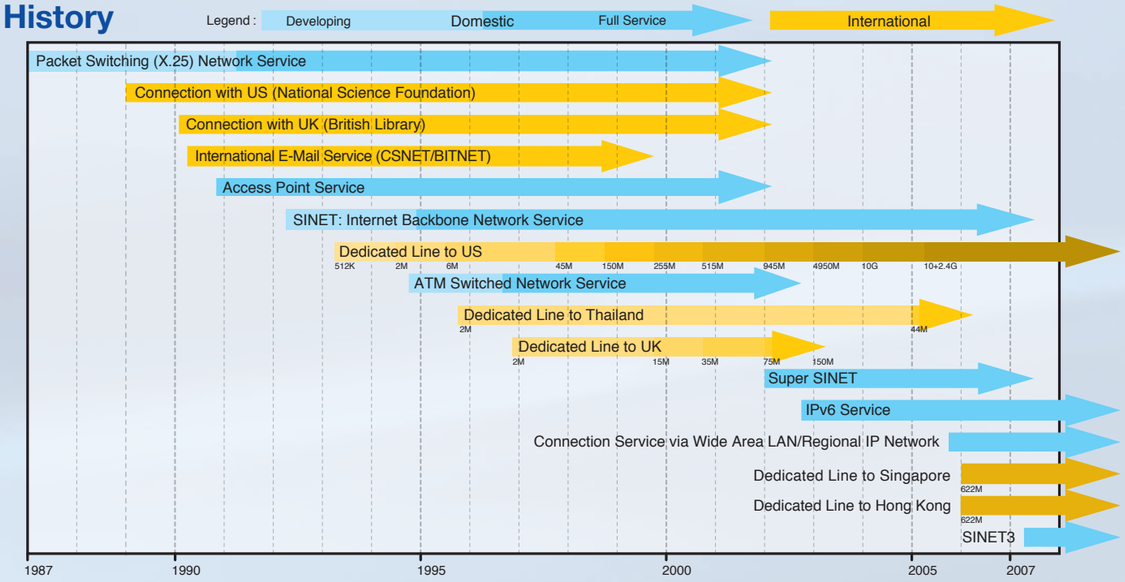
History



SINET Promotion Office

The SINET Promotion Office was established in October 2007 in order to promote the use of SINET. It provides consulting on the advanced use of the network, user support, and training and promotion regarding network services, and also carries out an educational campaign. If you experience any trouble or find something you do not understand, please contact us for assistance.

【Main activities in fiscal 2007】

- Held presentations on using SINET3 in Tokyo, Kyoto, Hiroshima, Fukuoka, and Sapporo.
- Conducted survey of performance-related problems and provided advice on usage (E-mail responses: 47; Visitors received: 4; Visits made: 4)

【Please direct queries to】

SINET Promotion Office
Research and Development Center for Academic Networks
Tel: +81-3-4212-2269 Fax: +81-3-4212-2270
E-mail: support@sinet.ad.jp

Services

User consultation/response
Consulting on the use of network services

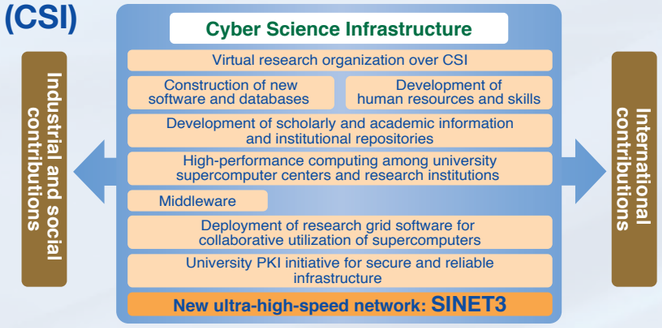
Interviews/surveys on user requests
Solicitation of comments and requests for SINET3

Troubleshooting of performance-related problems
Support for network service usage problems and performance improvements

Technology promotion and educational campaign (lectures and technological exchanges)
Presentations on using SINET3, educational campaign, case examples of SINET3 promotion, creation of documentation, and publication of information on the Web

Cyber Science Infrastructure (CSI)

The National Institute of Informatics (NII) is promoting the development of the Cyber Science Infrastructure (CSI) through cooperation with universities and other organizations. CSI supports Japan's academic research and educational activities and strengthen international competitiveness.
SINET3 plays an important role as the core component of CSI.



