

R&D Testbed for Networking, Computing and Applications

NetCentric 2020

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JGN



RISE



Contents of This Talk

- NICT's testbed
- Experimental applications
 - Towards beyond 5G



JGN



RISE



NICT's Integrated Testbed

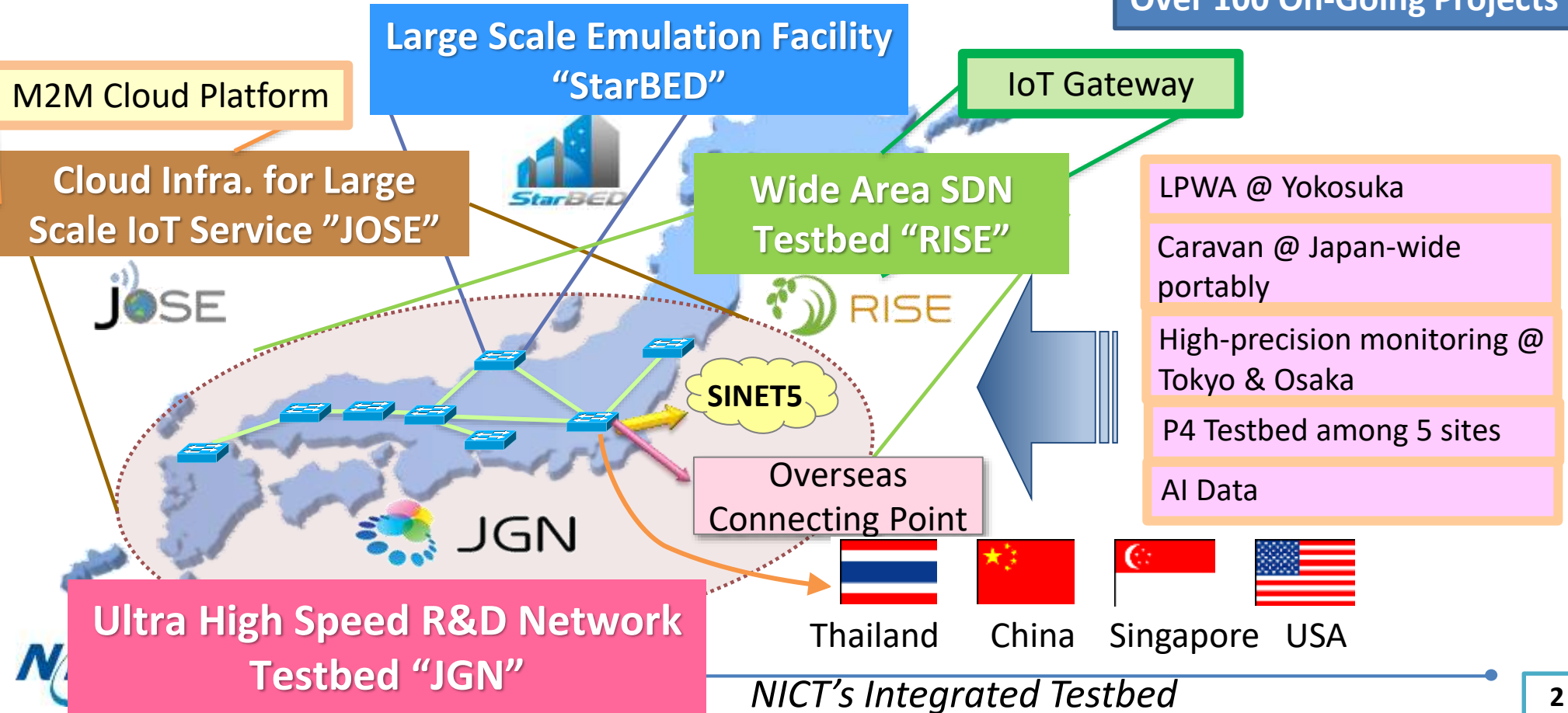
Testbed: Place for field trials of *new* technologies

Contract for R&D purpose

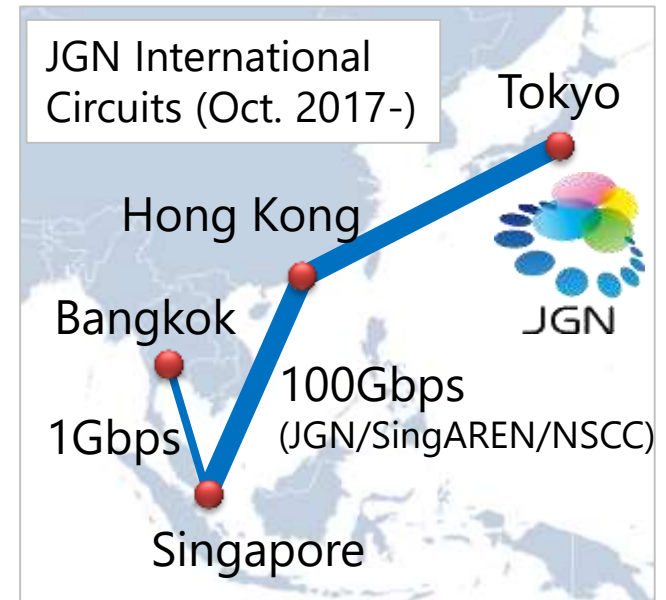
Unit for accelerating technical demo and actual proof in society

- Integrating NICT's testbeds on JGN infrastructure
- Activating testbed use & apps
- Establishing new testbed infrastructure techs
- Cooperation with both outside and inside NICT

