An Experiments Using JGN v6 at Tottori University of Environmental Studies

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Abstract

The limitation of IPv4 becomes a big problem. To resolve the problems, IPv6 is proposed and now growing. Various projects, such as WIDE project and TAO are making big efforts to promote IPv6. Tottori University of Environmental Studies (TUES) met the problem of IPv4. Though using IPv6 should be a good solution to the problem, there were some problems when we used IPv6 on JGN. We tried to transfer data of archaeological photographs from Tokyo to Tottori. The amount of the data is more than 75GB. The other application is to find the activity of web pages on the IPv6 Internet. We will describe the details in this paper. In shortly, the problems we met were similar to problems that we experienced with IPv4 network about fifteen years ago.

1. Introduction

The limitation of IPv4 becomes a big problem. As many readers know, lack of address is one of the most serious problems especially in Asian countries. IPv6 has been proposed to resolve the problems that IPv4 have. The detail of IPv6 is still discussing and implementing though the basics were already implemented. In these years, there are number of efforts to construct the IPv6 Internet. In Japan, WIDE project operates 6bone-JP and the IPv6 internet exchange. From 1999, Telecommunications Advancement Organization (TAO) began to operate Japan Gigabit Network (JGN). There are number of access points, at least one access point for a prefecture. From 2001, JGN began to accept IPv6 traffic. This situation makes IPv6 research easy for research institutes.

Tottori University of Environmental Studies (TUES) was established in 2001. All students are undergraduates. There is a plan to establish a graduate school in the near future. As TUES is a young university, the university is now equipping with things needed for researches. We prepared the IPv4 Internet Connection by an ISP. We met the lack of IPv4 address. We could not prepare IPv4 address for all students and faculties. At TUES, all students have their own note PCs as teaching materials. As the number of students for one grade is more than 320, we need more than one and half thousands of IP address. This situation was a big motivation for us to use IPv6. Fortunately, we got a chance to use JGN and we investigate the IPv6 network from two points of view. One is that of file transferring. The other is that of web accessing. We will describe the details of our result in this paper.

In the rest of this section, we describe the outline of IPv6 connection at TUES. TUES was connected to JGN in October 2002 to proceed researches related to IPv6. JGN has an access point at Tottori University with the interface of OC-3. The distance between TUES and Tottori University is about 10km. The speed of the access line is 100Mbps, Fast Ethernet. The campus network of TUES is based on IPv4. We constructed a new network only for IPv6. This means that the new network uses only IPv6. Computers connected the new network should use IPv6. If a computer has only one network interface, the computer should use network services via IPv6 including DNS.

The authors used this network to study the effectiveness of IPv6 network. First, we transferred a big volume of image data. Secondary, we investigated web accessibility in the IPv6 Internet in Japan.

2. Details of transferred data

In this section, we describe what kind of data we transferred. The authors are also studying metadata of archaeological photographs to preserve in digital format.

Figure 1 An example of photographs

Proceedings of the 2004 International Symposium on Applications and the Internet Workshops (SAINTW'04)
0-7695-2050-2/04 $20.00 © 2004 IEEE

An archaeologist took many photographs of historical sites, ruins and relics. Taking photographs of such things is very important because distributions of relics sometimes tell archaeologists meaningful information. To make comparative study between historical sites, archaeologists compare photographs of historical sites. Thus circulation of such photographs is very important. We digitized a volume of photographs of historical sites for our study. As the authors work in Tottori and Tokyo, we have to have same digital data of the photographs. Originally, the data were only in Tokyo. We transferred the data from Tokyo to Tottori via IPv6 Internet. The volume of the photographs is more than 75GB. Figure 1 shows an example of the photographs. We placed an order with a company for the digitization of photographs.

3. File Transfer Tool

Generally, transferring the data from Tokyo to Tottori, FTP program is appropriate. However, there were some problems about firewall, protocol, and file transfer system for using FTP program. In this section, we summarize these problems and describe a tool, WebDAV (World Wide Web Distributed Authoring and Versioning) that we adopted.

