JGN-X: SDN and cloud testbed in Japan

Shinji Shimojo
NICT/Osaka U
2012.11

New Generation Networking and its testbed

SDN

How does it help to improve cloud?

Find some scinario on testbed in collaboraiton

～新世代ネットワーク分野での米欧日研究開発の取組み～

FIND (Future Internet Design)／FIA(Future Internet Architecture)

研究開発

- 既存技術を前提としない“Clean Slate”アプローチ。
- FIND(2006年～2009年)では、萌芽的なプロジェクトを実施。 FINDの後継のFIA(2010年～2013年)では、4件のプロジェクトに収束させ、実証。
- マサチューセッツ工科大学、カリフォルニア大学バークレー校、ジョージア工科大学、ｽﾀﾝﾌｫｰﾄﾞ大学等が参加。

GENI (Global Environment for Network Innovations)

テストベッド

- 多様なアーキテクチャを実証するため、5つの形態のテストベッド構築を並行して実施し、競争的な設計・開発を推進。
- プログラマブルなノードのプロトタイプ開発とテストベッドの連携を重視し、また全米規模のMeso-scaleテストベッドを鋭意構築中。
- プリンストン大学、スタンフォード大学、ユタ大学、デューク大学、HP Labs等が参加。

US IGNITE

実証

- ホワイトハウス科学技術政策局(OSTP)と全米科学財団(NSF)が協力して推進する官民連携のイニシアチブ。
- 米国にとって重要度の高い健康、教育、エネルギー、経済開発等のためのギガビット級アプリケーションやサービスを開発。

Future Networks

- 助成プログラムFP7(2007年～2013年)で将来のネットワークに関する有望な研究テーマに対してファンディングを実施。
- ICT-Challenge 1.1として“**Future Networks**”を最重要視。
- エリクソン、SAP、テレフォニカ、Juniper Networks Ireland、NEC Europe等が参加。

FIRE (Future Internet Research and Experimentation)

- PCや商用ノードをベースとしたネットワーク仮想化ノードの開発や、有線/無線統合ネットワークの実現を重視。
- 現在FIRE 第2弾としてテストベッドおよびテストベッド上の実験主導型研究開発として多数のプロジェクトが実施中。
- ノキア、アルカテル・ルーセント、ドイツテレコム、フランステレコム、ブリティッシュテレコム等が参加。

FI-PPP

- 将来インターネット構築に向けた官民パートナーシップ(PPP) 。運輸、健康、エネルギー等の分野におけるビジネスプロセスとインフラの効率の向上等の課題に取り組む。
- 158の参加組織・企業 (18の学術機関) 、23の国(欧州外2)が参加。

新世代ネットワーク研究開発戦略プロジェクト

- 既存のインターネットの欠点を克服し、理想のネットワークを目指す研究開発プロジェクト。
- NICTを中心に委託研究・共同研究等の手法を駆使して研究開発を推進。
- 2015年度までにJGN-Xを新世代ネットワークのプロトタイプとすることを目標。
- NICT、NTT、KDDI、東京大学、慶応大学、京都大学、関西大学、NEC、日立、富士通等が参加。

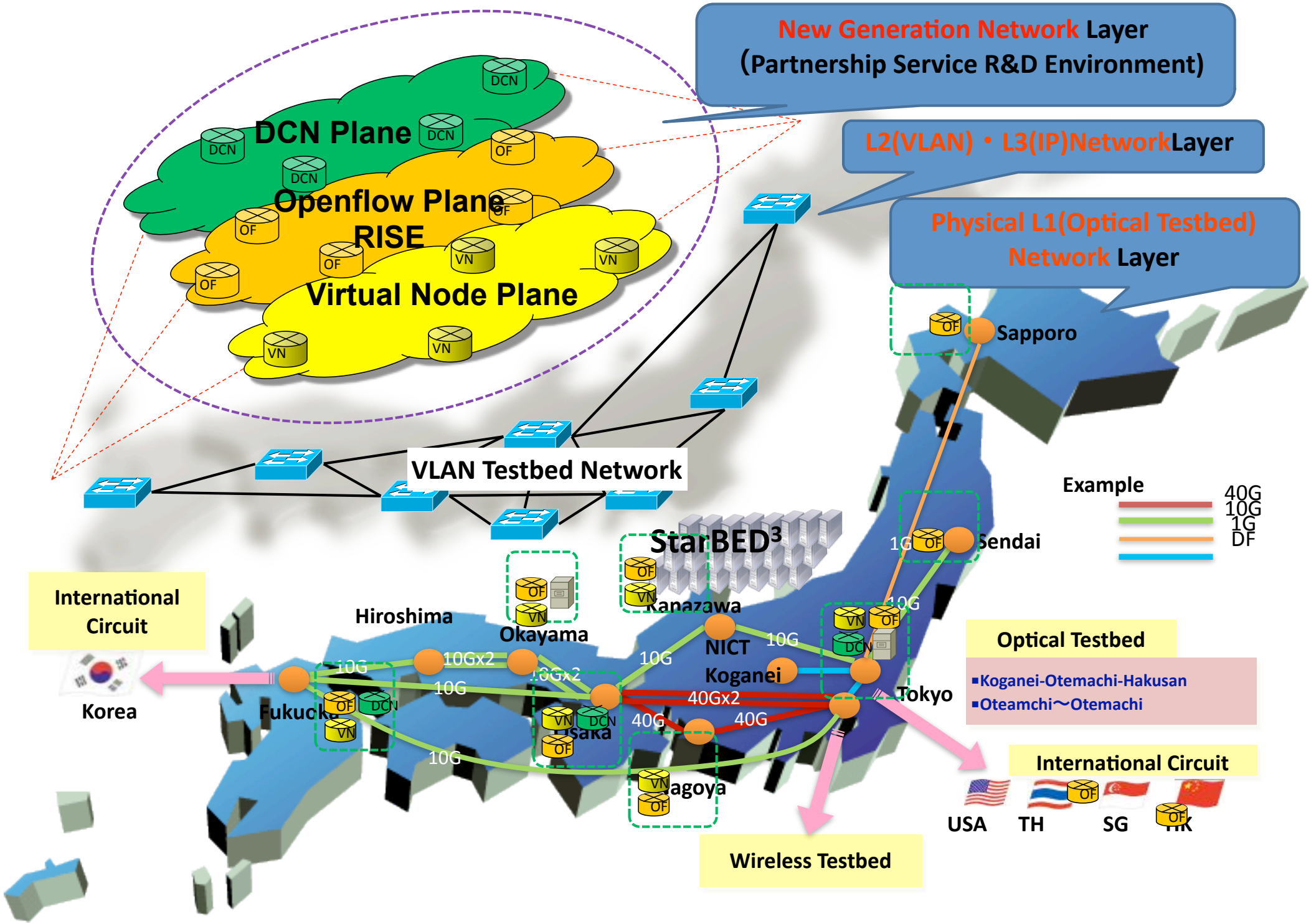
JGN-X

- 新世代ネットワーク技術の実現とその展開のための新たなテストベッドとして2011年から運用開始。
- 物理レイヤ(ファイバ)から、L2、L3の接続を提供するだけでなく、計算機クラスタによるサービス(アプリケーション)レベルまでの統合試験環境を提供。
- NTT、KDDI、東京大学、朝日放送、NEC、富士通、日立等が参加。

現在検討中。

Joint call with EU

JGN-X Network infrastructure Overview



What is the StarBED (*BED) ?

