A CASE STUDY ON IPv6 IMPLEMENTATION IN THE NORTH ASIAN TRIANGLE

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ABSTRACT

The North Asian Triangle - Japan, South Korea and China - is spearheading implementation of IPv6, with Japan being the furthest in its deployment even globally. While IPv6 has been discussed by the three governments at ministerial meetings, these three nations are planning to jointly develop IPv6, a move that will challenge the U.S.-dominated market for current IPv4-based Internet technology.

In Japan, the government supports IPv6 as part of the e-Japan program. Most ISPs including rural small ISPs and even start-ups have launched IPv6 services. Japan's famous electronics producers including NEC, Canon, Sanyo, Sony, Toshiba and Panasonic take the lead.

In South Korea, deployment of IPv6 has been driven forward by the government as heavily as in Japan. Among ISPs, only the largest one – KT – deploys and operates IPv6 network in South Korea unlike in Japan. The national IPv6 trial service is scheduled from 2004 onwards to promote the deployment of IPv6 in the nation and to facilitate the commercialization of IPv6 for ISPs and vendors.

Also in China, the government proactively develops trial projects to achieve solid IPv6 network deployment. Being different from Japan and South Korea, foreign participation in IPv6 arena is notable in China.

The North Asian Triangle cases presented in this paper serve as a guiding light for the IT and security professionals to meet the challenges delivered by the upcoming globalization of IPv6 from multiple perspectives – the information security perspective, IT policy perspective and IT evolution perspective.

KEY WORDS

IPv6, IETF, Security, IPSec, Ubiquitous Computing, e-Japan, ITU, DSL, NGN

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1 INTRODUCTION / MOTIVATION

IPv6 stands for Internet Protocol version 6. Interest in IPv6 has reached critical mass and the implementation of IPv6 is being discussed worldwide. The current Internet and all corporate and private intranets use Internet Protocol version 4 (IPv4). The effort to develop a successor protocol to IPv4 was started in the early 1990s by the Internet Engineering Task Force (IETF) in order to solve, among others, IPv4's shortage of addresses.

The present IP protocol - IPv4 - has no integrated security functionalities, since the Internet was originally designed for a closed community, namely the military and scientific one. It was not intended to be in use by the broad public, where malicious users might attack the network.

IPv6 is beyond doubt more reliable in terms of security. It improves many of the security shortcomings that exist in IPv4. It contains many enhanced security features such as IPSec, an indispensable part of IPv6. Furthermore, the IPv6 addressing scheme makes IP address scanning attacks less successful because the massive size of the IPv6 address space creates significant barriers to comprehensive vulnerability scanning.

Presently, more than 50 countries and regions have joined the rank of IPv6 studies. Router-manufacturers from North America have put out router products serving IPv6. European countries also pin high hope on IPv6. The North Asian Triangle - Japan, South Korea and China - realized the huge potential of IPv6 as well. The common meetings of the communication-concerned ministries confirmed that the countries aim to take the global lead in Internet technologies with a rapid move to adopt IPv6.

The North Asian Triangle is spearheading implementation of the IPv6, with Japan being the furthest in its deployment even globally. The three nations are planning to jointly develop IPv6, a move that is anticipated to challenge the U.S.-dominated market for current IPv4-based Internet technology.

This paper has been prepared to provide a guiding light to the IT and security professionals by granting an opportunity to review sustainable IPv6 practices in the North Asian Triangle. Such guidance will help the IT and security professionals to meet the challenges posed by the upcoming globalization of IPv6.

2 JAPAN

While IPv6 is seen as a very experimental technology in some sectors, not only nation-wide ISPs such as IIJ and NTT Communications, but also many other ISPs have

started IPv6 services in Japan. Table 1 lists the IPv6 services offered by Japanese key ISPs.

Table 1. IPv6 services of Internet Initiative Japan (IIJ) and NTT Communications

Companies/ Services	**Experimental/ Commercial**	**Access Technology**	**Connectivity Type**
IIJ			
IPv6/IPv4 Dual Stack Service	Commercial	Dedicated Line	Dual Stack
IPv6 Native Service	Commercial	Dedicated Line	Native
IPv6 Gateway Service	Commercial	Dedicated Line	Native
IPv6 Tunneling Service	Experimental	Dedicated Line, DSL, FTTH	IPv6 over IPv4 Tunneling
IIJmio Personal Domain Service	Commercial	Not Available	Not Available
NTT Communications			
IPv6 Gateway Service	Commercial	Dedicated Line	Native
OCN IPv6 Tunneling Service	Commercial	Dedicated Line, DSL, FTTH, ISDN	IPv6 over IPv4 Tunneling
OCN ADSL Service IPv6 Dual(A)	Commercial	ADSL	Dual Stack
Arcstar IP-VPN IPv6 Communication Option	Commercial	Dedicated Line, Ethernet Access	Dual Stack
Multicast Service	Commercial	Not Available	Not Available

2.1 IPv6 Opportunities

The global IT community should monitor IPv6's progress and adoption rate because:

- IPv6 will drive local Internet traffic growth;

- Niche opportunities to support IPv6-related applications will arise; and
- They may require unique skills and product offerings.

