

SINET: High-Speed Academic Network as Scientific Information Infrastructure

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Brief introduction: Location information

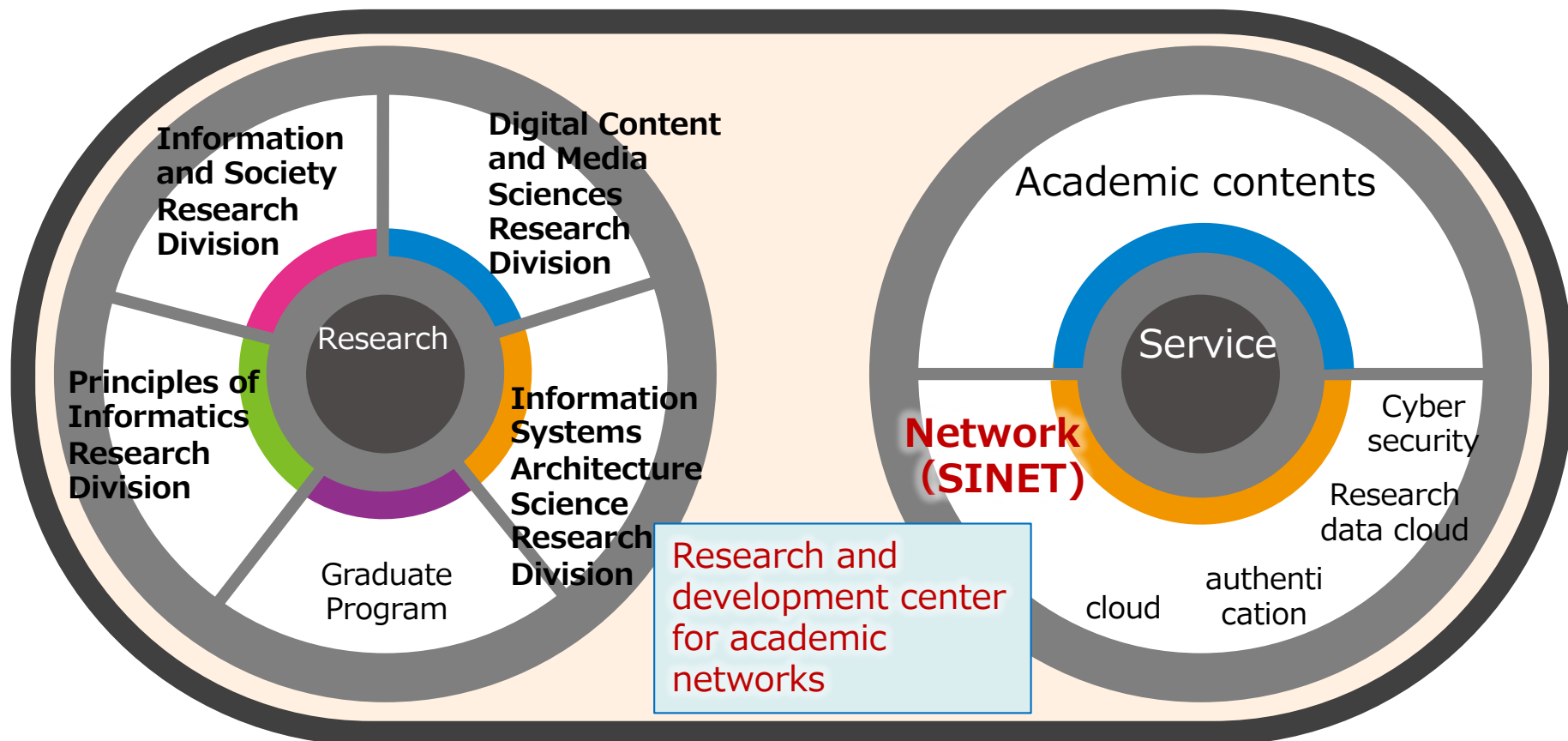
Google Maps NII (National Institute of Informatics)



NII's roles: Research and Service

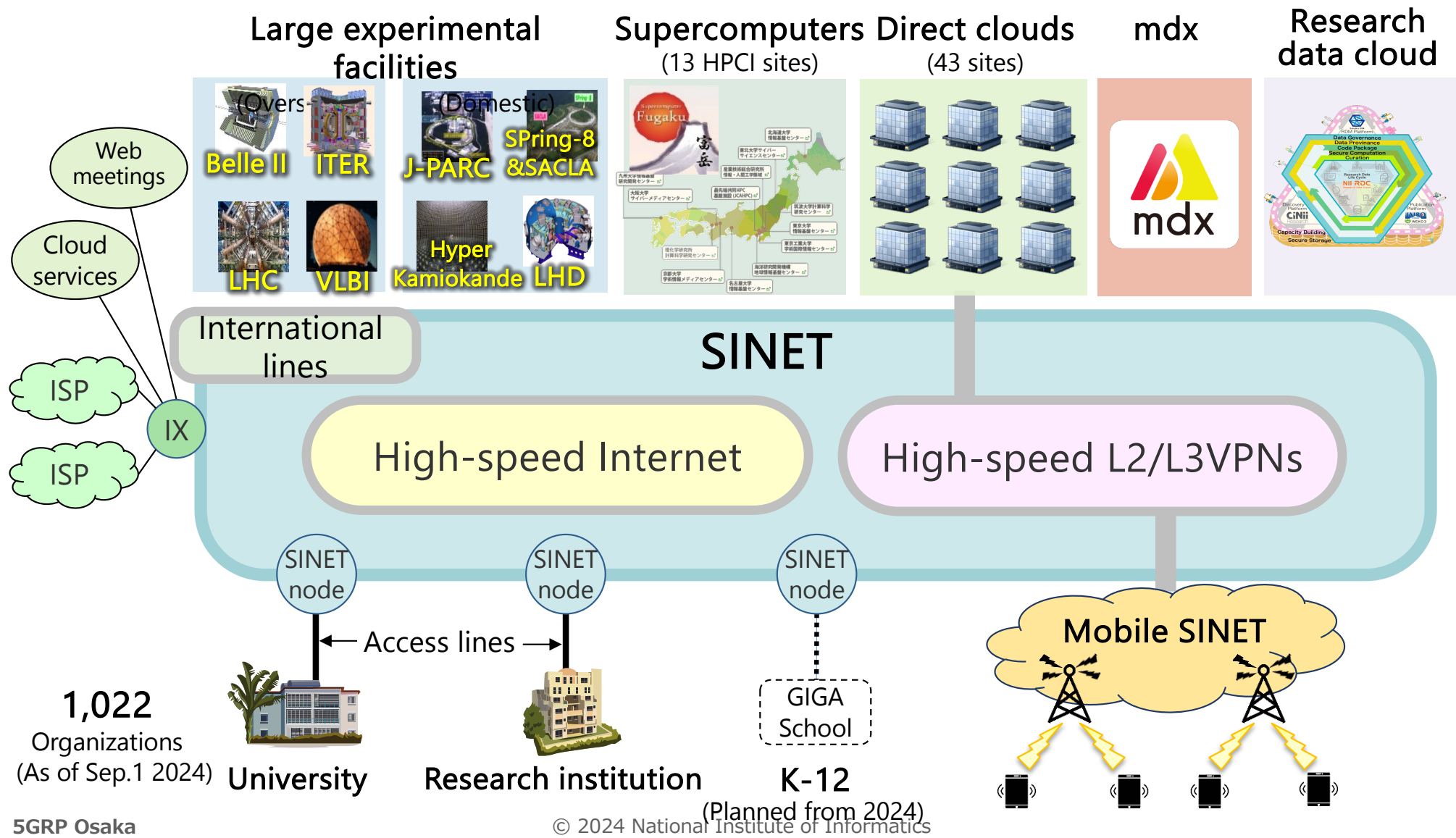
- **NII** is a national institute funded by MEXT in Japan and has the following two missions.
 - To advance **research in information-related fields** from fundamental research to practical applications.
 - To create **state-of-the-art academic information infrastructure** for the research and education.
- **R&D Center for Academic Networks** is responsible for research and development of new technologies and services to advance the network infrastructure, known as **SINET**.

MEXT: Ministry of Education, Culture, Sports, Science and Technology



Science Information Network (SINET)

- SINET**, an ultra-high-speed academic network, is dedicated to enhancing research and education activities of universities and research institutions in Japan.