- It's an Internet/Ubiquitous System Emulator/Simulator
  - Re-configurable cluster supporting various user requirements
  - Large scale
    - over 1000 PCs

Concept of StarBED

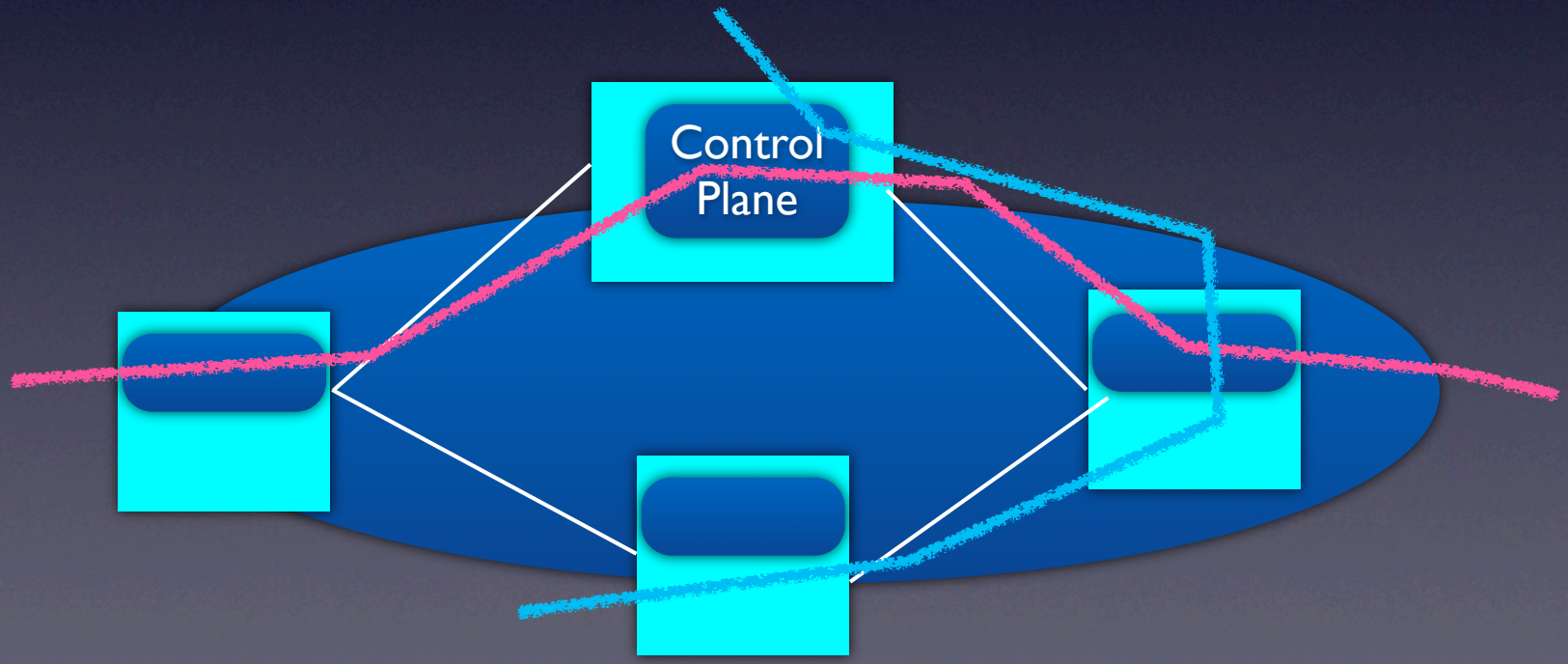
- Verification using Accurate Emulation
  - Verify Actual Running-Codes as in Operate, in Wall-Clock
    - PC, Embedded System, ...etc.
  - Large Emulation Capacity
    - PC level: 1000 Physical nodes (over 10K using VM)
    - Micro-sensor level: over 1million nodes
  - Configurable Network topology
    - Flexible L2 topology configuration using Redundant network switches and VLAN
    - L3 Routing emulations
      - PC-based routers
      - Installation of commercial routers at plug-in points
  - External connectivity
    - External connectivities are available for both:
      - Control Path/Simulation Data Path
    - Connection to:
      - JGN-X (10GbE), JAIST (10GbE), and WIDE Project (10GbE)

New Generation Network Technology

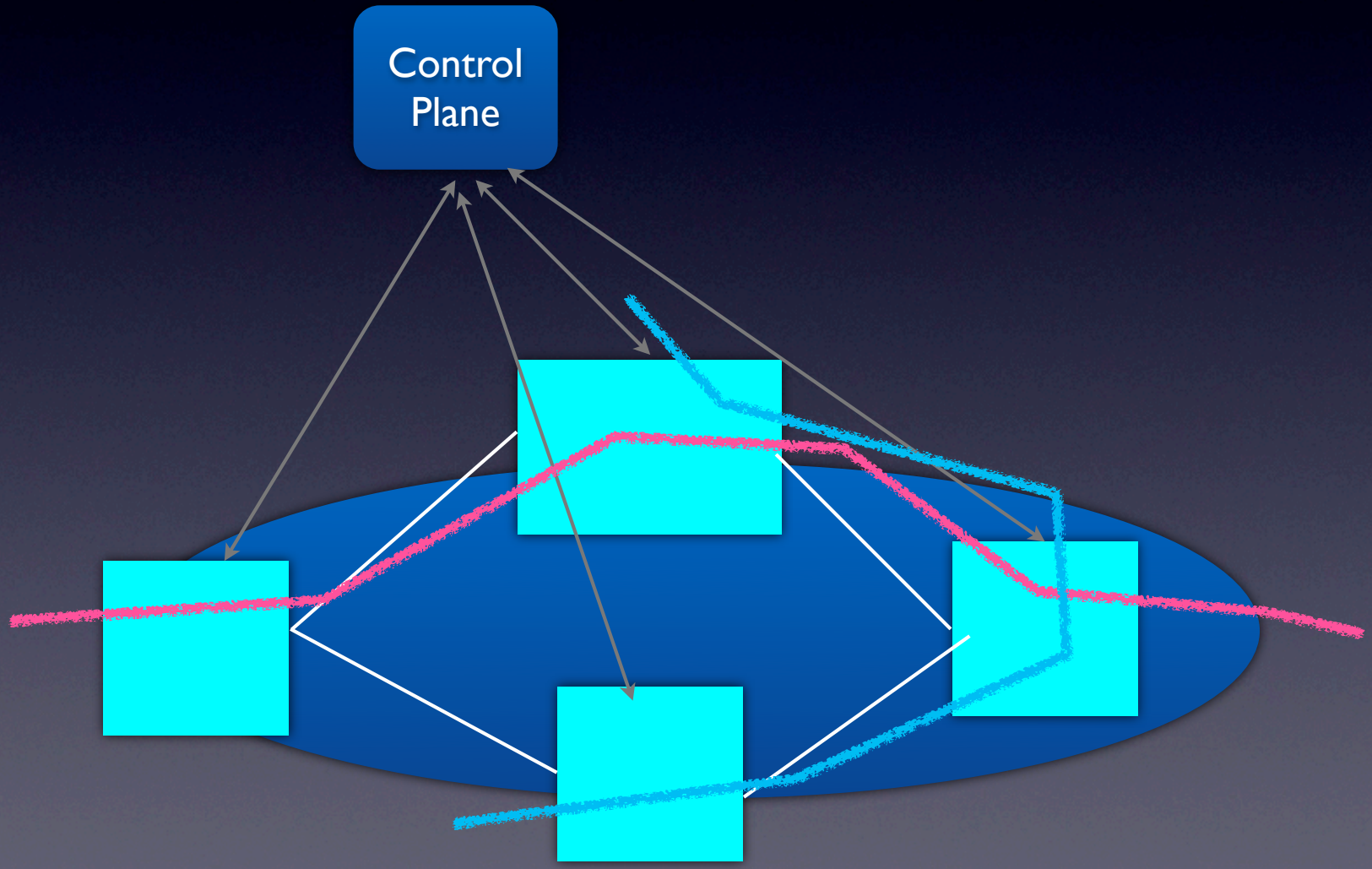
- Network Virtualization
- Programability on Network
- ID/Locator Separation
- Contents Oriented Network
- In Network Processing
- Optical Networking
- Wireless Networking

