JGN II (Japan Gigabit Network II)

A research and development system for advanced broadband networks

Yoshihiko Kanaumi
NEC Corporation
NEC Bldg., 5-7-1 Shiba
Minato-ku, Tokyo, 108-8001 Japan

Ichiro Yamauchi
NTT Communications Corp.
NTT Hibiya Bldg., 1-1-6 Uchisaiwai-cho
Chiyoda-ku, Tokyo, 100-8019 Japan

Takashi Miyake
Kurashiki University of Science and the Arts
Nishinoura 2640, Tsurajima-cho
Kurashiki-shi, Okayama, 712-8505 Japan

Kazumasa Kobayashi
Kurashiki University of Science and the Arts
Nishinoura 2640, Tsurajima-cho
Kurashiki-shi, Okayama, 712-8505 Japan

Hiroshi Esaki
The University of Tokyo
Hongo 7-3-1 Bunkyo-ku, Tokyo, 113-8656 Japan

Abstract

This paper presents a overview of JGN2, Japan Gigabit Network 2, which has been established on the end of March 2004. JGN2 was built as a successor of JGN1, which has been established by Telecommunication Advancement Organization (TAO) in 1999. First, JGN2 network structure is explained. JGN2 provides gigabit level layer one, two, three functionalities to the research communities. Layer one provides optical path, layer two provides Ethernet connection, layer three provides IPv6 network respectively. JGN2 can be used not only for Japanese domestic network research but also for international network research. Network structure of Pacific Northwest GigaPoP and Aisia Pcific POPs are described and it is shown how JGN2 is connected to other gigabit research network in worldwide. Experiments on JGN2 at international conferences are also described. High Definition(HD) TV transmission experiment at JGN2 symposium 2005 and VoIP connection to the Internet at APRICOT 2005 is described and examined the effectiveness of the gigabit network.

1. Introduction

In Japan, we use the most inexpensive broadband Internet in the world, and amount of the high quality multimedia contents flow in the Japanese Internet grows very rapidly. As the usage of the broadband internet increases, some problems occur gradually. To use multimedia in the Internet, we need to solve many issues for VoIP, video, security, etc. The National Institute of Information and Communications Technology (NICT)[1] conducts research and development for various technologies to resolve these problems. NICT activities cover not only commercial base services but also consumer base services. NICT is also very active on the research on an international network. Japan Gigabit Network 1 (JGN1) was designed for the nation-wide research and development network for high speed network infrastructure. JGN1 was used for the research on the multimedia transmission, collaboration through the network, IPv6, multicast, etc. Japan Gigabit Network 2 (JGN2) has the same objectives as JGN1, however uses different technologies. While JGN1 deployed ATM, JGN2 deployed 10Gigabit or 1Gigabit Ethernet in addition to the bandwidth increase. A nationwide IPv6 testbed, which was the largest scale of multivendor IPv6 network was developed on the JGN1 as well. JGN2 needs to take over the JGN2 IPv6 functions. The network transition from JGN1 IPv6 to JGN2 IPv6 has been smoothly achieved last year, and JGN2 IPv6 is used continuously for various researches, for example, IPv6 multicast transmission of multiple sources at the Sapporo Snow Festival project. It is possible to send moving image with higher quality than DV[1] format, is HD[2] format, and it can be IPv6 multicasted.

Furthermore JGN2 has the international POPs, Pacific

1 Digital video
2 High Definition

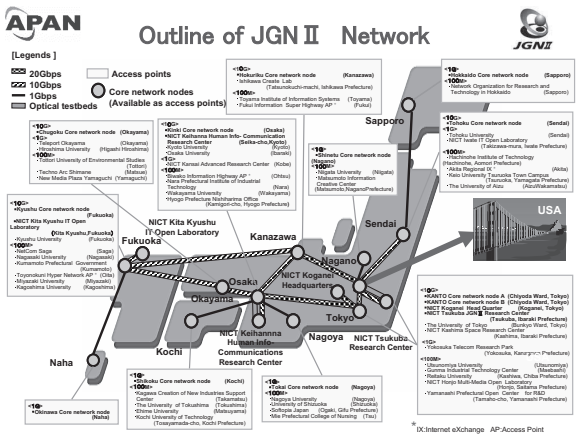

Figure 1. Outline JGN2 Network

Northwest GigaPoP (PNWGP), Asia Pacific POPs.