The IPv6 technology may be unexpectedly important to the development of Japan's optical transport networks. IPv6 will become an important driver for local Internet traffic growth, impacting the market for optical transport equipment. Most of the impact in Japan will be for short-haul equipment and service to support connections between access points and hosting servers.

Many Japanese IT companies, especially consumer electronics specialists, envision an IPv6 world in which daily products will contain electronic components with their own unique IP addresses. All kinds of devices - PCs, telephones, refrigerators, ovens, TV, clocks, and cars - could have their own individual IP addresses, creating what is known as "ubiquitous computing." The idea is to allow people to access information networks at any time, from anywhere, using any kind of digital device.

2.2 Strategy and Action

In December 2001, Toshiba introduced the world's first networked IPv6-compatible home appliances. The company also sells routers and other network equipment and is currently working on developing home security devices. Ricoh, a Japanese printer manufacturer, is researching remote printing technology.

IPv6 does not require an entirely new set of electronic devices, as CD technology earlier drove demand for CD players. As a consequence, Japan's electronics producers such as NEC, Canon, Sanyo, Sony, Toshiba, and Panasonic do not have to change their products significantly. Many existing devices will carry over to IPv6 easily, so they will not need any kind of upgrade to work properly in an IPv6 environment. However, IPv6 does enable attractive, potentially lucrative new functions to be added to existing electronic devices.

2.3 e-Japan

Japan's commercial deployment of IPv6 has been driven by a wide range of organizations pushing IPv6: the Japanese government, industrial groups, router vendors, service providers, enterprise IT managers, and software vendors.

Among others, the government has played an important role in pushing for IPv6 deployment. As part of the government's e-Japan program, the Ministry of Public Management, Home Affairs, Posts, and Telecommunications (MPHPT) committed itself to conducting R&D on "technology that will effectively promote the diffusion of IPv6, including those that can enhance and utilize IPv6 functions and those that will expand the scope of devices (other than PCs) that can access the Internet." The government offered a tax incentive program for IPv6 diffusion. The program had been inaugurated

for encouraging ISPs to further expand commercial IPv6 services in 2002 and extended the incentive to other IPv6 players.

3 SOUTH KOREA

Organisation for Economic Co-operation and Development (OECD) announced in May 2001 that South Korea is the first to realize the highest broadband Internet access penetration rate in the world. In September 2001, International Telecommunication Union (ITU) also addressed that South Korea ranked top in the penetration rate of broadband Internet. ITU pinpointed government driven policy and unique residential pattern as key success factors of South Korean Internet.

Currently, South Korea's Internet industry is concentrating on emerging services and business challenges such as home appliances networking and multimedia contents delivery beyond a simple broadband Internet access service.

3.1 Government Policy

As seen in the broadband Internet penetration rate, South Korea's Ministry of Information and Communication (MIC) is proactive in introducing IPv6 to the country.

MIC had initiated several projects related to IPv6 routers, IPv4 / IPv6 translators, and IPv6 applications since February 2000 and subsequently declared its commitment to adopting IPv6 in February 2001. It also announced the IPv6 promotion plan in December 2002 and thereafter selected IPv6 as one of the nation's IT core technologies in January 2003. The IPv6 deployment plan to encourage Internet relevant industries was finalized by MIC in September 2003. Funding has been being made to develop IPv6-applied broadband Internet opportunities, including IPv6 ready routers, IPv6 killer applications, and digital-home service. The digital-home service provides networking access for any device to any device from anywhere. The total investment will be up to 140 million USD until 2007.

3.2 Network Deployment

The nation's IPv6 network deployment commences with its experimental network named 6Bone-KR deployed in 1998. It is nation's virtual IPv6 backbone network and tunneling IPv6 network over IPv4. The country's first native IPv6 network is KOREN deployed in 1999 and it is operated by KT – Korea's largest ISP. Figure 1 shows the topology of KOREN.