SDN=
Software Defined Network

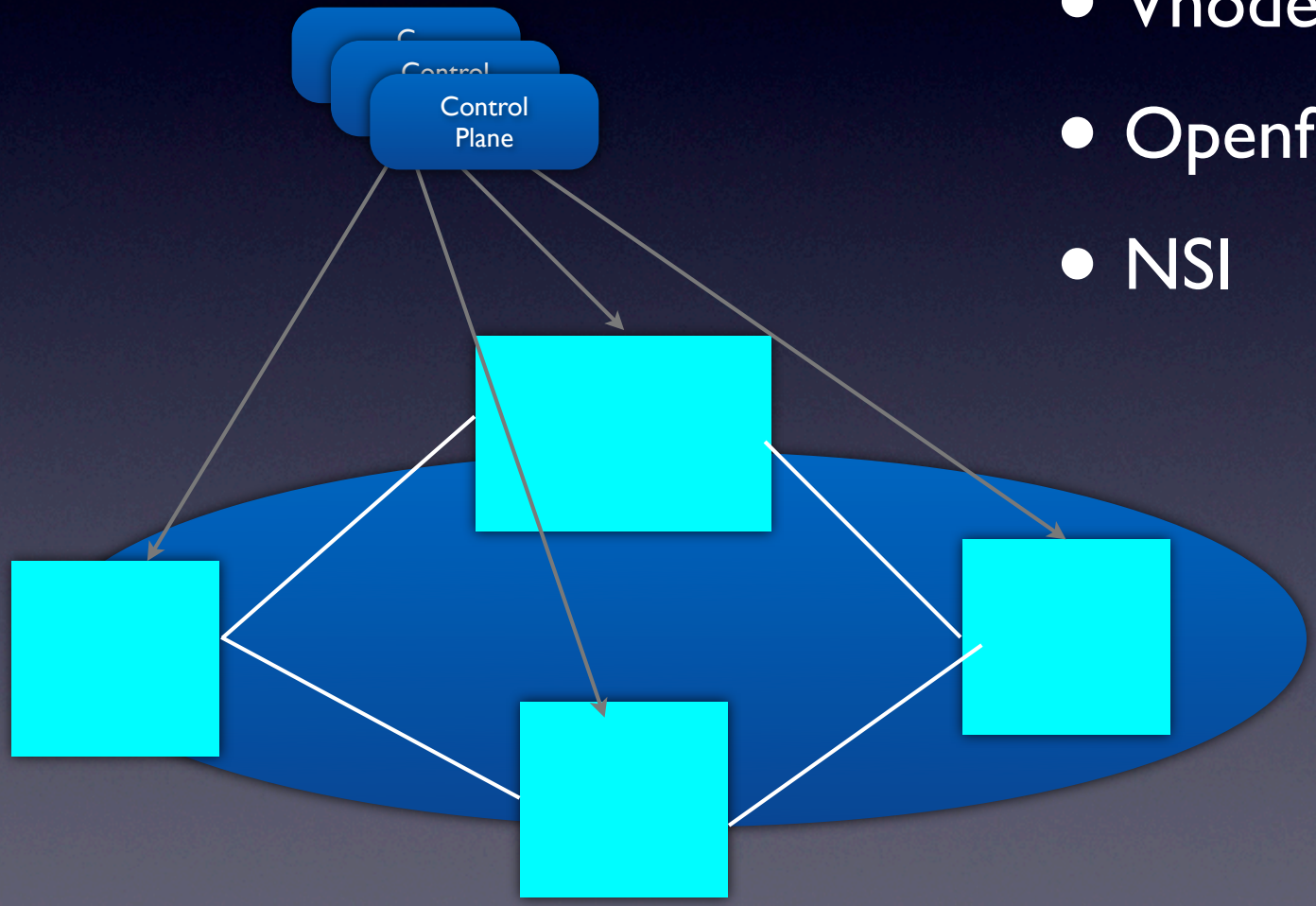
Software Defined Network



Software Defined Network

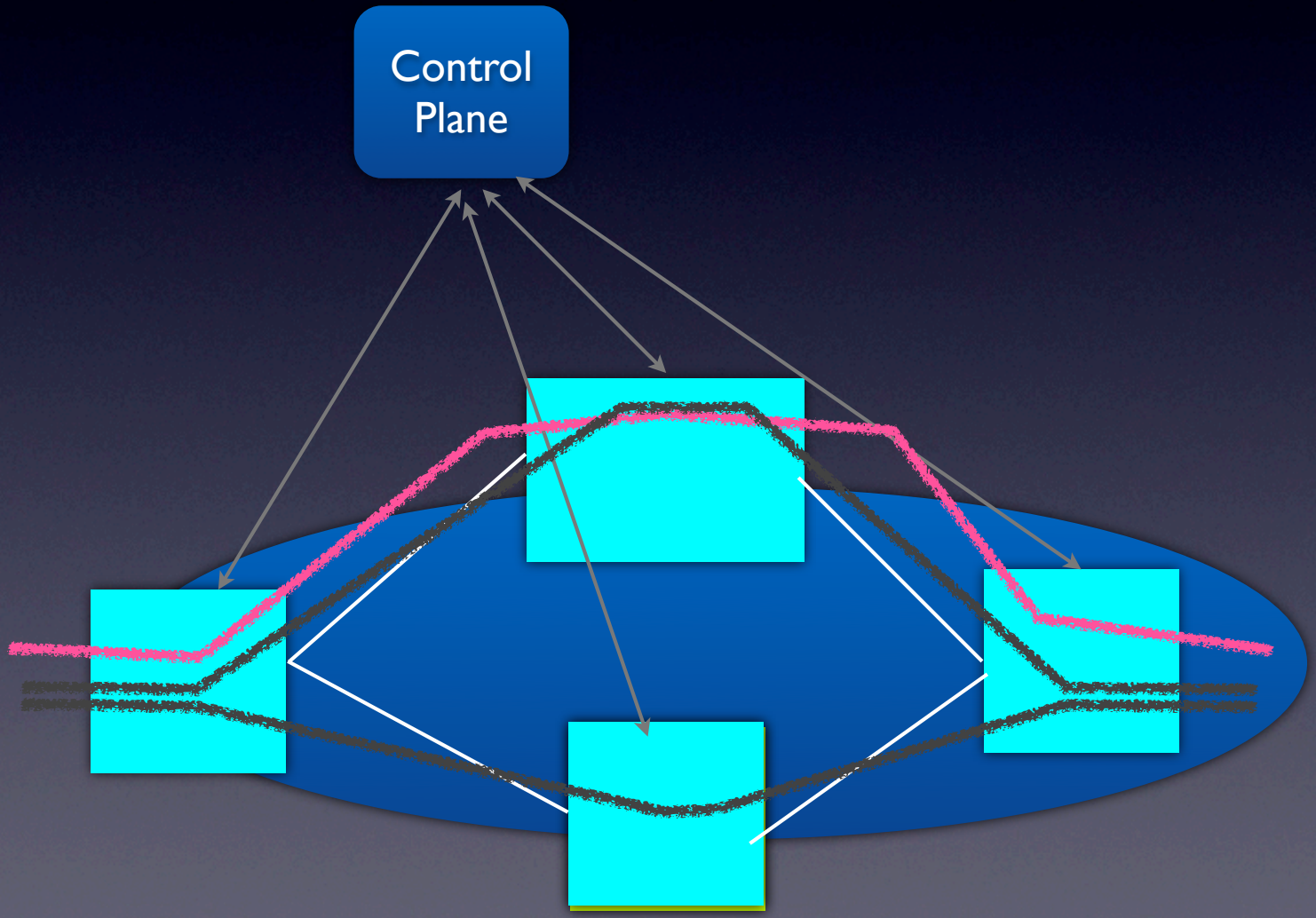


Software Defined Network



- Vnode/Corelab
- Openflow
- NSI

path aggrigation for maintenance



SDN makes network design easy

- SDN gives you
  - programability of network design
  - central control of all network device
  - network virtualization
- Network Operation and configuration becomes centralized.
- Effective sharing of resources brings reduction of CAPEX&OPEX.
- Advanced network control such as
  - path aggregation for maintenance
  - selective use of network appliance
  - dynamic path addition for scale out

