

# **KREONET SOFTWAREIZATION**

- KREONET SD-WAN Deployment based on ONOS-

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**Open Networking Korea 2015**

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- KRE○NET-S\* as the Next KREONET
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# KISTI, R&D Partner for the Better Society

## Provide Research Infrastructures

For the advancement of national scientific, technical, and industrial development



## Do the Research

For leading the new research paradigm  
And providing better services

As a national institute focused on S&T information, supercomputing, and research networking, KISTI plays a key role in facilitating the national R&D competitiveness

# Background of KREONET-S\*

<< Nationwide 17 Regional Centers in Korea (~100Gbps), 3 International Connections to the US and China (~20Gbps), Global Research Network Collaborations (GLIF & GLORIAD), ~200 member institutions, Supercomputing/Advanced Application Services >>

\*\*\* 24 x 7 Network Operations Center \*\*\*



**Toward Software and User driven Virtualized, Dynamic, and Flexible Environment**  
 from Hardware-based Fixed, Closed Network Infra & Services

**Map of  
 KREONET & GLORIAD**



Global Ring Network for Advanced Applications Development



# KREONET (Top 10) Advanced Applications



**Deterministic Network Performance and QoS**  
for ~100G Data Transfer

Weather & Climate



High Energy Physics



Education & Collaboration

**User-oriented Dynamic & Flexible Networks**  
for **Time-to-Research & Time-to-Collaboration**

Medical Science

Future Internet



Astronomy

**Very Reliable and Security-guaranteed Networks**  
for Collaborative Research



New Medicine/Bio



Culture & Art

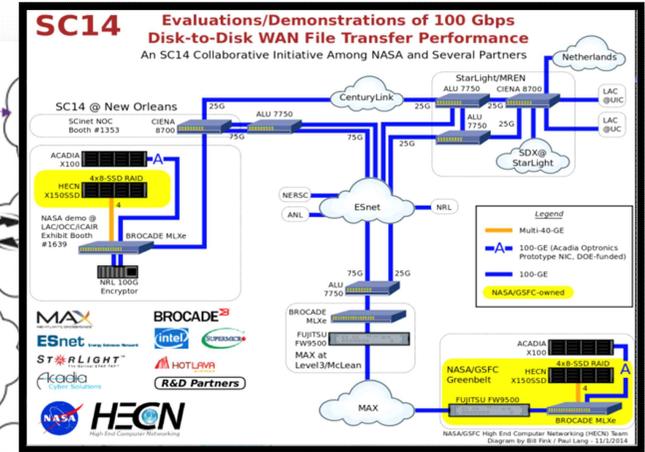
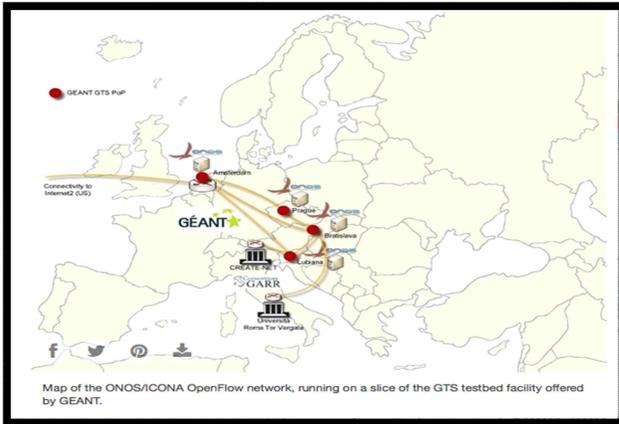