New SINET Started in April 2022

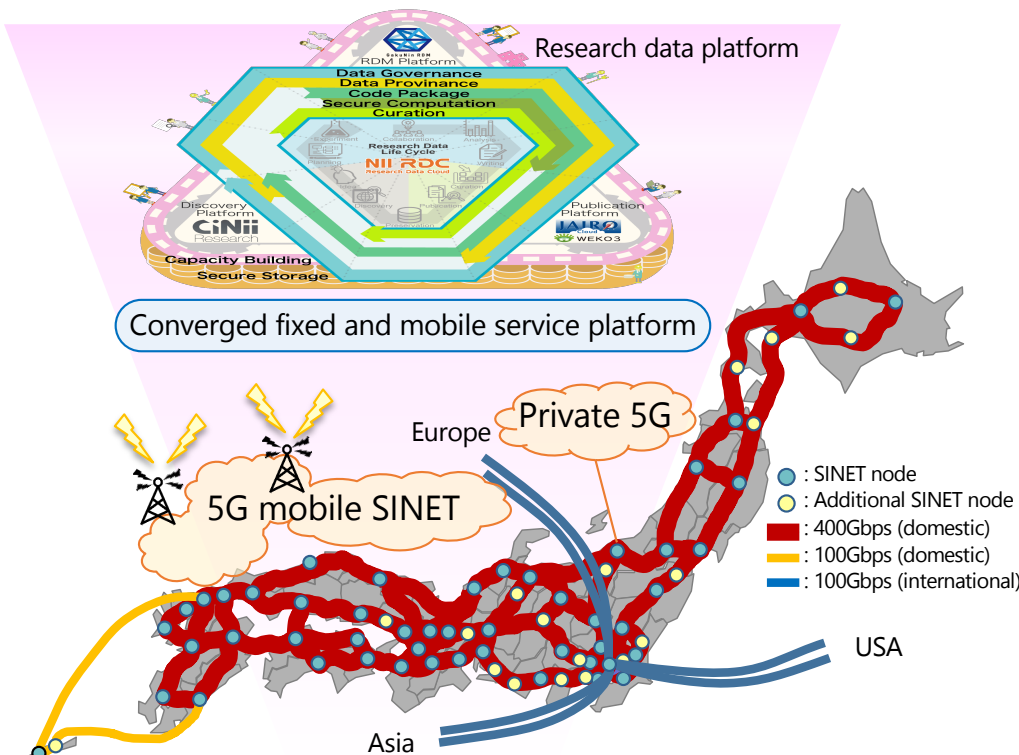
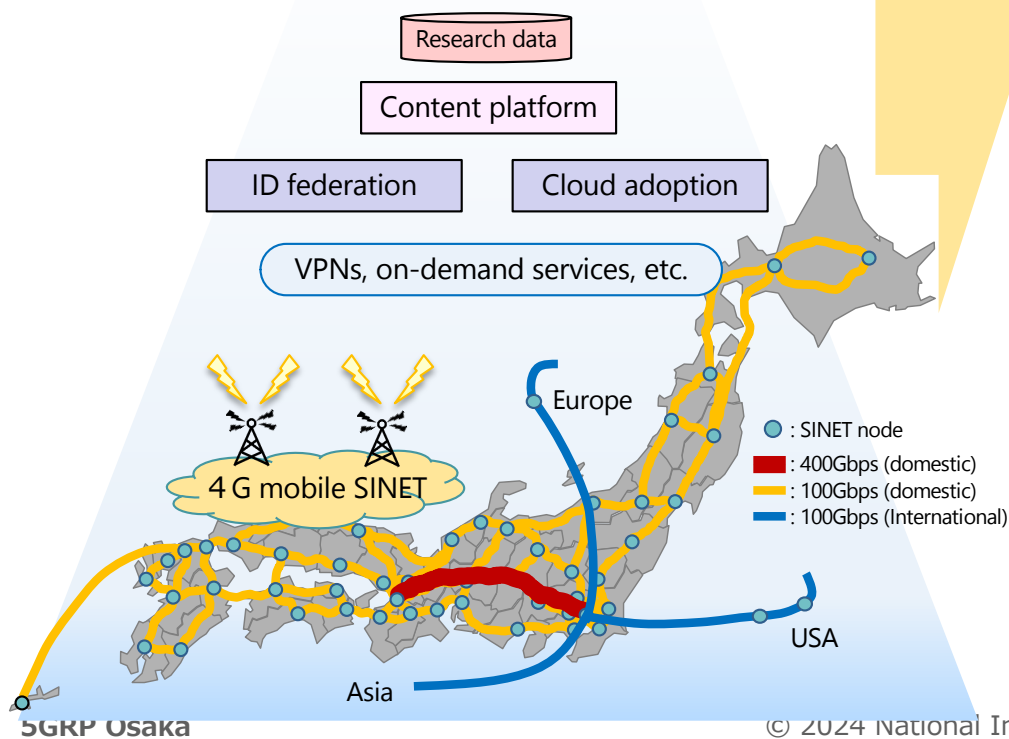
- SINET6 aims to attain the world's highest performance using 400GE interfaces, improve the access environment to SINET, incorporate 5G mobile capability, enhance security services, and strengthen international connectivity.

SINET5 (2016.4 - 2022.3)

- Nationwide 100Gbps (partly 400Gbps)
- 4G mobile SINET
- VPN services by routers
- 100Gbps international lines

SINET6 (2022.4 - 2028.3)

- Nationwide 400Gbps lines + additional nodes
- 5G mobile SINET + Private 5G
- Secure and flexible services by NFV and routers
- 200Gbps or more international lines

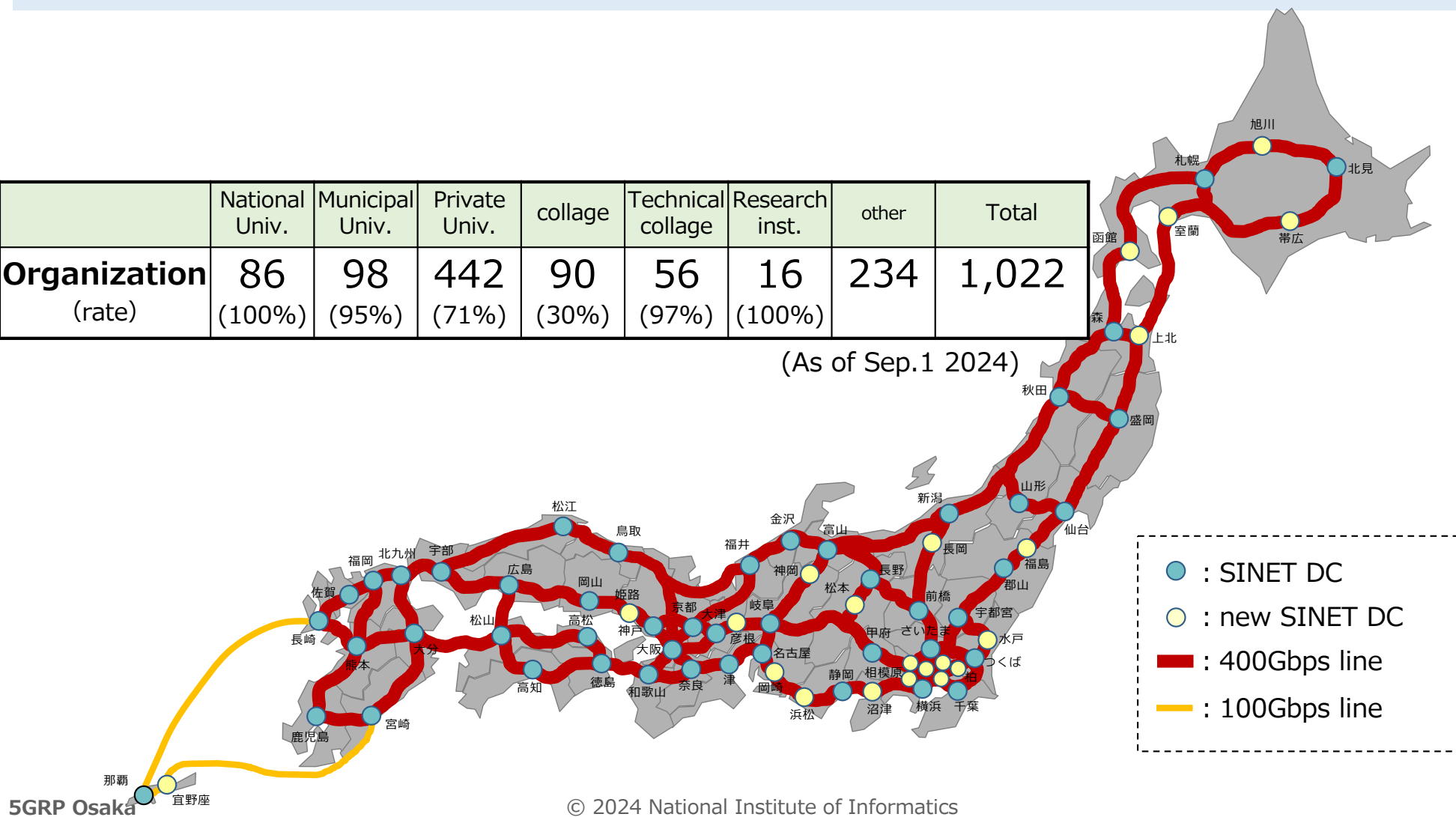


Domestic network

- SINET6 places 70 SINET nodes nationwide and connects them over 400-Gigabit Ethernet (400GE)-based lines, excluding one prefecture (Okinawa).
- 2 years have passed, and now stable operation can be achieved.

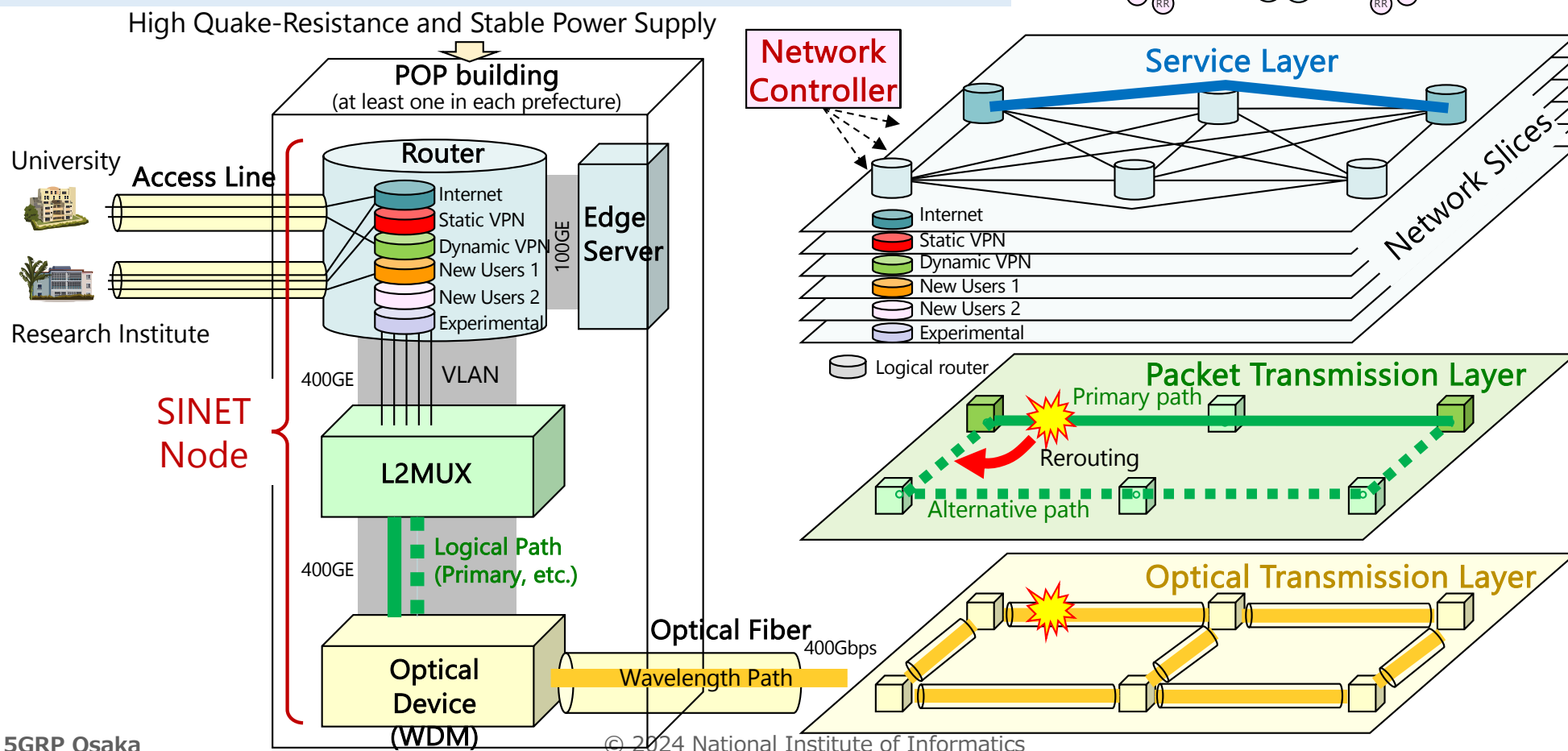
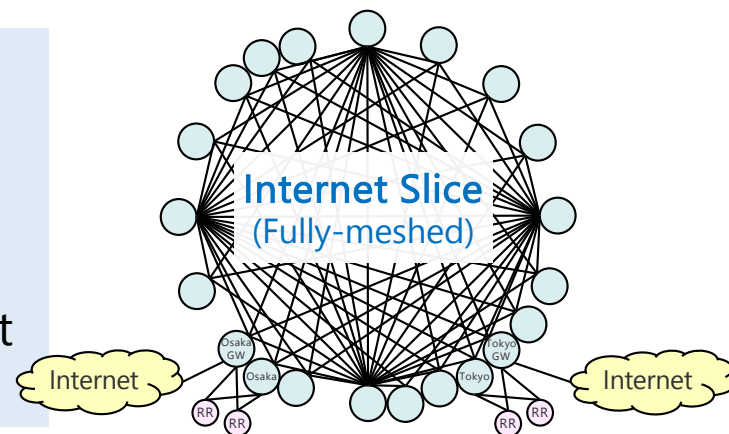
	National Univ.	Municipal Univ.	Private Univ.	collage	Technical collage	Research inst.	other	Total
Organization (rate)	86 (100%)	98 (95%)	442 (71%)	90 (30%)	56 (97%)	16 (100%)	234	1,022