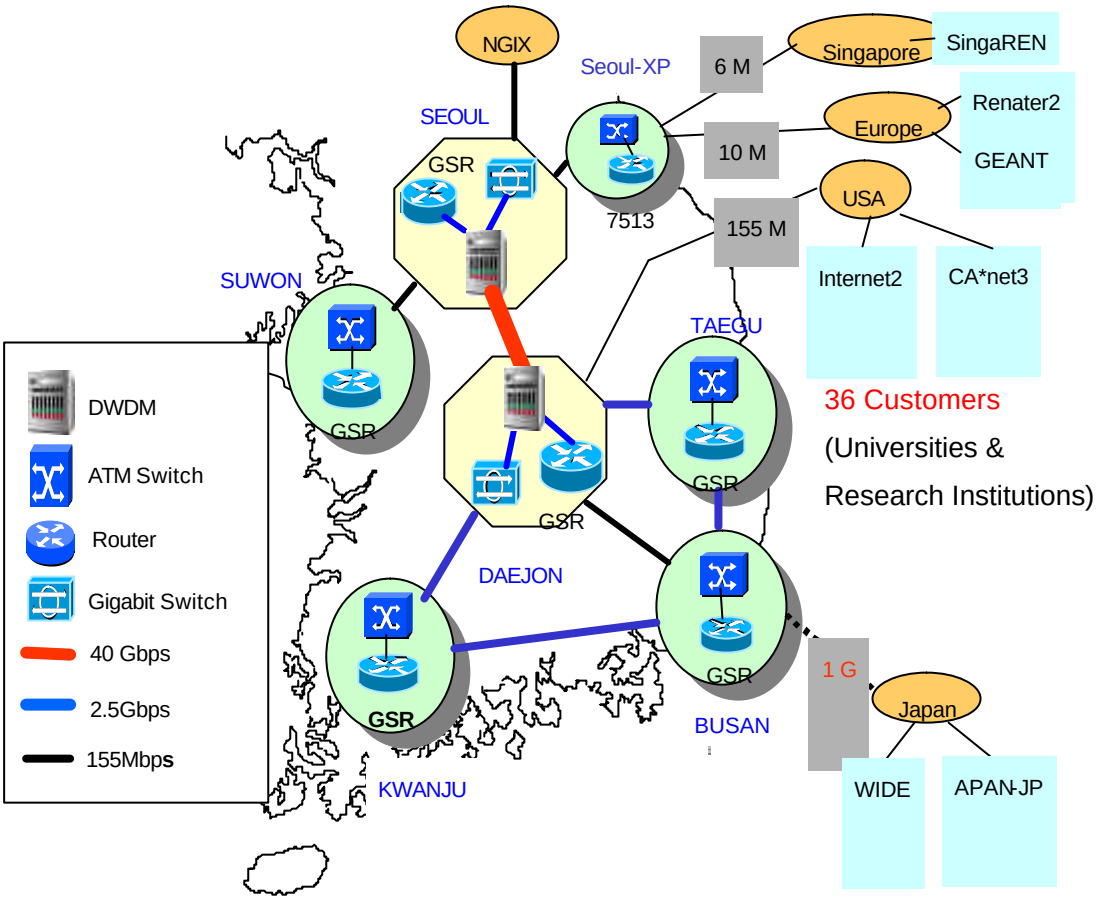

Figure 1. Topology of KOREN

Following KOREN, Trans Eurasian Information Network (TEIN) was deployed in 2001. It is the next generation Internet infrastructure and a continental IPv6 network between Asia and Europe. 6NGIX - the nation's IPv6 Internet exchange - has been in operation since 2001.

3.3 R&D and Trial Services

The nation's principal R&D project on IPv6 is KRv6. It is comprised of three parts - 6TALK, 6ANTS and 6NEAT – and has been in operation since 2001. 6TALK develops the IPv6 transition strategies and translation technologies. 6ANTS is concerned with the development of the IPv6-based auto-configuration networking technologies. Finally, 6NEAT is operational to develop the IPv6 network infrastructure and applications.

The nation's IPv6 trial services date back to 2002 when IPv6 application development was made under the 6NEAT of KRv6. IPv6 applications developed include multicast conferencing, IPv6 HDTV, IPv6 live video streaming, and VoIPv6. The multicast conferencing features MPEG-based real-time encoding and decoding for audio and video, multi-parties conference, text messenger support, and traffic

monitoring. IPv6 video streaming highlights MPEG-1,2,4 video support, MP3 streaming support, and IPv6 / IPv4 networking support.

IPv6 mobile networking was also introduced in 2002. It includes IPv6 service using wireless LAN in public area and IPv6 protocol networking home appliances.

