

# Experience of the RISE Testbed Deployment

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NICT



# JGN-X

JGN-X is a wide-area network testbed operated by NICT to promote R&D on Future Internet technology

- Open to researchers, developers, students, etc. (free of charge)
- Forms the global R&E network infrastructure in collaboration with APAN, Internet2, TransPAC3, TEIN, GÉANT, GENI, FIRE, etc.



1999.4  
ATM  
1Gbps



2004.4  
Wide-area  
Ethernet  
10Gbps



2008.4  
Service Platform  
Net. Virtualization  
40Gbps



2011.4  
Future Internet  
Net. Orchestration  
MPLS  
100Gbps

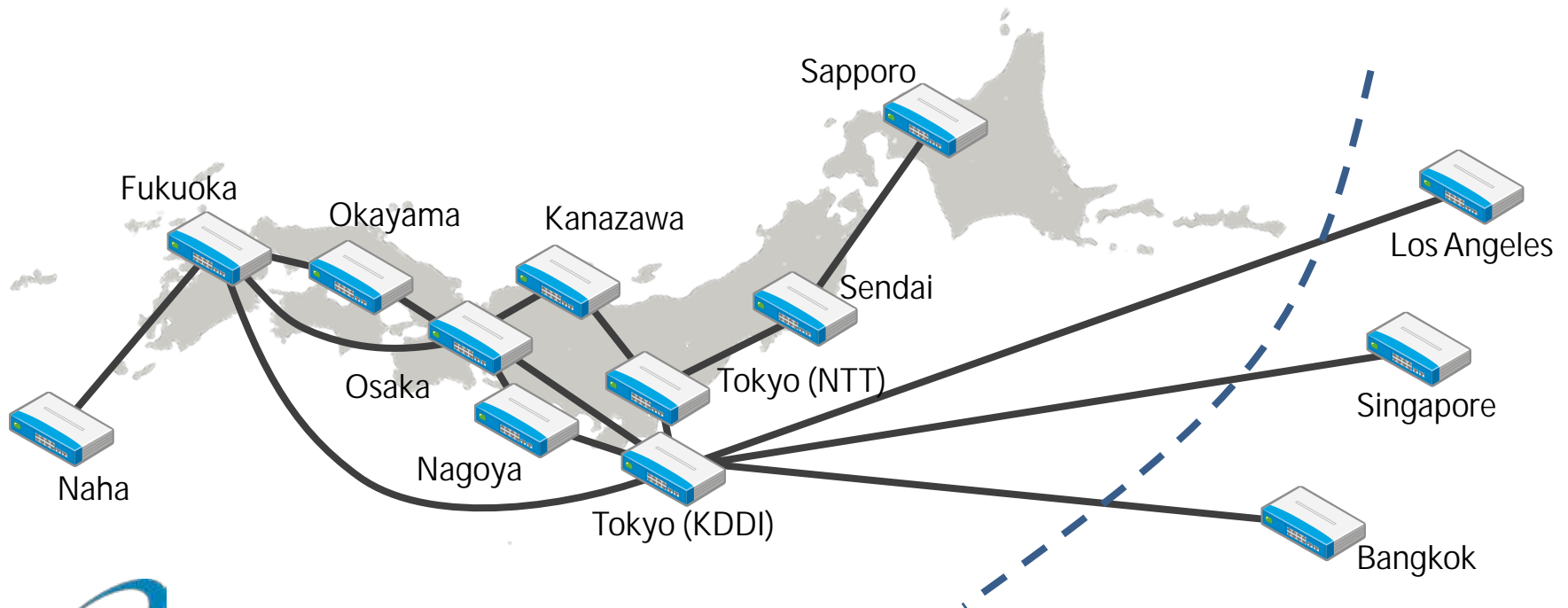


# RISE

*Research Infrastructure for large-Scale network Experiments*



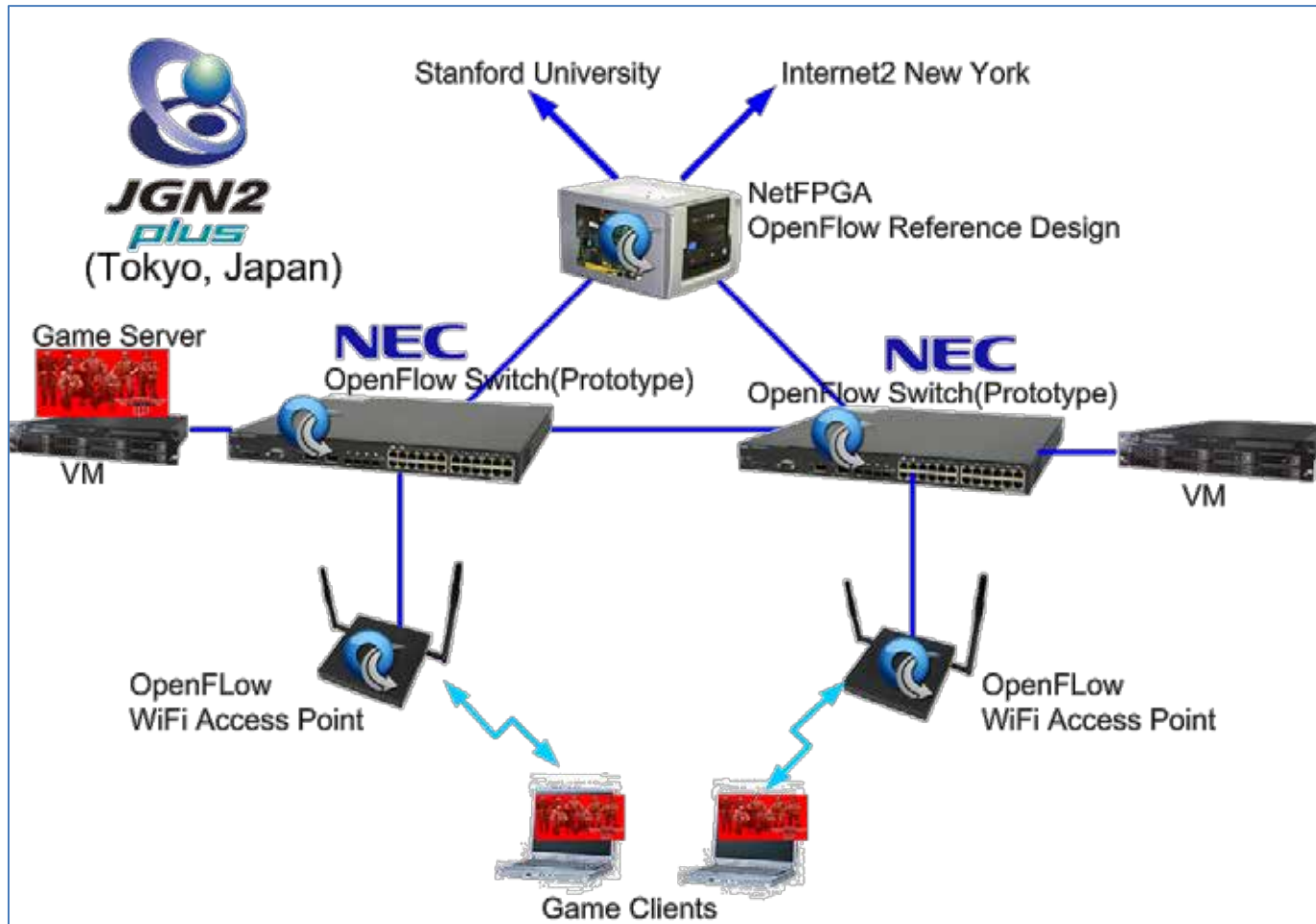