Constructions

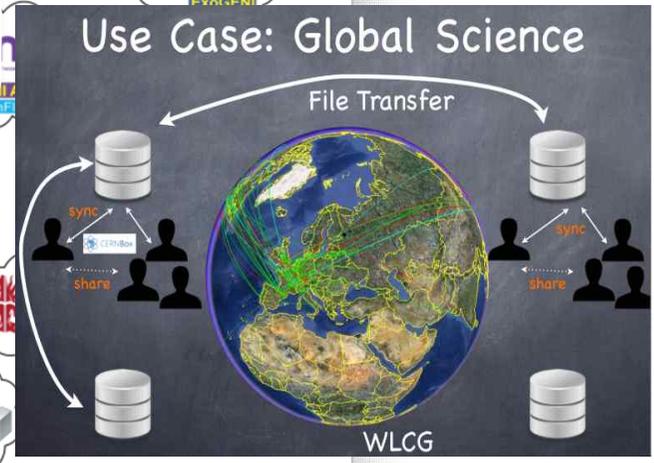
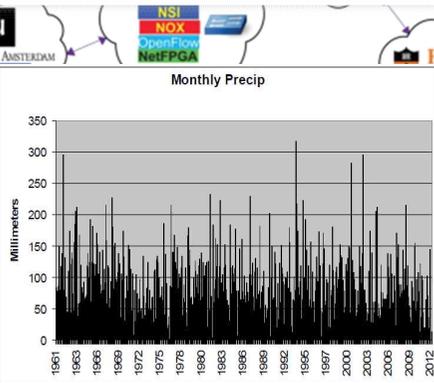
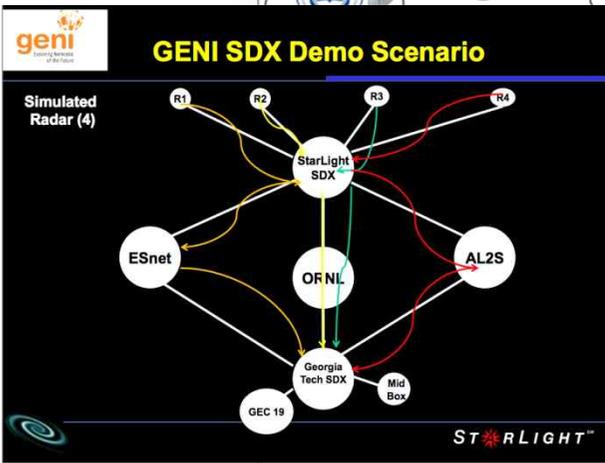


Supercomputing

# Global Collaborations



**New Network Environment**  
for Global and Domestic  
Experimenters & Researchers



Source: ONOS ICONA Project, SC14 Demos, StarLight's SDX Project

# The Next: KREONET-S\*

- **KREONET-S\* Main Goals**
  - **Carrier-grade Reliable “Public SD-WAN” Operations**
    - Distributed Controls and 24 x 7 Network Operations
  - **New User Interfaces, Services, and Experiences**
  - **Multi-vendor and Multi-layer Network Infrastructure**
- **Principal Building Blocks**
  - Northbound (Apps & Services): **VDN, UoV, vSciZ**, etc.
  - Southbound: **OpenFlow**, TLI, NETCONF, etc.
  - East-Westbound: **Distributed Controls**
    - **KISTI/KREONET - ONOS Affiliate** (in a joint effort with KAIST)
    - Service Composition: KREONET COREEN Platform, vSciZ, etc.