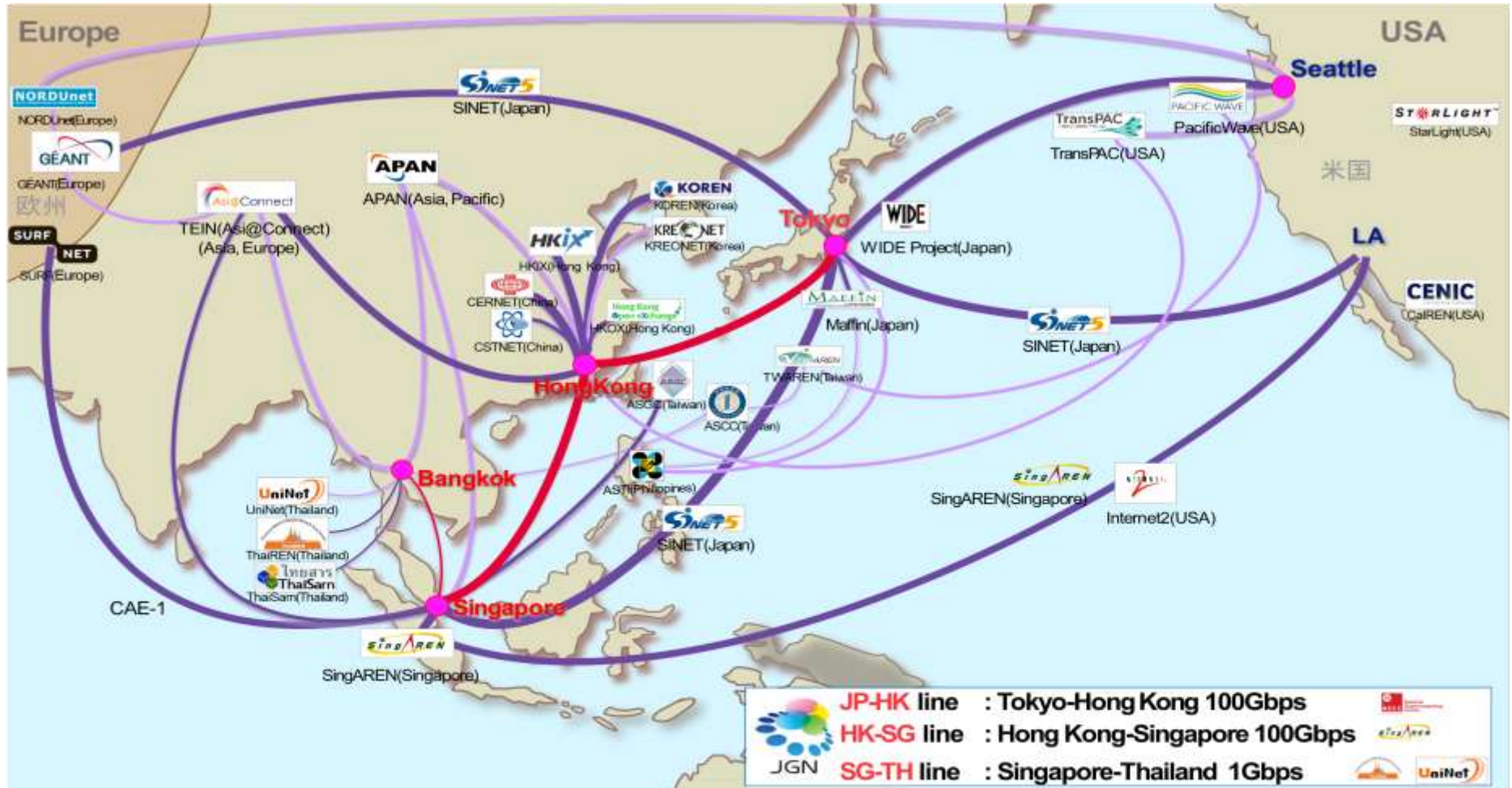
Over 100 On-Going Projects



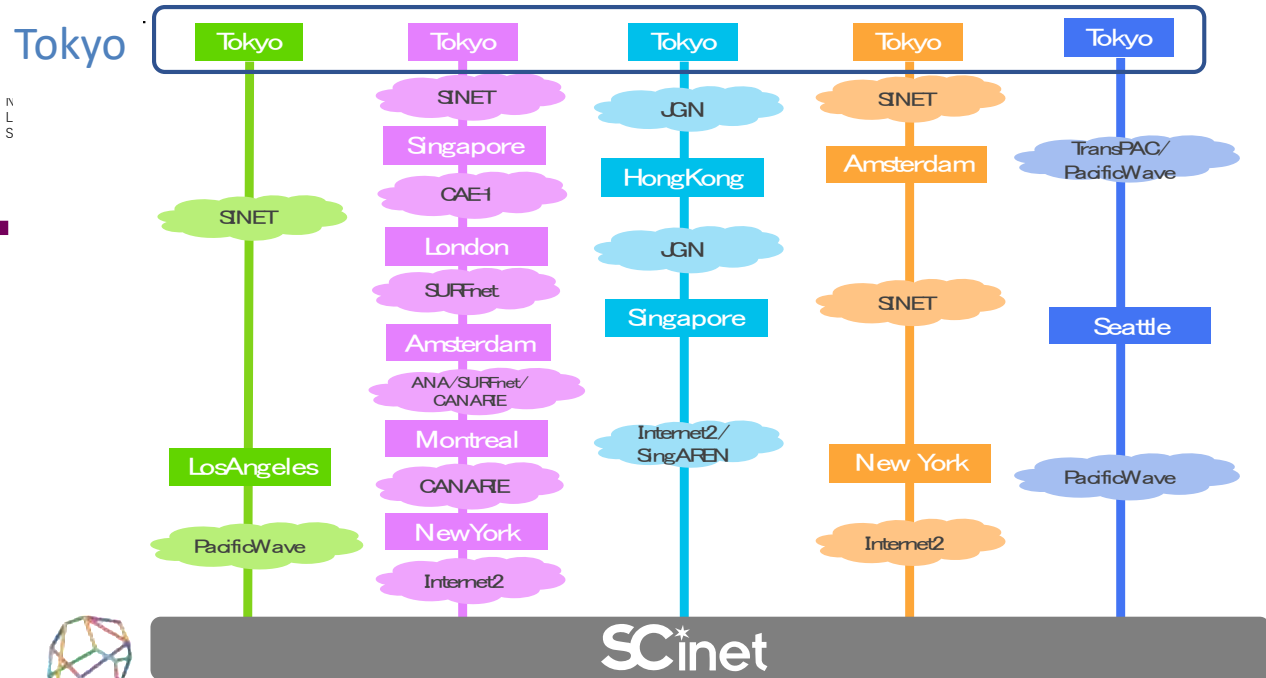
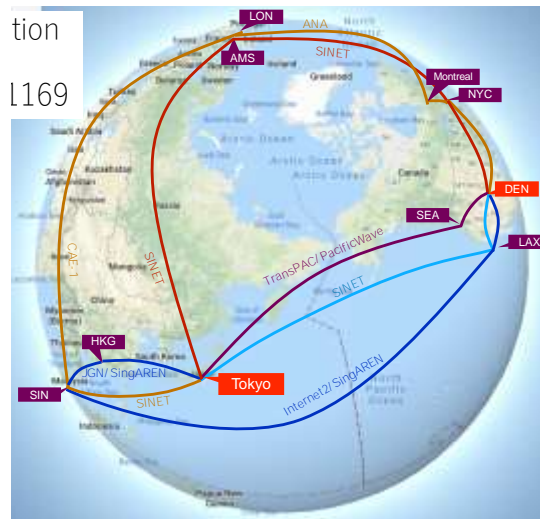
- A **network testbed** operated by NICT
 - JGN started in 1999
- JGN has **international** circuits and **domestic** circuits
 - 100 Gbps: Tokyo-Hong Kong-Singapore (*JGN/SingAREN/NSCC*)
 - 1 Gbps: Singapore-Bangkok
- JGN supports cutting-edge network experiments
 - High-speed app: uncompressed 8K video transmission
 - Time-sensitive app: next-generation ICT-supported surgery, etc.
- We have been collaborating with SINET to extend network reachability in Japan