RISE is an SDN/OpenFlow testbed on JGN-X which provides OpenFlow networks (and VMs) for experiments in which users can bring and use their own controllers.



Apr. 1, 2015

# Origin of RISE

## Demonstration at GEC3 (2008)



# Wide-area OpenFlow Network

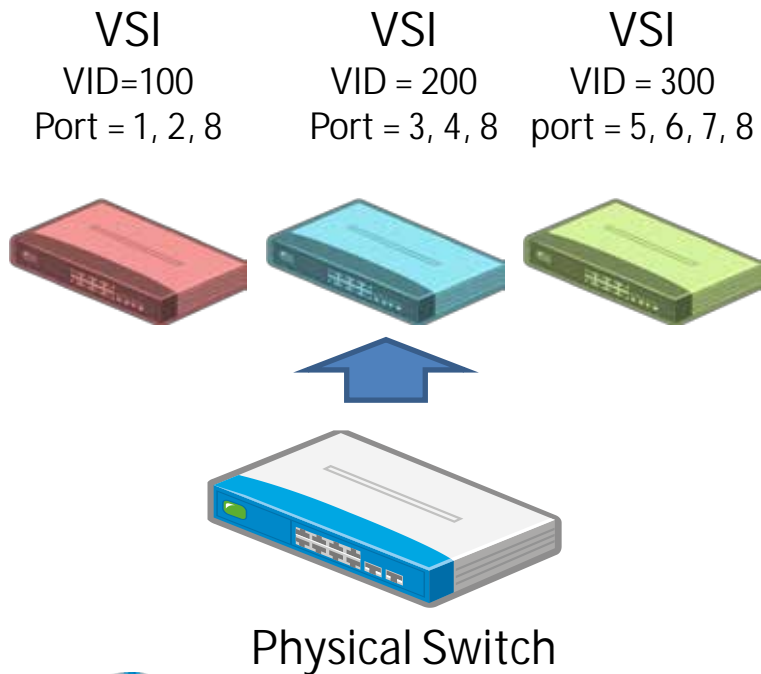
Through the experience in trials (demonstration of traffic engineering, etc.) on our wide-area OpenFlow network, we reached the initial design of RISE

- Multi-tenancy (open access)
  - VSI (Virtual Switch Instance)
- Overlay networking
  - Path-Port mapping



# Multi-tenancy with VSI

- VSI is a switch virtualization mechanism similar to VLAN
  - NEC's switches support VSI
- A VSI is defined by a VLAN ID and a set of ports
- Different VSIs are independently controlled by different controllers