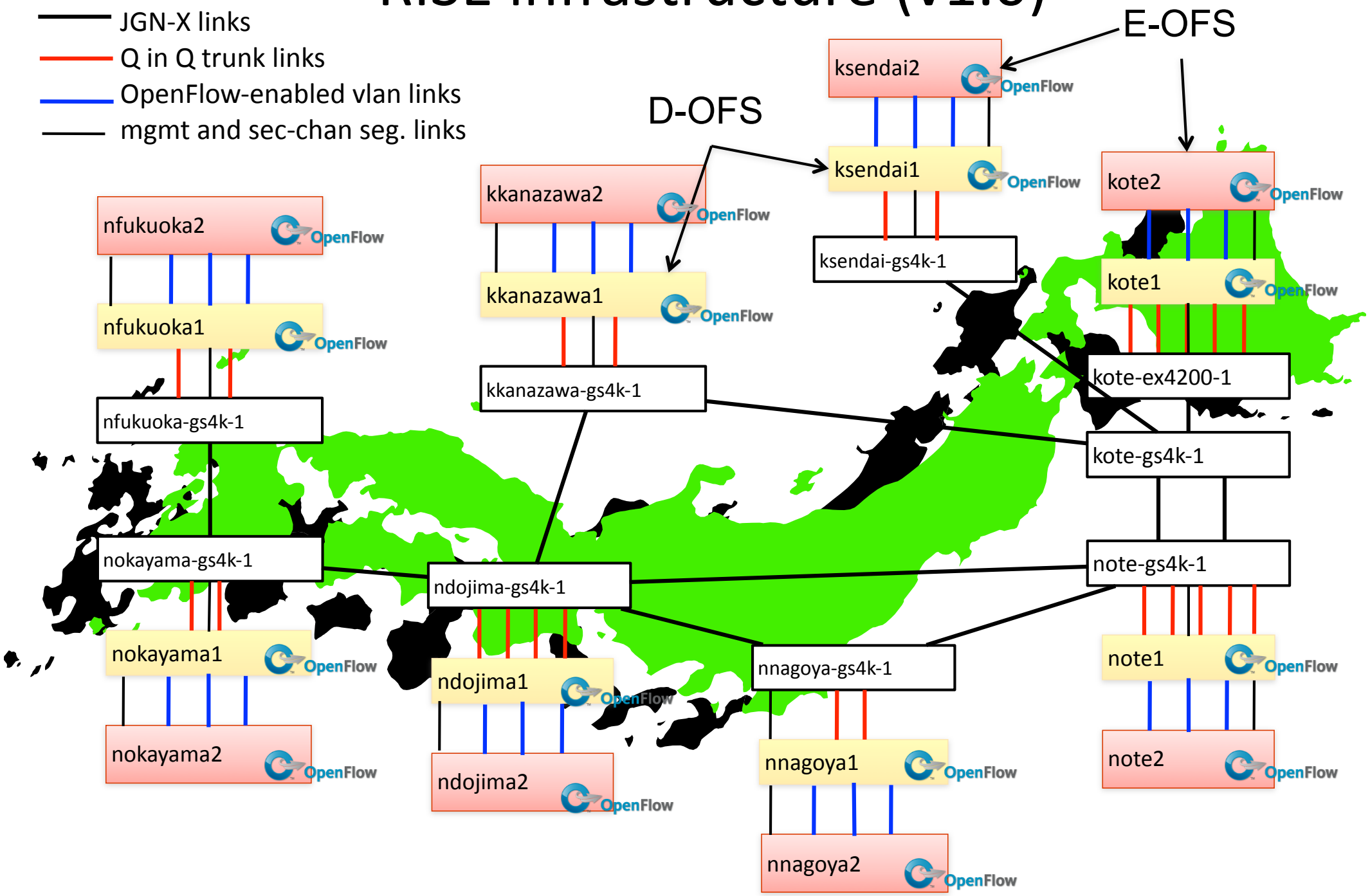
Our challenge

- Is SDN possible in wide area
  - Technology
  - Management
  - Business model

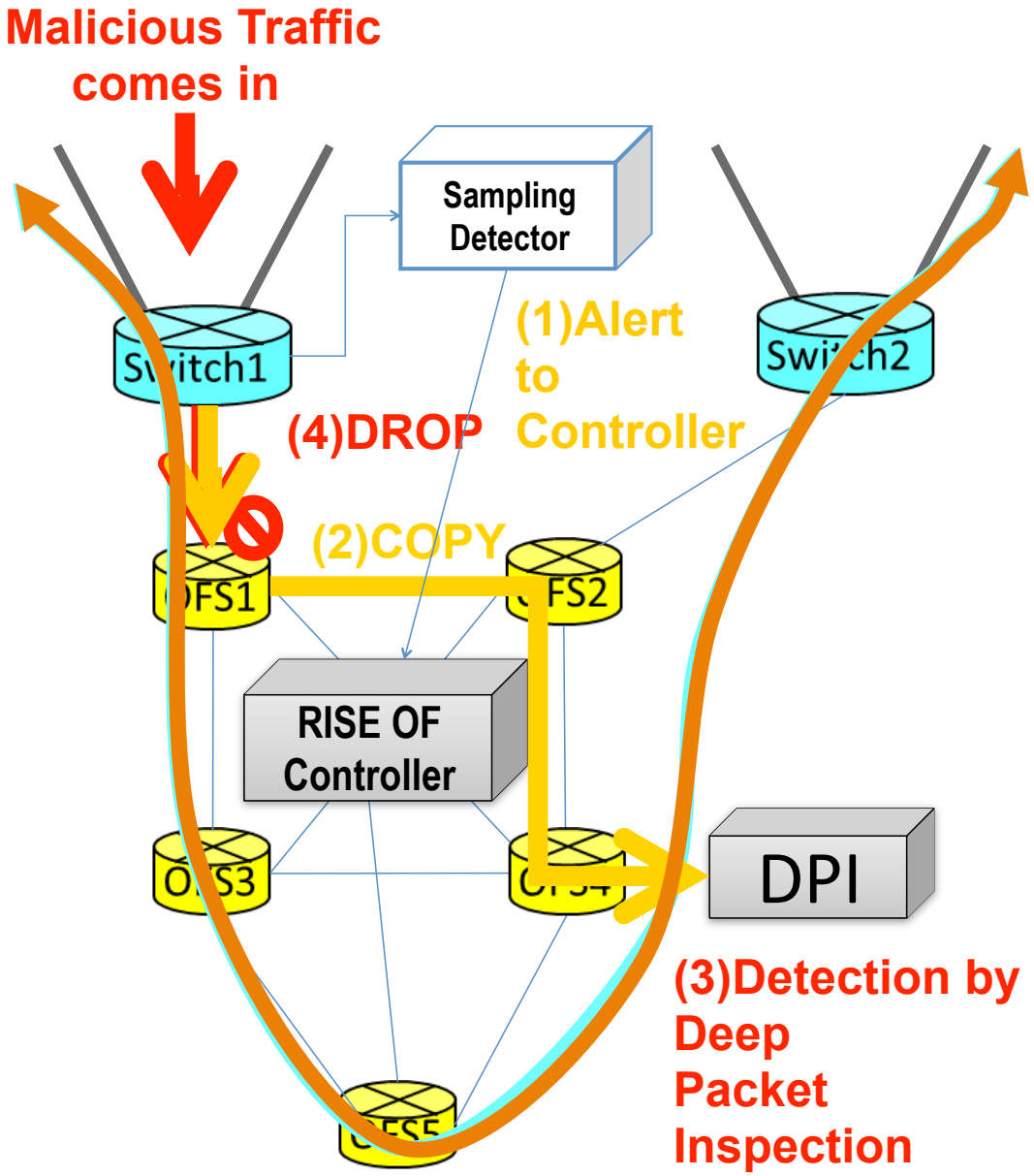
RISE: OpenFlow/SDN Testbed

- A large-scale OpenFlow/SDN testbed on JGN-X
  - for researchers, students, engineers, operators, …
- Challenges
  - Initially, demonstration of wide-area deployment of OpenFlow technology (since 2009)
    - Design of under-lay network architecture (tunneling)
    - Know-hows in shooting OpenFlow network troubles
  - Now, development of OpenFlow testbed with …
    - User isolation that allows user-defined controllers
    - Interconnection of various testbed facilities such as network emulator, wireless/optical network testbed, cloud infrastructure, …

RISE infrastructure (v1.0)

