



Network Virtualization Research In Japan

Updates @ GEC11

Aki Nakao

University of Tokyo

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Network Virtualization Research in Japan

✧ NV Research Lab (UTokyo+NICT)

Objective: Understand “Advanced Network Virtualization” infra.

⊕ CoreLab (UTokyo+NICT)

- ▣ Enabling net-virt via only S/W on COTS x86 machines

⊕ WiVi (UTokyo)

- ▣ Enabling wireless (wifi) net-virt via COTS hardware

⊕ VNode (UTokyo+NICT+NTT+NEC+Hitachi+Fujitsu)

- ▣ Enabling net-virt via designing H/W add-ons in routers

⊕ Slice Applications

- ▣ ANIAS (Any Network In A Slice)
- ▣ Programmable Network
- ▣ In-Network Processing
- ▣ Non-IP Protocols



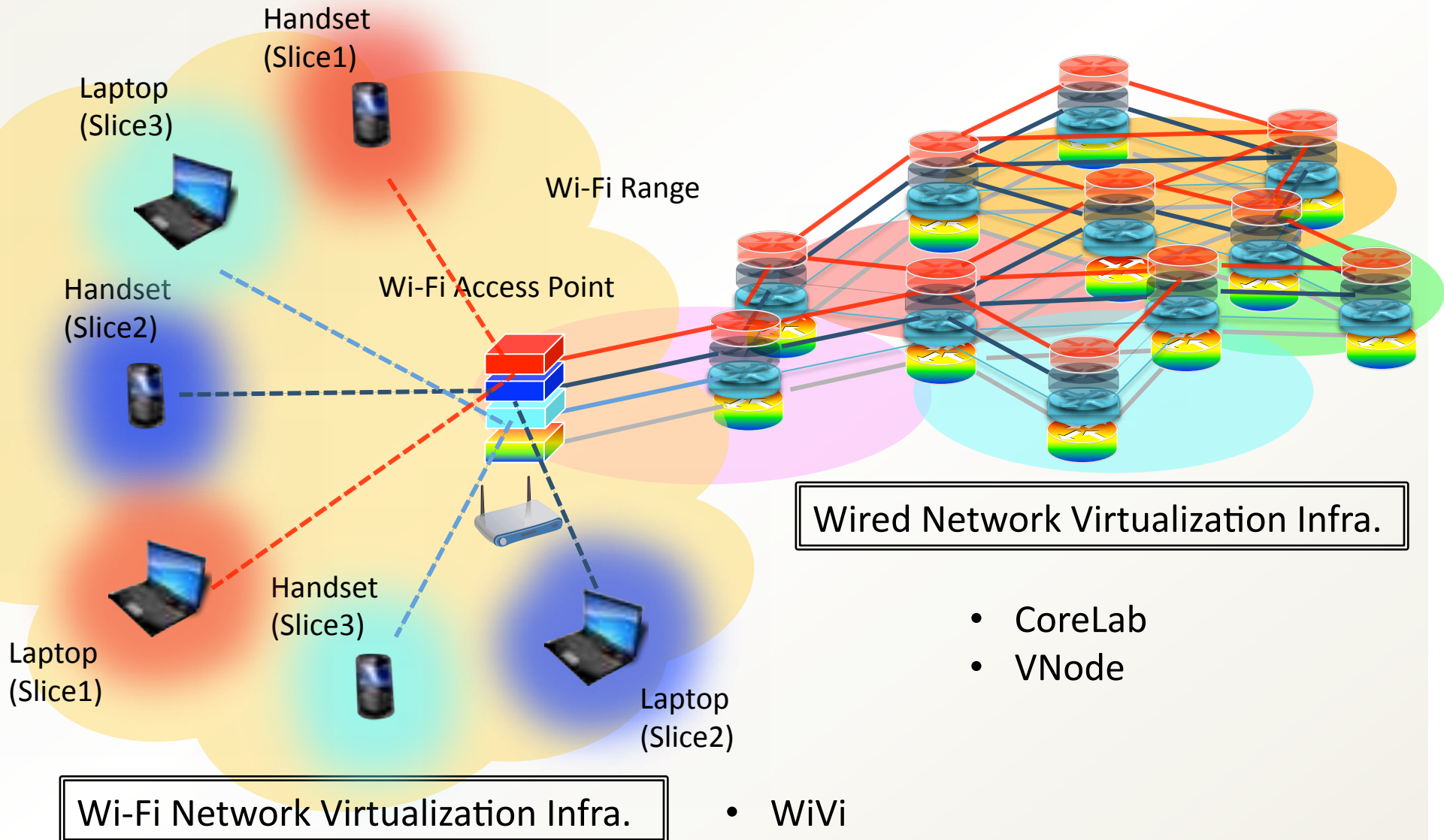


WiVi [wi:vi:]
Wi-Fi Network Virtualization Infrastructure



Slicing Wi-Fi Access Point

Goal : Slicing Wi-Fi Access Point to extend our reach from wired slices to wireless ones