VSI configuration

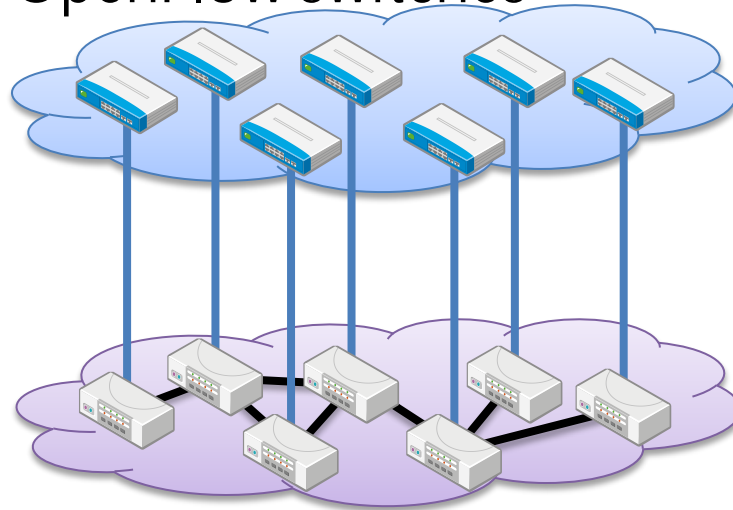
Port #	1	2	3	4	5	6	7	8
VID: 100	✓	✓						✓
VID: 200			✓	✓				✓
VID: 300					✓	✓	✓	✓

# Overlay networking for OpenFlow

JGN provides underlay network (virtual circuits) that interconnects OpenFlow switches in RISE



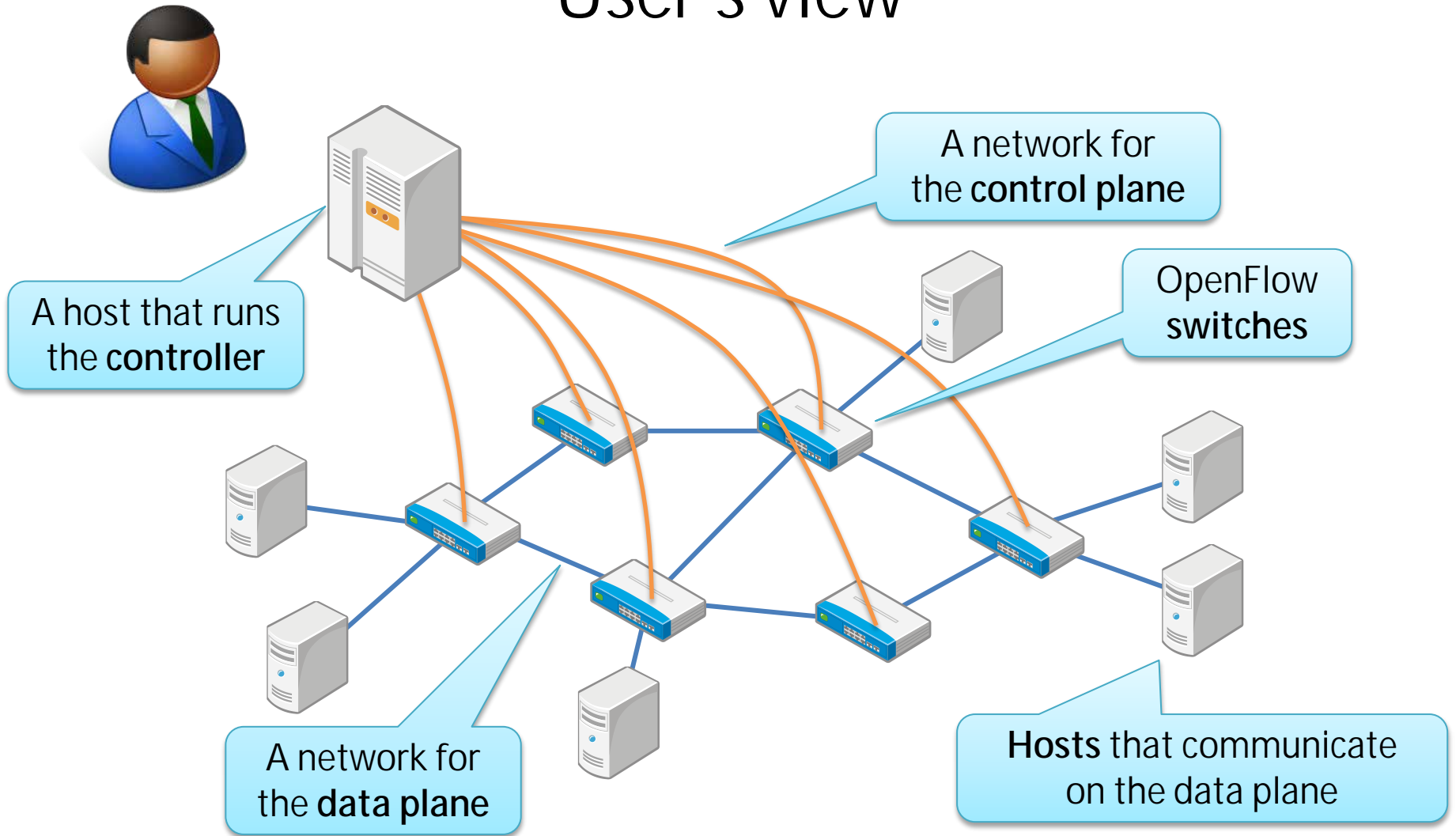
OpenFlow switches



RISE  
overlay network

JGN-X  
underlay network

# User's view

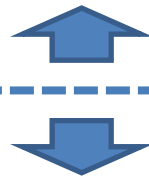
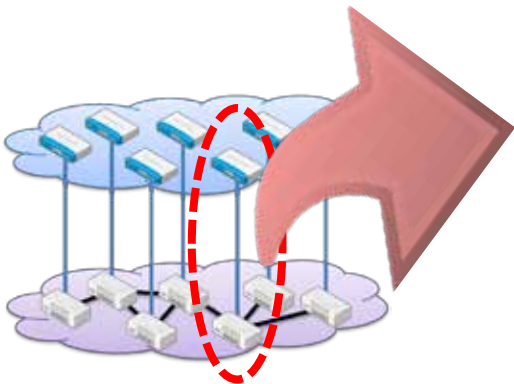