Inter-University Research Institute Corporation
Research Organization of Information and Systems
National Institute of Informatics
NII

2-1-2 Hitotsubashi, Chiyoda-ku, Tokyo 101-8430 URL http://www.nii.ac.jp/

Contact SINET Planning Team, Academic Network Division
Cyber Science Infrastructure Development Department
TEL: +81-3-4212-2255, FAX: +81-3-4212-2270
E-mail: net6@sinet.ad.jp **URL http://www.sinet.ad.jp/**

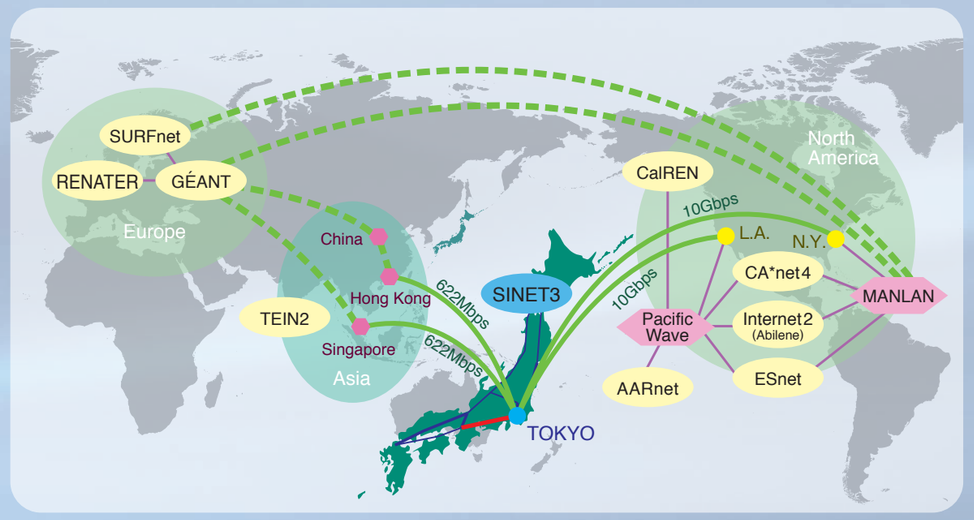
R100 Printed on 100% Recycled Paper
PRINTED WITH SOY INK
2008.04