3.1 Environment and problems

The problems about file transfer from Tokyo to Tottori are below:

1. Reliability of the network
2. Kanji characters in file name
3. Firewall policy of the organization
4. To use IPv6 application

The reason why FTP program is not useful to transfer the data was that the network was not reliable for sending flood of data, as described in section 3.2. Though network managers attempted to fix the network problems, the quality of stability was not enough to keep transferring large data using FTP program. FTP program dose not have facilities to re-try and re-send when a network replies error such as time-out, packet loss, etc. If FTP connection is finished with network error as we send a file, we have to send again the file from the beginning. Additionally, FTP program dose not detect whether a file is transferred completely or not in a directory, when we use wild card to point files in program argument. It makes hard to manage about 5 thousands file transfer, because we have to check whether each file for is send correctly. As a matter of fact, FTP program was finished by error at intervals of a few minutes. Thus, other useful file transfer tool is required to send large size a large amount of files.

The other problem is that the files are named using Japanese SJIS code to encode kanji characters. FTP program cannot transfer Kanji character, two-byte character file name sometime. It was not possible to convert over 5-thousand file name. And converted fine name has less information that original name, because Kanji character is ideogram. Japanese Kanji characters have a lot of information in one character. For example, “Kurayoshi-Iseki” needs 8 bytes to write by Kanji character, though same meaning alphabetical word “Kurayoshi historical site” uses twenty-three bytes. These digitized photographs were originally taken at Japanese historical site. Thus, the photographs are arranged and stored using Japanese historical name and kanji. These kind of Japanese names are familiar with Japanese archaeologist. It was strongly required to keep Kanji character file name.

Recently, firewall policy of the organization limits to use application to keep security. FTP program packets are prohibited to send from Tokyo to Tottori. Since HTTP packets are admitted to transfer, file transfer program using HTTP is needed.

The most important challenge is that TUES has IPv6 address only. A few program was implemented for IPv6, however, we had to select a program carefully, because some programs need the environment that is supported IPv4 and IPv6.

3.2 WebDAV as file transfer tool

To solve these problems, we adopted WebDAV [1] program. WebDAV is “Web-based Distributed Authoring and Versioning”. It is a set of extensions to the HTTP protocol that allows users to collaboratively edit and manage files on remote web servers. WebDAV is implemented as a part of apache 2. Apache 2 also supports IPv6. There is a patch for supporting Japanese Kanji characters in file name.

We built WebDAV server on FreeBSD at TUES, and WebDAV clients on Windows XP at Tokyo. In Tokyo, we have two network access points to send data. One is from IIJ broadband network, about 33Mbps, the other is from ADSL network, about 0.5Mbps, shown as Figure 2. When we connect using WebDAV client to WebDAV server though http, we can move and copy remote files on the local machine. It is easy to move file from Tokyo to TUES, since WebDAV provides folder like GUI tool to handle files as if we move file in local directory. WebDAV manages to file transfer when network condition is unreliable. However, since sometimes WebDAV reported error to transfer file, we had to check whether a file is transferred completely. In next section, we describe network condition.

4. Network condition

Network managers that operate JGN IPv6 network were expert and they had much experience to operate IPv4 network. However, in present, it seems that there are some problems to operate IPv6 network. Since we are not network manager and cannot solve and/or analyze problems, we can report network condition from user point of view.

4.1 Datalink problem

Observed problem is that FTP program is finished abnormally while data is transferred. Since PING command did not report an error, Datalink is doubted to have some troubles. In the backbone, some errors were detected in a wide area Ethernet line. On the end point, ADSL access line was disconnected sometimes. A network operator fixed both problems, instantly. Quality of network were improved, however, network connection was not stable yet.

4.2 Routing problems

Trouble of routing configuration occurred twice while we transferred photograph data for two months. First time, it was observed packet loss because TRACEROUTE command replied fine routing information. Since TUES found they could not access and reach some WWW server, router configuration was detected.

Second time, TUES was not discovered and connected from Tokyo one day. TRACEROUTE said routing information was not right from Tokyo to Tottori. It became clear that configuration in the router was mistaken when router was replaced.

This kind of miss operation shows that IPv6 network operation has not maturity enough compare with IPv4 network. Experiments of operating IPv6 network on JGN must be very fruitful to develop and deploy IPv6.