# Path-Port mapping

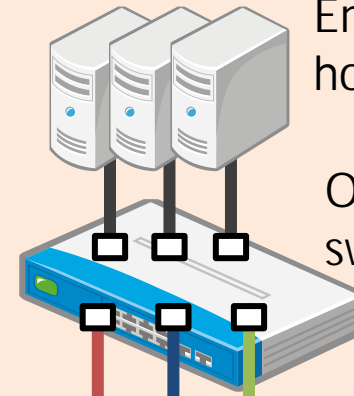
OpenFlow switches are interconnected via dedicated ports

- Simple view of a user OpenFlow network
- Saving ports of JGN-X backbone routers



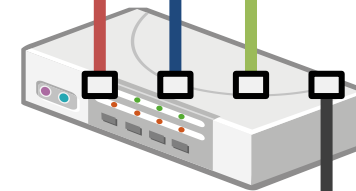
Virtual circuits  
(Q-in-Q/EoMPLS)

RISE  
user  
env.



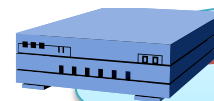
End  
hosts

OpenFlow  
switch

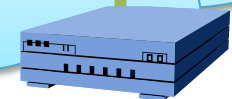
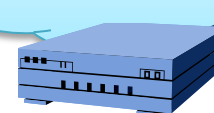


Aggr.  
Switch  
(Q-in-Q)