First- & Last-Mile Slicing – A Case For WiFi

A WiFi AP provide usually provides access service for single operator

Handset



WiFi Access Point

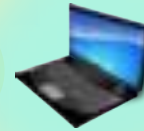


Laptop

The Internet

A WiFi AP can dynamically provide **independent access services** for multiple operators

Laptop (Slice3)



Handset (Slice1)



Handset (Slice2)



WiFi Access Point



Laptop (Slice1)



Handset (Slice3)



Laptop (Slice2)



WiFi Access Virtualization



App: Emergency & Public Safety Slices



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Multiple Virtual APs Coexistence

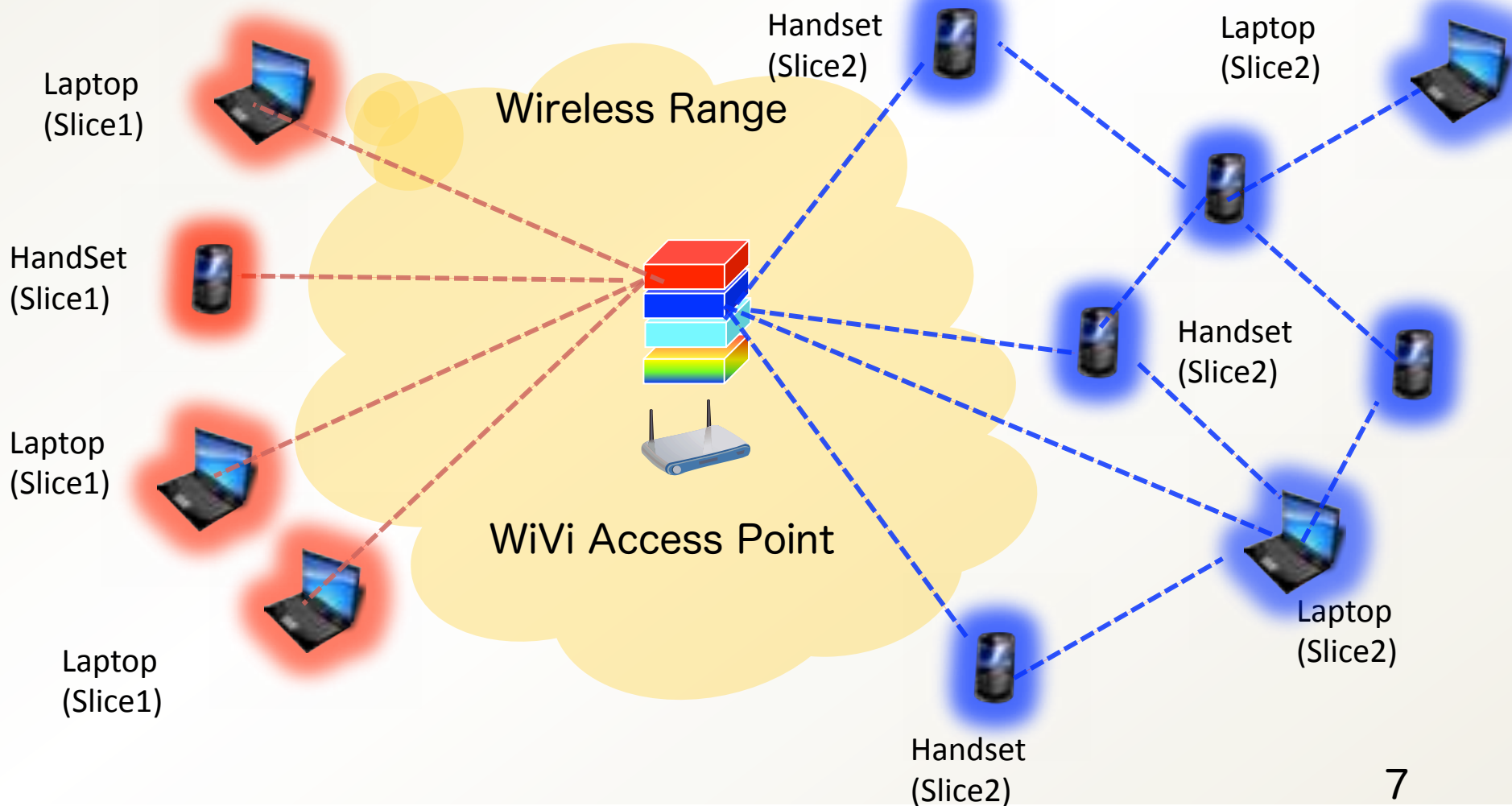
Mesh Slice and WiFi Access Slice

Slice 1 (AP)

802.11 a/b/g/n WiFi Access Service