This paper describes the outline of JGN2 structure, international connection from Tokyo to PNWGP and Asia Pacific POPs, and JGN2 usage at JGN2 Symposium 2005 in Osaka are explained.

2. Overview of JGN2 network

JGN2[2] outline network is shown in Figure1. JGN2 is composed of the following 4 functions of the network, Optical Testbed Network, GMPLS 3 Testbed Network, Layer 2 Ethernet Testbed Network, and Layer 3 IPv6 Testbed Network. Layer 3 IPv6 Testbed Network is composed of the following 3 functions of network: IPv6 native, IPv6 multicast, and international connections. JGN2 has access points capable of providing layer 2 services not only throughout 47 prefectures and city governments (totalof 63 places) in Japan, PNWGP and Asia Pacific POPs international access points. The network's entire core-nodes is connected with 10GBase-X links. At the JGN2 access points, layer 2 Ethernet and layer 3 IPv6 services are available. Additionally, the IPv6 multicast is of course available. JGN2 has access points in PNWGP and Asia Pacific POPs for international connections in addition to the Japanese locations. Details of the network such as bandwidth of every link and topology is shown in Figure 2. Figure 3 shows Layer 3 Testbed Network topology. Layer 2 and Layer 3 service provide the following:

- Layer 2 Ethernet connection/network services
  1. Point-to-Point connection service. This service connects 2 points by L2 connection based on VLAN.
  2. Multi-point connection service. This service connects multiple points by L2 connection based on VLAN.

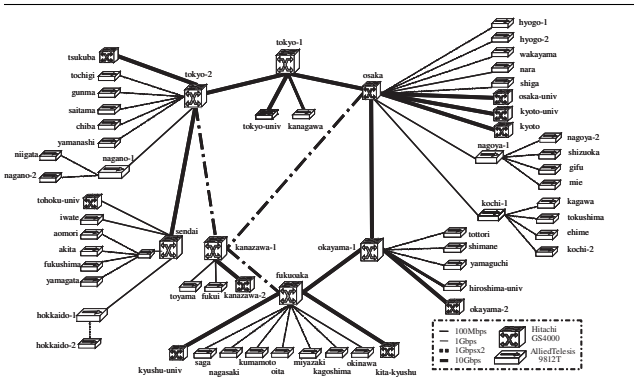

Figure 2. Layer2 network topology

- Layer 3 IPv6 connection/network services This service connects JGN2 users among each other, or to other research networks and other users, at the IP level (a service with an IPv4/IPv6 dual stack).
- Available interfaces to JGN2 user are:
  1. 10/100/1000base-T
  2. 1000base-X
  3. 10Gbase-X, LR or ER

Layer 2 Testbed Network consists of the equipment of Layer 2 switch devices Hitachi GS4000 series and Allied Telesis CentreCOM series. Layer 3 IPv6 Testbed Network can handle BGP4+, OSPFv3, PIM-SM, MLD[3]. Layer 3 IPv6 Testbed Network consists of the router which supports those protocol with Hitachi GR4000 series, Allied Telesis SB7800R series, and NEC IP8800/R series.
JGN2 also offers the following Layer 1 services with the next generation network technologies:

- GMPLS Testbed Network
- Optical Testbed Network

3. Internationalized JGN2

JGN2 provides international Layer 2 and Layer 3 services in the same way as domestic JGN2 services. As shown in Figure 4, presently the international connection point have been constructed in the U.S.A. Configuration of JGN2 Japan-US link is as follows (in the Figure5):

- 10Gbps (10GbE-EW) 1 line
- JAPAN (Tokyo) - USA (PNWGP, Chicago)
- To succeed TRANSPAC
- Management under (or as) JGN2 project (Link owner NICT)