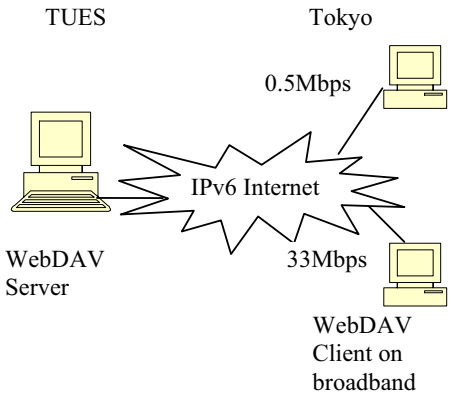

Figure2 Network and server environment

4.3 Continuous data stream

We could not solve trouble that packets are reachable to the server using PING and TRACEROUTE command, but FTP and WebDAV session often disconnected. Since the amount of transferred data is 75GB, data packets continue to flow for a long time. It is not clear that which component caused this problem. Problems must be caused not only by network configuration and equipment but also end system. We used FreeBSD for WebDAV server and Windows XP for WebDAV client. IPv6 protocol stack and applications are developing at this time. A lot of IPv6 experiments collaborate with real application might accelerate to develop and deploy IPv6 network.

5. Web Hosts on IPv6

AT TUES, there are two campus-networks. One is based on IPv4, and the other is based on IPv6. No part of campus-network accepts both IPv4 and IPv6 at the same time. TUES is connected to the Internet via commercial ISP with IPv4 and connected to the Internet via JGN with IPv6. Figure 3 illustrates this situation.

At this point, only 128 IPv4-addresses are assigned to TUES. On the other hand, all students have their own note PC as his/her teaching materials. Off course, students use the Internet via campus-network. They use e-mail, web browsing and some other internet services. To provide internet services such as web browsing, we use the NAPT and local address of IPv4 to connect the note PC of students simultaneously. To use the bandwidth of a line to the ISP, we use an http proxy server. Though TUES has IPv6 connection to the 6bone, only limited persons can access to the IPv6 network directly. IPv6 network is still in experience.

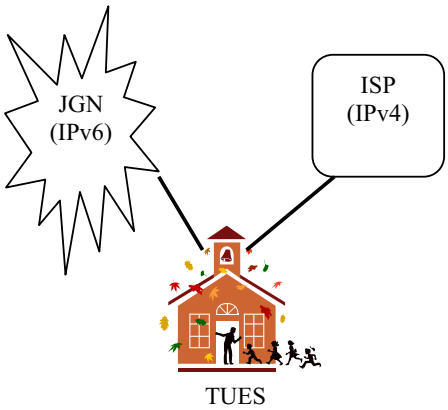

Figure 3 Internet Connection at TUES

Similar to many universities, most of traffic at TUES is for access to web pages. If we have an appropriate proxy server that uses IPv6 connection as well as IPv4, we can improve the efficiency. We made efforts to find out such kind of http proxy server. The proxy server has to satisfy a following condition: the proxy server accesses via IPv6 if a host is IPv6 reachable. We found that there is no proxy server that satisfies our condition. We also found that it's easy to modify wwwoffle[2] to meet with our request. The modification was only several lines or around. As wwwoffle is designed for personal use, the program has no capabilities to serve for many requests from many clients. We used the software with some clients. The program works well.

Using modified wwwoffle, clients on the IPv4 campus network can access to the hosts on the IPv6 Internet. If a host is connected to both IPv4 Internet and IPv6 Internet, our modified wwwoffle retrieves web contents of the host via IPv6 instead of IPv4. One of objectives of the modified wwwoffle is to make IPv4 clients easy access to IPv6 web hosts. Figure 4 shows the role of the proxy.

Using this mechanism, we can increase traffic of IPv6 and decrease that of IPv4. It is easy to understand that our modified wwwoffle increase the traffic of IPv6. But how much the program increases the traffic? The answer should be "It depends on the number of web hosts on the IPv6 network." Who knows the number of web hosts on the IPv6 Internet? It is very difficult to answer this question. But, it is easy to know some of the web hosts on the IPv6 Internet if we add some codes to our modified wwwoffle. Table 1 shows the hostnames detected by our program. A couple of faculty of TUES used our modified wwwoffle as a proxy server for their web browser from September 2003.

There are 46 sites in Table 1. We can see the names of IPv6 related projects, ISPs, companies. The number of sites is not big. Is the number of IPv6 ready-sites so small? To find the answer, we made access to official web pages of Japanese universities. At universities, many researchers are working. The possibility having web page on the IPv6 Internet is higher than other organizations. In Japan, it is easy to get a list of URL of universities. These two points are the reasons why we chose Japanese universities. As a list of official web pages, we used http://www.yozemi.ac.jp/daigaku/. (This page is written in Japanese.) Using this page, we made access to official web pages of universities and found that only three universities have IPv6 address for their sites. More than 400 universities do not have IPv6 address for their