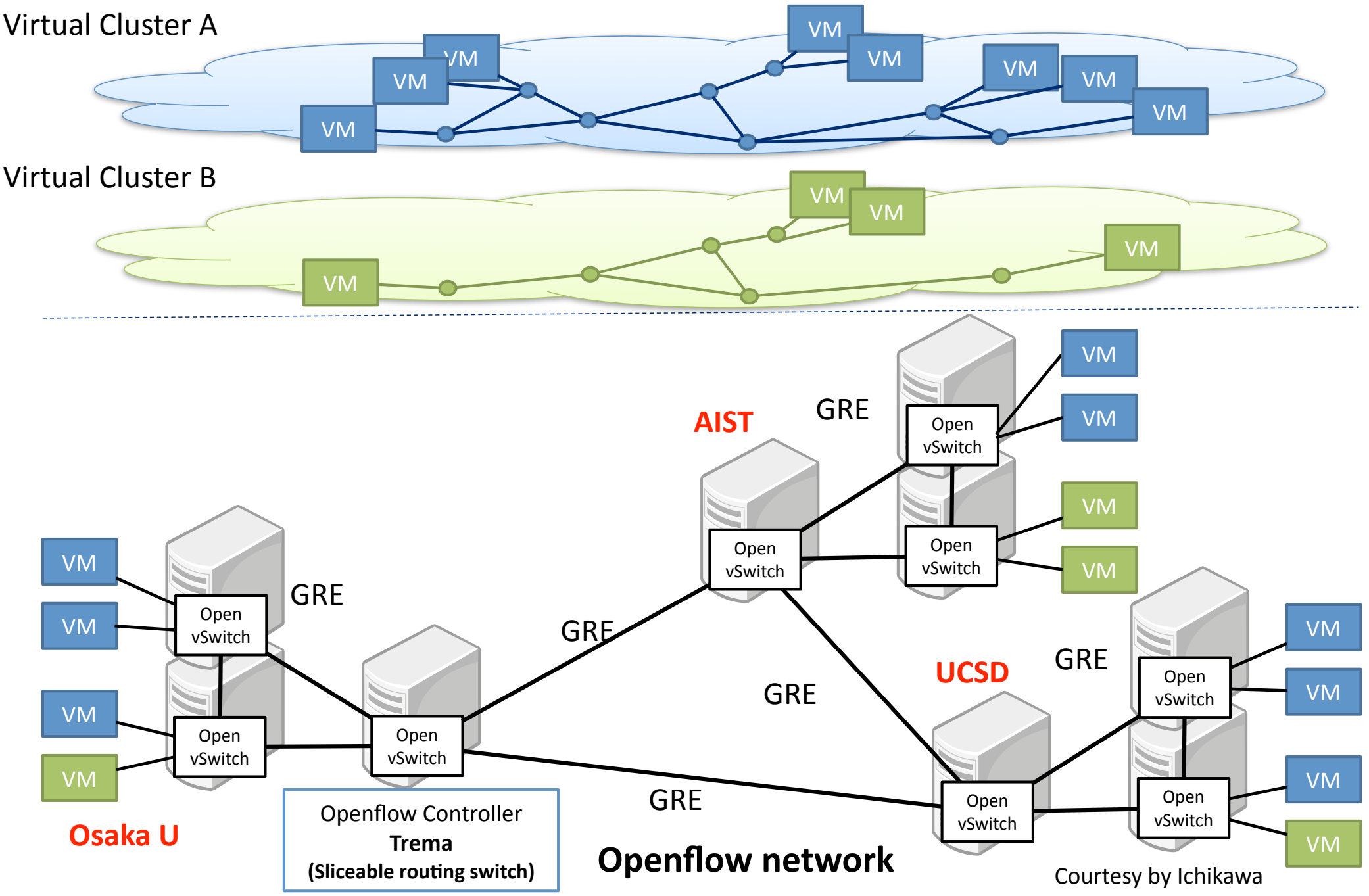


Interop Tokyo 2012 Demonstration



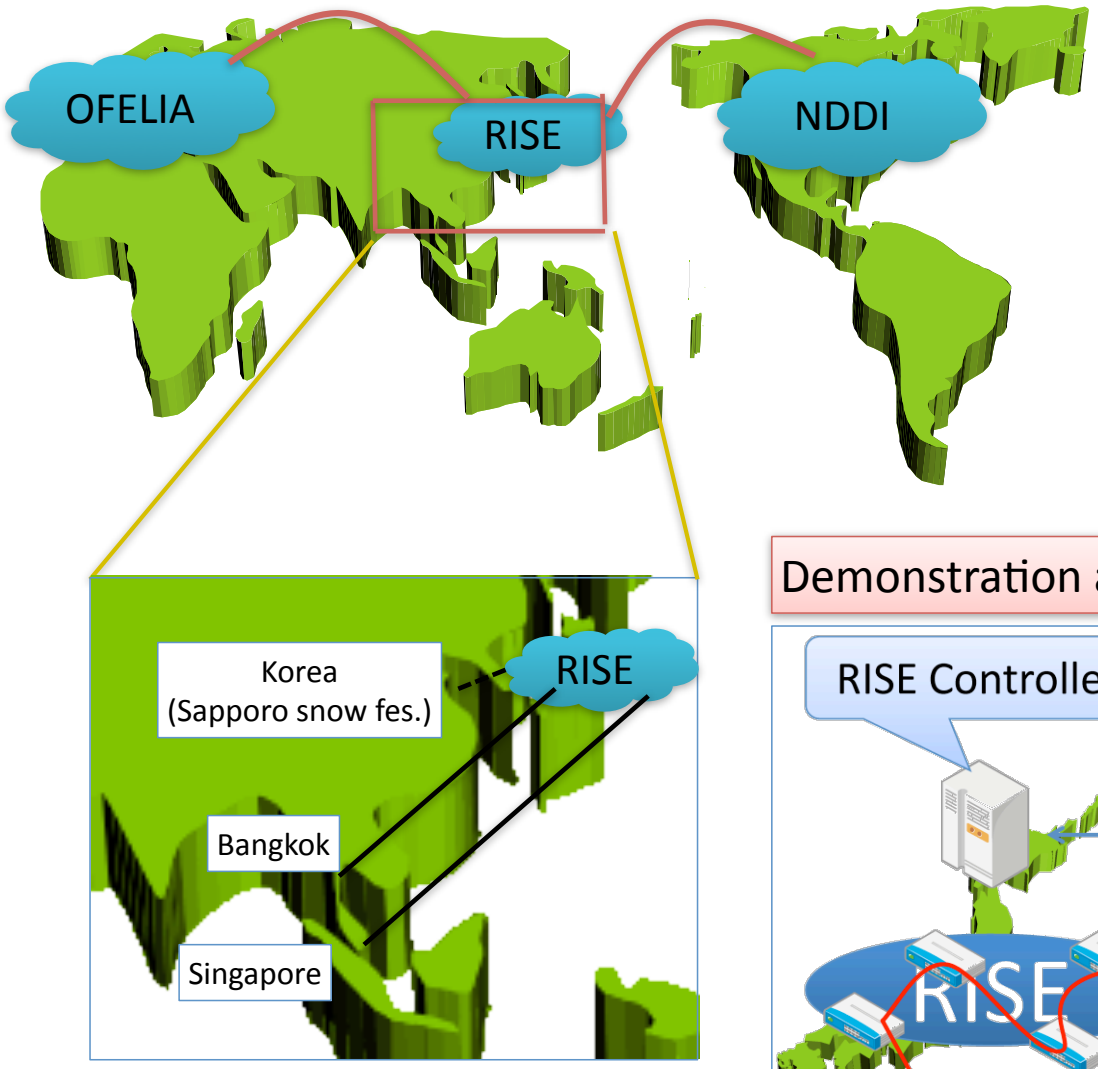
Demonstration Scenario:

- Malicious traffic comes in, and sampling detector finds suspicious traffic flow
- Detector sends alert to RISE OpenFlow Controller
- RISE Controller copies suspicious flow to DPI machine
- RISE Controller drops the flow


Virtual Cluster A
VM
VM
VM
VM
VM
VM
VM
VM
Virtual Cluster B
VM
VM
VM
VM
AIST
GRE
Open vSwitch
Open vSwitch
Open vSwitch
VM
VM
VM
VM
GRE
GRE
GRE
GRE
UCSD
GRE
Open vSwitch
Open vSwitch
Open vSwitch
Open vSwitch
Open vSwitch
VM
VM
VM
VM
VM
VM
VM
VM
Osaka U
Openflow Controller
Trema
(Sliceable routing switch)
Openflow network
Courtesy by Ichikawa

