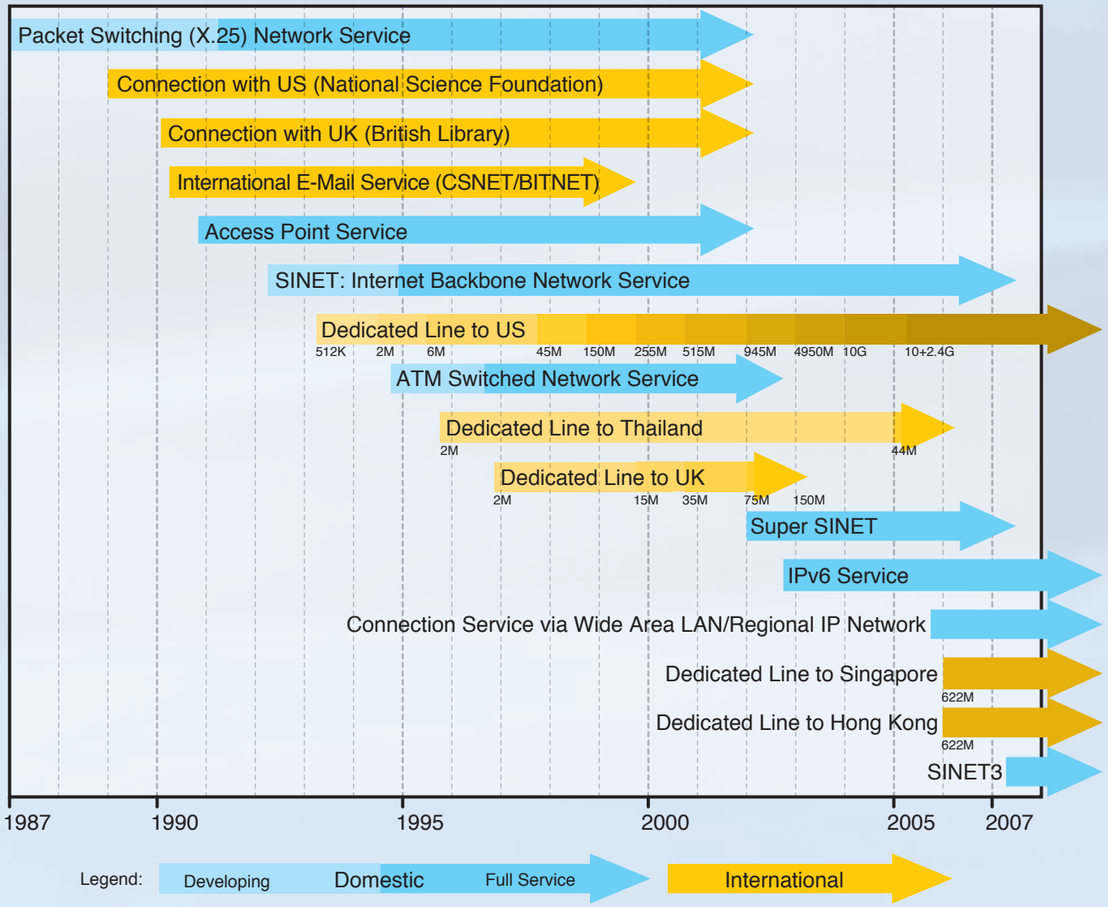
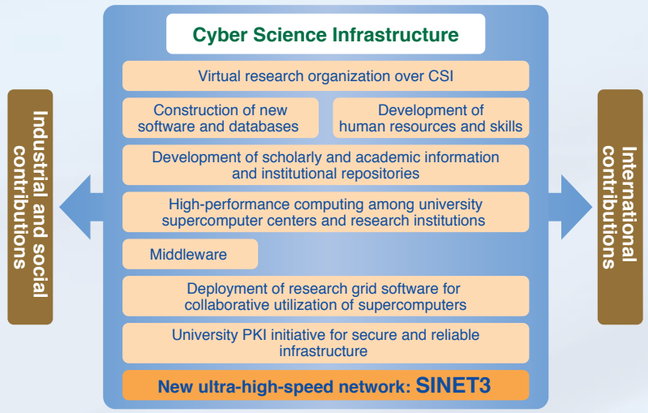
History



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.