(As of Sep.1 2024)



Network Architecture of SINET6

- Each pair of SINET routers is directly connected by logical paths for high-performance and high-reliability.
- Rerouting functions are implemented in both packet transmission and service layers for high reliability.
- Network slices of VPNs are logically separated from that of the Internet for high security.



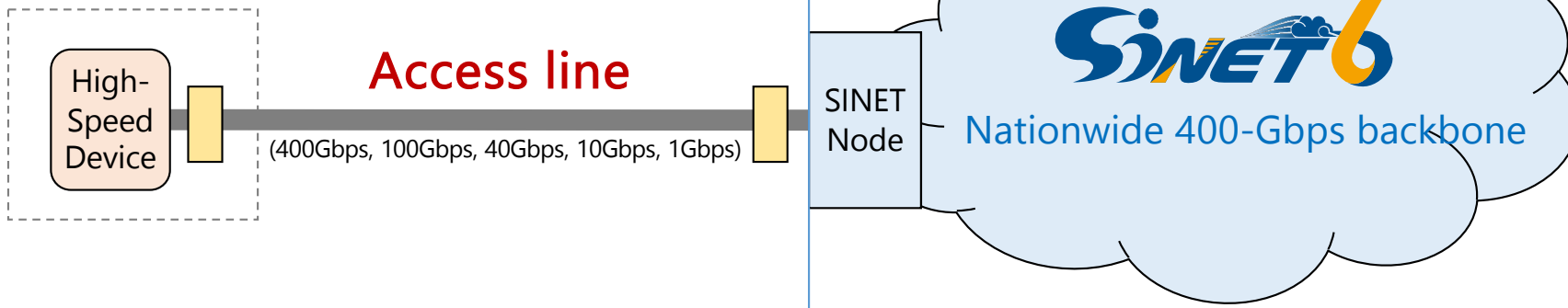
Access Lines of User Organizations

- The average speed of access lines became 2.8 times compared with that of SINET5.
- Supercomputer FUGAKU are connected to SINET6 by three 400GE lines. Experimental devices and medical universities located in rural areas also increased the line bandwidths.

The number of access lines

Access line speed SINET version	400Gbps	100Gbps	40Gbps	10Gbps	≤1Gbps	Average Speed
SINET6 (As of Sep.1 2024)	16	94	24	959	613	15.8Gbps
SINET5 (As of Apr. 2016)	0	18	7	218	700	5.3Gbps

University,
research Institution,
etc.



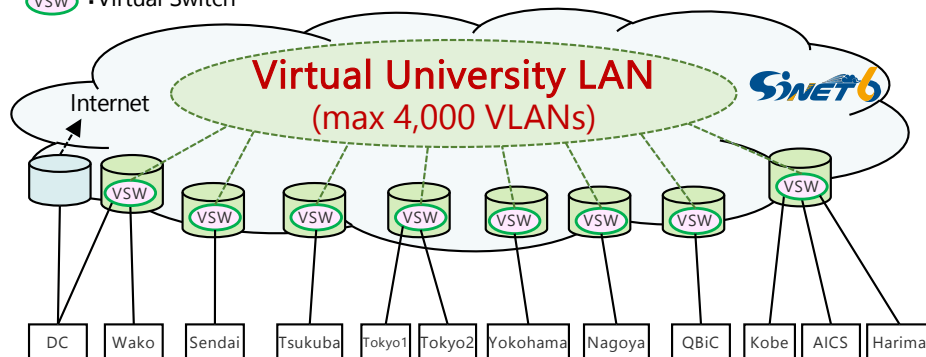
Usage in Campus Infra Evolution

Virtual University LAN

VLANs among multiple campuses are automatically setup by Institutes' LAN operators not SINET operators.

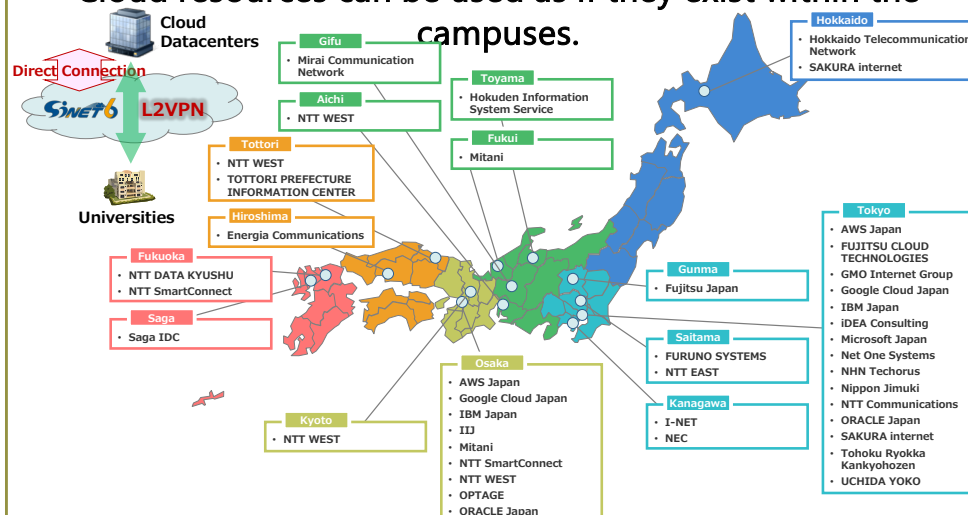
Riken, JAXA, AIST, mammoth univs, etc.

(VSW) :Virtual Switch



Directly-Connected Clouds

Cloud resources can be used as if they exist within the campuses.

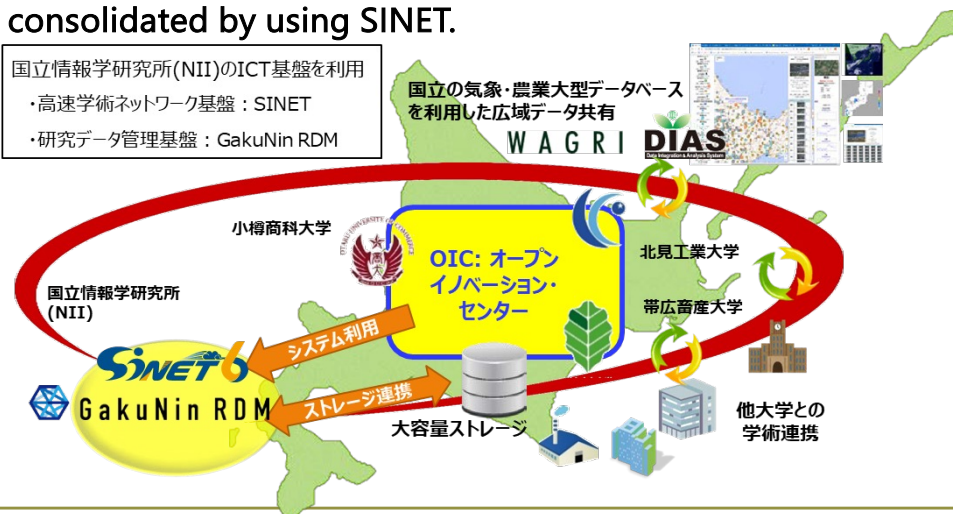


Consolidation of Universities

Three national universities in Hokkaido have been consolidated by using SINET.