JGN Global Networks: Connections

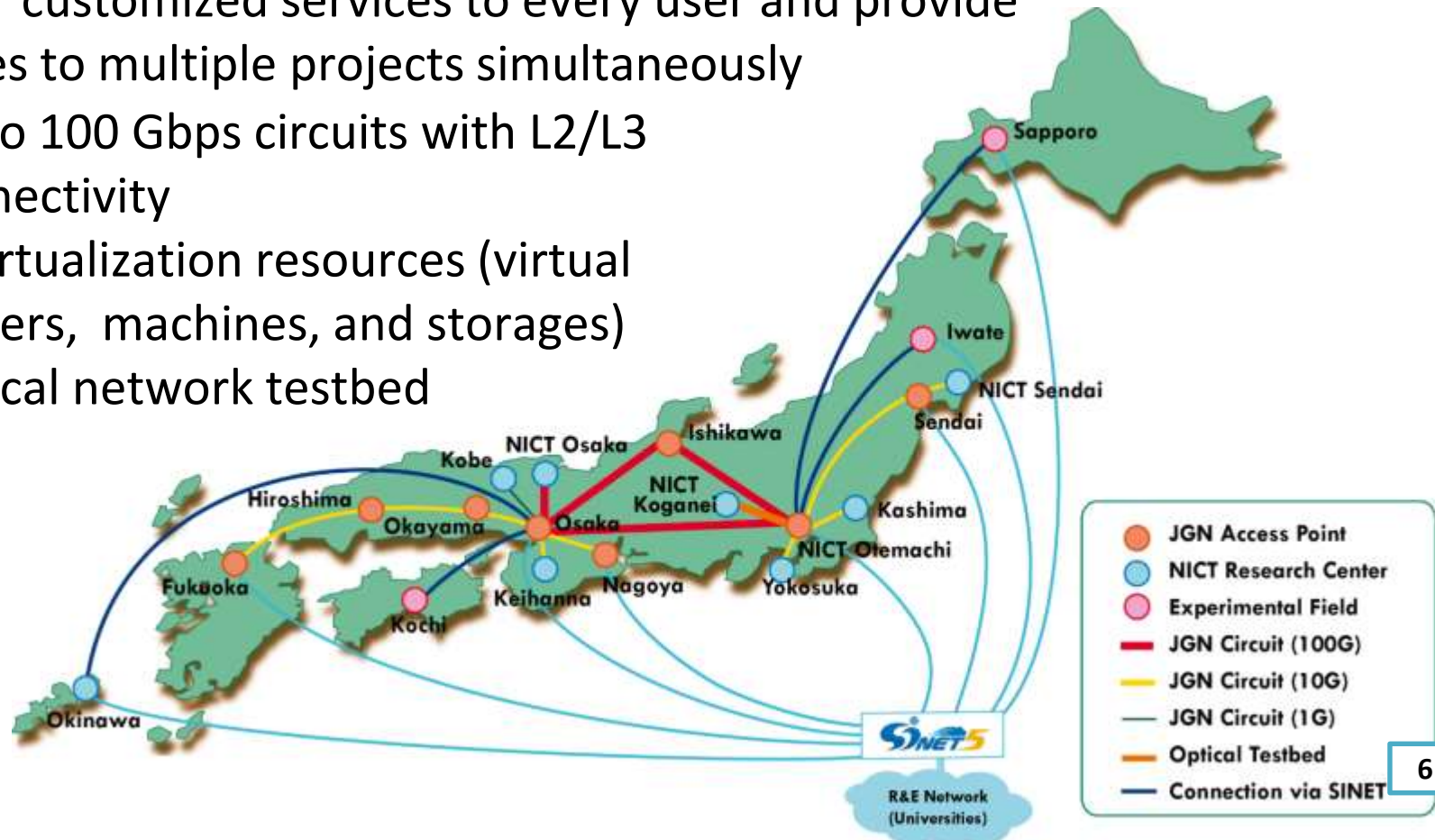


- Succeed Max 416.29 Gbps data transfer with 5 x 100 Gbps routes
- Memory-to-memory, Tokyo to Denver
- NII's file transfer protocol MMCFTP (Massively Multi-Connection File Transfer Protocol)



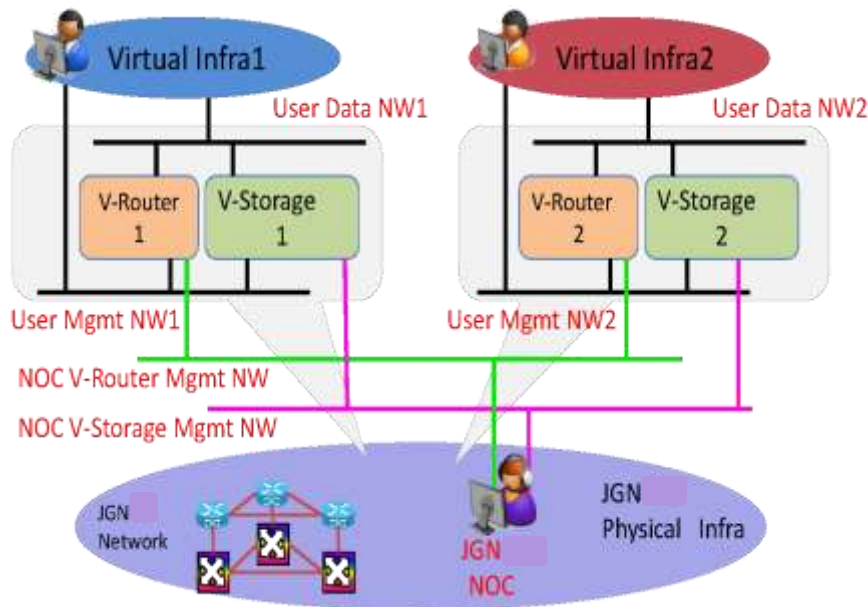
And also to
 Univ. of Tokyo Booth #1949
 Univ. of Texas Dallas Booth #381
 Osaka Univ. Booth #1843

- A high-speed R&D network infrastructure for ICT technology development
- Designed to provide testing environment for researchers of advanced networking technologies
- Deliver customized services to every user and provide services to multiple projects simultaneously
 - Up to 100 Gbps circuits with L2/L3 connectivity
 - IP virtualization resources (virtual routers, machines, and storages)
 - Optical network testbed



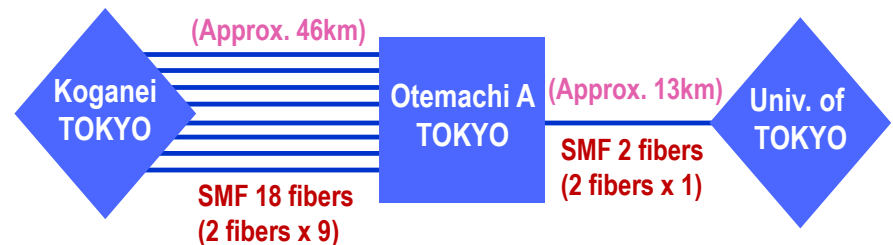
Virtualized IP Services

- VMs, virtual routers, 10Gbps iSCSI (per blade server) capable storages
- Tailor-made network computing environment with computers, storages, and networks for each user slice



Optical Network Testbed (Dark Fibers)

- G.652 single mode fibers (SMFs)
 - 18 SMFs (46km, <17dB@1550nm)
 - 2 SMFs (13km, < 13dB@1550nm)
- Total length: approximate 854 km
- No amplifiers (Installed by users)



NICT Uncompressed 8K Video Transmission at Sapporo Snow Festival (2018)