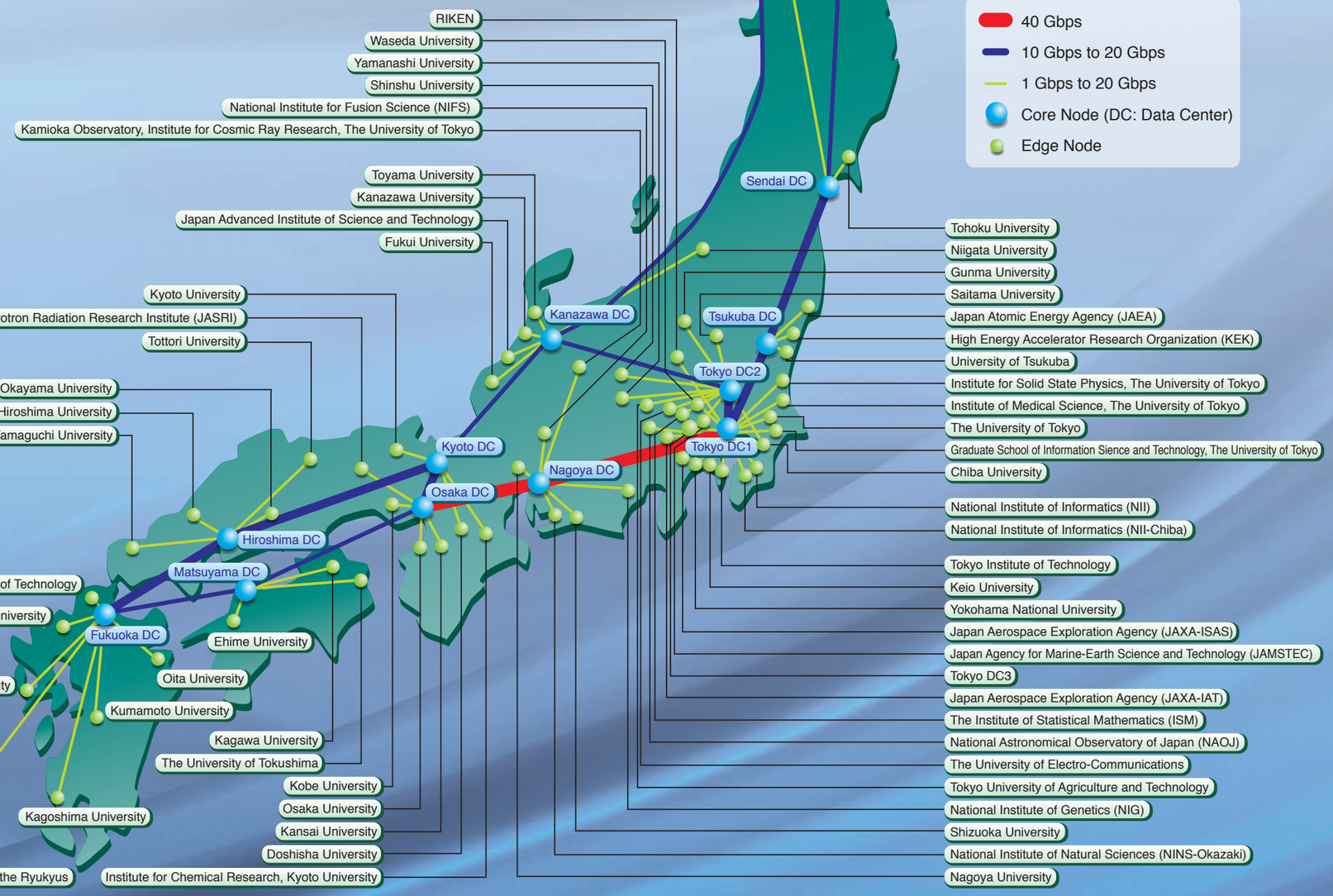
Science Information NETwork 3

The Science Information Network (SINET) is an information and communication network connecting universities and research institutions throughout Japan via nationwide connection points (nodes). It is designed to promote research and education as well as the circulation of scientific information among universities, research institutions, and similar entities. SINET is also connected to research networks such as Abilene in the U.S. and GÉANT in Europe to facilitate dissemination of research information and collaborations over networks.

SINET3 began operations in April 2007, and it replaces the previous SINET and Super SINET. SINET3 plays an important role as the core component of the Cyber Science Infrastructure (CSI).

Network Architecture of SINET3





Before April 2007, the National Institute of Informatics (NII) had operated two academic infrastructures, the Science Information Network (SINET) and Super-SINET. SINET was a nationwide academic internet backbone, and it promoted research and education at more than 700 universities, research institutions, and related entities. The network provided pure IP-based services, and the line speed was up to 1 Gbps. Super-SINET provided a high-speed network environment, with line speeds up to 10 Gbps, to academic institutions concentrating on such research areas as high-energy physics, nuclear fusion science, space and astronomical science, genome analysis, nanotechnology research, simulation sciences, and grid computing.

After taking into consideration the increasingly diversified requirements and functional limitations of current equipment, i.e. IP routers, NII decided to construct SINET3, a next-generation academic infrastructure that integrates SINET and Super SINET.

SINET3 is hybrid network composed of layer-1 switches and IP/MPLS routers. It provides layer-1 end-to-end circuit services as well as IP and Ethernet services in a cost-effective manner, and it enables flexible resource allocation in response to service demands.

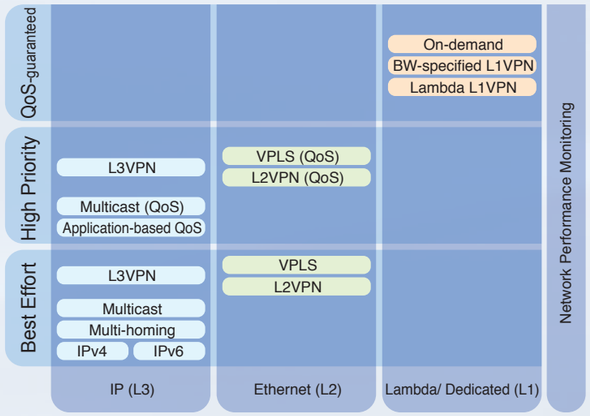
The network has a two-layer transport structure with edge and core nodes. To reduce the number of expensive IP routers and provide multi-layer services, the network does not have IP routers in the edge layer. The edge node is an edge layer-1 switch with layer-2 multiplexing. It is located at a university or research institution and accommodates user equipment. The core node is composed of a high-end IP/MPLS router and a core layer-1 switch located at a public data center.

As of April 2007, the network has 63 edge nodes and 12 core nodes, i.e., 75 layer-1 switches and 12 IP/MPLS routers. The line speed between the edge and core nodes is 1 to 20 Gbps, and the backbone line speed between the core nodes is a maximum of 40 Gbps. The network deploys Japan's first STM256 (40 Gbps) lines between Tokyo, Nagoya, and Osaka. The backbone links form three loops to enhance network resiliency nationwide and to enable quick service recovery after network failures. The topology also enables efficient use of network bandwidth by sharing backbone links among users for all services.

SINET3 Services

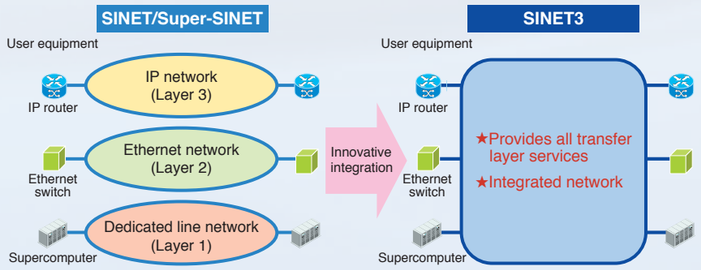
Service Categories in SINET3

SINET3 has five service categories: transfer layer, secure (VPN), quality-of-service (QoS), bandwidth-on-demand(BoD), and network performance monitoring.