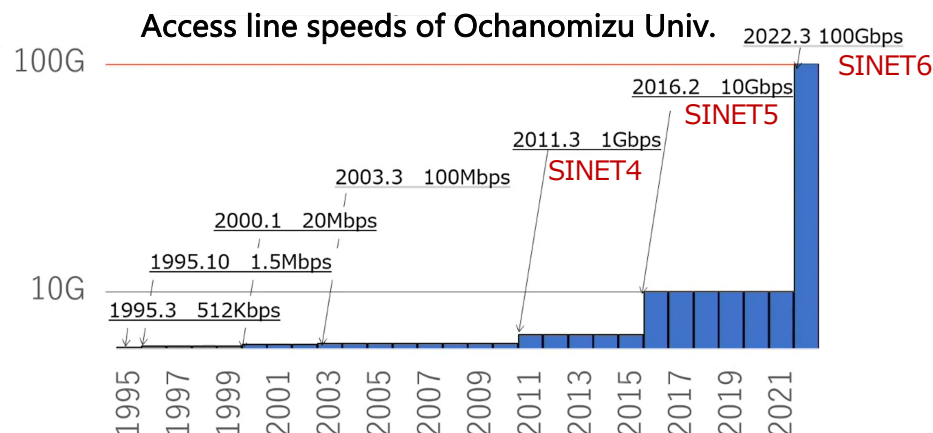
国立情報学研究所(NII)のICT基盤を利用

- ・高速学術ネットワーク基盤: SINET
- ・研究データ管理基盤: GakuNin RDM



High-Speed Access Lines

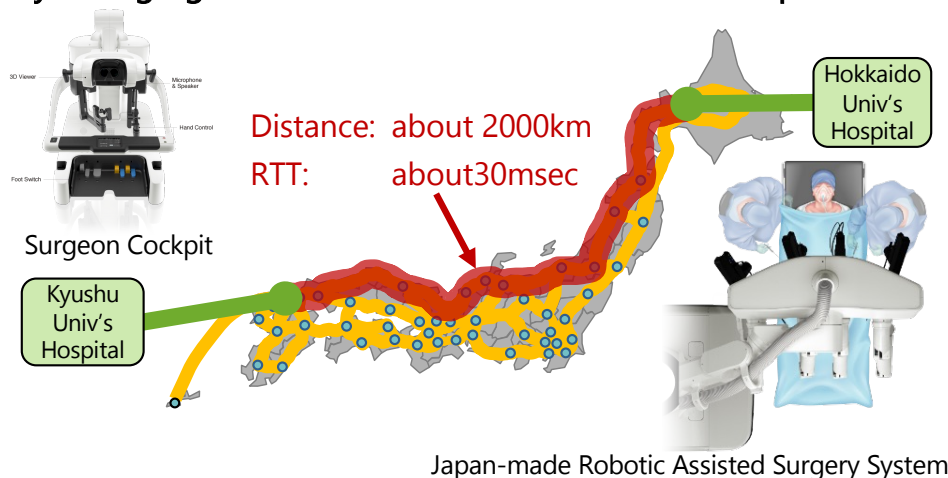
Access lines of user organizations have been largely upgraded along with SINET upgrade.



Examples of Network services

L2 on demand

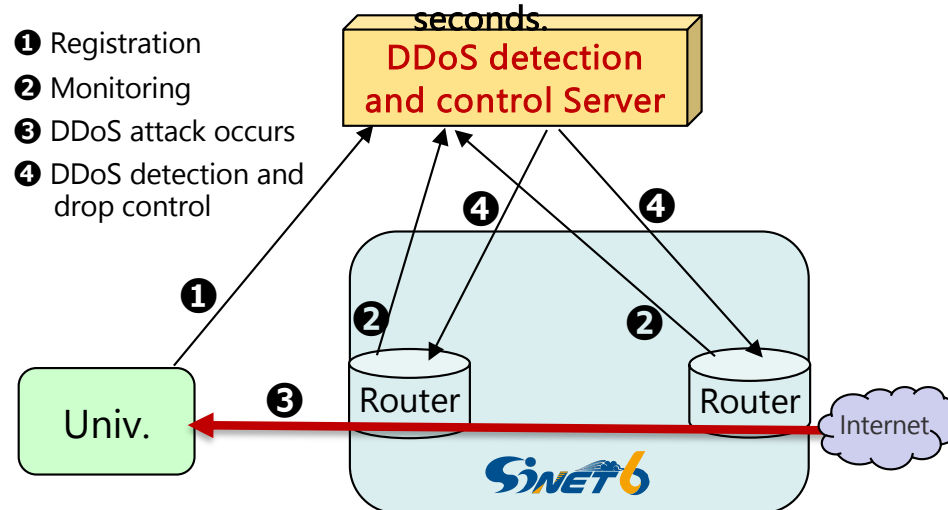
Various conditions for a surgical robot system were verified by changing the bandwidth between the two hospitals.



New DDoS Mitigation

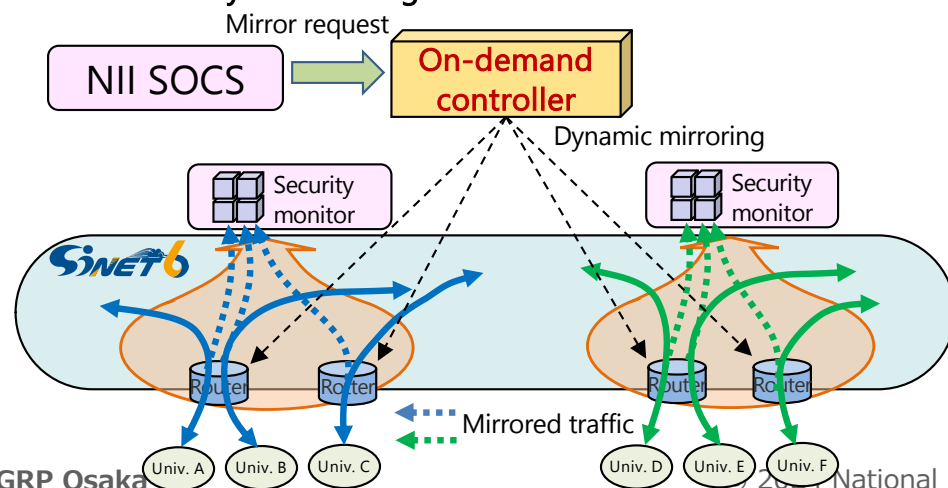
DDoS detection and discard are performed within 10 seconds.

- ① Registration
- ② Monitoring
- ③ DDoS attack occurs
- ④ DDoS detection and drop control



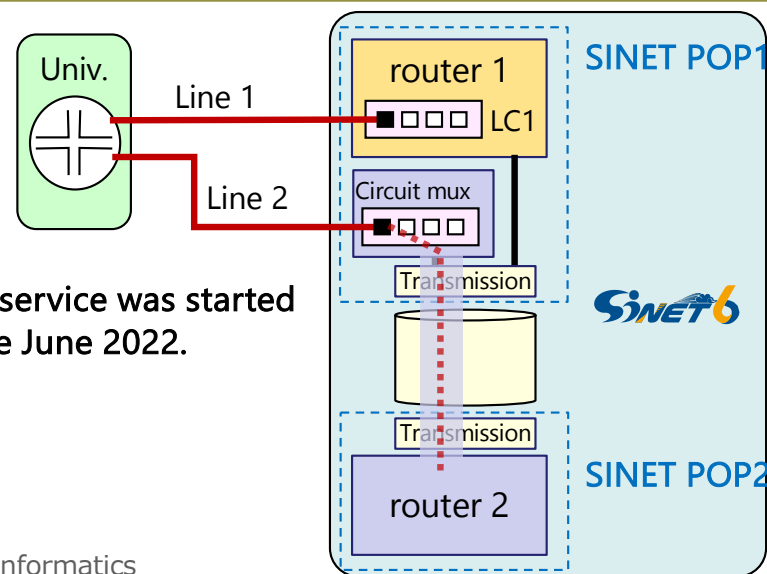
Mirror on demand

Target traffic is dynamically copied and forwarded to security hub for security monitoring.



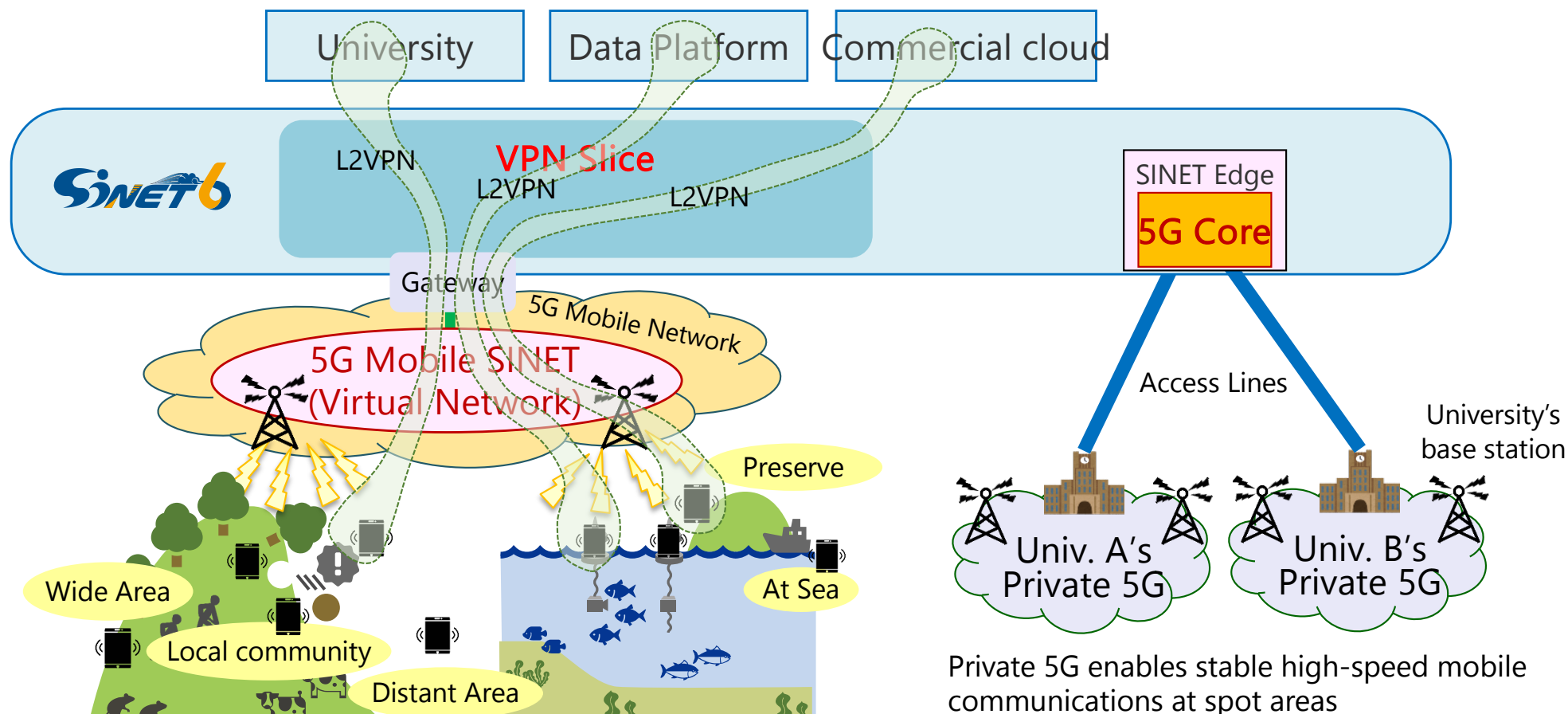
Redundant Connection

this service was started since June 2022.