The up-to-date service is KOREAv6. It is the national IPv6 trial service from 2004 onwards to promote the deployment of IPv6 in the nation and to facilitate the commercialization of IPv6 for ISPs and vendors. KOREAv6 will cover Digital Subscriber Line (DSL), home appliances networking, wireless LAN, and 3G networks. To make the trial successful, it will employ the results obtained from the nation's relevant R&D projects.

4 CHINA

China, in particular, suffers serious IP address shortage. Currently the nation has more than 60 million Internet users, but only a total of about 30 million IP addresses are available. Meanwhile, the nation's 240 million mobile phone users are turning into potential Internet surfers and they need their own IP addresses too, worsening the current situation.

The inadequate supply of IP address is becoming a bottleneck for the Internet development in the country. China will be one of the first countries to adopt large-scaled IPv6 commercial networks.

4.1 Drivers of IPv6

Chinese telecom operators are eager to invest in new IP service due to the industry restructuring and keen competition. They are also eager to migrate to IPv6 due to the increasing number of broadband customers and mobile users, the shortage of IP addresses, and the lack of profitable business models. Most major operators are expected to kick off their IPv6 trial network soon. Beijing Olympic 2008 and World Trade Expo 2010 require the most advanced ubiquitous environment demanding greater number of IP addresses than IPv4 can afford.

Chinese government actively and reliably develops trial projects to achieve solid IPv6 network deployment. It prepares appropriate new requirements, standards and regulations, necessary for supporting healthy development of IPv6 market. Such governmental bodies include State Council Informationization Office, Ministry of Information Industry (MII), Ministry of Science and Technology (MST), National Natural Science Foundation of China (NSFC) and National Development and Reform Commission (NDRC). Standardization of IPv6 in China already started up. The first set of standards includes basic protocol, networking, auto-configuration, mobile IPv6, and

routing protocols. In 2002 and 2003, special funds were raised by the government to support and promote IPv6 commercialization in China.

4.2 IPv6 Players

The industry's IPv6 Players in China include telecom operators and network vendors. The domestic operators are China Telecom, Unicom, China Netcom, China Railcom and China Mobile whereas NTT, KDDI and France Telecom represent the foreign operators. Cisco, Jupiter, Hitachi, NEC, Fujitsu and Huawei are among the network vendors. Other key players are Microsoft, HP, Panasonic and Sharp.

4.2.1 Telecom Operators and IPv6

The goals of telecom operators to introduce IPv6 are:

- To solve shortage of IPv6 addresses;
- To create profitable business model;
- To gain necessary experience for IPv6 commercial network;
- To provide available telecommunications services for Next Generation Network (NGN); and
- To learn about new technology trends.

In order to achieve such goals, telecom operators have to deal with IPv6 network technology testing, equipment evaluation, interoperation and transition policy, security, broadband access, new business model requirements, and new applications. IPv6 applications encompass DNS, Network Management System (NMS), PDA, VoIPv6, and video conference.

4.3 IPv6 Projects

China's IPv6 projects started in 1998 with the China Education and Research Net (CERNET) initiative. Figure 2 shows the CERNET IPv6 testbed. In 1999, Nokia and CERNET jointly began Internet 6 Project.