Backbone router

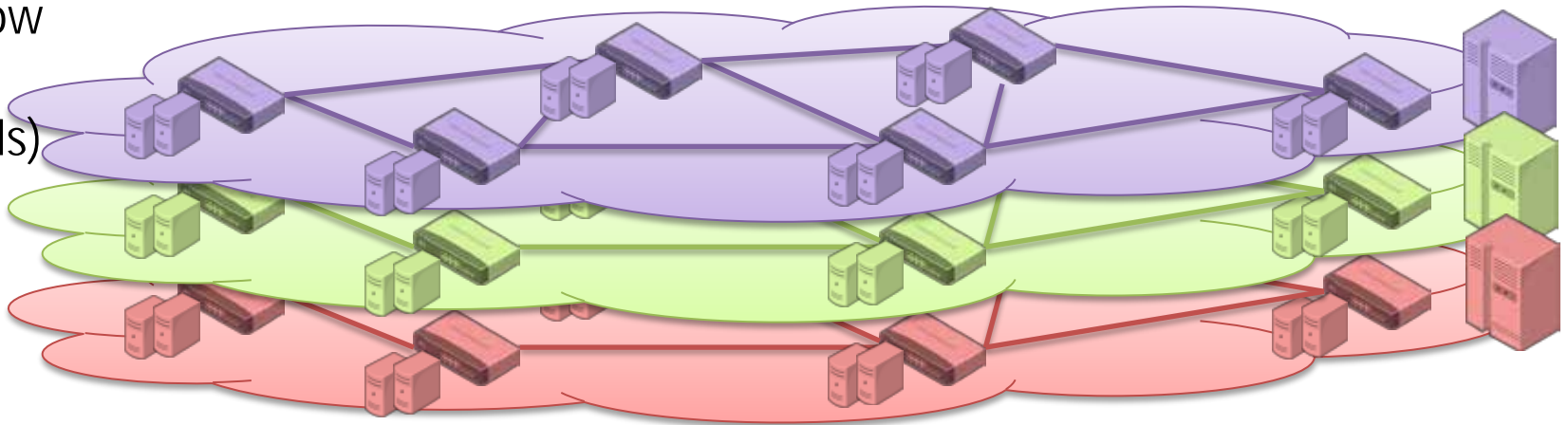


JGN-X

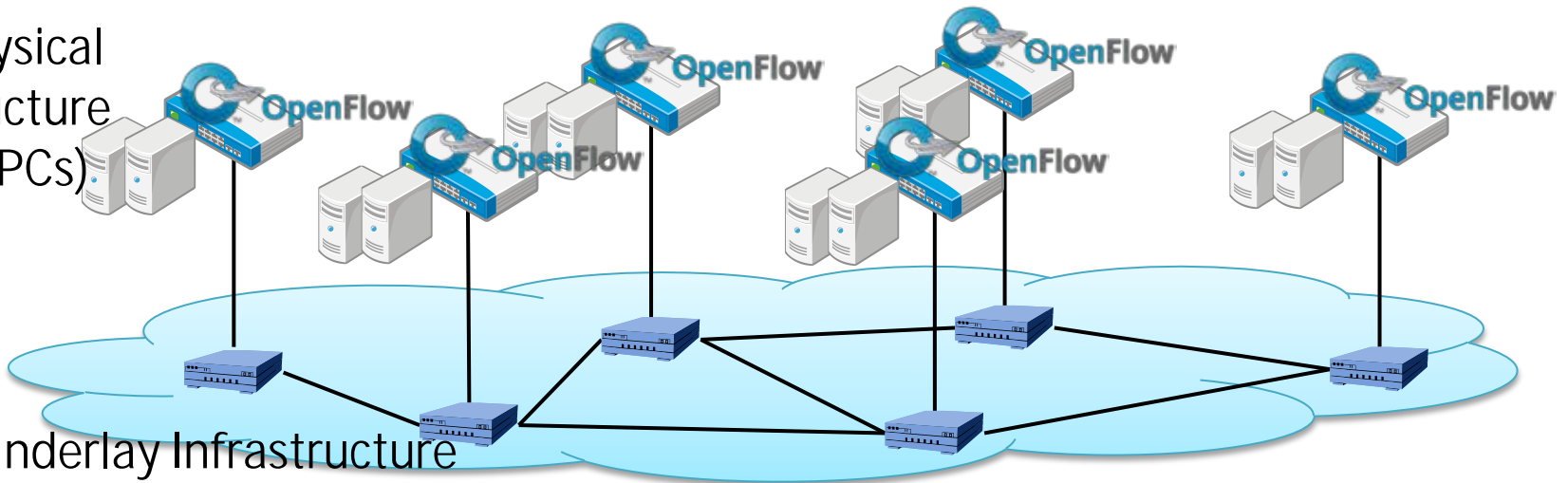


# Overview of RISE 2.0 (2012-2013)

OpenFlow  
Slices  
(incl. VMs)



RISE Physical  
Infrastructure  
(OFSSs + PCs)



JGN-X Underlay Infrastructure  
(MPLS pseudo wires)

Yoshihiko Kanaumi et al., "Deployment and Operation of Wide-area Hybrid OpenFlow Network," in proc. of IEEE/IFIP MANFI 2012.

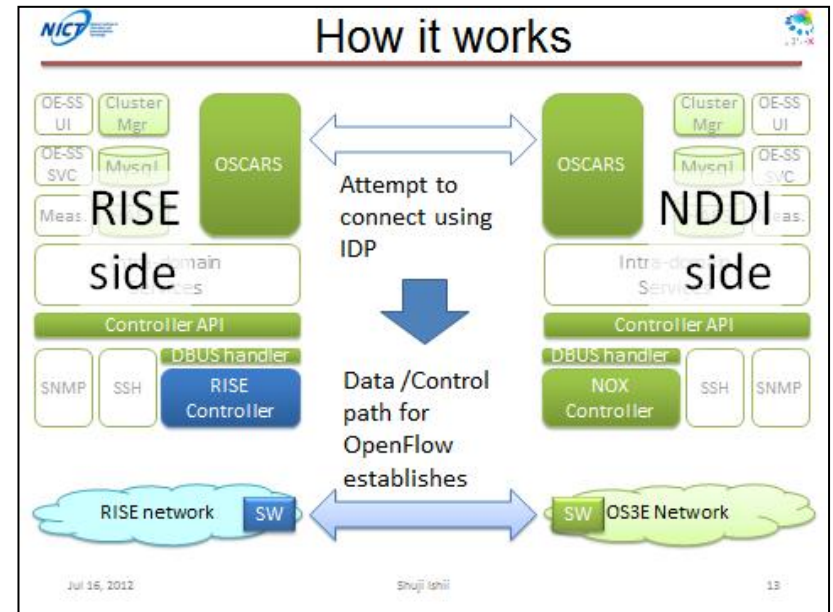
# International Collaborations

## Interconnection of RISE and OS<sup>3</sup>E/NDDI (Internet2)

- Our Trema-based controller worked with OESS
- Presented at I2 Joint Techs and SC2012



Presentation at I2 Joint Techs (2012)



International Collaborations with US and EU

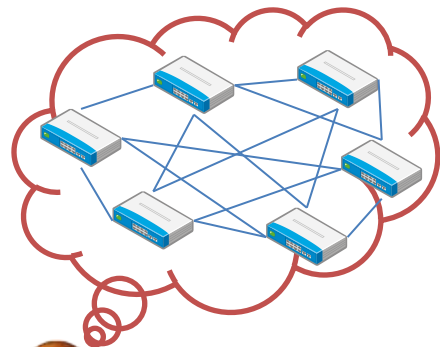
# Issues in RISE 2.0

- Limited network topology for experiments
- Limited number of concurrent user slices

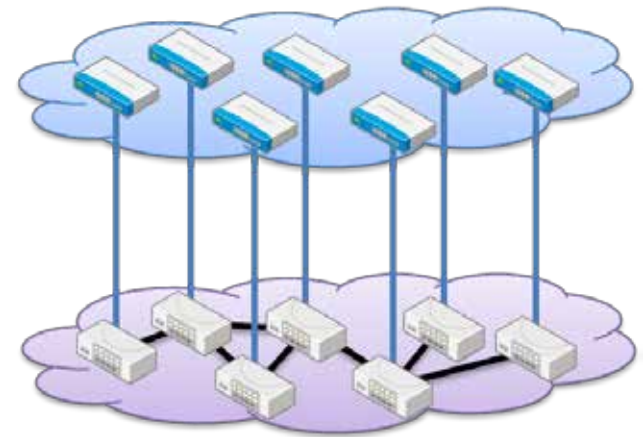
# Users Need More Flexibility in Network Topology

The topology of RISE OpenFlow network is tightly bound to that of JGN-X

- Experimental network topology is highly limited.