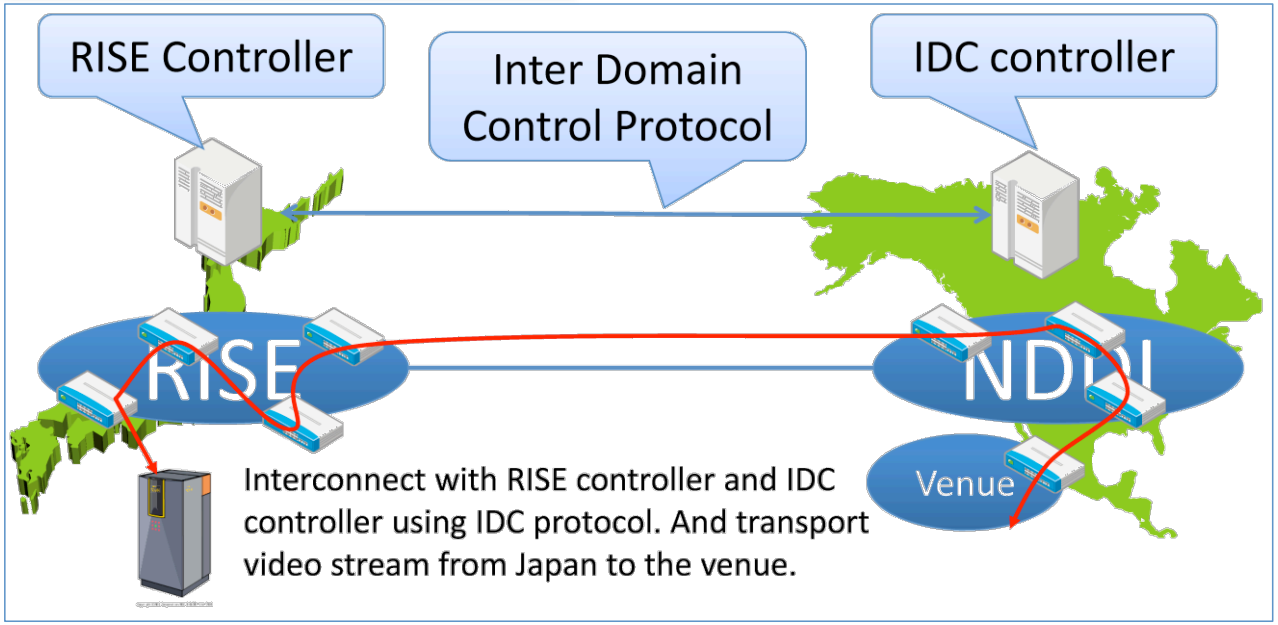
DEMONSTRATIONS @ SC12

Towards global OpenFlow testbed



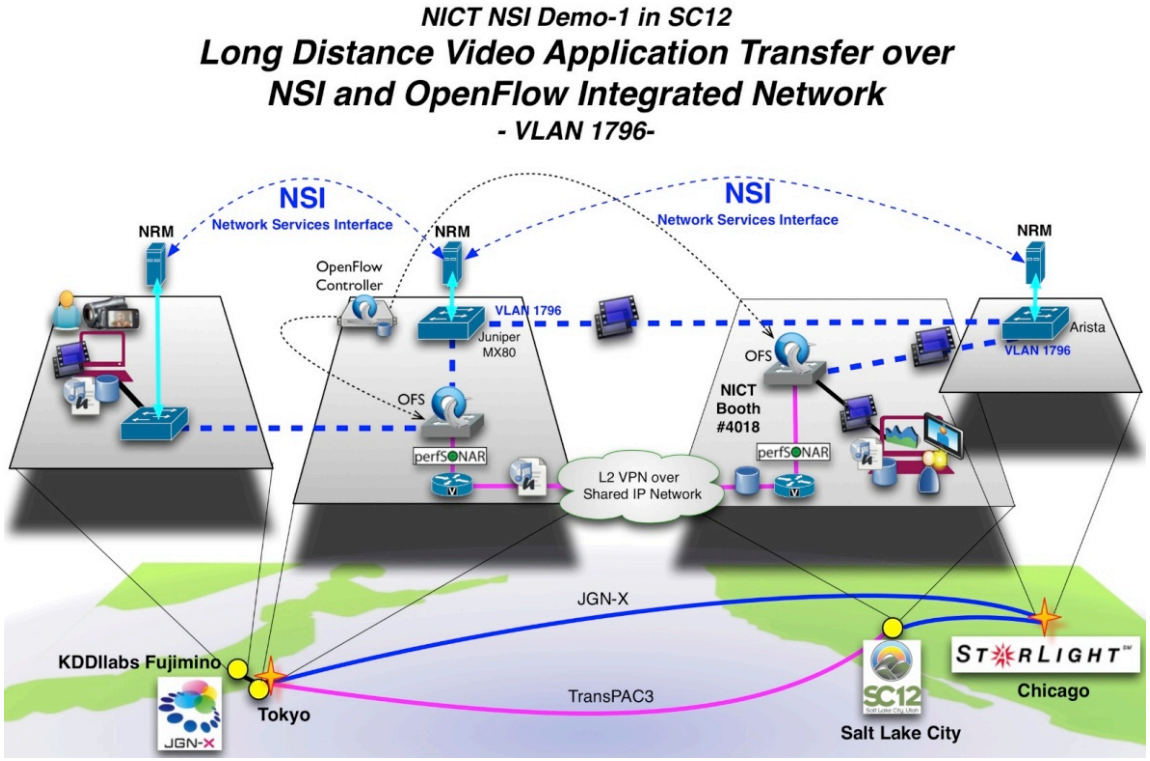
- Inter-connection among OpenFlow testbeds
  - RISE, OFELIA (EU), NDDI(US), and some Asian countries.
    - With OFELIA, starting from using each other's OF testbed by OpenVPN
    - With NDDI, RISE will inter-connect utilizing OESS

Demonstration at SC12



Integration of NSI and OpenFlow

- Application (Flow) based inter-domain route selection is demonstrated by Integrate OGF NSI, OpenFlow and PerfSONAR functions to realize multi-domain SDN.
- Automatic path selection based on PerfSONAR performance measurement.
- Run three applications (A-GOLE, SDN, Cloud IMS) at the same time.
- Update Web services interface to NSI Connection Service v2.
- Introduce NSI Disocvery Service v1 to publish supported services.



Future plan

- NSI production service slate to start in JGN-X for provisioning inter-domain transport link.
- Connection and performance verification of dynamic provisioned network.
- Establishment of NSI and SDN integration technology.

Cloud-based IMS

Research and Development of Realizing Disaster Tolerance and Electric Power Saving based on Cloudizing Telecommunication Network†

Realize operational optimization over total network system by collaboration with flow-based transport and Service Control

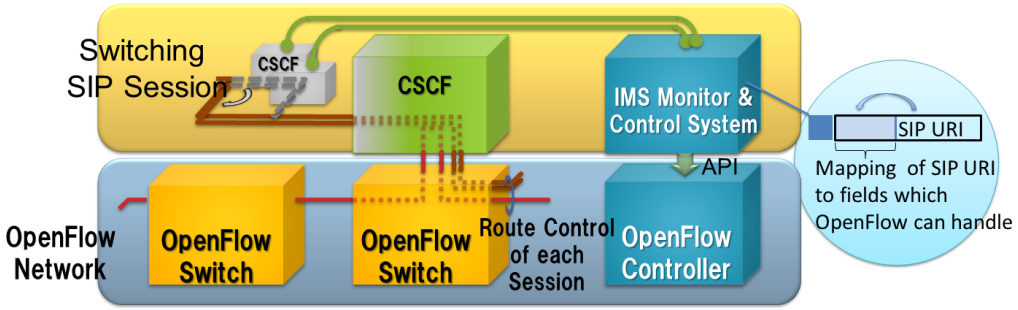
- Realize "IP agnostic" SIP session control by mapping of SIP session and OpenFlow controllable flow