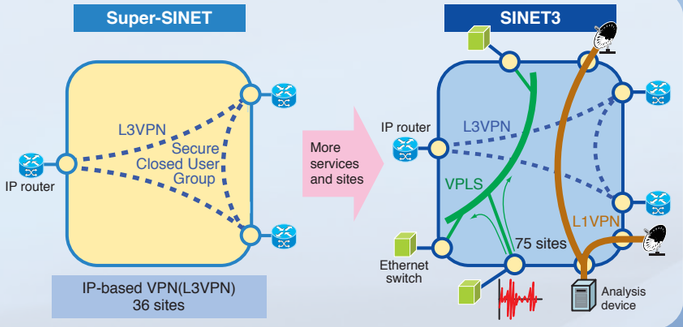
Multiple layer Services

SINET3 is an integrated network providing all transfer layer services. Users can freely choose the best transfer layer for their applications. SINET3 enables economical service provision and flexible network resource assignment for ever-changing and unpredictable service demands.



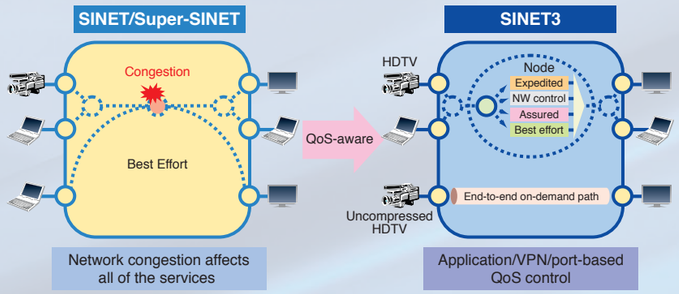
Multiple VPN Services

A closed user group environment (virtual private network: VPN) is essential for ensuring the security of collaborative research. Users can choose from L3VPN (IP), L2VPN/VLLS (Ethernet), and L1VPN.



Multiple QoS Services

SINET3 provides QoS by identifying applications, VPNs, and physical/logical ports. Layer-2/3-based QoS has four priority classes: expedited forwarding (EF), network control (NC), assured forwarding (AF), and best effort (BE). Layer-1-based QoS has the smallest packet delay, no delay variance, and no packet loss.

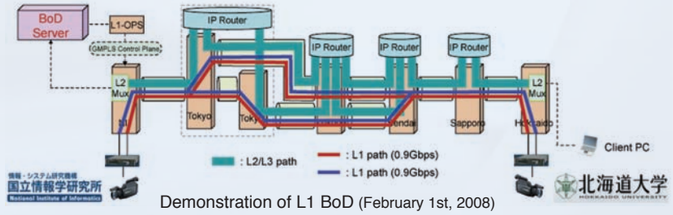


Network Performance Monitoring Service

SINET3 will give users network information, such as backbone traffic and delay. Accesss to this information should help to improve usability and facilitate network research.

Bandwidth-on-demand Services

SINET3 provides bandwidth-on-demand (BoD) services on layer-1. Users can specify destination, duration, bandwidth with a granularity of 150 Mbps, and route option. The BoD server receives reservation requests, schedules accepted reservations, and triggers layer-1 path setup.



Demonstration of L1 BoD (February 1st, 2008)

Confirmation of bandwidth reservation

SINET3 Service Menu

P: service is being provided.
S: service is scheduled to be provided.
E: the possibility of providing this service is being examined.

Service Menu				schedule (: regular service, : trial service; '07 7 9 11 / '08 1 3 5 7 9 11 / '09 1 3)	Notes
User Interface	Serial	1.5Mbps or less	P		
	Ether family	10Mbps (Ethernet)	P		
		100Mbps (FE)	P		
		1Gbps (GE)	P		
		10Gbps (10GE)	P		SINET3 will gradually increase node availability.
	SDH/SONET family	2.4Gbps (STM-16)	P		Only for large data transfers.
		10Gbps (STM-64)	E		
Network Service	L3 service	IPv4	P		
		IPv6	P		Native IPv6(2007.12～)
		Multi-homing	P		
		Full routes	P		
		Multicast	S		
		L3VPN	P		
		Application-based QoS	S		
		Multicast (QoS)	S		
		L3VPN (QoS)	S		
	L2 service	L2VPN	P		
		VPLS	P		
		L2VPN (QoS)	S		
		VPLS (QoS)	S		
	L1 service	Lambda L1VPN	P		IF: GE, 2.4G (SINET3)
		BW-specified L1VPN	S		IF: GE, 10GE. granularity: 150Mbps (SINET3)
		On-demand	S		
		Dedicated Line	–		SINET3 provides Lambda L1VPN instead.
	Network Performance Monitoring	Traffic information	E		
		Delay information	E		
		Route control information	E		
		Access filter information	E		