8K monitor



8K Camera

4K Camera



Sapporo



IP Multicast
IP Multipath

100Gbps * 2

Osaka

Tokyo



4K monitor

100Gbps

Seattle



LA

100Gbps



Singapore



8K Camera



4K monitor

Hong Kong



100Gbps

IP Multicast
IP Multipath



Technical Keypoint of 2018
IP Multicast on Multipaths

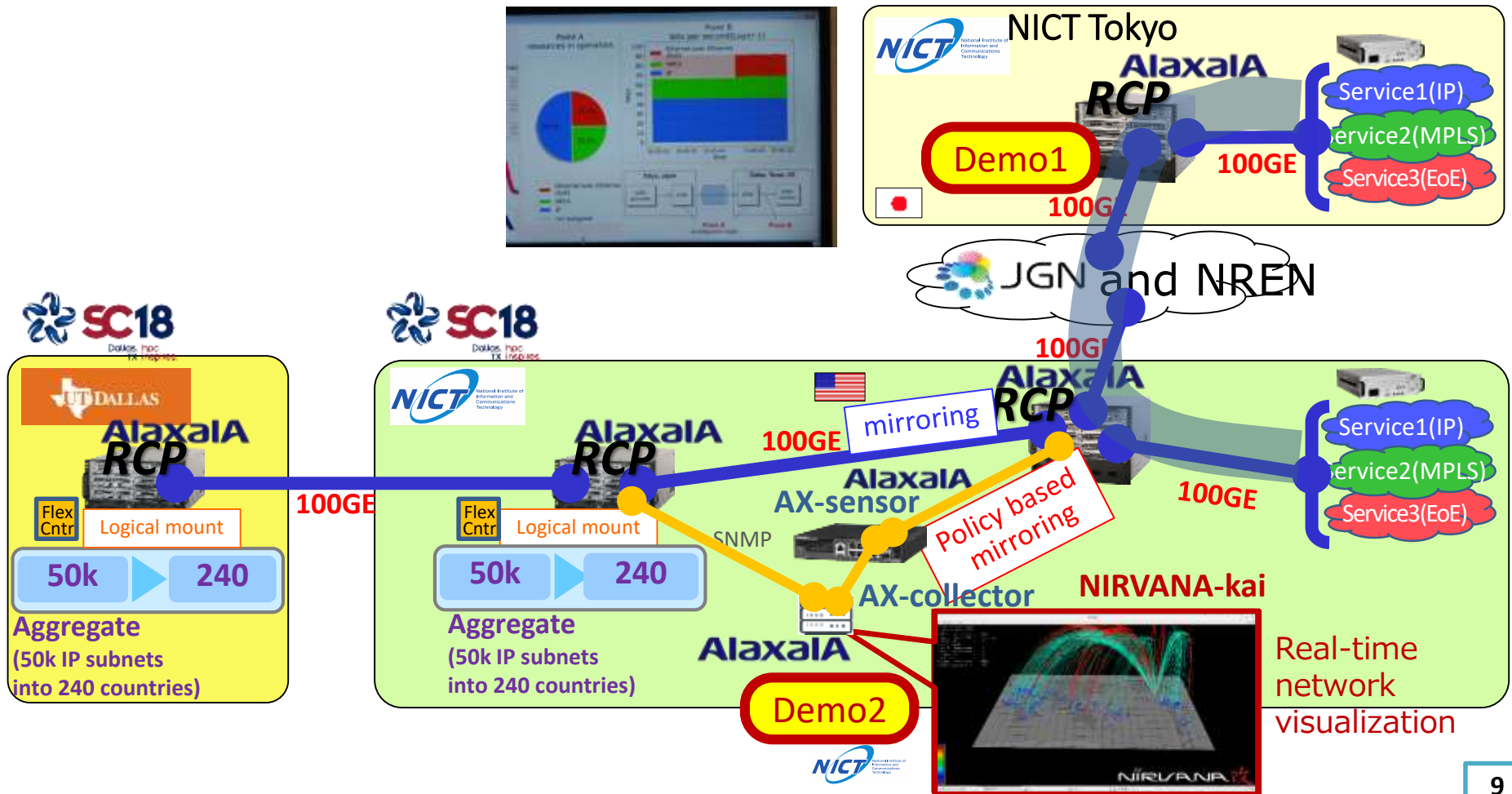
Total **51 organizations** joined the demonstration, including Broadcasting Companies, Telecom Carriers, Network equipment manufactures, AV manufactures, Universities, Research Institute, NRENs...

Field trial place for a number of organizations to bring new services, products, equipment, technologies and so on.

Reconfigurable Processors at SC18 Demo

(Joint work w/ Keio Univ. & Alaxala)

- Reconfigurable Communication Processor (RCP) on 100G
 - Resource changeable Multi-protocol (IP, MPLS and EoE) D-plane
 - Flex Counters (aggregation of IP subnets into countries)

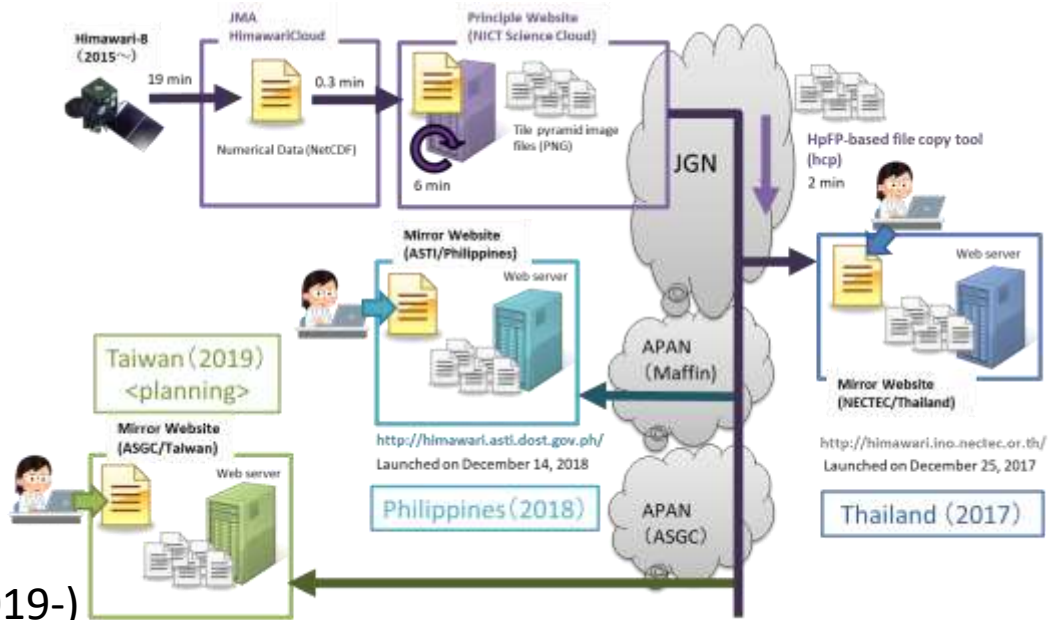
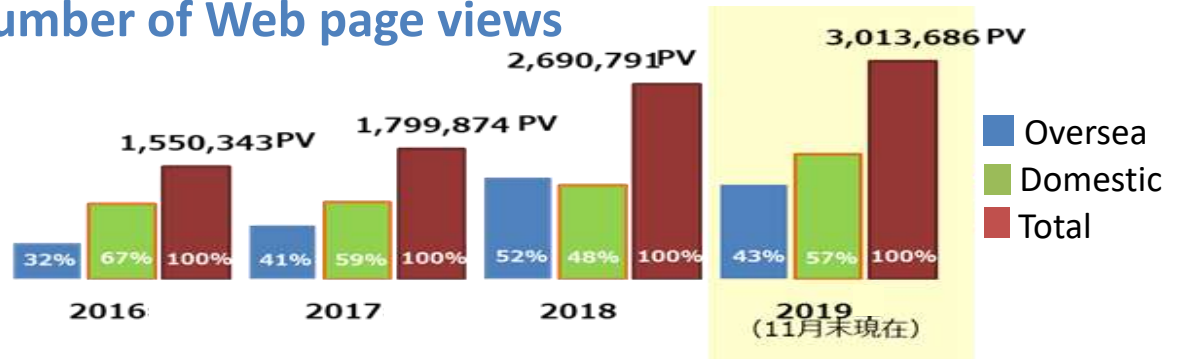