# The Next: KREONET-S\*

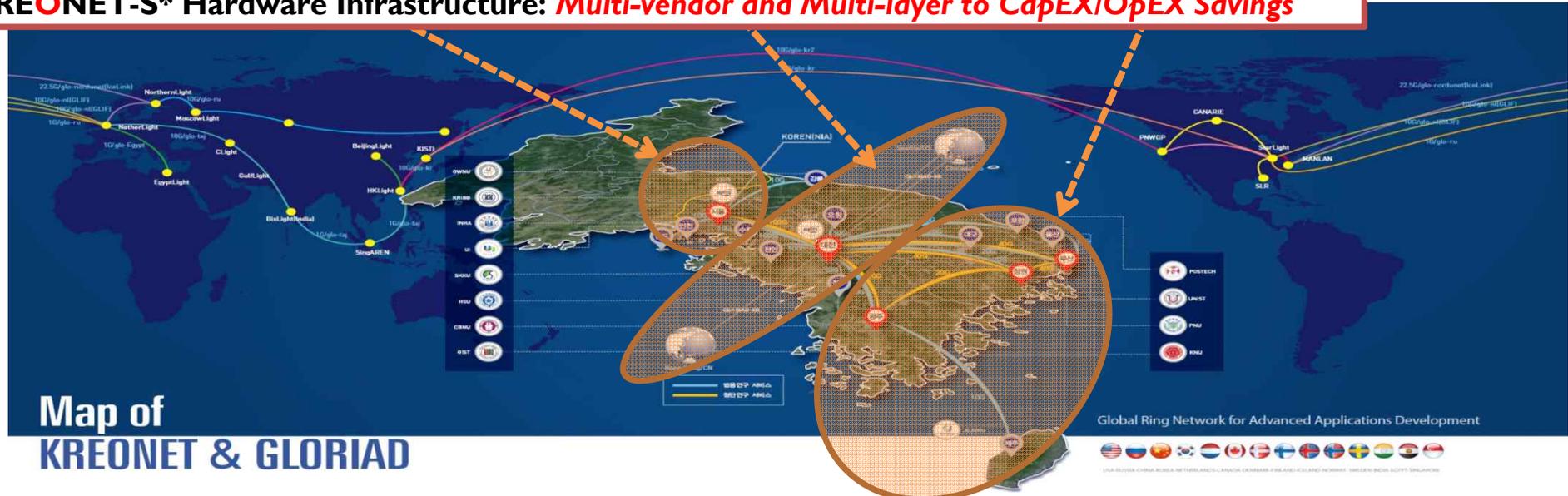
**KREONET-S\* Applications & Services: *High Performance, Advanced Security, New User Services & Experiences***



**KREONET-S\* Controller Infrastructure: *Carrier-grade High Availability/Failover and Scalability***



**KREONET-S\* Hardware Infrastructure: *Multi-vendor and Multi-layer to CapEX/OpEX Savings***

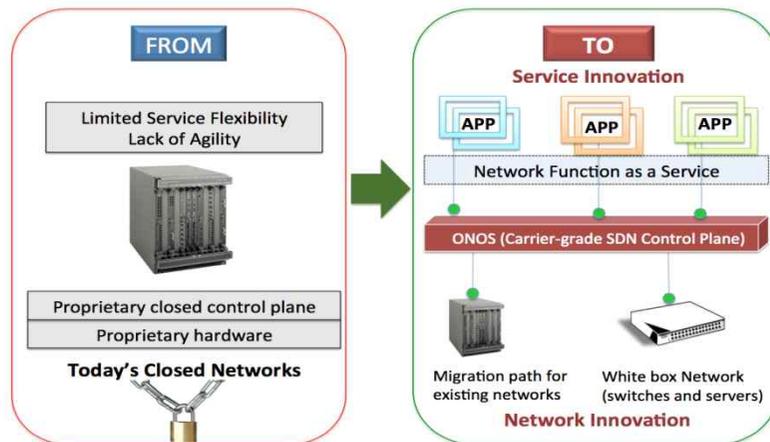


# The Next: KREONET-S\*

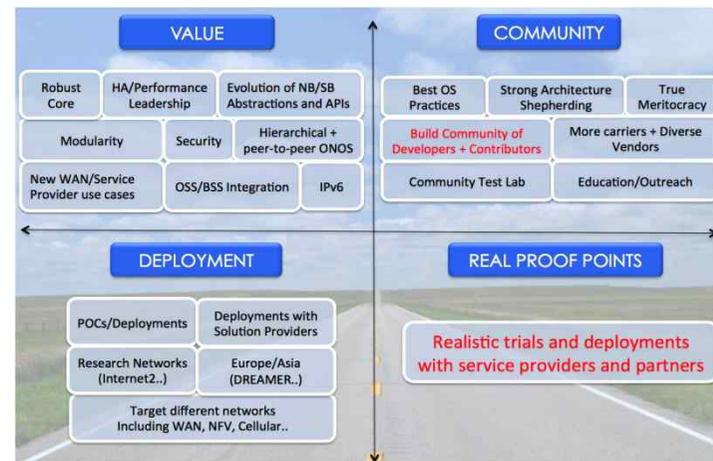
- Embracing Open Technologies
  - OpenFlow, OVS, OPNFV, OpenStack, Many others..
  - **ONOS Affiliate**
    - Technical collaborations for ONOS deployment
    - Setting up discussion channel for operational experiences
    - Applying various SDN applications on KREONET-S\*