5G Mobile SINET + Private 5G

- New mobile SINET introduces 5G technology in order to attain high-speed and low-latency.
- SINET6 will also support private 5G by implementing 5G core functions in SINET edges.



Mobile SINET covers a wide range of research activity areas with secure communication environment

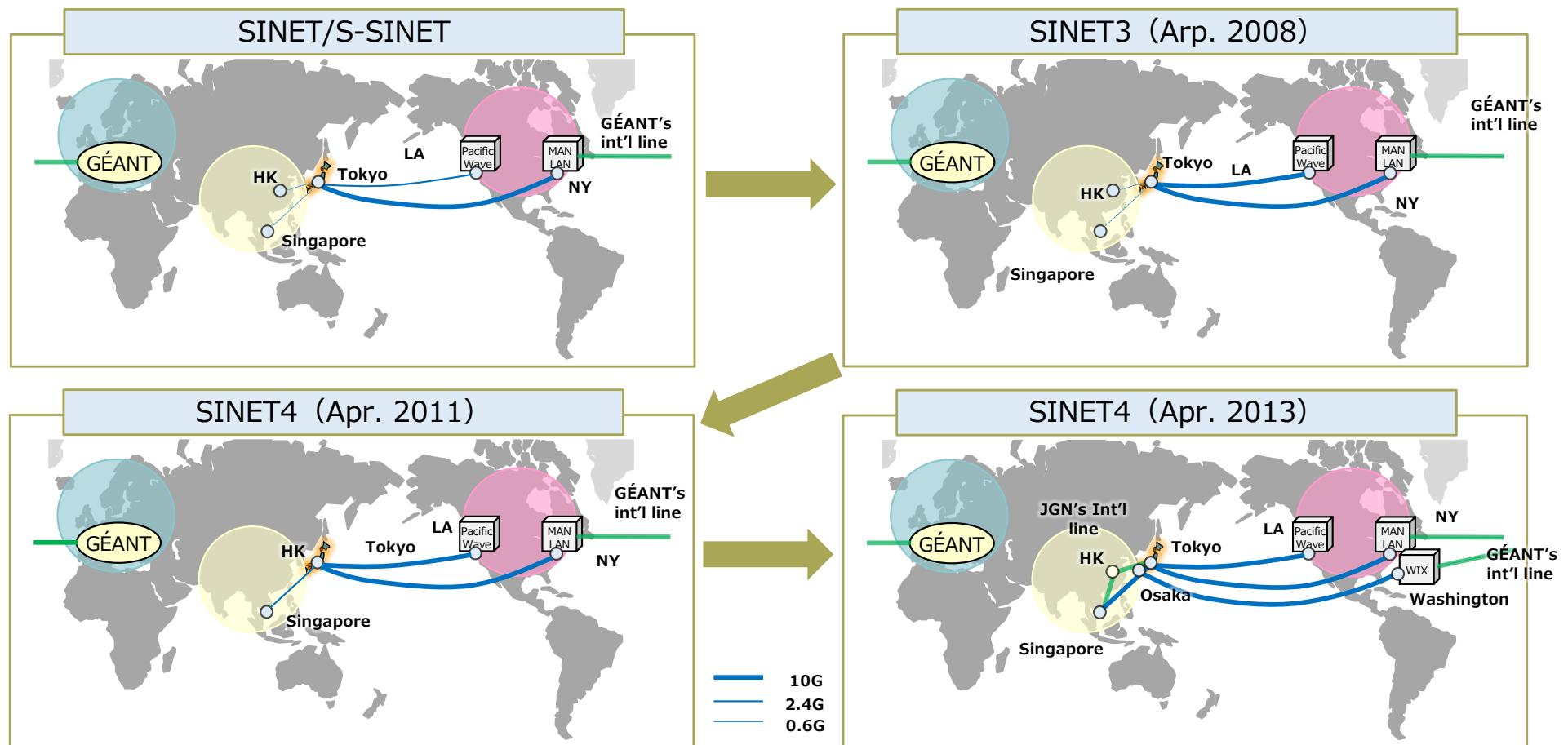
Mobile SINET **×** 5G

High Speed	→ Quick Data Collection
Low Latency	→ Real-time Control
High Density	→ Larger Number of Sensors
Private 5G	→ Stable Performance

History of SINET international lines

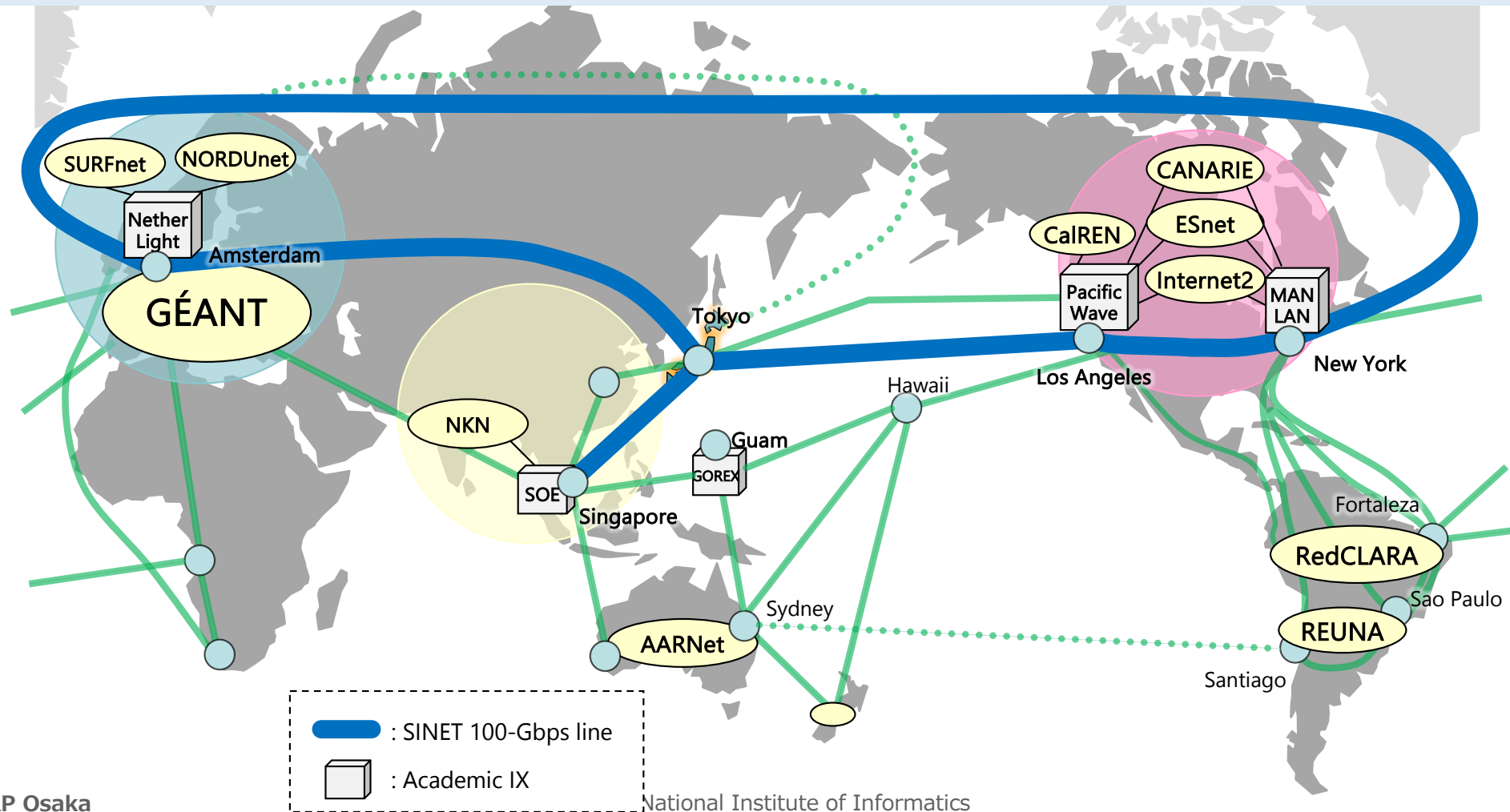
(SINET~SINET4)

- Before SINET5, traffic to EU was delivered via GEANT's international line, which was connected to SINET at USA.



SINET5 international lines (- 2022.3)