- Realtime cloud visualization (update 10 min each in Asia-Oceania Area)
- Collaborative work between NICT, Japan Meteorological Agency and Chiba Univ.
- For disaster prevention

<https://himawari8.nict.go.jp/en/himawari8-image.htm?>
<https://himawari.asia/>



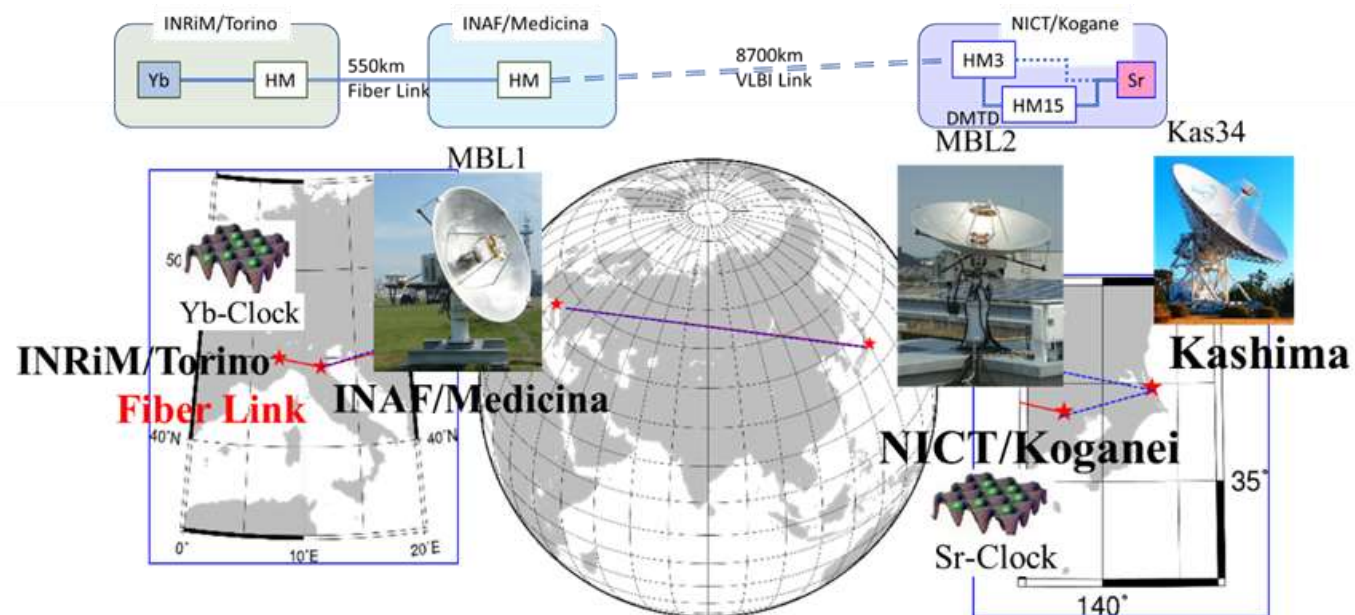
Number of Web page views



Mirrors to Thailand (2017-),
 Philippines (2018-), Taiwan (2019-)

- Intercontinental comparison of lattice clocks
- Developed a broadband VLBI system for intercontinental frequency transfer
 - 4 - 6 Gbps Global Data Transfer, 60 TB for 1 session monitoring
 - 8,700 km baseline
- Transportable radio telescopes could provide global high-precision comparisons of the best atomic clocks

<https://www.nict.go.jp/en/press/2020/10/08-1.html>



NICT's Integrated Testbed

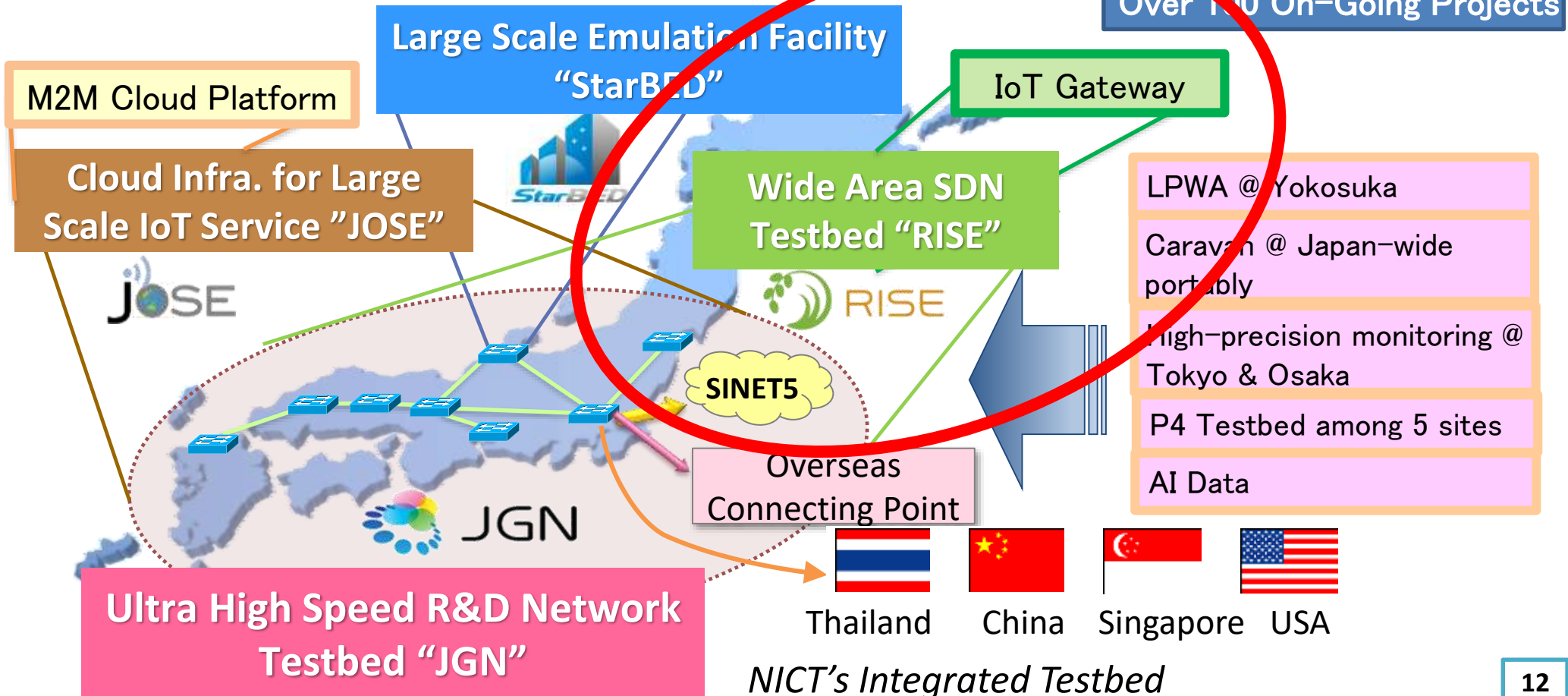
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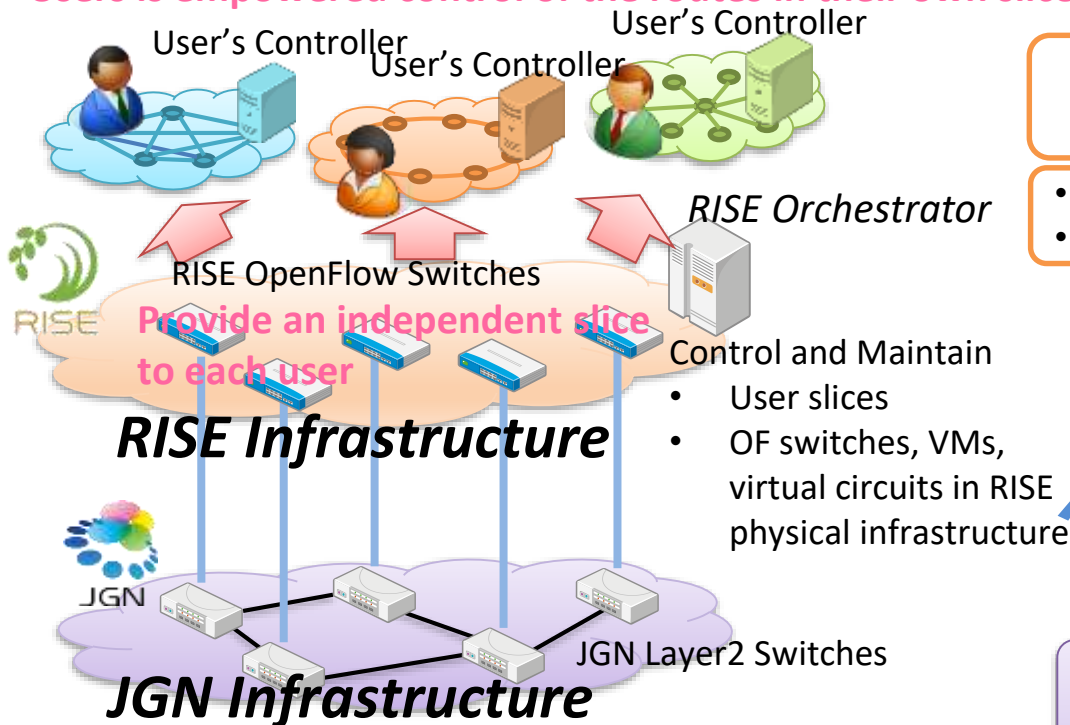