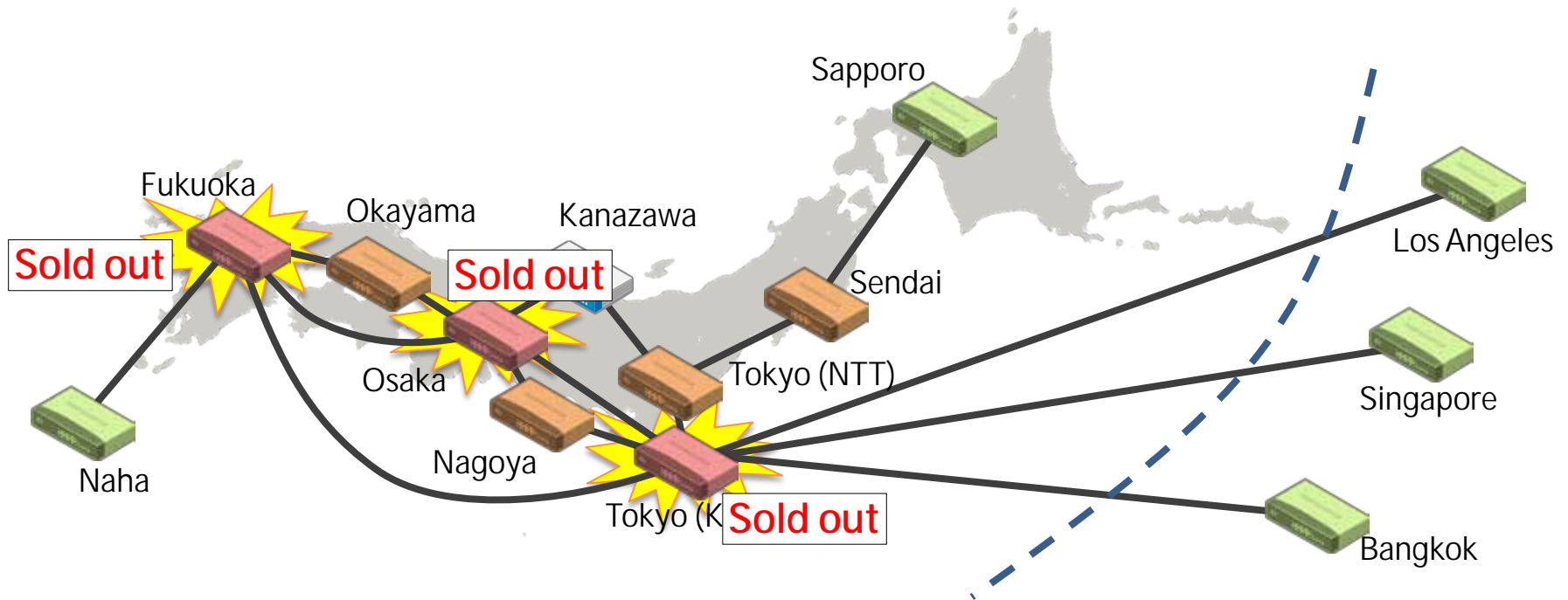
User  
(Experimenter)



# Limited Number of User Slices

Users often want VSIs with many links to other switches

- More links mean more choices for packet forwarding control
- Only 16 VSIs can be configured in a NEC's OpenFlow switch