Slice 2 (Mesh)

802.11s Mesh Network Slice



Slice Creation (802.11g slice and 802.11s slice)

WiVi Demo:

Slice Creation

Slice1: 802.11g slice

Slice2: 802.11s Mesh slice

Captive Portals

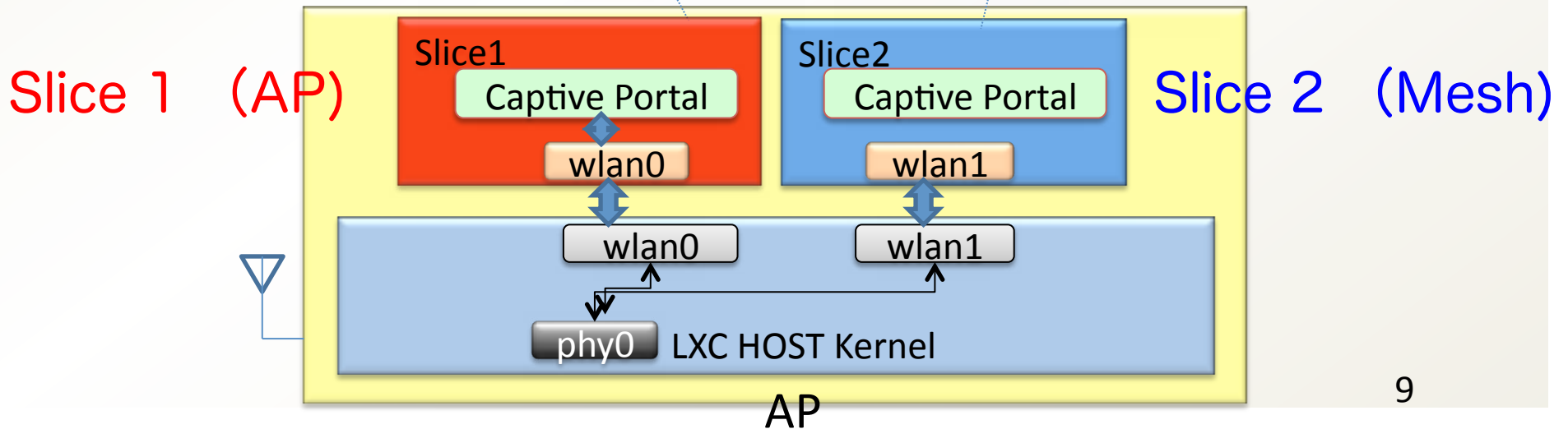
Multiple virtual APs w/ different policies/services



iPhone



Mesh Device



Intelligent Mesh Nodes



Joining 802.11s Mesh Slice

**WiVi Demo:
Joining the IEEE 802.11s mesh Slice**

Connecting IPOD to 802.11g Slice (while 802.11s Slice Operating...)

WiVi Demo:

Connecting iPod touch to AP Slice
while 11s slice is running

Other Demos

- ⊕ Last Mile Cache (GEC10)
- ⊕ Fast Hand-Over (GEC10)
- ⊕ BeaconCast (GEC10)
- ⊕ Multiple Captive Portals (MVNO)