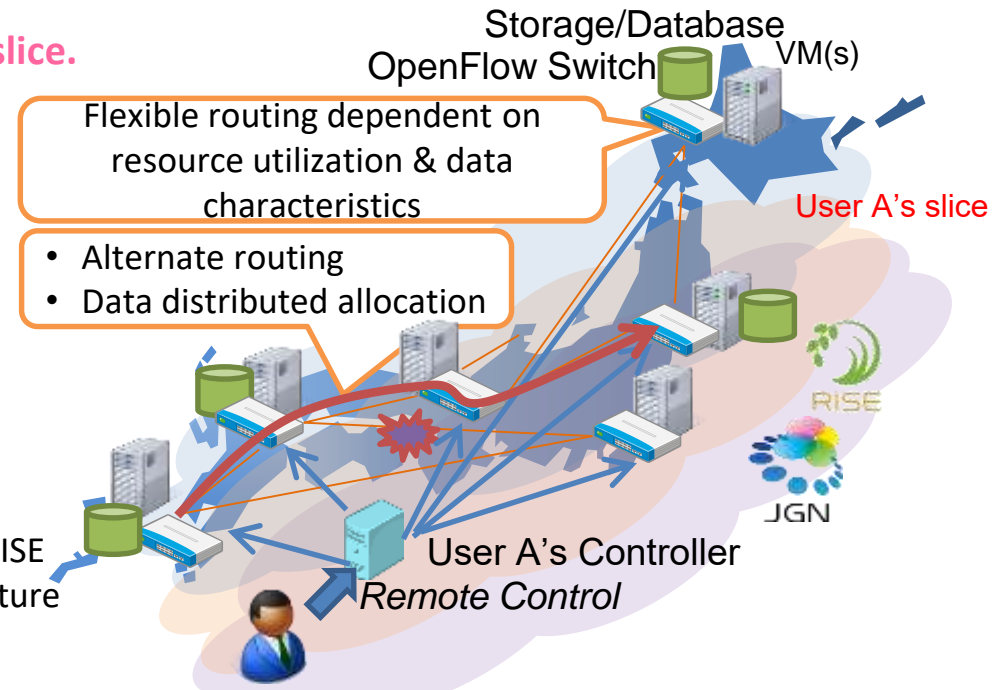
A wide-area SDN testbed supporting deployments of various network functions on the edge infrastructures

- SDN/OpenFlow testbed on JGN
- Provide provides OpenFlow networks and VMs for experiments
- Users can bring and use their own controllers

Users is empowered control of the routes in their own slice.



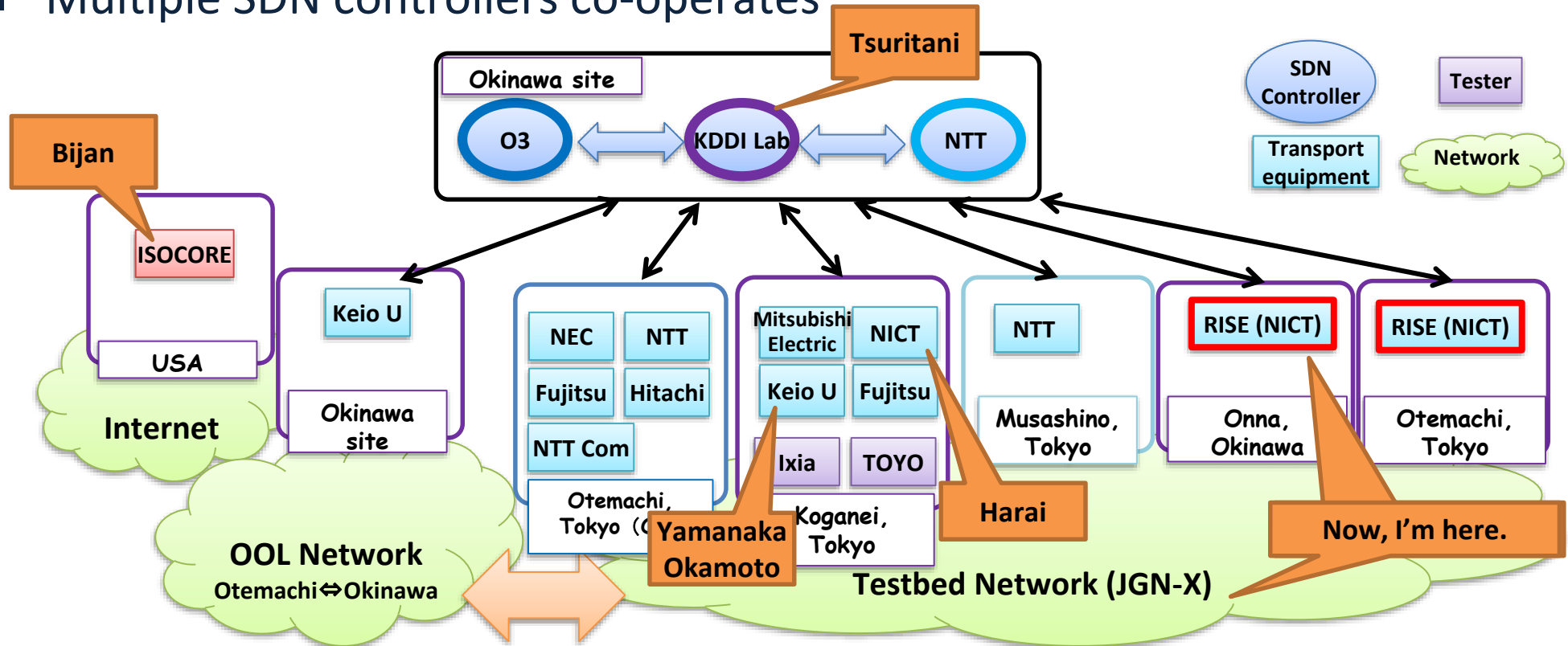
- ◆ 50 users can use RISE simultaneously
- ◆ 11 domestic sites & 4 oversea sites