## ONOS Vision for Service Provider Networks

Enabling Service Provider SDN adoption for carrier-grade service and network innovation



## ONOS in 2015

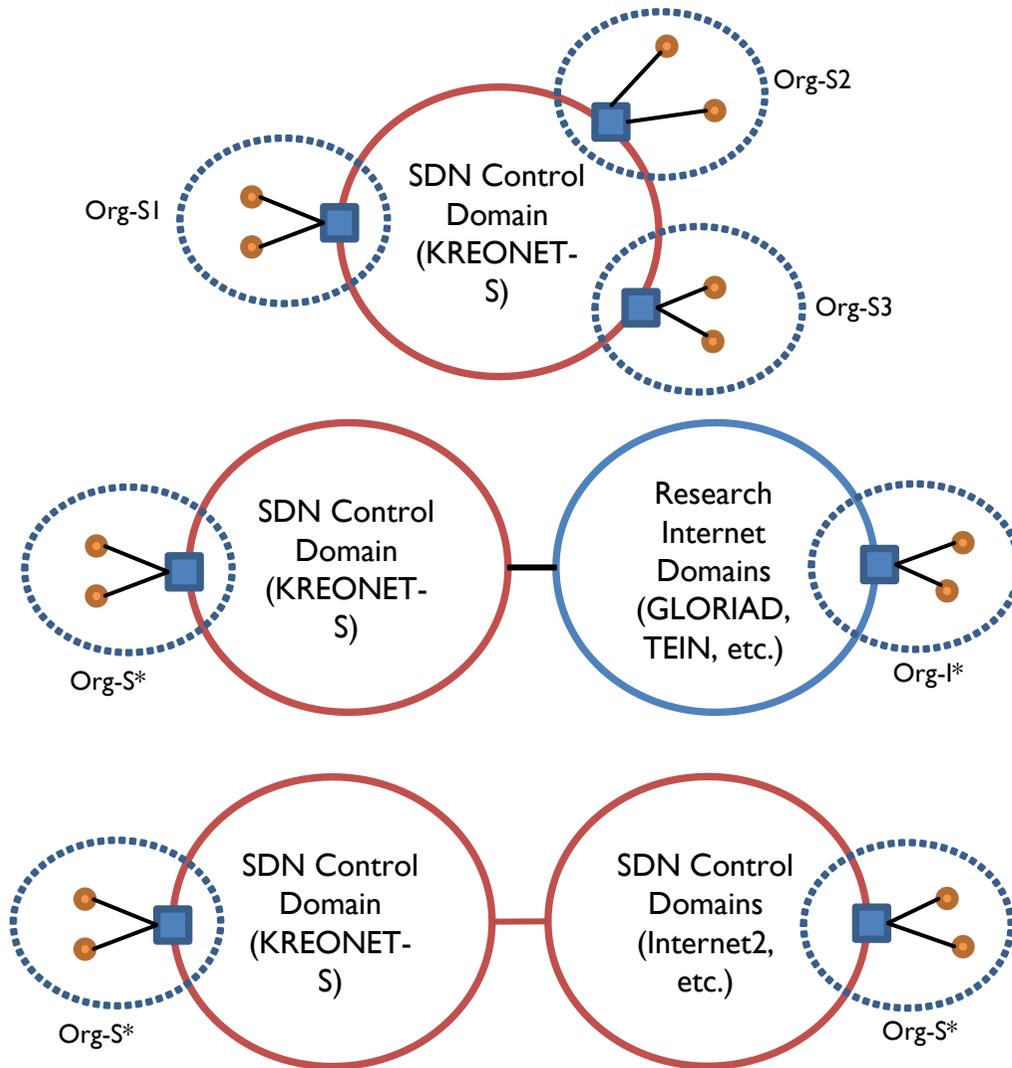


# KREONET-S\* Roadmap

## KREONET SOFTWAREZATION Phase I by 2017



# KREONET-S\* Service Types



## Pure SDN Services

- Deterministic QoS & Performance
- Virtually Isolated User Group Networks
- Enhanced Security & New User Experiences
- User-centric Open Networking Environment