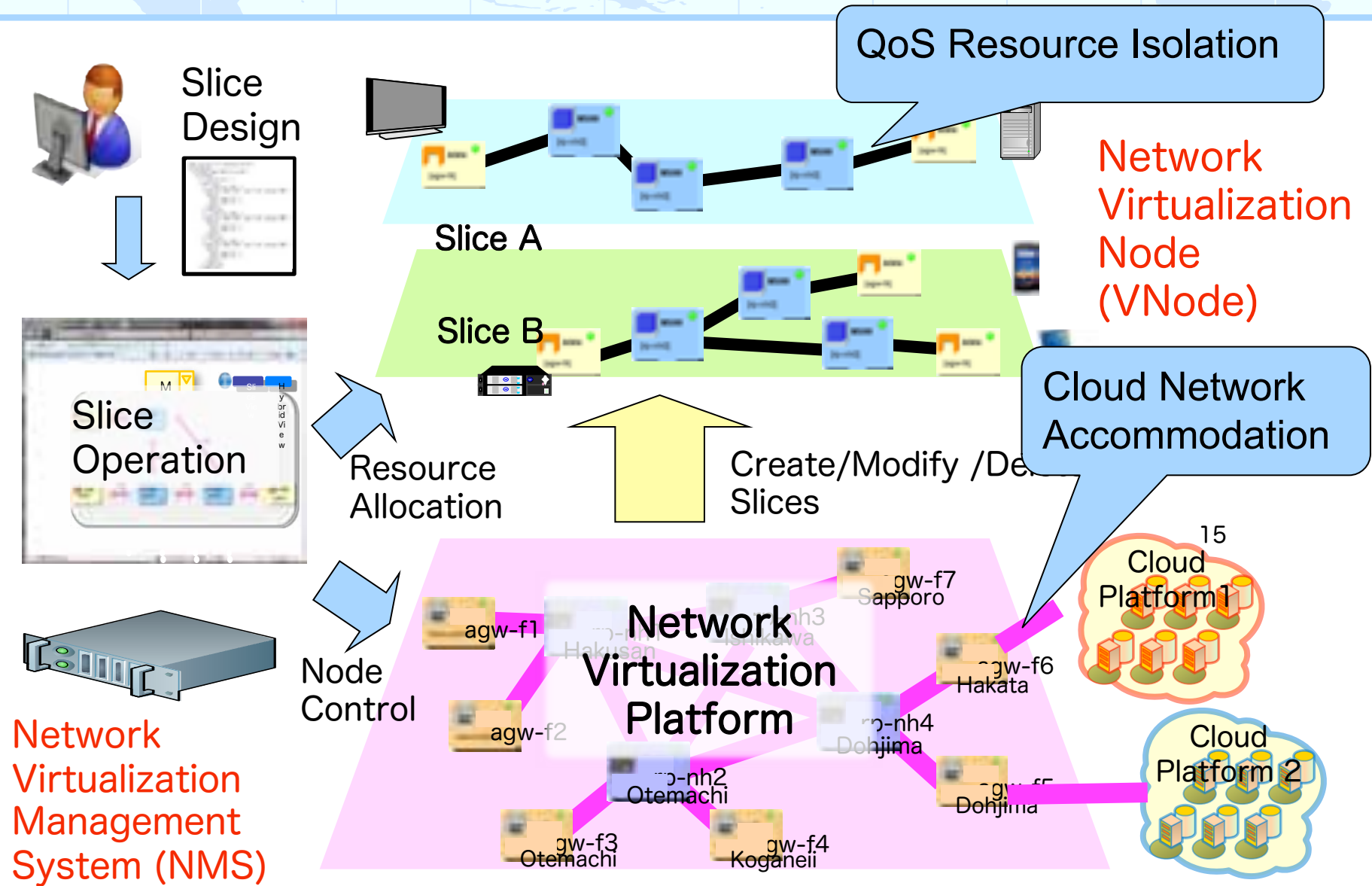
VNode

(UTokyo, NICT, NTT, NEC, Hitachi, Fujitsu)