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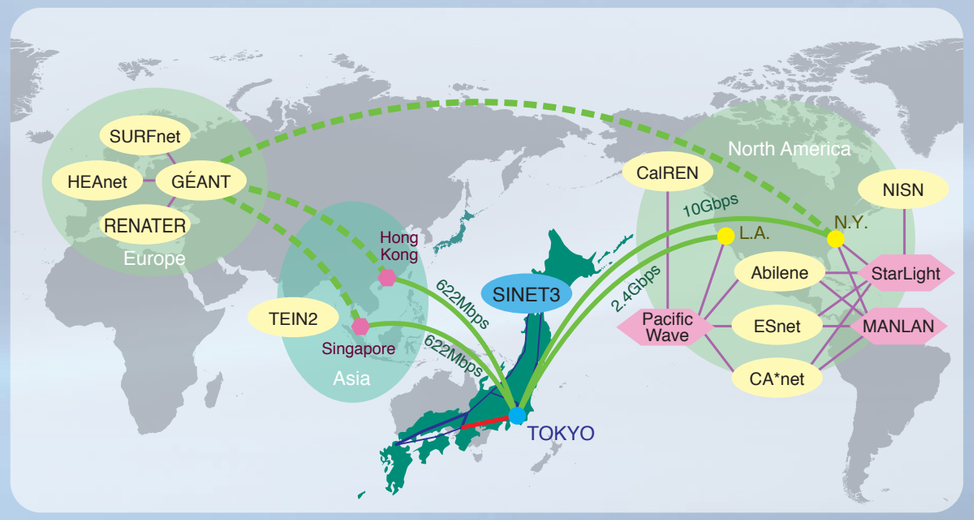
SINET3

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.

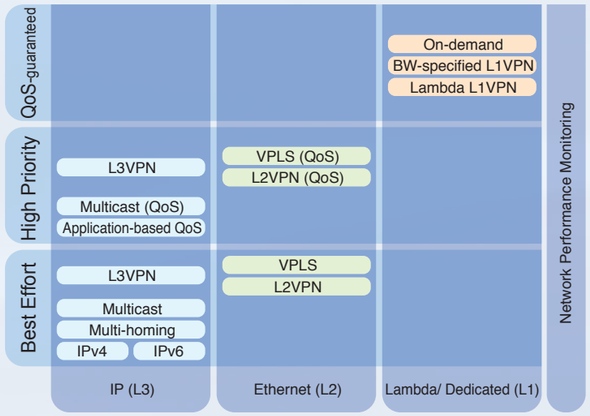
The network has a two-layer transport structure with edge and core nodes. To reduce the number of expensive IP routers and provide multi-layer services, the network does not have IP routers in the edge layer. The edge node is an edge layer-1 switch with layer-2 multiplexing. It is located at a university 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

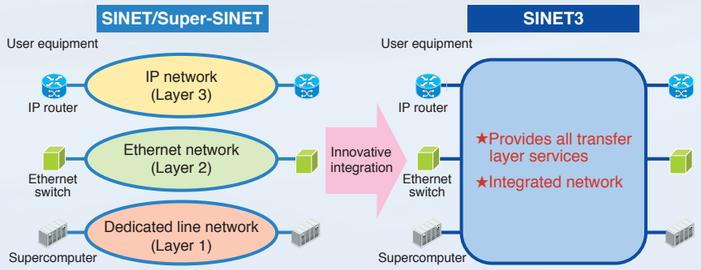
Service Categories in SINET3

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



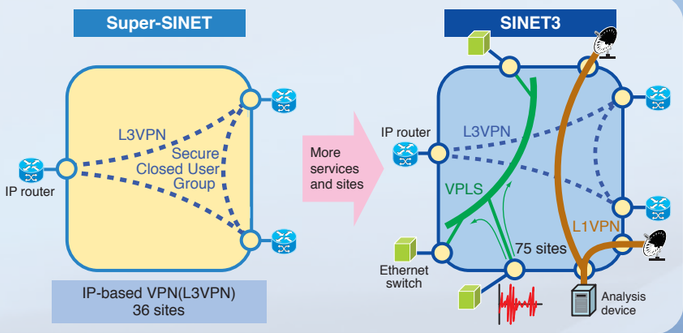
Multiple layer Services

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.