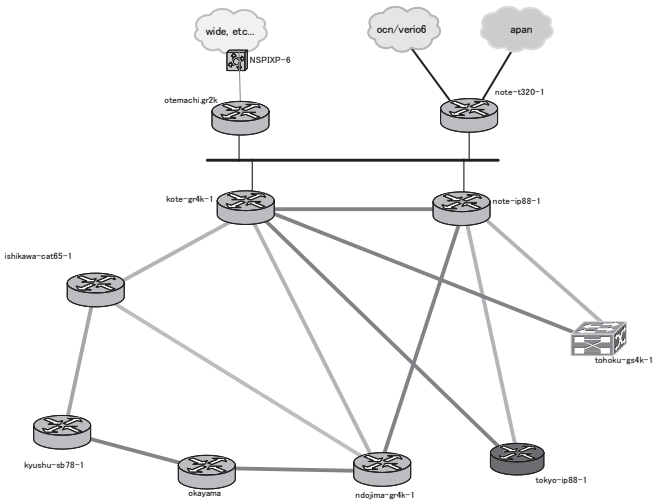

Figure 3. Layer3(IPv6) network topology

JGN2 has the 10GbE-EW connection to PNMGP, Chicago. In addition, Juniper T640 which JGN2 operates provides connection to Asia/Japan R&E networks directly, and US R&E Networks via TransPAC2, and Pacific WAVE. Procket 8812 is directly connected to Asia/Japan R&E networks as well.

3.1. Tokyo POP

Tokyo POP has JGN2 Network Operation Center which controls and manages whole JGN2 network. As shown in Figure5, the domestic NOC is located in NTT Otemachi, and the international NOC in KDDI Otemachi.

3.2. Pacific Northwest GigaPoP

As shown in Figure 5, We installed Hitachi GS4000/80E, Super-micro SC822R-400RC, Cisco 7960, Allied Telesis Centre-COM 9812T. Configuration of these devices are as follows:

- Hitachi GS4000/80E:
  3ports 10Gigabit Ether(EW, LW, LR), 12ports 1Gigabit Ethernet(SX)
  10GbE-EW is for Tokyo POP.
  10GbE-LR is for Force10, StarLIGHT.
  10GbE-LW is for reserve.
- Supermicro SC822R-400RC:
  Pentium4 3GHz, Mem 512MB*2, HDD SEAGATE 250GB*2(RAID-1), 100Base-TX*2, 1000Base-SX*1
- Allied Telesis CentreCOM 9812T:
  12ports 10/100/1000Base-TX, 4ports 1Gigabit Ethernet(SX)

Network used in the experiment

Figure 4. Third Generation DR

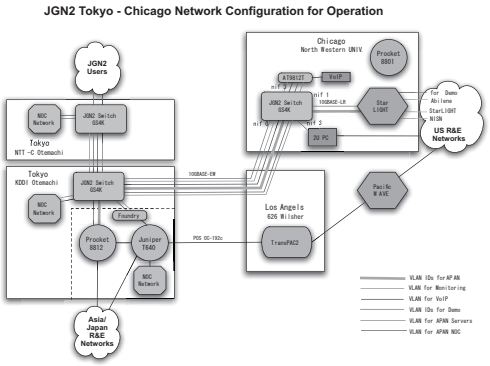

Figure 5. Tokyo POP and PNWGP

- Cisco 7920:
  usage as the communication tool for the operators, and installation of Call Manager in NTT Otemachi, Tokyo

In order to login to these devices except Cisco 7920, operators must login to Supermicro SC822R-400RC server. Therefore Supermicro SC822R-400RC server is set ACLs to limit the network login. Furthermore, we'll only use SSH for remote login.

3.3. Asia Pacific POPs

JGN2 Asia Pacific POPs opens in November 2005. Configuration of Asia Pacific POPs is similar to the PNWGP and provides Layer 2 and Layer 3 connections to the APAN group Asian counties shown in Figure6.