Project Leader: Aki Nakao

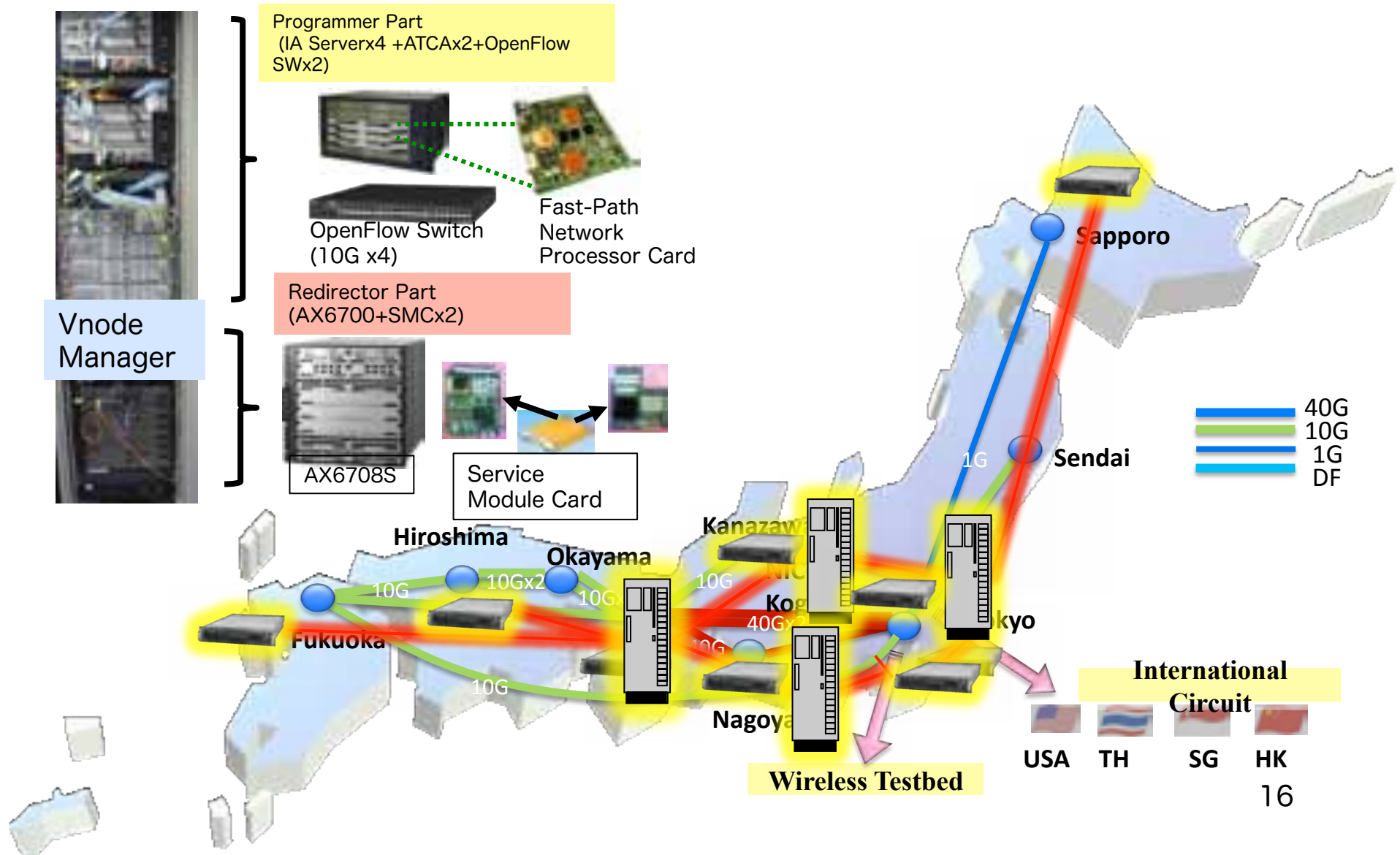
Enabling net-virt **via H/W based on production routers**