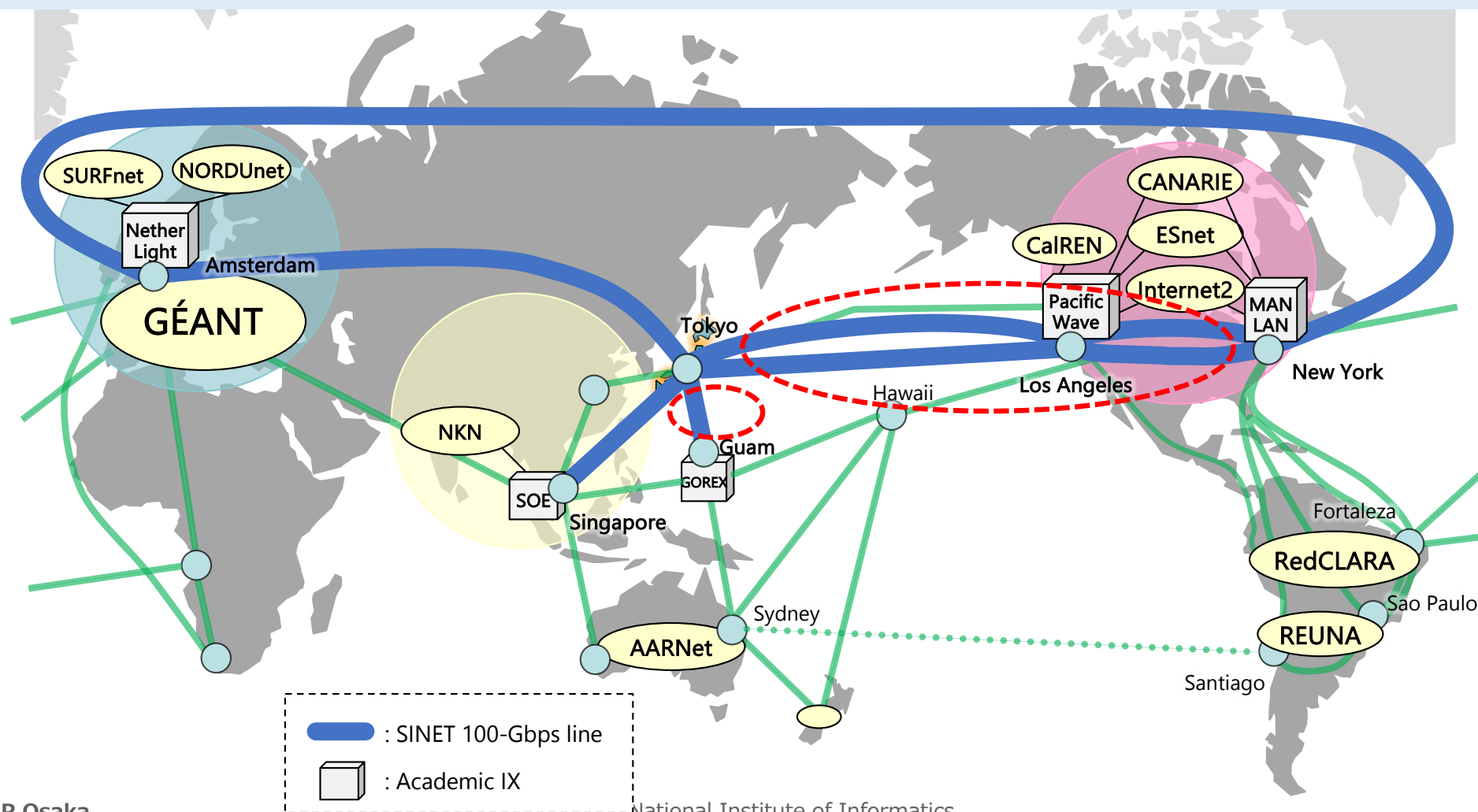
- SINET5 increased international line bandwidths to USA, Europe and Asia.
 - USA: Los Angels and New York, 100Gbps
 - Europe : Amsterdam, 100Gbps
 - Asia: Singapore, 100Gbps
- Ring structure over the world



SINET6: Strengthened Global Connectivity #1

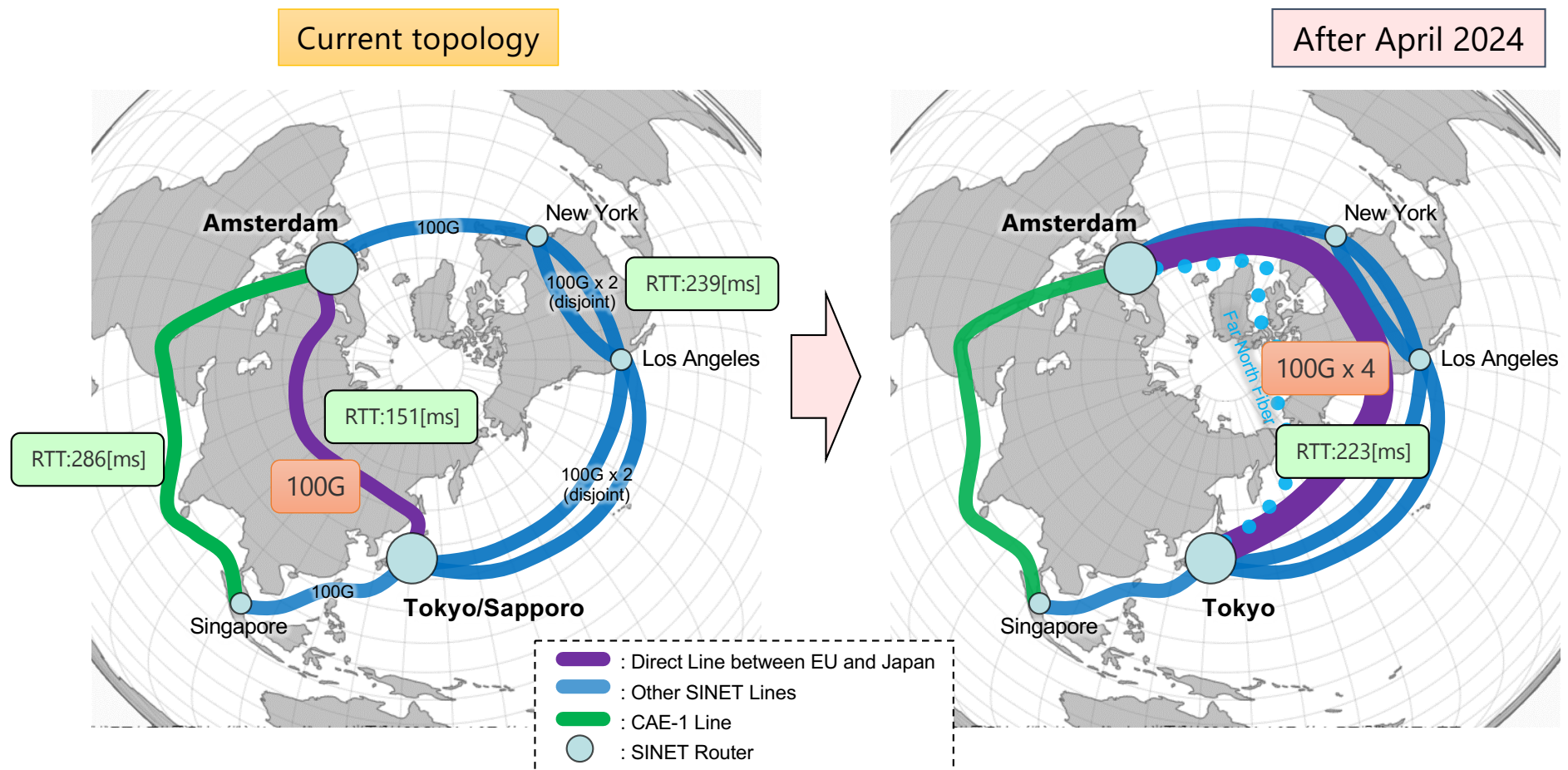
April 2022 – March 2024

- SINET6 increased international line bandwidths to USA, Europe and Asia.
 - USA: Los Angels and New York, 100Gbps x 2 (in 2022)
 - Europe : Amsterdam, 200Gbps or more (in 2024)
 - Asia: Singapore and Guam, each 100Gbps (in 2022)



New Connectivity between EU and Japan

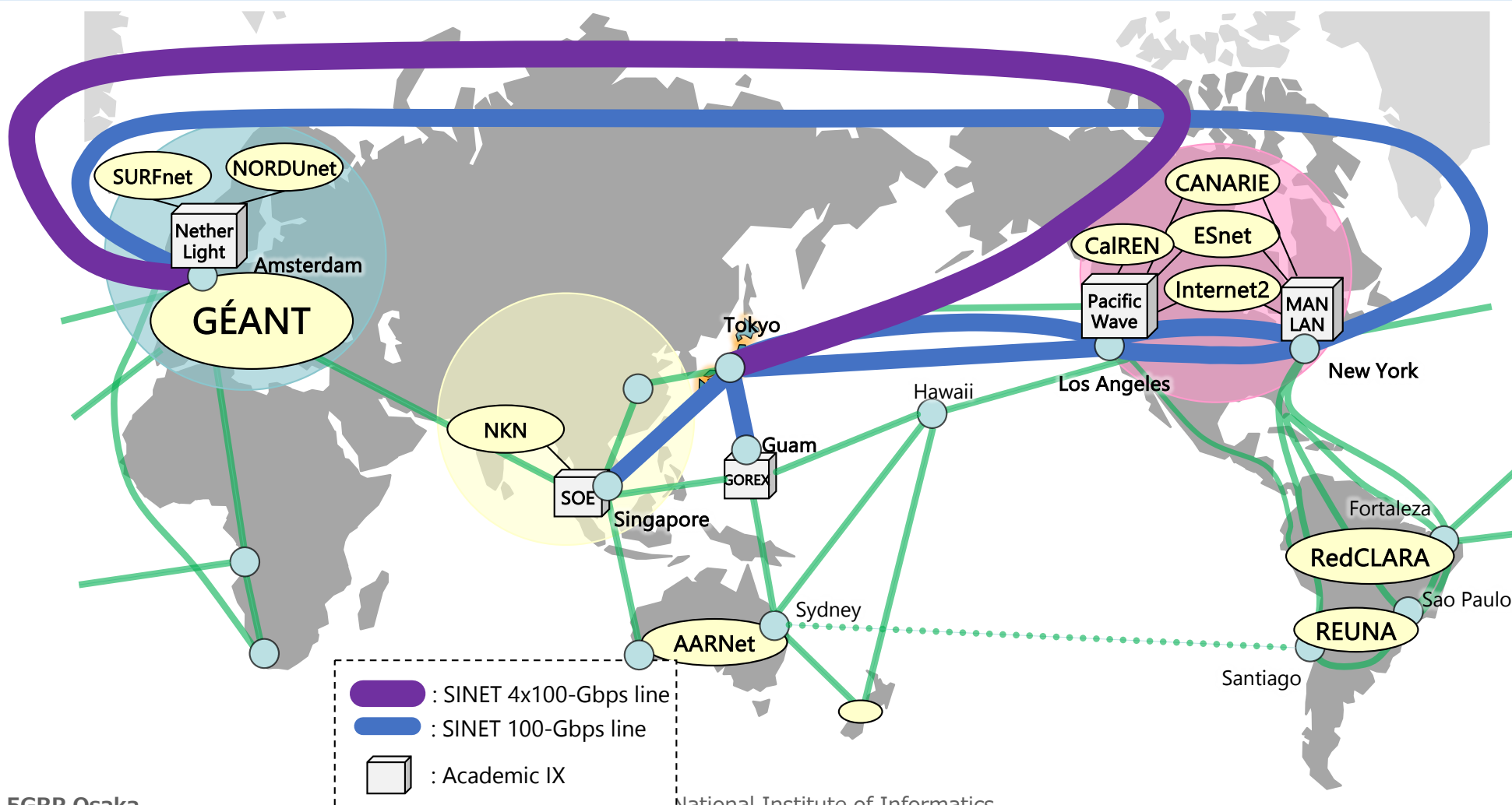
- SINET will keep a direct line between Tokyo and Amsterdam via a different route and increase the bandwidth from 100Gbps to **4 x 100Gbps** in April 2024.