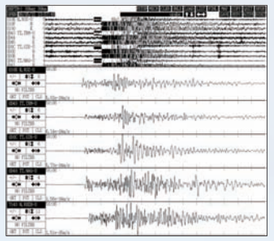
Case examples using SINET3

Research

— A next-generation national earthquake data exchange and distribution system —

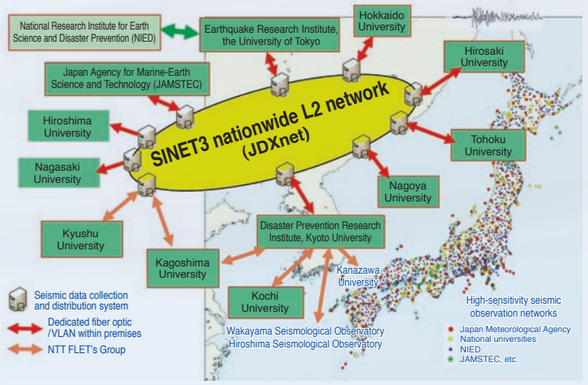
The Earthquake Research Institute, the University of Tokyo (ERI) is building a system, in cooperation with other research institutes, that uses SINET3 nationwide L2 network (VPLS) to enable the exchange of seismic waveform data that is collected at universities and research institutes. The system will provide the nation's universities and other institutions with real-time waveform data of high-sensitivity seismic observation networks of Japan.

Seismic station
(Picture shows the Mt. Asama/ Yunotaira seismic station in Nagano Prefecture)



Waveform data
from seismic observation networks

Construction of a next-generation national earthquake data exchange and distribution system using the SINET3 nationwide L2 network



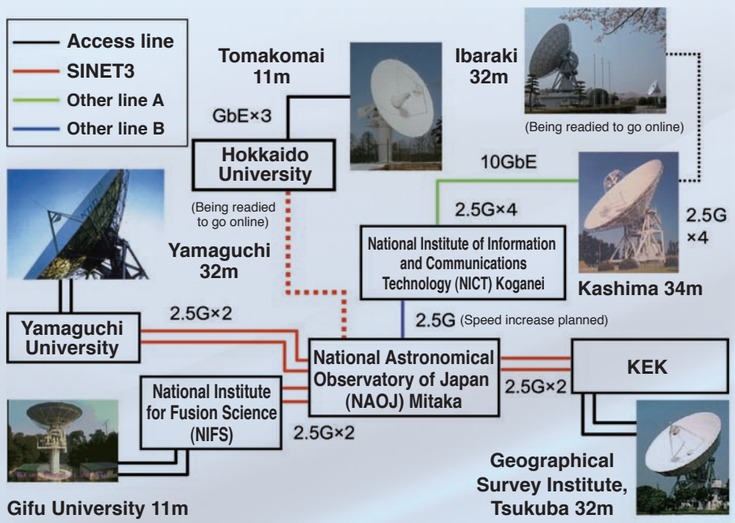
(Source : ERI)

Research

— Construction of an Optically Connected Array for VLBI observatories —

The National Astronomical Observatory of Japan uses SINET3's Layer-1 (quality assured) path to connect radio telescopes located throughout Japan —with antenna diameters of 11 m in Gifu, 32m in Yamaguchi, 34m in Kashima, 32m in Tsukuba, and 11 m in Tomakomai—and conduct high-sensitivity radio interferometer observations (optically connected VLBI observations) in real time. (It will use a Layer-1 bandwidth-on-demand (BoD) service starting June 2008.)

With VLBI observations able to perform correlation processing in real time, astronomical objects that were difficult to detect before—such as fixed stars, gamma-ray bursters, and flare stars—can be observed in real time, opening up a new type of astronomy previously impossible to do, in addition to making a major contribution to astronomical research.



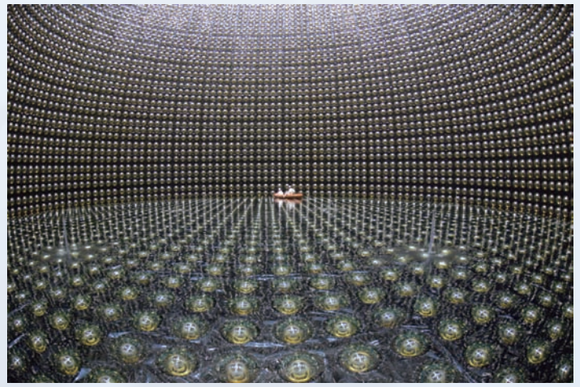
(Source : National Astronomical Observatory of Japan)

Research

— Super-Kamiokande experiments,
next-generation long-baseline neutrino oscillation experiment (T2K experiment) —

In a mineshaft 1,000 meters underground can be found Japan's largest subterranean physics experiment site, run by the University of Tokyo's Institute for Cosmic Ray Research (ICRR) Kamioka Observatory, located in Hida City, Gifu Prefecture. In this mineshaft, the Kamioka Observatory is conducting the world's most cutting-edge, precision physics experiments and research and development, including the Super-Kamiokande (SK) experiments.