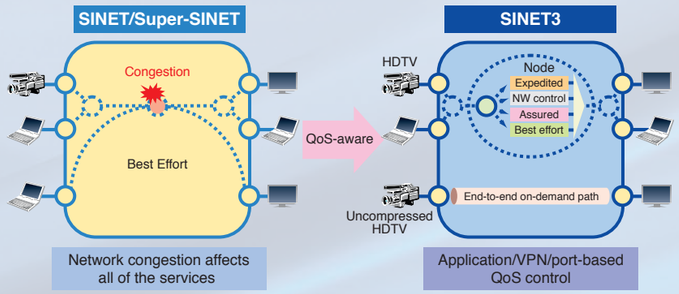
Multiple VPN Services

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.



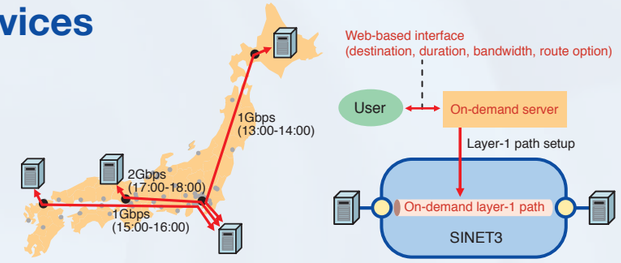
Multiple QoS Services

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.



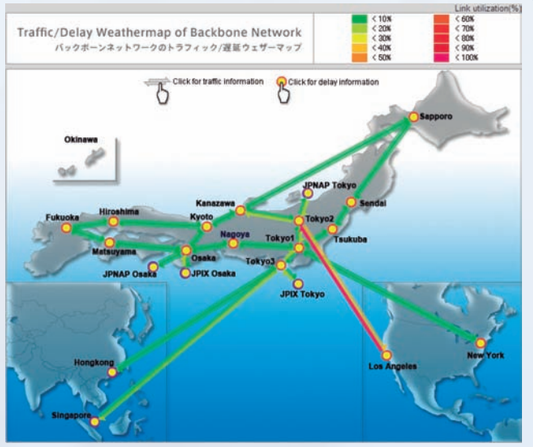
Bandwidth-on-demand Services

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.



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.



Comparison of SINET/Super-SINET and SINET3

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

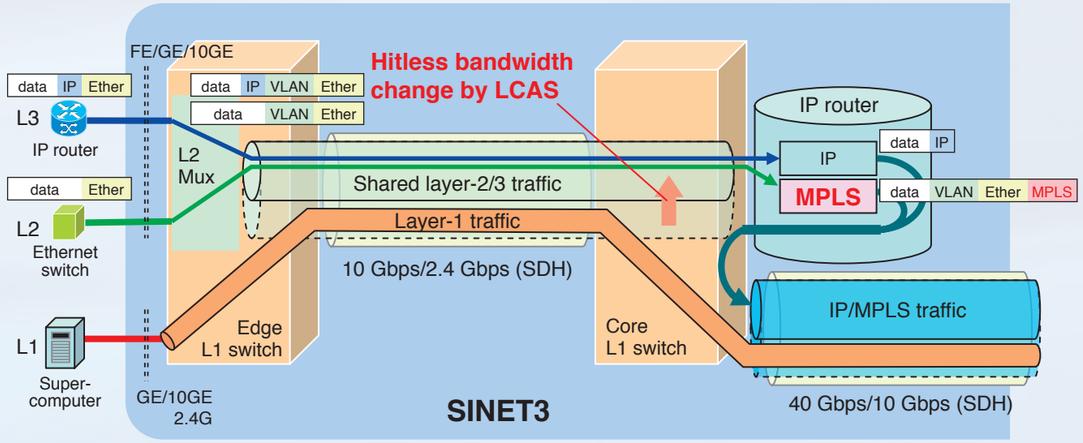
Service Menu			SINET	Super-SINET	SINET3	Notes
User Interface	Serial	1.5Mbps or less	P	–	P	SINET/Super-SINET serial service is gradually being replaced with wide area LAN and regional IP Network.
	Ether family	10Mbps (Ethernet)	P	–	P	
		100Mbps (FE)	P	P	P	
		1Gbps (GE)	P	P	P	
		10Gbps (10GE)	–	–	P	SINET3 will gradually increase node availability.
	SDH/SONET family	2.4Gbps (STM-16)	–	P	P	Only for large data transfers.
		10Gbps (STM-64)	–	–	E	
Network Service	L3 service	IPv4	P	P	P	
		IPv6	P	–	P	Native IPv6 (SINET3)
		Multi-homing	P	–	P	
		Full routes	–	–	P	
		Multicast	–	–	S	
		L3VPN	–	P	P	
		Application-based QoS	–	–	S	
		Multicast (QoS)	–	–	S	
		L3VPN (QoS)	–	–	S	
	L2 service	L2VPN	–	–	P	
		VPLS	–	–	S	
		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	–	P	–	SINET3 provides Lambda L1VPN instead.
	Network Performance Monitoring	Traffic information	–	–	S	
		Delay information	–	–	S	
		Route control information	–	–	E	
		Access filter information	–	–	E	