SINET6: Strengthened Global Connectivity #2

April 2024 – Mar 2025

- SINET6 increased international line bandwidths to USA, Europe and Asia.
 - USA: Los Angeles and New York, 100Gbps x 2 (in 2022)
 - Europe: Amsterdam, 4 x 100Gbps (in 2024)
 - Asia: Singapore and Guam, each 100Gbps (in 2022)



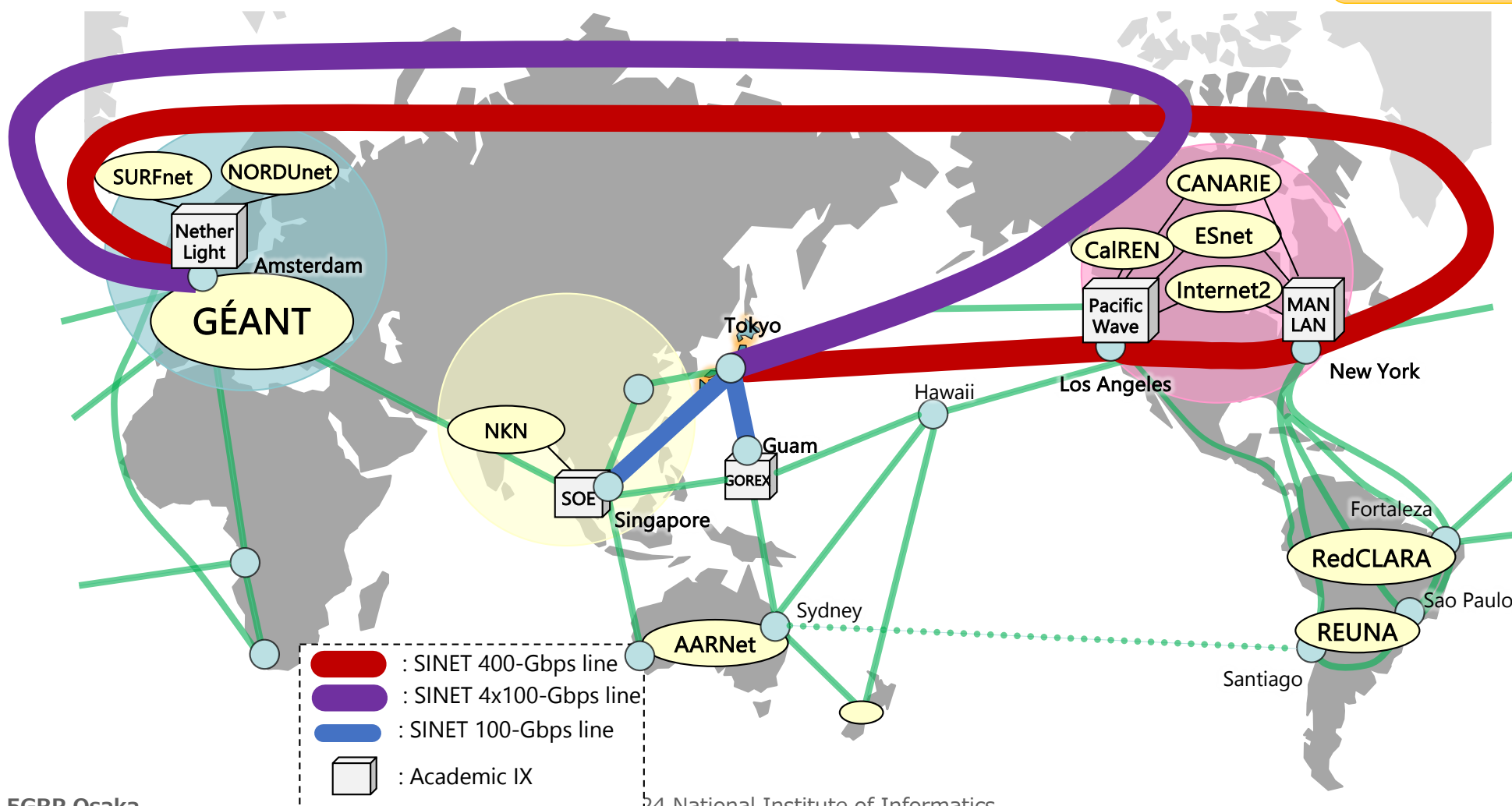
SINET6: Strengthened Global Connectivity #3

April 2025 –

- SINET6 increased international line bandwidths to USA, Europe and Asia.

- **USA:** Los Angeles and New York, 400Gbps (in 2025)
- Europe : Amsterdam, 4 x 100Gbps (in 2024)
- Asia: Singapore and Guam, each 100Gbps (in 2022)

Under preparation



Collaborations with Other NRENs

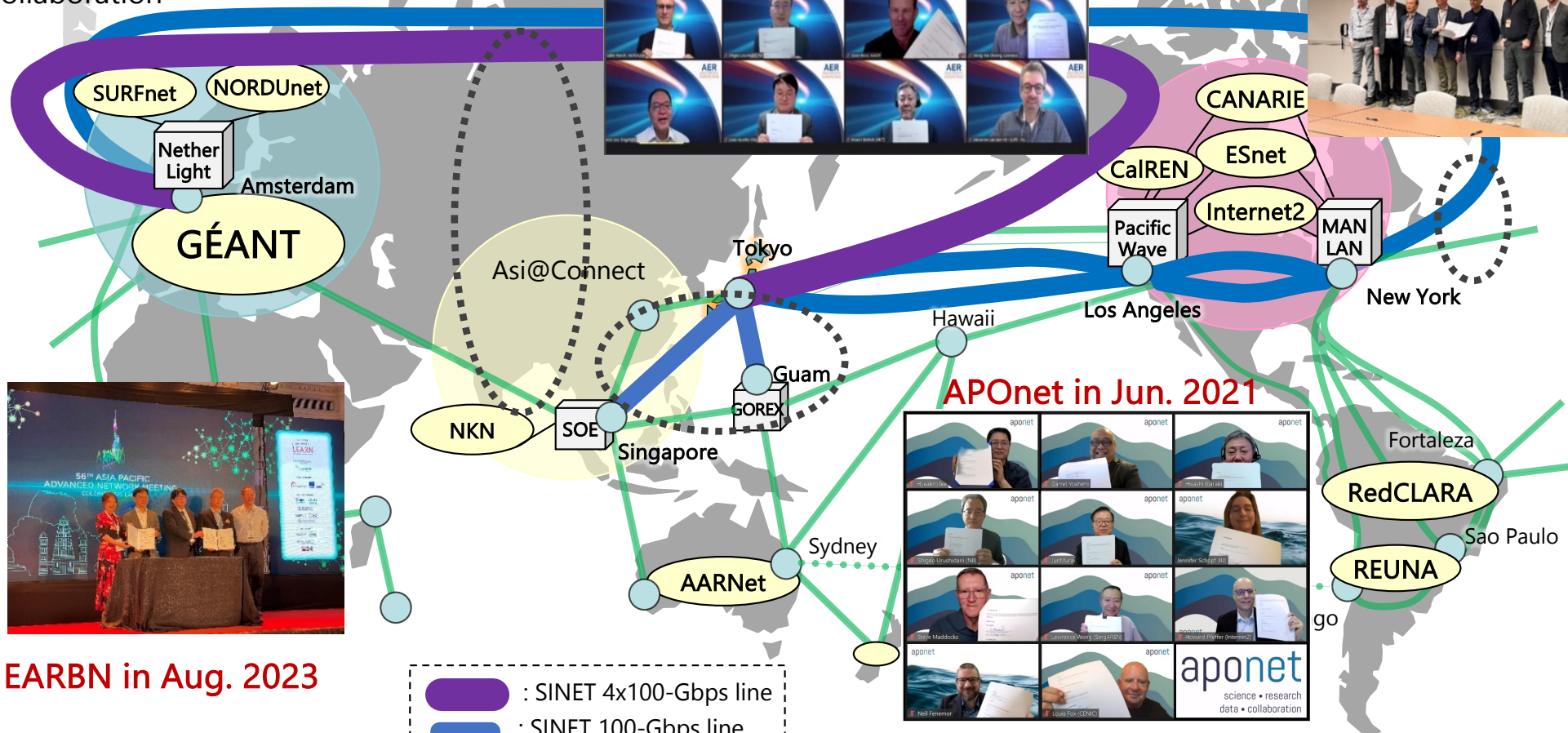
- SINET establishes resilient international communication environment in collaboration with other NRENs.

AER: Asia-pacific Europe Ring
 ANA: Advanced North Atlantic
 APOnet: Asia Pacific Oceania Network
 EARN: East Asia Resilient Backbone Network
 Collaboration