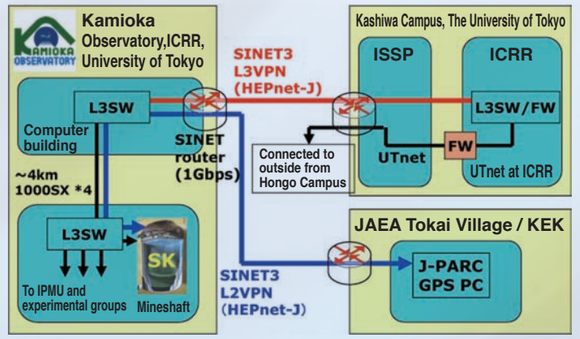
SINET3's L3 VPN is currently being used as the LAN connecting the Kamioka Observatory and the ICRR located on the University of Tokyo's Kashiwa Campus. The Kamioka Observatory is connected to the Internet through the ICRR. This L3 VPN is essential in order to allow collaborative researchers in Japan and abroad to access the data retrieved by the experimental equipment installed at the observatory as well as to allow the on-site researchers to communicate with researchers in Japan and overseas through e-mail, the Web, IP video conferencing, and other means.



View inside Super-Kamiokande
(currently filled with pure water)
(© Kamioka Observatory, ICRR<Institute for Cosmic Ray Research>, The University of Tokyo)

The Kamioka Observatory is the site of preparations for the successor to the K2K experiment, a next-generation long-baseline neutrino oscillation experiment (T2K) scheduled to begin in April 2009. In the experiment, SINET3 will be used to transmit the GPS timing of a neutrino beam shot from the Japan Proton Accelerator Research Complex (J-PARC) located in Tokai Village to SK in real time. Since February 2008, timing tests have been conducted in which an L2 VPN is set up between the High Energy Accelerator Research Organization (KEK) and the Kamioka Observatory. This is one way in which SINET3 is actively making major contributions to advances in particle physics.

Note 1. K2K: KEK to(2) Kamioka
Note 2. T2K: Tokai to(2) Kamioka



Network connection to Kamioka (ICRR-related facilities)

(Source : Kamioka Observatory, ICRR, University of Tokyo)

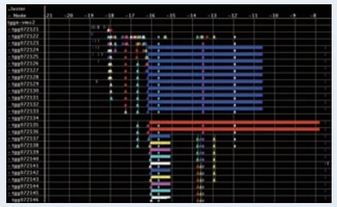
Case examples using SINET3

Research

— Integration achieved through distributed computing using grid middleware —

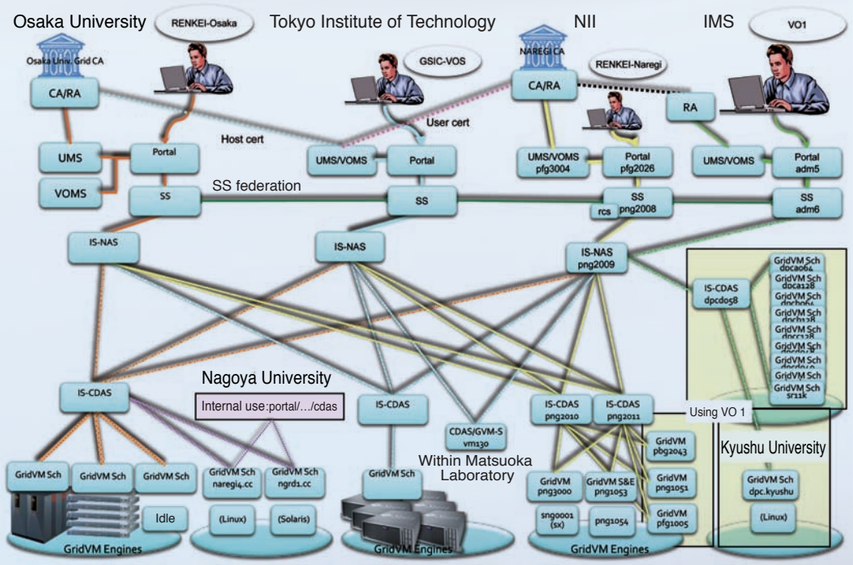
SINET3's L3 VPN (CSI-grid) was used to build a large-scale grid computing environment using NAREGI middleware to link multiple university systems.

In March 2008, Osaka University, Nagoya University, Kyushu University, Tokyo Institute of Technology, the Institute for Molecular Science, and the National Institute of Informatics participated in a demonstration test in which large-scale federated Grid operation was performed. The test succeeded in confirming the stability of the entire system, where jobs were submitted from multiple sites in multiple virtual organizations (VOs) and multiple resources were concurrently reserved. The test constituted major progress toward actual implementation.