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



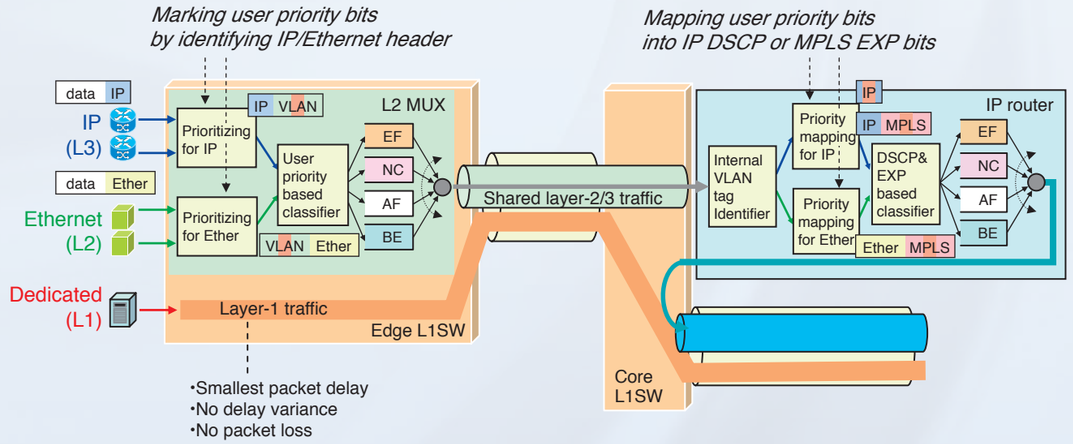
Accommodation of Multi-QoS Services

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:

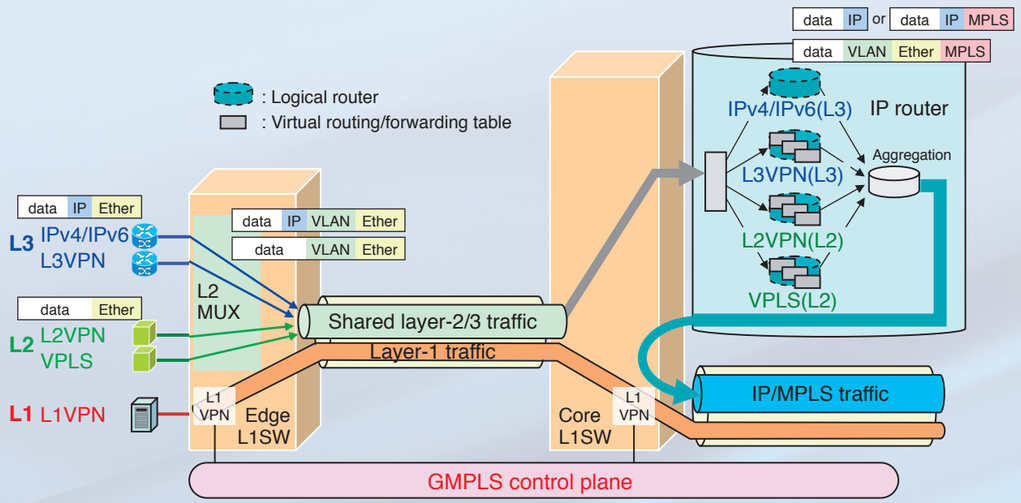
- Layer-1 switches assign the end-to-end bandwidth on demand.



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.