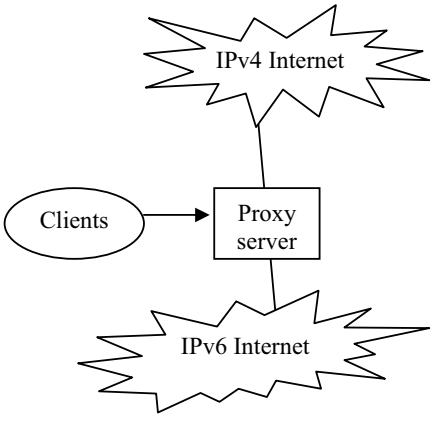

Figure 4 The role of our proxy

Table 1 Hosts, which have IPv6 address

2003.9.11	6bone.informatik.uni-leipzig.de
2003.9.11	altavista.ipv6.digital.com
2003.9.11	contents.pr.v6pc.jp
2003.9.22	ftp.netbsd.org
2003.9.11	ipv6.research.microsoft.com
2003.9.19	mirrors.bieringer.de
2003.9.11	ngi.spawar.navy.mil
2003.9.11	ny6ix.net
2003.10.10	squid.internet2.edu
2003.9.17	tiis.hitachi.co.jp
2003.10.1	turtle.sfc.wide.ad.jp
2003.10.1	v6start.net
2003.9.18	winpcap.polito.it
2003.9.11	www.6bone.net
2003.9.19	www.6tap.net
2003.10.30	www.allbsd.org
2003.9.19	www.bieringer.de
2003.9.19	www.deepspace6.net
2003.10.1	www.freebit.com
2003.9.11	www.hitachi.co.jp
2003.9.12	www.hokudai.ac.jp
2003.9.11	www.iij.ad.jp
2003.9.11	www.ipv6.org
2003.9.19	www.ipv6forum.com
2003.9.11	www.ipv6style.jp
2003.10.22	www.jp.freebsd.org
2003.9.19	www.jp.ipv6.org
2003.9.11	www.kame.net
2003.9.12	www.koeki-u.ac.jp
2003.9.11	www.linux-ipv6.org
2003.9.11	www.netbsd.org
2003.9.12	www.nihon-u.ac.jp
2003.9.11	www.ocn.v6.ntt.net
2003.9.19	www.odn.ne.jp
2003.9.30	www.poweredcom.net
2003.10.1	www.sfc.wide.ad.jp
2003.9.19	www.sinet.ad.jp
2003.9.19	www.tahi.org
2003.9.19	www.tdoi.org
2003.10.8	www.v6.hitachi.co.jp
2003.9.11	www.v6.kddi.com
2003.9.19	www.v6.linux.or.jp
2003.9.26	www.v6.ntt.net
2003.9.19	www.v6.wide.ad.jp
2003.9.11	www.v6pc.jp
2003.9.19	www.wide.ad.jp

official web sites!! Additionally, only one university provides their official web page via IPv6. Though the rest universities have IPv6 address for their official sites, we could not reach the sites. In fact, only one Japanese university provides their official web pages via IPv6.

From the point of view of users, there is no motivation to use IPv6 if the user cannot retrieve any information from IPv6 Internet. If we want IPv6 to be more popular, we have to make much more web pages on the IPv6 Internet.

6. Conclusion

In this paper, we described experiments done at Tottori University of Environmental Studies using JGN v6. We transferred a large size of image data from Tokyo to Tottori. Though we tried to use FTP first, we met various difficulties. To avoid the problems, we used WebDAV and succeeded to transfer the data. We also investigated the actual situation of Web sites on the IPv6 Internet. What we experienced during our research is very similar to the situation of IPv4 Internet of fifteen years ago. It may take a little more time IPv6 to be popular. The authors hope that IPv6 network became more popular than IPv4 network in the near future. A lot of experiments of both IPv6 application and operating IPv6 network on JGN should accelerate to develop and deploy IPv6 network.

Acknowledgements

This research is supported by WIDE project, NTT East and JGNv6 Operation Members. Prof. Tadashi Katata allowed us to use his photographs of historical sites. Part of this research is supported by Telecommunications Advancement Organization of Japan (TAO, Project No.: JGN-G14005), and Academic Funds of Tottori Prefecture for Environmental Studies. The authors gratefully thank to them.

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[1] WebDAV, http://www.webdav.org/
[2] wwwoffle, http://www.gedanken.demon.co.uk/wwwoffle/