Resource reservations
on Tokyo Tech's TSUBAME supercomputer
(Source : NAREGI)

Node configuration of large-scale coordinated connections demonstration test Phase-2 (3/27)



Use of international connection

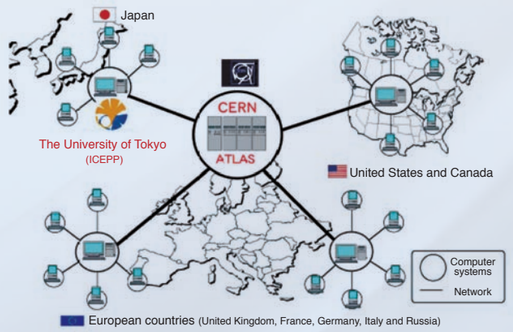
— Distributed analysis of enormous amounts of data produced by the LHC accelerator —

International Center for Elementary Particle Physics (ICEPP) at the University of Tokyo, along with other Japanese research institutes, is participating in the ATLAS Experiment, a collaborative international experiment using the Large Hadron Collider (LHC). Producing an enormous amount of data far in excess of experiments of the past, the ATLAS Experiment will require an incredible amount of data storage equipment and computer processing facility in order to process and analyze the data and produce physics results.

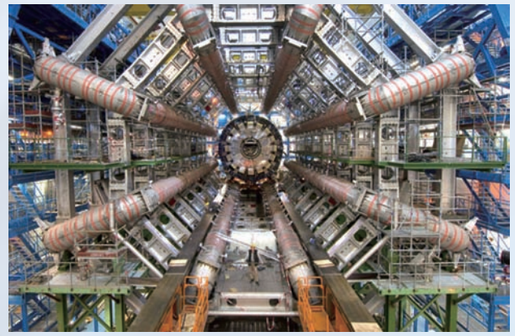
The Worldwide LHC Computing Grid (WLCG), which provides this processing power through computer systems distributed across the globe, has been deployed, and ICEPP is responsible for serving as a regional center for data analyses in Japan. ICEPP has a 10 Gigabit Ethernet connection to SINET3 through the university's LAN. International lines of SINET3 are being used to send huge amounts of data between ICEPP and the computing center in Lyon, France and the European Organization for Nuclear Research (CERN). ICEPP is carrying out preparations for data analysis night and day at a rapid pace toward the start of the experiment this summer.

In this way, SINET3 is providing a tremendous support for this kind of large-scale, collaborative international experiment.

Note: The Large Hadron Collider is the large proton-proton collider of the world's highest energy, currently being constructed by CERN. It is scheduled for completion in the summer of 2008.



Regional centers and world-world-wide network for ATLAS data analysis



The ATLAS detector during assembly (Copyright CERN)

Education

— International remote lectures in coordination with universities abroad —

Since 2005, the University of the Ryukyus has used SINET3 to hold international remote lectures in coordination with the University of Hawai'i, the United Nations University in Tokyo, Keio University, the Asian Institute of Technology in Thailand, the National University of Samoa, and the University of the South Pacific. With students able to receive credits starting in the 2007 academic year, these lectures constitute an environment of high-level education that takes advantage of information technology.

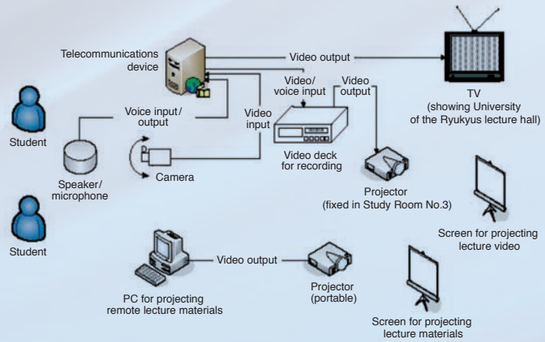


Diagram of the University of Hawai'i's remote lecture system (Attendance)

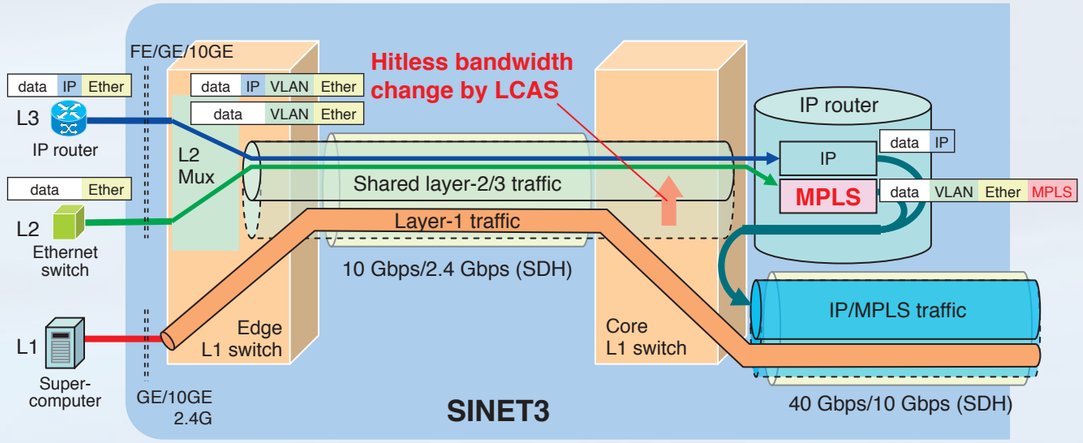
(Source : The University of the Ryukyus)

SINET3 Technologies

Accommodation of Multi-layer Services

L3 and L2 traffic are accommodated in the shared bandwidth by L2 multiplexing and are transferred to IP routers, where traffic is encapsulated with MPLS* labels as needed. L1 traffic is assigned a dedicated bandwidth and separated from L3/2 traffic. The bandwidth of L2/3 (or IP/MPLS) traffic can be hitlessly changed by LCAS*.