- SDN controller & algorithm
- Secret distribution of medical info.
- Disaster resilient network
- Advanced image distributed processing

RISE Use Case - iPOP2015 ShowCase

- Building a nation-wide optical SDN transport network where architecture, communication technologies and operation methods are diverse in different domains
- Dynamic creation of seamless communication flows via SDN
- Multiple SDN controllers co-operates



Building a multi-tenant P4 testbed based on BMv2 model

As of Dec 2020



Overview

NICT provides P4 testbed network for multi users. Currently, the testbed serves software P4 switch "BMv2" in five sites, Japan. We have a plan to provide hardware and multi-tenancy enabled P4 switches in the future.

<https://p4-testbed-demo.jgn-x.jp/>



Demonstration

In this demonstration, we create two P4 based projects(networks) and activate alternatively.

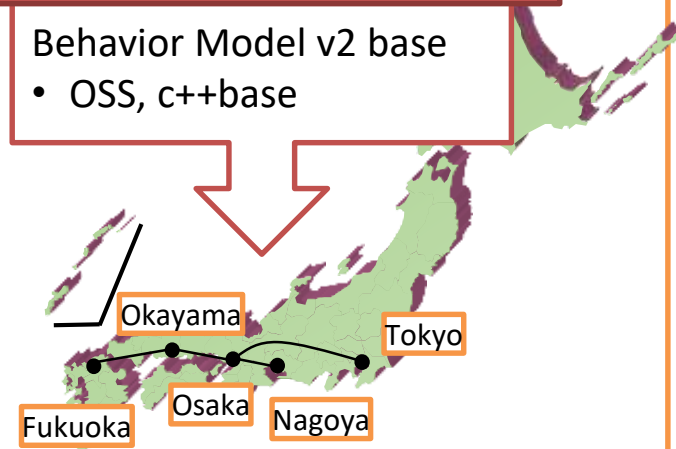
Live demonstration is [here](#).



Space division multiple tenants

Behavior Model v2 base

- OSS, c++base

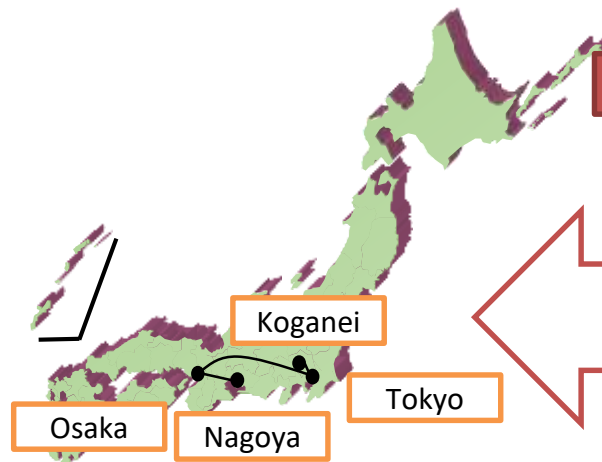


Future

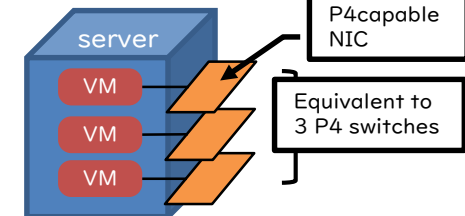
Time division multiple tenants

Edgecore Wedge 100BF-32X

- Switch LSI: Barefoot Tofino
- CPU: Pentium D-1517
- Switching 3.2Tbps
- Packet buffer 22MB