VNode System Architecture



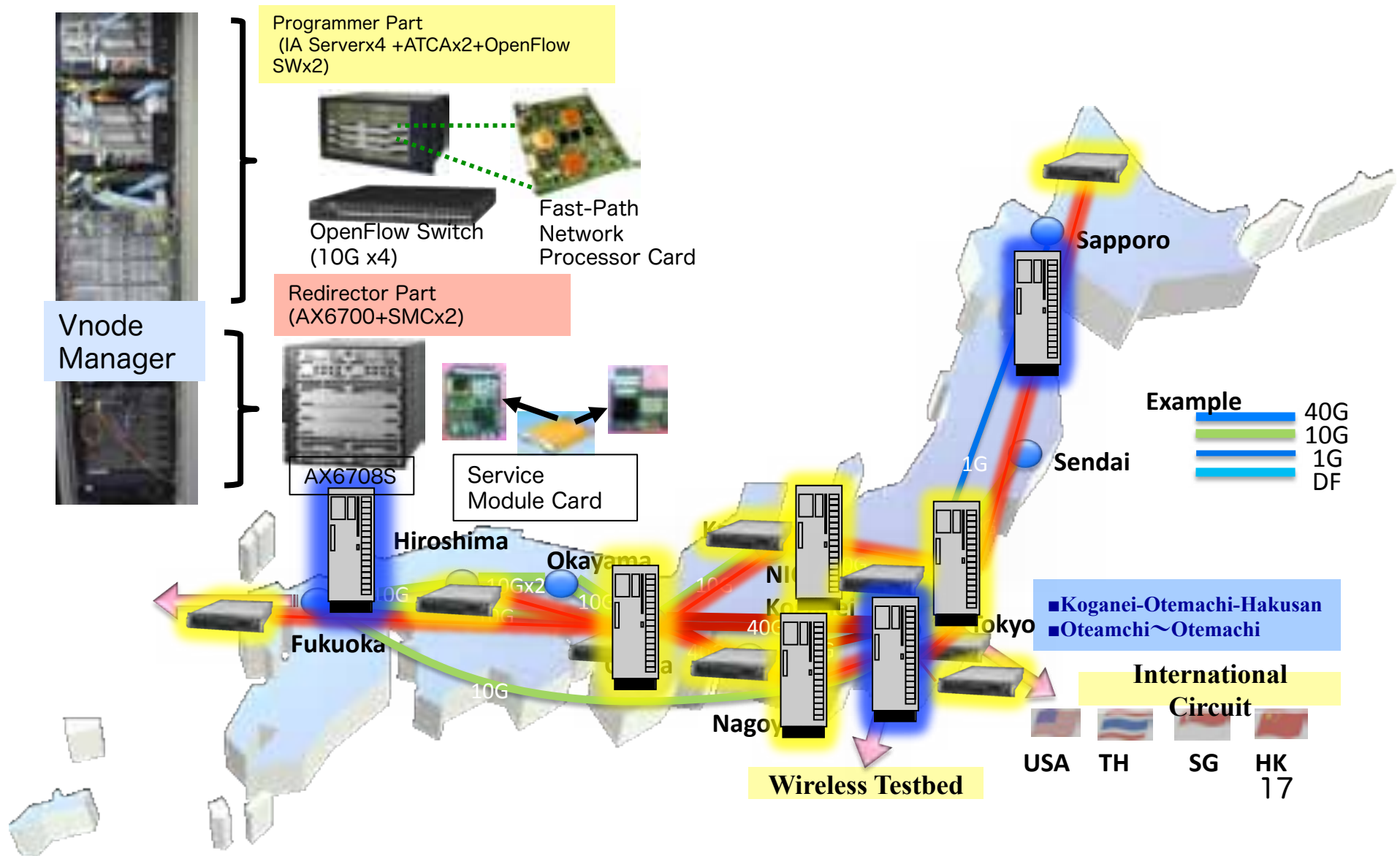
VNode Deployment on JGN-X

4 VNodes deployed and in operation as of now



VNode Deployment on JGN-X

7 Vnodes will be deployed in coming fall





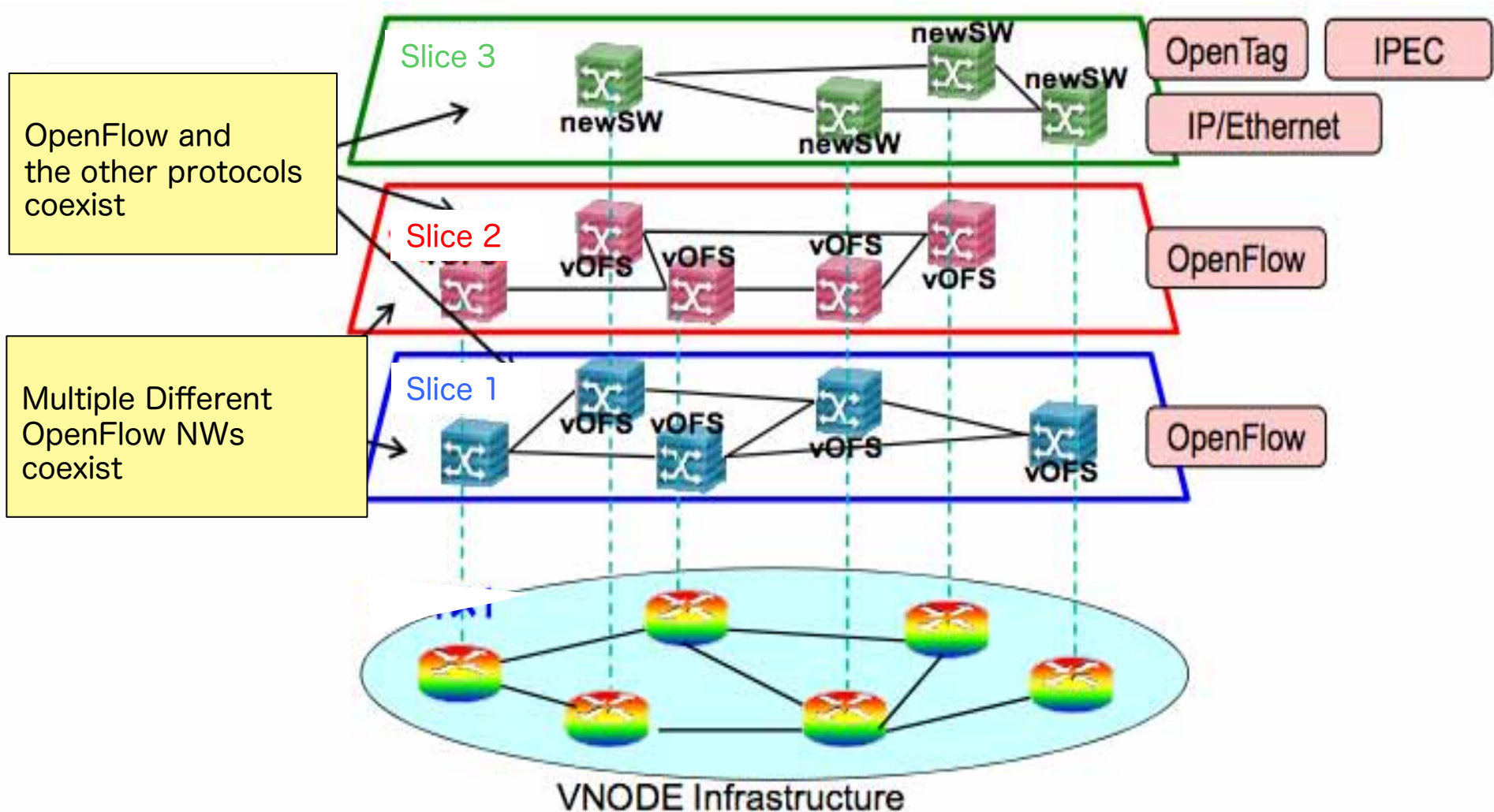
ANIAS (AnyNetwork In A Slice) OFIAS (OpenFlow In A Slice)

Demonstrated in

- GENI Engineering Conference (GEC8) Plenary Talk
- GENI Engineering Conference (GEC10)
- Ping Du, Akihiro Nakao, "OFIAS: A TestBed for Exploring In-Path Processing Network", TridentCom 2011

ANIAS (Any Network In A Slice)

OFIAS (OpenFlow In A Slice)



Goals of ANIAS/OFIAS

⊕ Attempting to encourage transitions:

How to **use** OpenFlow ->

How to **improve** OpenFlow ->

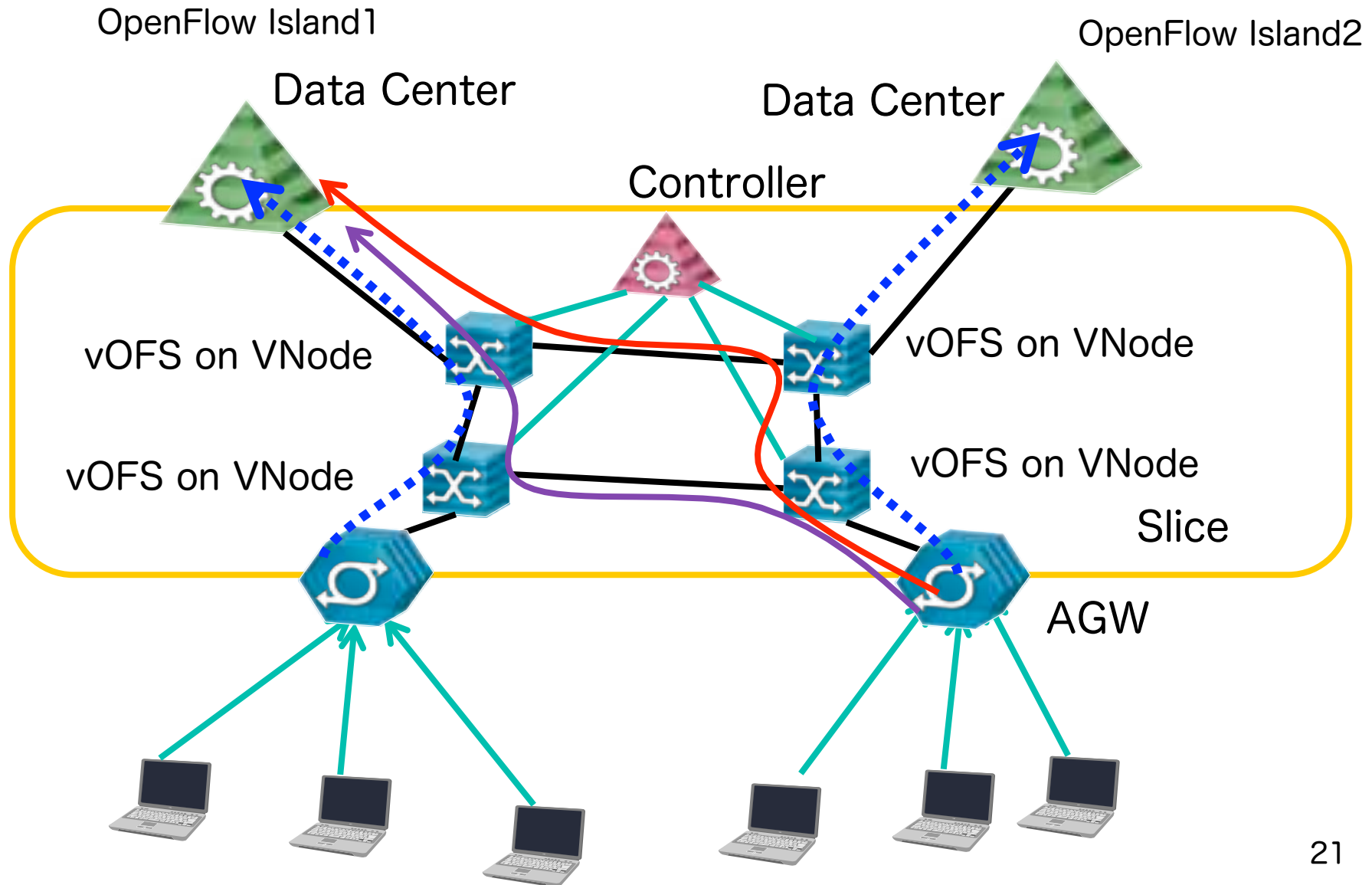
How to **invent** OpenXXX

R. Furuhashi & A. Nakao,

“OpenTag: Tag-based network slicing for wide-area coordinated in-network packet processing”

IEEE ICC FutureNet IV

Seamless Access to Multiple Data Centers



OpenFlow In A Slice Cloud Access Demo

The screenshot displays a web browser window with the URL `http://vnode7.grower.tnet.co.jp/BS1/gw/Developer/SliceLotView.do`. The page title is "Developer: Slice Operation". On the left, a green sidebar contains navigation buttons: "Main", "User", "Physical Info", "Resource Info", "Slice", "Preview", "Reservation", "Slice Operation", "Silver Delete", and "Logout". Below the sidebar, the text "UserID:dev-nec1" is visible. The main content area is titled "Slice Operation" and features a dropdown menu set to "NEC_Slice_00_00". In the top right corner of the main area, there are buttons for "Info" and "Hybrid View", along with a zoom level of "x0.795" and zoom controls. The central part of the interface shows a network topology diagram with several nodes and links. The nodes are represented as blue and orange boxes with labels like "N004 [ip=10.0.0.1]", "N002 [ip=10.0.0.2]", "N003 [ip=10.0.0.3]", "N001 [ip=10.0.0.4]", "N005 [ip=10.0.0.5]", and "N006 [ip=10.0.0.6]". The links are pink lines labeled "L001" through "L006". The diagram shows a central node (N003) connected to other nodes, with some nodes also connected to external resources (orange boxes).

Future Work

- WiVi+CoreLab Campus Deployment
- VNode Version 3 (OF Redirector)
- AP/Terminal Virtualization
- Large-scale Slice Applications
- First and Last Mile Slice Applications

Conclusion

- ❊ Network Virtualization is one of the key technologies for proceeding further in defining NwGN architecture(s)
- ❊ We are turning this vision into reality..

Net-Virtualization Research Lab Contact:

nakao@iii.u-tokyo.ac.jp

info@nvlab.org

<http://www.nvlab.org>



THE UNIVERSITY OF TOKYO

NICT

National Institute of
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