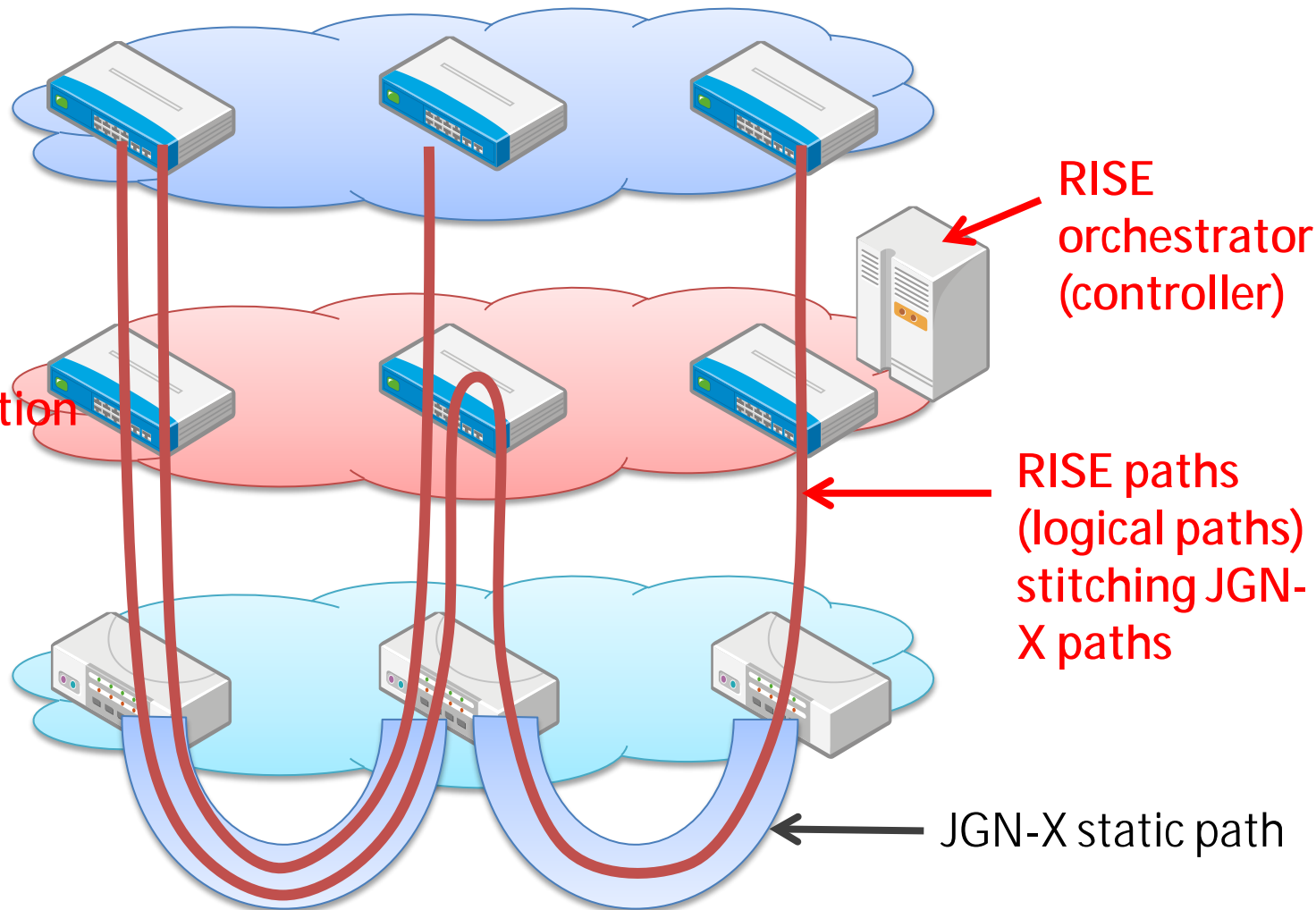


# Insert Another SDN Layer for More Flexible Topology

RISE  
User Slice  
Layer

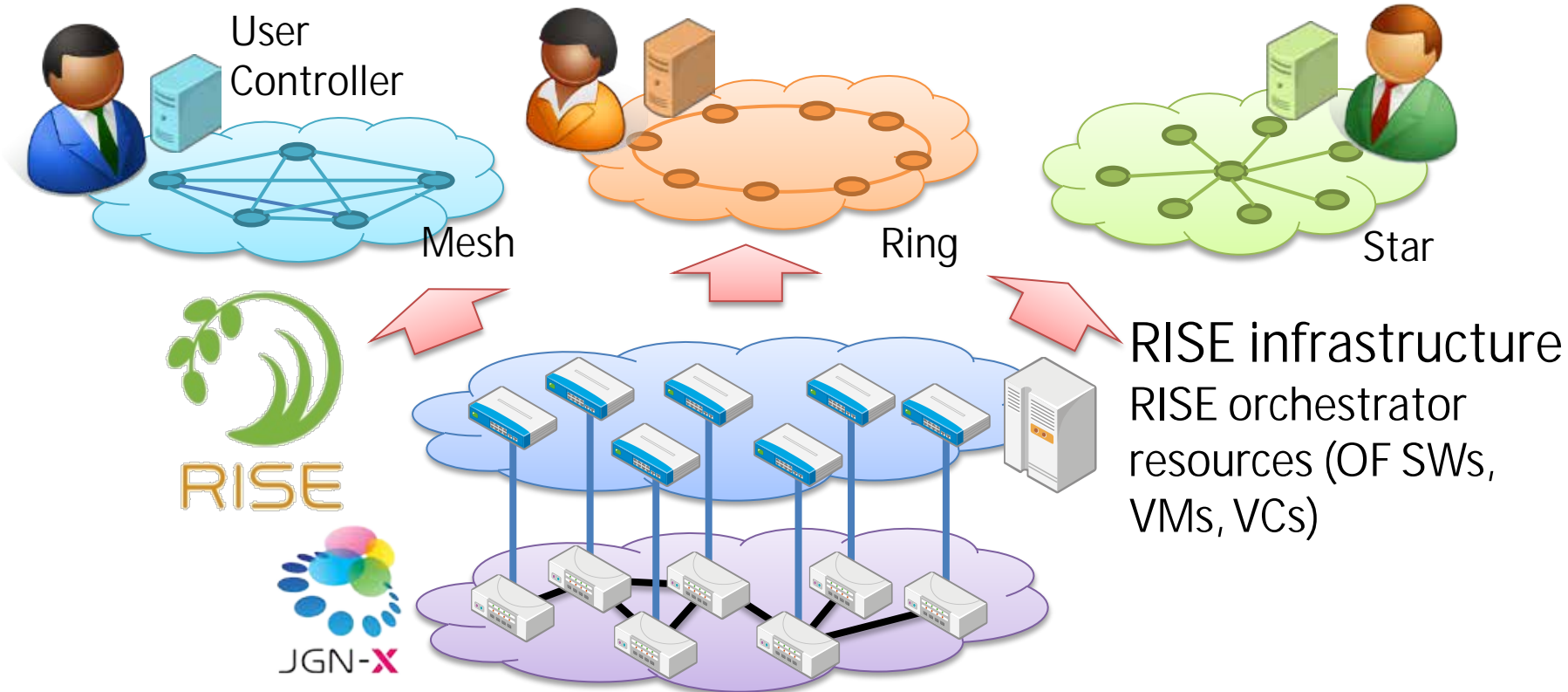
RISE  
Topology  
Virtualization  
Layer

Physical  
Path  
Layer  
(JGN-X)