Space division multiple tenants

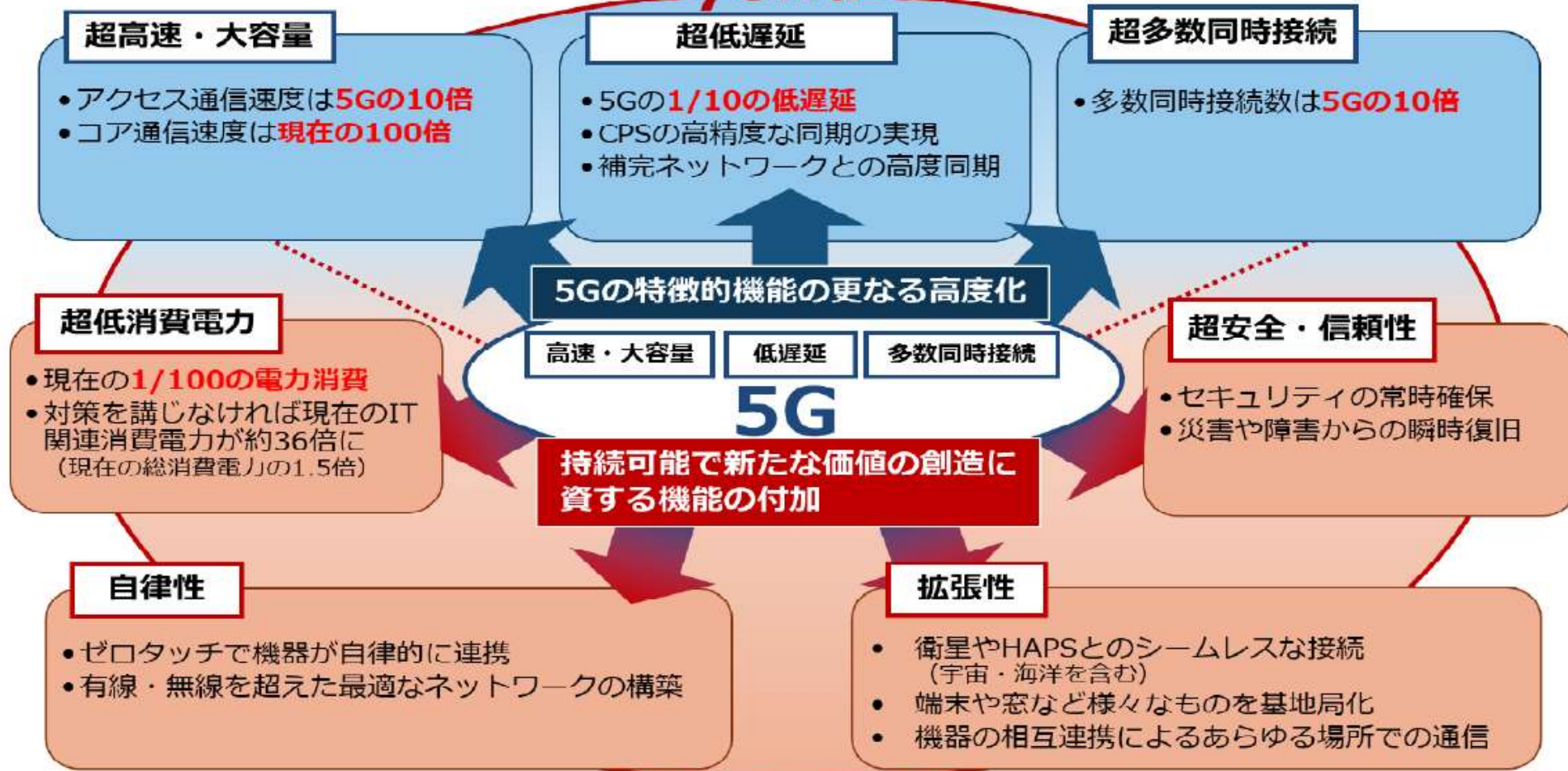


Next Step

Beyond 5G Requirement

Beyond 5G Promoting Strategy - MIC

Beyond 5G

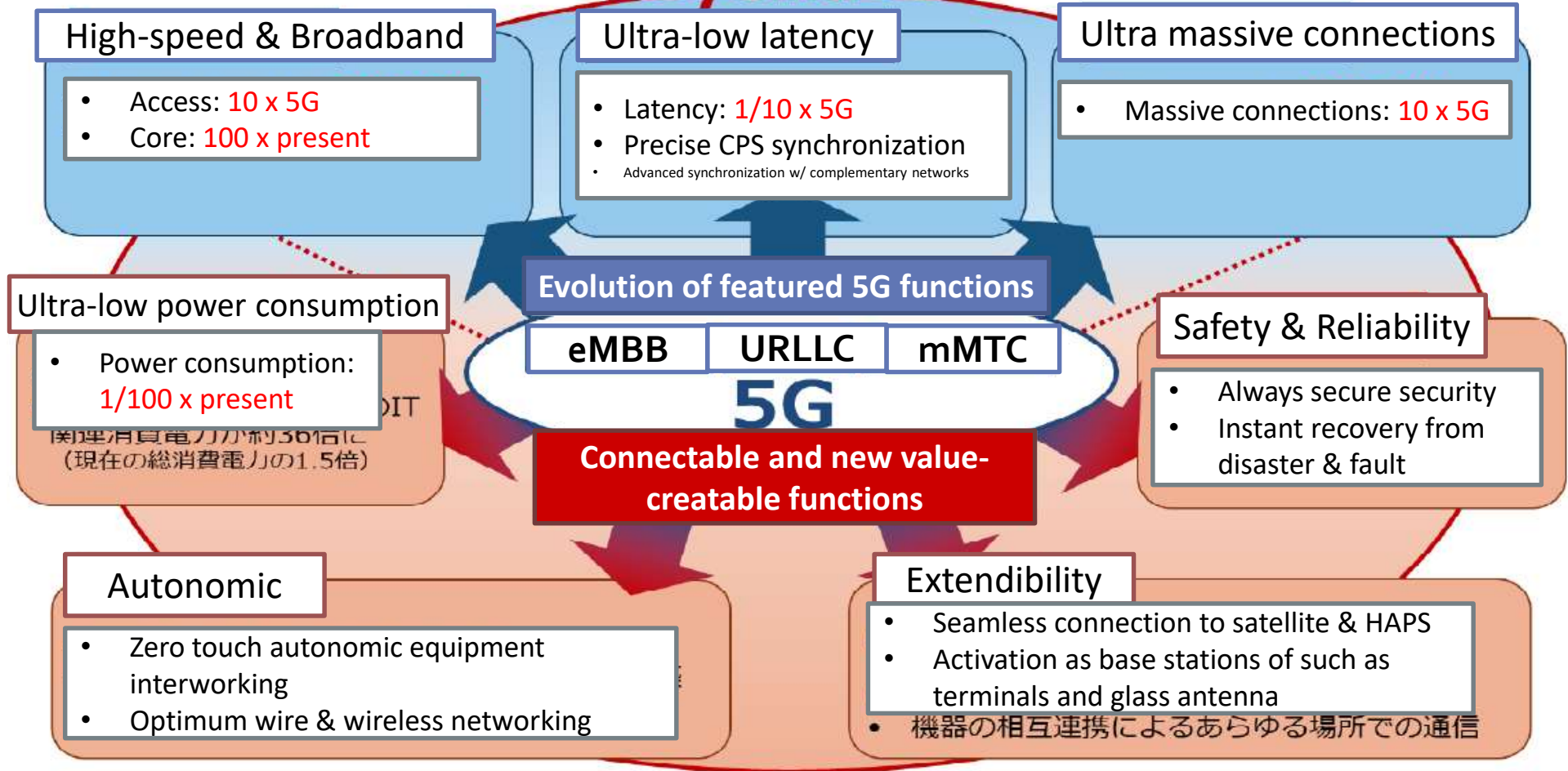


Source: Beyond 5G Promoting Strategy, MIC (2020)

Beyond 5G Requirement

Beyond 5G Promoting Strategy - MIC

Beyond 5G



Edited by the presenter:

Source: Beyond 5G Promoting Strategy, MIC (2020)

(Post) Cloud Native

- Cloud friendliness, OSS platform, softwarization, programmability

Mobile Communication

- B5G/6G, mobile core, RAN, local 5G

Optical Communication (Raw Fiber)

- Ultrafast optical commun., multi-core fibers, quantum commun., optical lattice clock

Testbed Fundamental Functions

- Monitoring, debugging, reproducibility

Testbed Common Platform


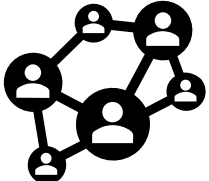
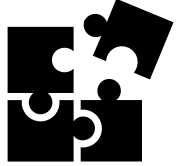
- Openness, PPP test-site, standardization



Testbed as an innovation eco-system hub

Human and Tech Development

- Raising level of community
- Personnel exchange, training / circulation
- Technology utilization, evolution & deployment

Induction of demonstration experiments by companies

- Sustainable evolution of network and service infrastructure towards beyond 5G
 - Cooperation with telecom, datacom and their vendors
- Provide open places as **innovation eco-system hub**
- Activate community such as industry collaboration and university involvement
- Build a system that allows developments to be used **within the community and returns the results to the development side**
- Expand functions required to induce social implementation

- We operate “**Network & Distributed Cloud**” testbed for R&D toward practical and social implementation
 - 100 Gbps Nation-wide & Asian circuits
 - International NREN partners
 - SDN + IoT aware verification environment
 - Distributed cloud & emulators
- Contribute to making the future thru’ the testbed
- Testbed as an innovation eco-system hub

<https://testbed.nict.go.jp/jgn/english/>

Thank you!