv6) is the challenges and responsibilities of all the internet users. It is the responsibility of universities to provide a knowledgeable work force sufficient to address the nation on a full time migration from IPv4 to IPv6 to happened. This paper has discussed the methods use by the IPv6 reserach lab to stimulate students to understand and master IPv6 technology.

Based on the the study on the needs of IPv6, the researcher has studied the development of IPv6 in develop coutries and from it we realize that the development of IPv6 in Malaysia is still far behind.

For that reason through our IPv6 research lab we are introducing some activities that

can stimulate the student to have interest and understanding on IPv6 and the survey has proved that the activities done by the IPv6 research lab has help the student to have a better understanding on the concept and configuration of devices in IPv6. This is the preliminary work for the IPv6 research lab, in the near future we will upgrade the lab facility into one complete testbed so that more research and training can be done in enhancing the students knowledge in IPv6.

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