# RISE 3.0 (2014-)

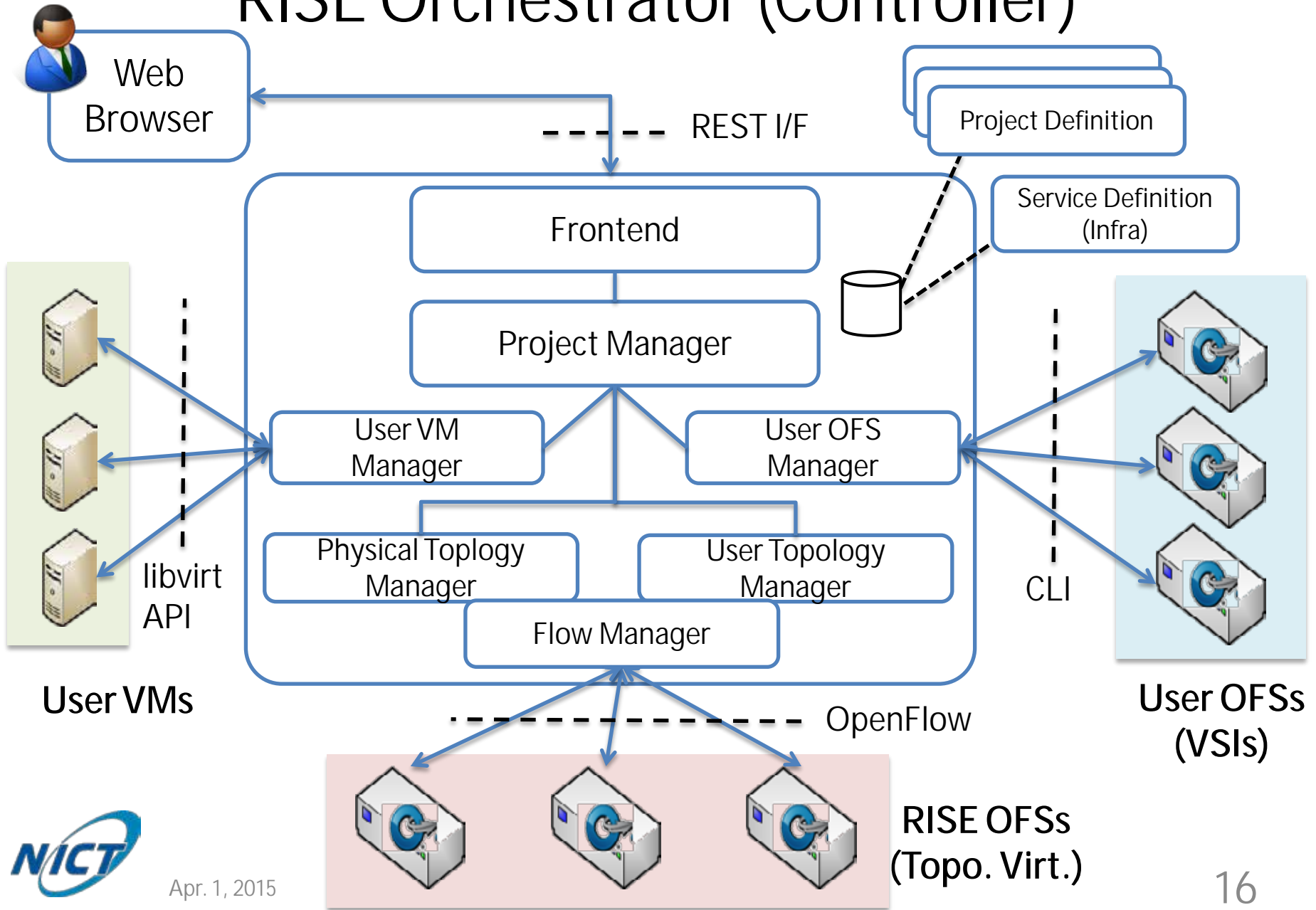
## RISE User Slices



- Users can ask various slice topologies
- Slice scalability is improved 2-3 times (50+ slices)
- Configuration time of a RISE slice is reduced to under 10 min.

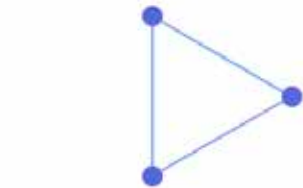


# RISE Orchestrator (Controller)

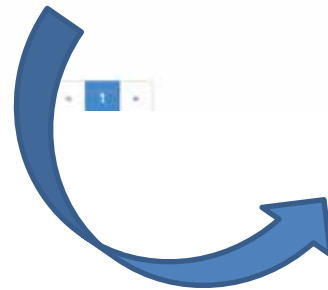


# RISE Management GUI

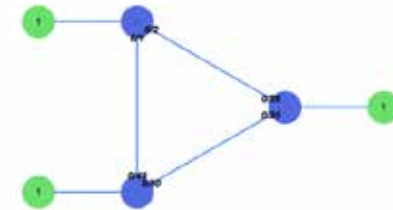
The screenshot shows the RISE Management GUI search results page. At the top, there is a navigation bar with the RISE logo and tabs for SEARCH, PHYSICAL, CREATE, USERS, and FAVORITES. The user is logged in as Shuji Ishii. Below the navigation bar, there are filters for RUNNING, IRUNNING, and ALL. The search results show one result for Project ID JGNX-001, with a Research Project Theme, Start Date of 2014/02/10, End Date of 2014/02/28, and Status of running. A 'Details' button is visible next to the result.



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User Topology



Physical Topology



Easy to show and hide the detailed information of the virtual and physical infrastructure

# Summary

- We have been developing and operating the RISE testbed
  - We are providing SDN/OpenFlow capability to users as well as using it in our infrastructure
- We are looking for opportunities for international collaboration with global partners
  - Internet2, TransPAC3, Pragma-ENT, FIRE/OFELIA, FELIX, etc.
- We are much interested in SDN/OpenFlow virtualization and multi-domain federation

**Thank you!!**