AER in Mar. 2022



ANA in Dec. 2022



EARBN in Aug. 2023

APOnet in Jun. 2021

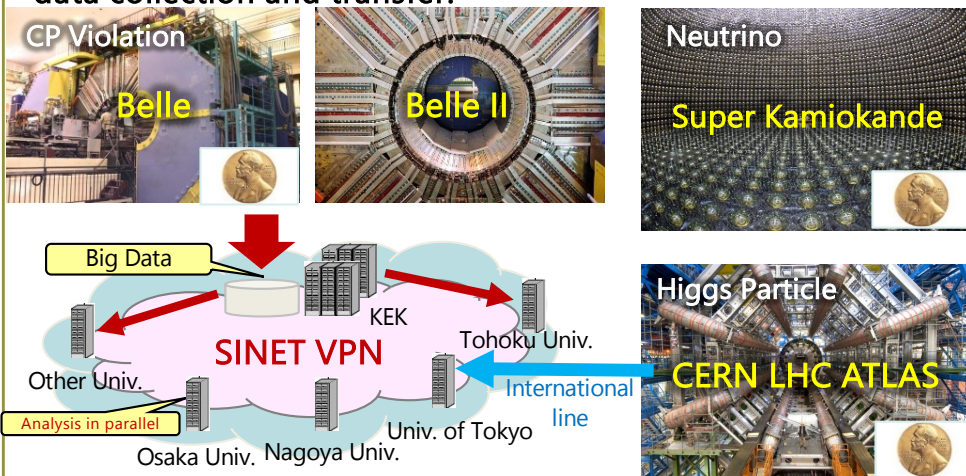


- : SINET 4x100-Gbps line
- : SINET 100-Gbps line
- : Academic IX

Usage in Cutting-edge Research

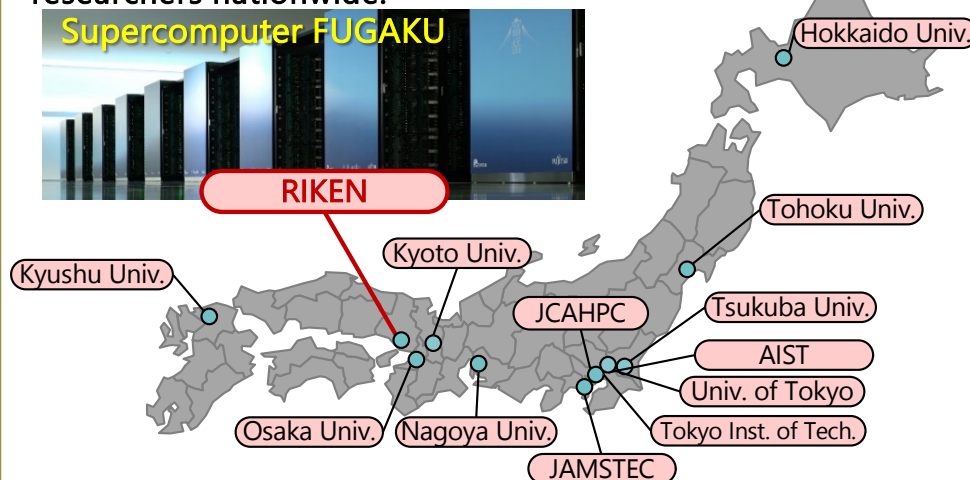
High-Energy Physics

SINET contributed to winning the Nobel Prizes through big data collection and transfer.



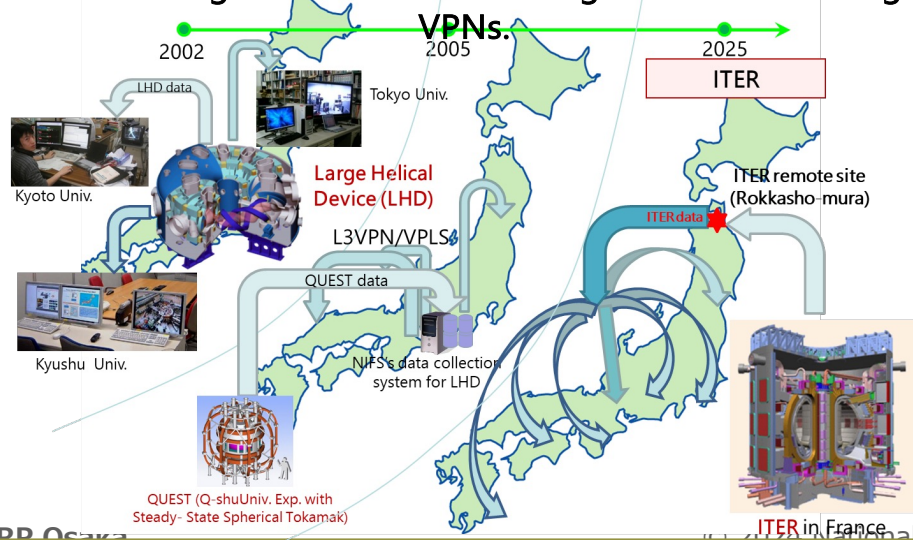
High-Performance Computing

SINET contributes to sharing supercomputers among researchers nationwide.



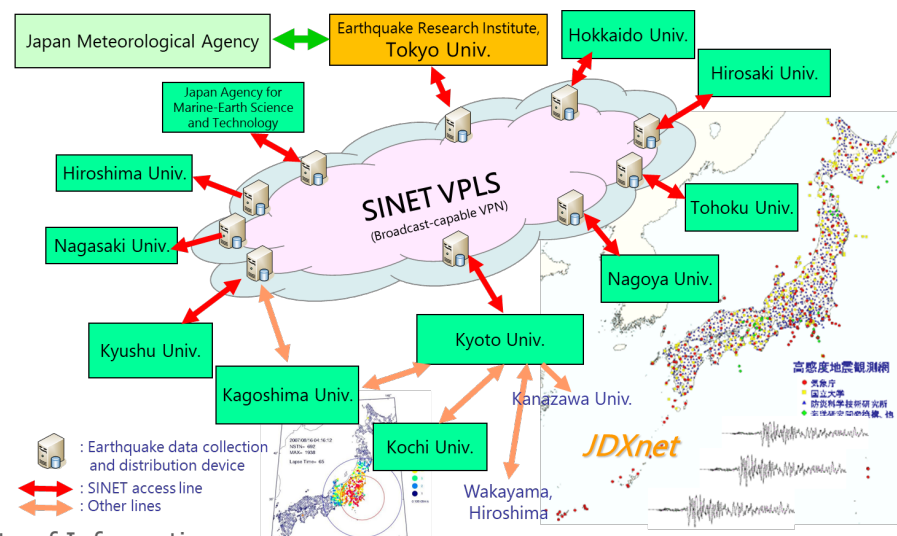
Nuclear Fusion Science

Generated big data are shared among researchers through



Seismology

Monitored data are broadcast to all the devices nationwide.



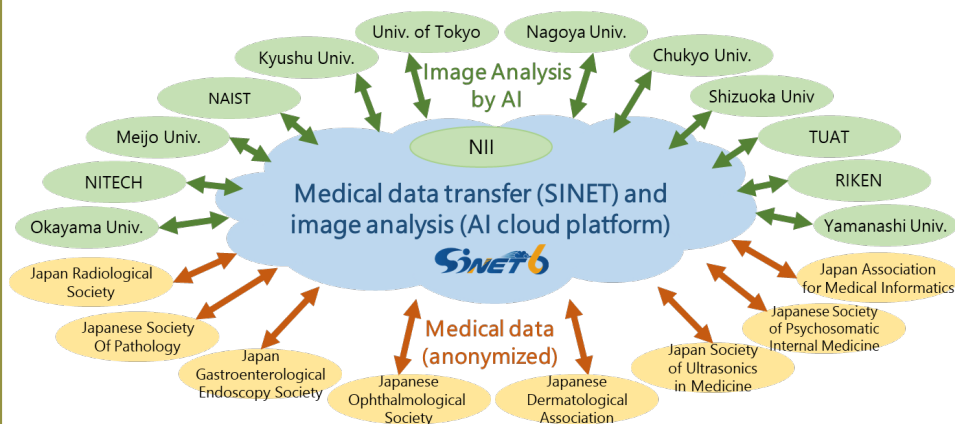
<https://twiki.cern.ch/twiki/bin/view/LHCONE/LhcOneMaps>

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Usage in Medical Research

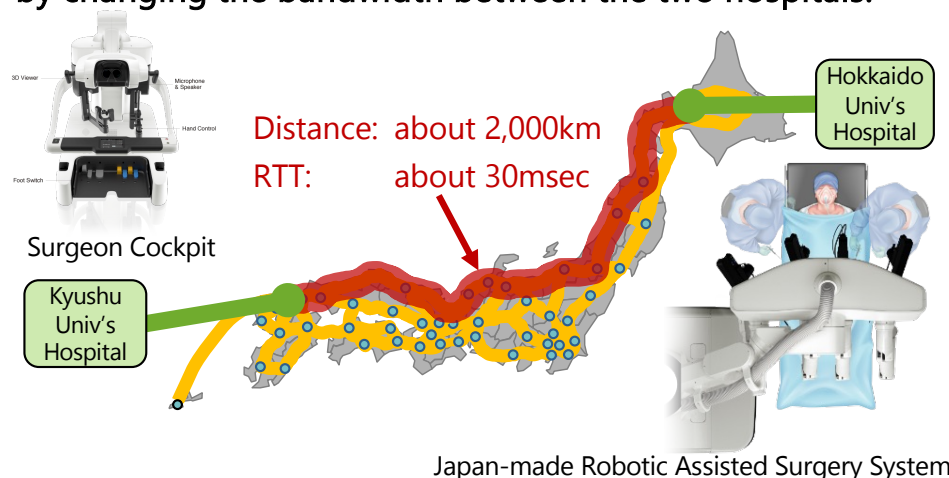
Medical Image Data Analysis

Medical data are analyzed by cooperation between medical societies and AI analysis researchers.



Remote Surgery

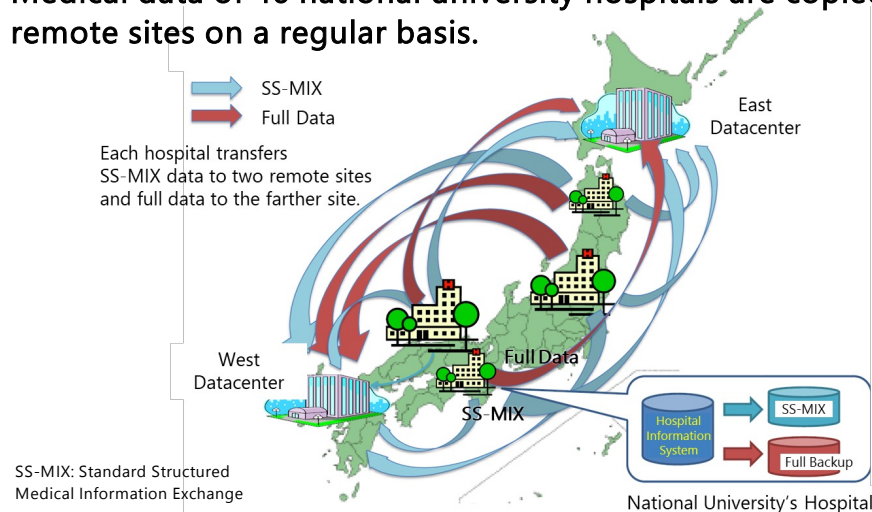
Various conditions for a surgical robot system were verified by changing the bandwidth between the two hospitals.



Japan-made Robotic Assisted Surgery System

Medical Data Backup

Medical data of 46 national university hospitals are copied to remote sites on a regular basis.



Animal Telemedicine

Moving animal telemedicine facility is monitored in real time.



Co-design and Co-creation



Thank you for your cooperation!