  【Dynamic re-configuration】 Even if the CSCFs* which are processing sessions move to servers in another data center, their sessions can be also moved to those servers by the route control of Open Flow

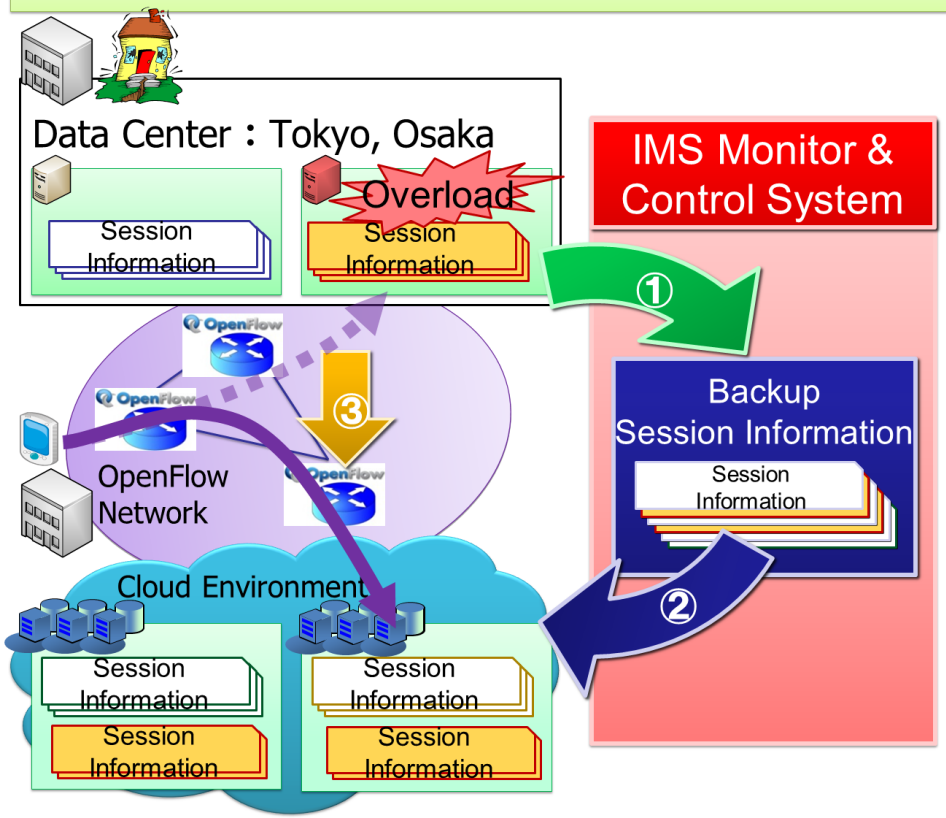
  【High Reliability】 Sessions being processed at a damaged server by disaster or failure are moved to another data center without any interruption

  【Electric Power Saving】 Improvement of operational efficiency by consolidating sessions on several servers during off-peak times

* CSCF (Call Session Control Function) : Function of control a call(SIP) session in IMS



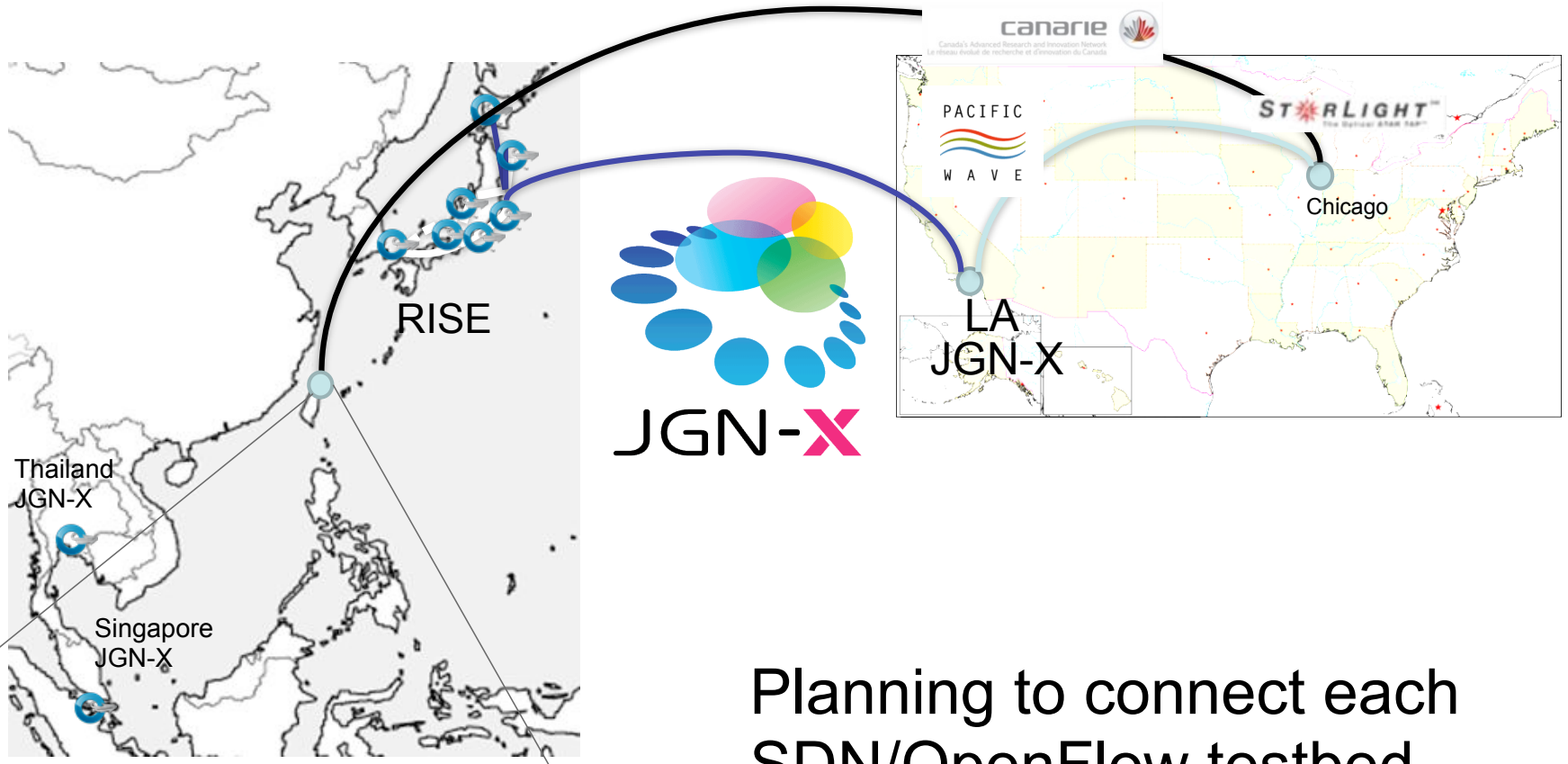
Procedure of Call Session Restoration and Continuity in case of disaster and failure

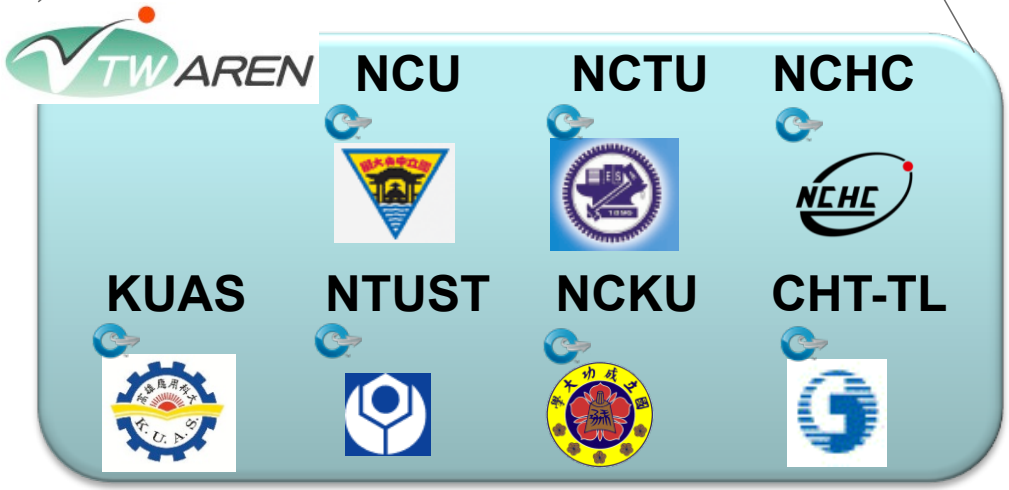


① Back up session information efficiently during a call
② Restore session information on servers in cloud environment
③ Update routes between terminals and servers at once