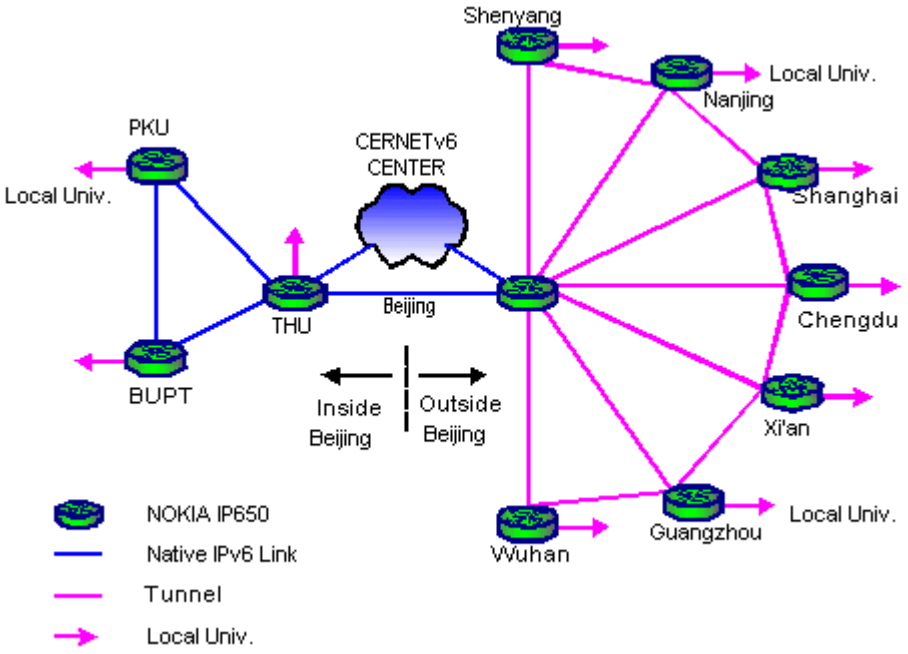

Figure 2. CERNET IPv6 testbed

Beijing Internet Institute (BII) established an IPv6 R&D Center in 1999. In 2000, BII interconnected their IPv6 testbed with the 6 BONE. It also built BII-BUPT NGN Lab with Beijing University of Post and Telecommunications (BUPT) in 2001. In 2002, BII and Research Institute of Telecommunication Transmission (RITT) inaugurated IPv6 Telecom Trial Network (6TNET), the first and biggest IPv6 multi-vendor, multi-operator project in China. BII also built up the first commercial IPv6 network for China Telecom in the same year. Thereafter, China Telecom's Beijing, Shanghai and Guangzhou IPv6 trial projects have been launched.

5 CONCLUSION / IMPLICATION

The analysis of the North Asian Triangle's implementation of IPv6 showed that all governments give strong support for IPv6 but that the private sectors involvement differs significantly.

The Japanese government supports IPv6 as part of the e-Japan program. Many ISPs including rural small ISPs and even start-ups have launched IPv6 services. Japan's famous electronics producers including NEC, Canon, Sanyo, Sony, Toshiba and Panasonic take the lead, with Toshiba having introduced the world's first networked IPv6-compatible home appliance.

In South Korea, deployment of IPv6 has been driven by the government in the same way as in Japan. Among ISPs, only the largest one – KT – deploys and operates IPv6 network in South Korea unlike in Japan. The national IPv6 trial service is

scheduled from 2004 onwards to promote the deployment of IPv6 in the nation and to facilitate the commercialization of IPv6 for ISPs and vendors.

In China, the government proactively develops trial projects to achieve solid IPv6 network deployment as well. Being different from Japan and South Korea, foreign participation in IPv6 arena is notable in China.

The observed cases serve as a guiding light for the IT and security professionals in meeting the challenges delivered by the upcoming globalization of IPv6 from multiple perspectives.

From the information security perspective, technological combination and integration can allow introduction of IPv6-based ubiquitous services and businesses, including 3G, P2P, automation, sensor networking, context-ware computing, and automotive services. IPv6 is a technology enabler for establishing global ubiquitous environment as observed in the Japanese case. Therefore, it is necessary that the current security measures and systems should be realigned to guarantee security under the ubiquitous environment.

From the IT policy perspective, IPv6 networks deployment is expected to commence from research and project oriented testbed level, and move to production and commercial level. While it is witnessed from the Japanese case that the diffusion of commercial IPv6 network and service requires motivation of ISPs through indirect incentives and merits for the operation of IPv6 network, the Chinese case implies that direct funding by the government is a driving force to establish a solid base for enabling strong IPv6 commercialization.

From the IT evolution perspective, most present services and applications over IPv6 networks remain at legacy level as seen in the Japanese case. However, technological combination, integration and convergence can give birth to new IPv6-based services and applications, including digital-home services which connect any digital device anywhere as observed in the case of South Korea. They are expected to evolve to global ubiquitous services and applications in the long run.

REFERENCES

- Book

  Silvia Hagen, "IPv6 Essentials," O'Reilly & Associates, 2002

- Proceeding

  Keiichi Imai, "NEC's IPv6 Solutions," Global IPv6 Summit in Asia Pacific 2004

  Kosuke Ito, "Deployment Status of Japan," Global IPv6 Summit in Korea 2003

Hyungsoo Kim, “IPv6 Activities and Deployment Strategy in Korea,” Global IPv6 Summit in Asia Pacific 2004

Hiroaki Sadata, “Asian Industry and IPv6,” Global IPv6 Summit in Asia Pacific 2004

- Web sites:

Security Implication of IPv6: http://documents.iss.net/whitepapers/IPv6.pdf

Japan: http://www.ipv6style.jp/en/index.shtml

South Korea: http://www.ipv6.or.kr

China: http://english.peopledaily.com.cn, http://ipv6.net.edu.cn, http://www.ipv6.net.cn