*MPLS: Multi-Protocol Label Switching, LCAS: Link Capacity Adjustment Scheme



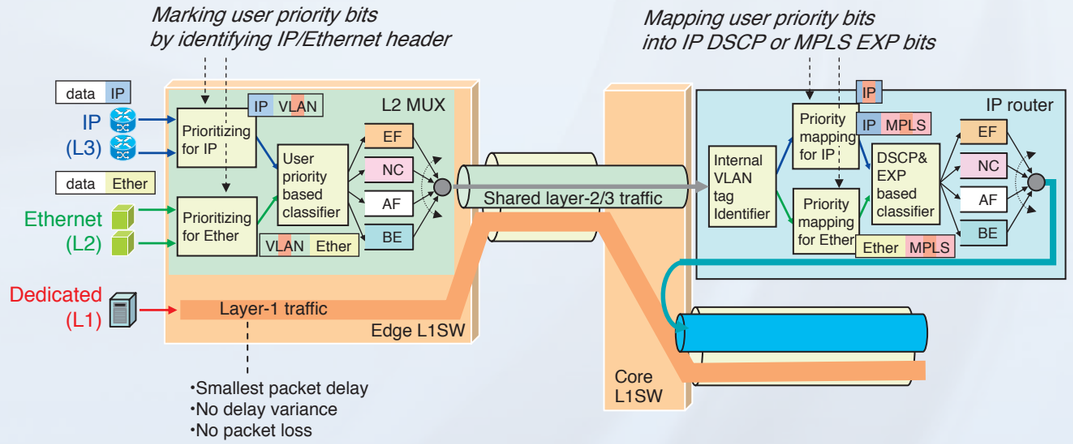
Accommodation of Multi-QoS Services

Layer-3/2 QoS:

- User priority bits of internal VLAN tags are marked at edge L2 MUX.
- User Priority bits are mapped into DSCP (IP) or EXP (MPLS) bits at IP router.
- There are four priority (forwarding) classes: EF, NC, AF, and BE.

Layer-1 QoS:

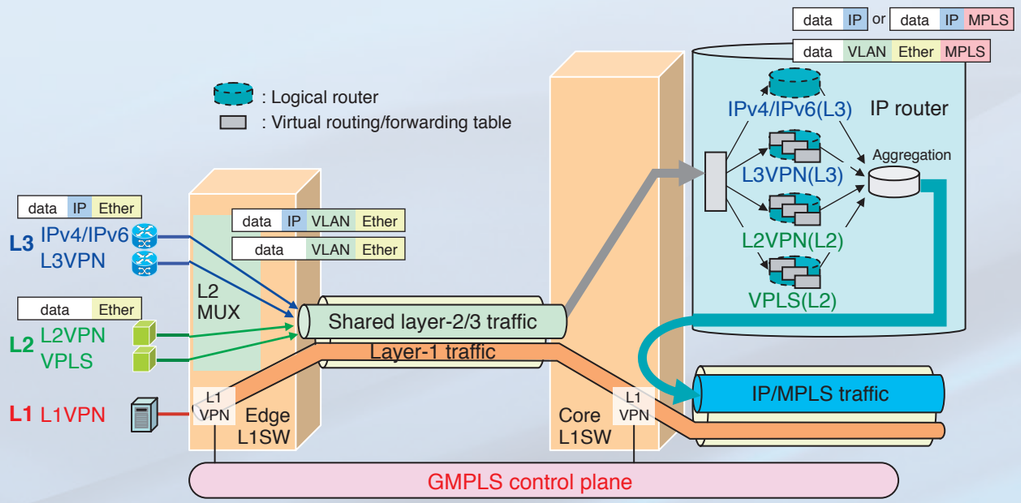
- Layer-1 switches assign the end-to-end bandwidth on demand.



Accommodation of Multi-VPN Services

L3VPN, L2VPN, and VPLS are logically separated by internal VLAN tags and logical routers. Each logical router exchanges different protocols for each VPN service. L1VPN and on-demand services need GMPLS* protocols to set up layer-1 paths and have a separate control plane from that of the IP routers.

*GMPLS: Generalized MPLS



Architecture of Bandwidth-on-demand (BoD) Services

The BoD server receives reservation requests, schedules the accepted requests, and triggers layer-1 path setup of the source layer-1 switch via L1-OPS. The source layer-1 switch sets up the path to the destination by using GMPLS. The BoD server changes the bandwidth of L2/3 traffic by LCAS via L1-OPS as needed.