4. The international conference

In this section, two events which use JGN2 are described to show how effective the network is for interna-

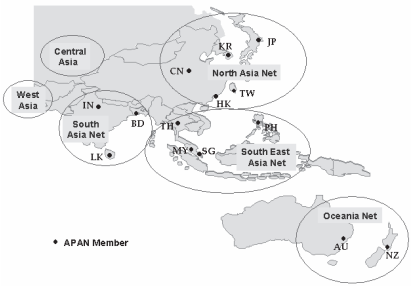

Figure 6. APAN Group

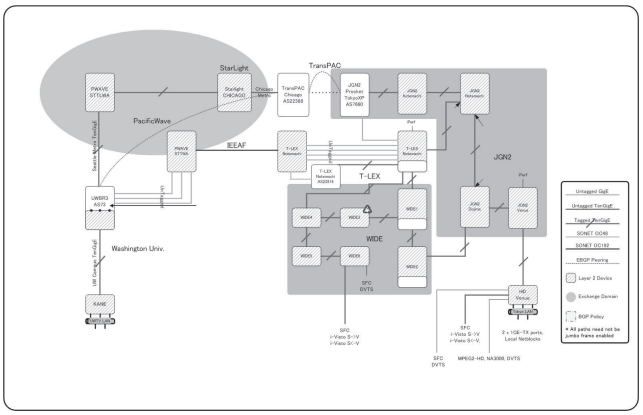

Figure 7. JGN2 Symposium Network

tional events.

4.1. JGN2 Symposium 2005 in Osaka

January 20, 2005 – Dignitaries and researchers attending the JGN2 Symposium 2005 in Osaka, Japan. This week listened and watched as Internet visionary Larry Smarr gave the keynote presentation on a large high-definition television (HDTV) screen above the podium. Unlike traditional keynote speakers, Smarr was 5,000 miles away in Seattle, Washington, but the picture was so clear that Osaka attendees could even distinguish a hair on the speaker's head. Advances in transmitting live, uncompressed HDTV signals over optical networks are enabling true tele-presence, in which participants feel they were together in the same room. The Internet HDTV broadcast system used for this event was developed by the University of Washington for the ResearchChannel. A server in Seattle transmitted uncompressed, real-time, high-definition digital video and digital audio at very high quality and in low latency to a client system in Osaka. Professor Smarr's presentation originated on the University of Washington campus in Seattle and was transmitted without any compression at 1.5 Gbps to the Pacific Northwest GigaPoP (PNWGP)[4], then across a 10Gbps transpacific link from Seattle to Tokyo, and then via the JGN2 to Osaka. The transpacific link was provided by the Internet Educational Equal Access Foundation (IEEAF)[5], and is managed by the PNGWG in Seattle and the WIDE project[6] in Japan. The network of JGN2 symposium is shown in Figure 7

4.2. APRICOT 2005 in Kyoto

The APRICOT 2005 Kyoto from February 18th to 25 days, was held in Kyoto International Conference Hall (KICH). Inside the conference place wireless LAN service and wired service in the exhibition space was offered. It was possible to use the service of the wireless LAN telephone. T-LEX, WIDE project network, and JGN2 are utilized to connect the Internet.

5. Conclusions

- 10Gigabit Ethernet based nation wide R&D network JGN2 is explained.
- JGN2 provides Layer2 connections as well as Layer3(IPv4/IPv6) connections
- JGN2 is use not only for R&D but also for international research conference.

6. Acknowledgements

We appreciate all the people contribution to JGN2 world wide. Specially, when JGN2 and JGN2 IPv6 are constructed, many people relate, appreciate in those people. In the future, in order to be able to use in for many researchers, you watch the state of network, keep trying to release the data widely.

References

[1] N. I. of Information and C. Technology. NICT - National Institute of Information and Communications Technology. http://www.nict.go.jp, 2004.

[2] N. I. of Information and C. Technology. Japan Gigabit Network. http://www.jgn.nict.go.jp, 2004.

[3] B. Haberman. Source Address Selection for the Multicast Listener Discovery (MLD) Protocol. RFC 3590, 2003.

[4] http://www.pnw-gigapop.net

[5] http://www.ieeaf.org/

[6] http://www.wide.ad.jp