† This system is developed by the national project entitled with the "research and development toward the construction of advanced green cloud platform" funded by the Ministry of Internal Affairs and Communications

Collaborating with TWAREN



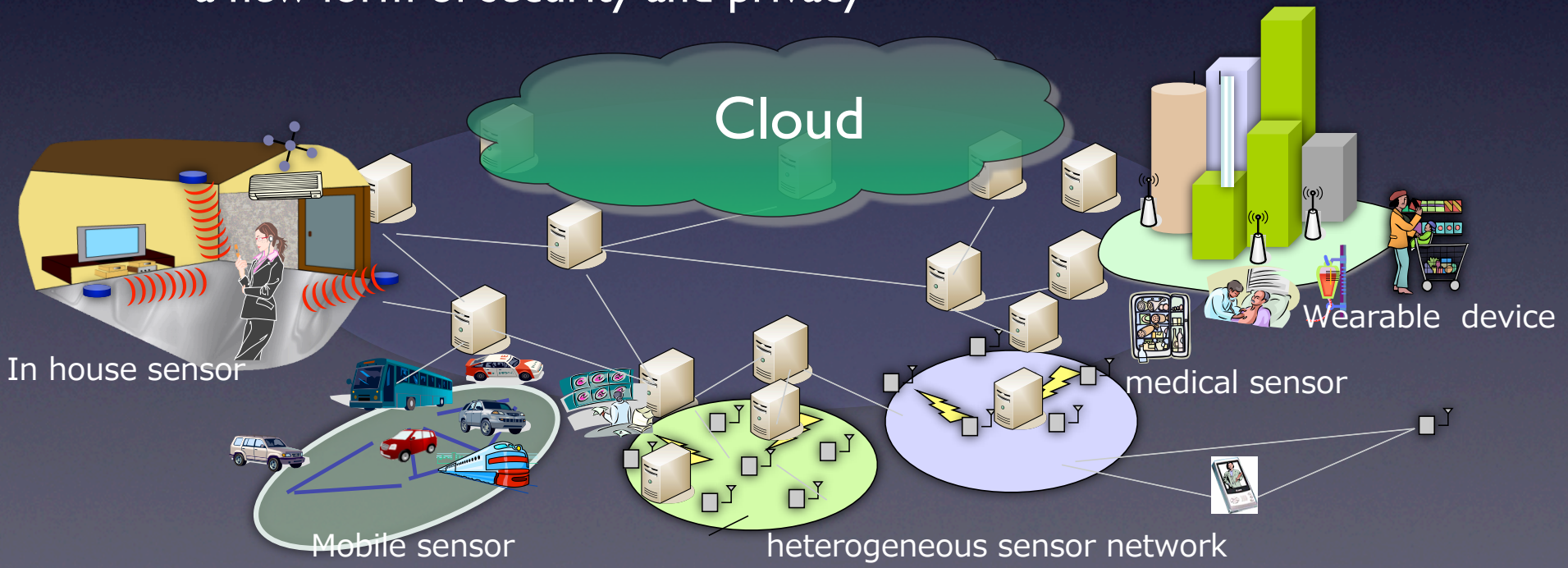


Planning to connect each SDN/OpenFlow testbed through US academic networks.

(As of Nov.2012 : Connected via StarLight / PacificWave with L2 path)

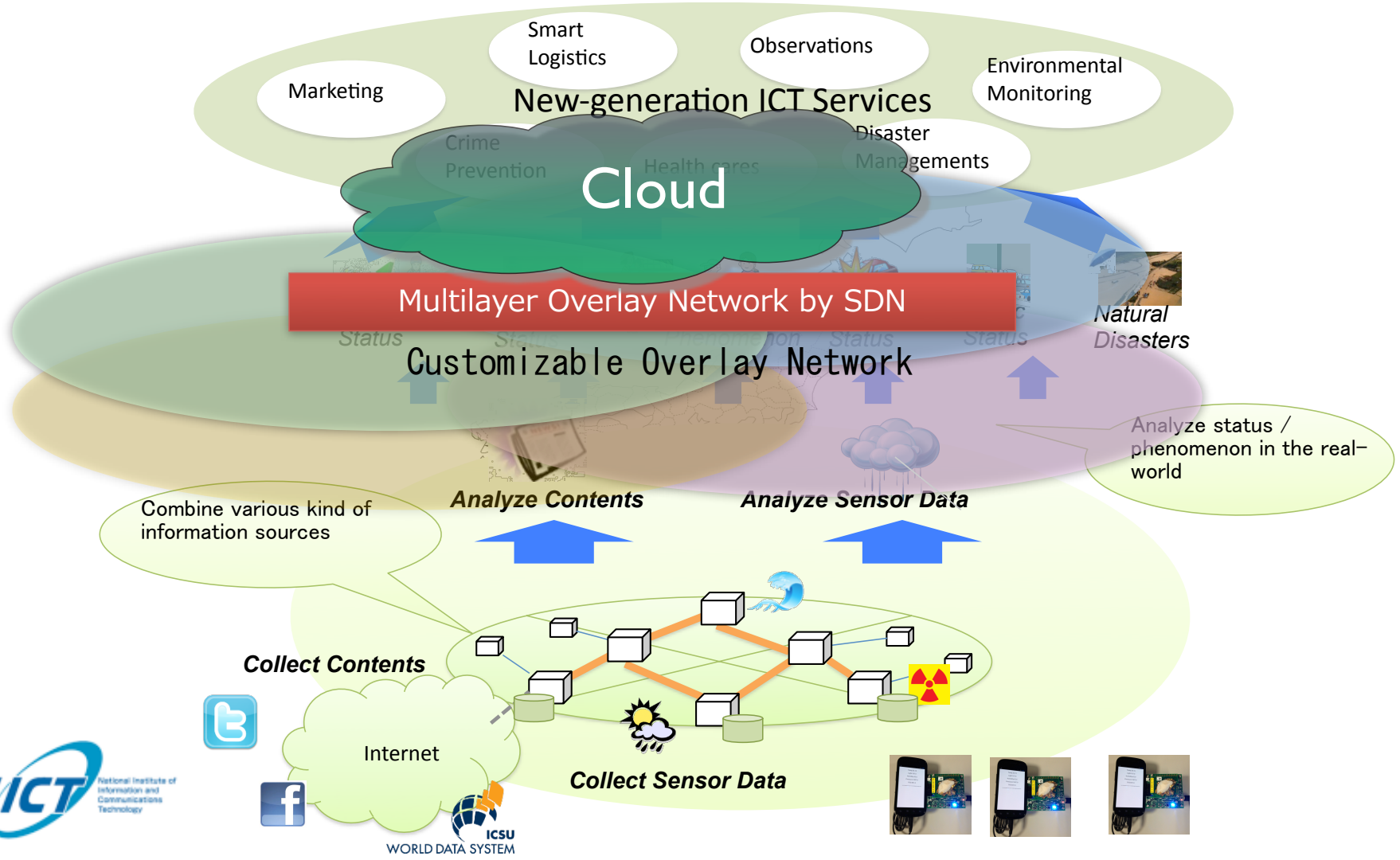
Smart X = Cyber Physical System

- IoT (Internet of Things)
  - billions of data sources, large scale data
  - mobility, charn
  - feature as a group or a set
  - a new form of security and privacy



Ongoing research project:
Platform for the real-world analysis

The aim of the project is to provide a platform for real-world analysis using various data sources such as sensors, contents of the social network services, etc.



Global Testbed is the field

Thank you

Presented version is here!
https://sites.google.com/site/sshimojo/talks