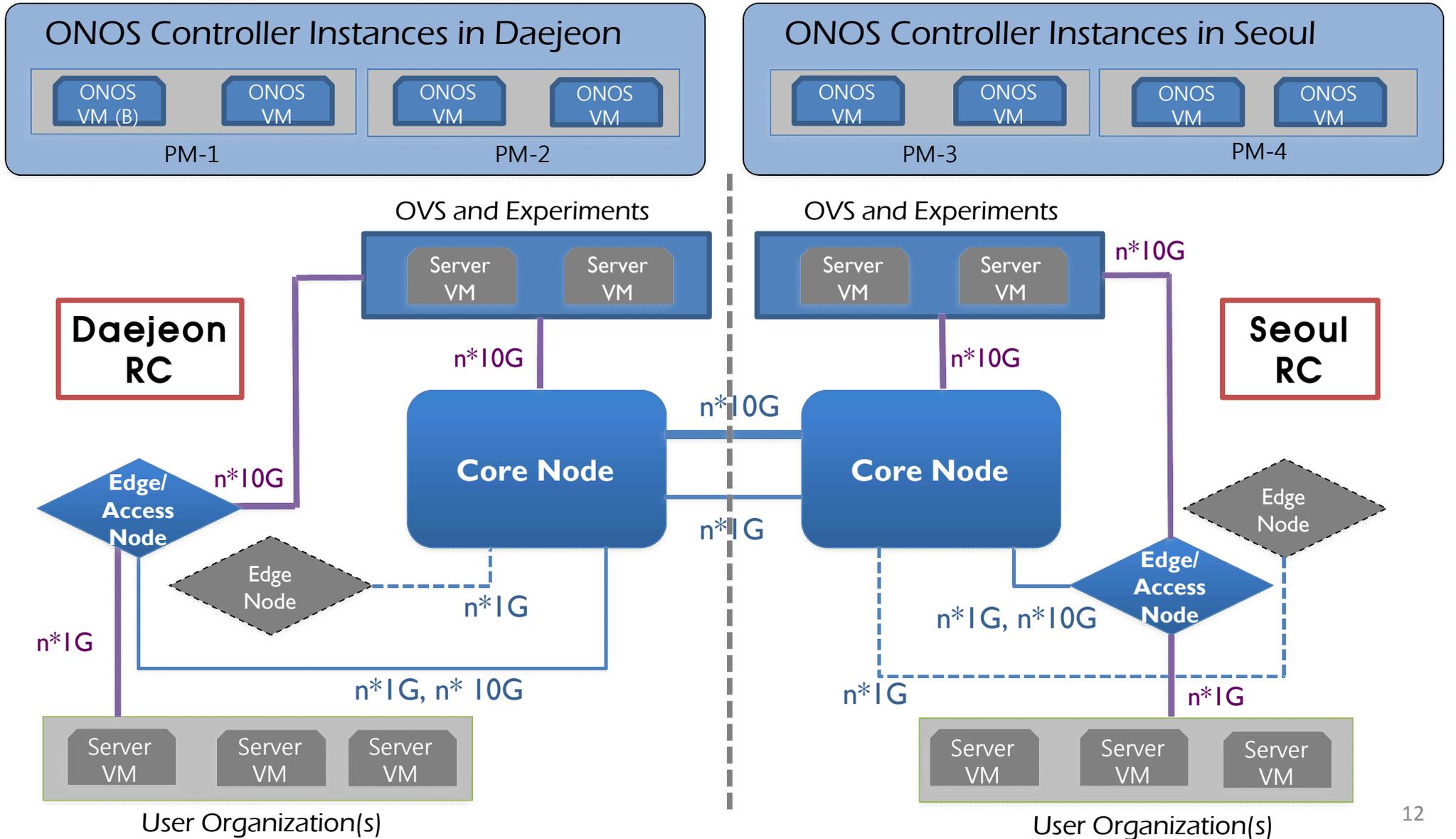
## SDN-IP Services

- SDN-to-Internet Extended Connectivity
- Traffic-engineered AS Transit (DC to DC)
- Partial Guarantee of QoS & Performance
- Partial Security, but still New User Experiences

## Federated SDN Services

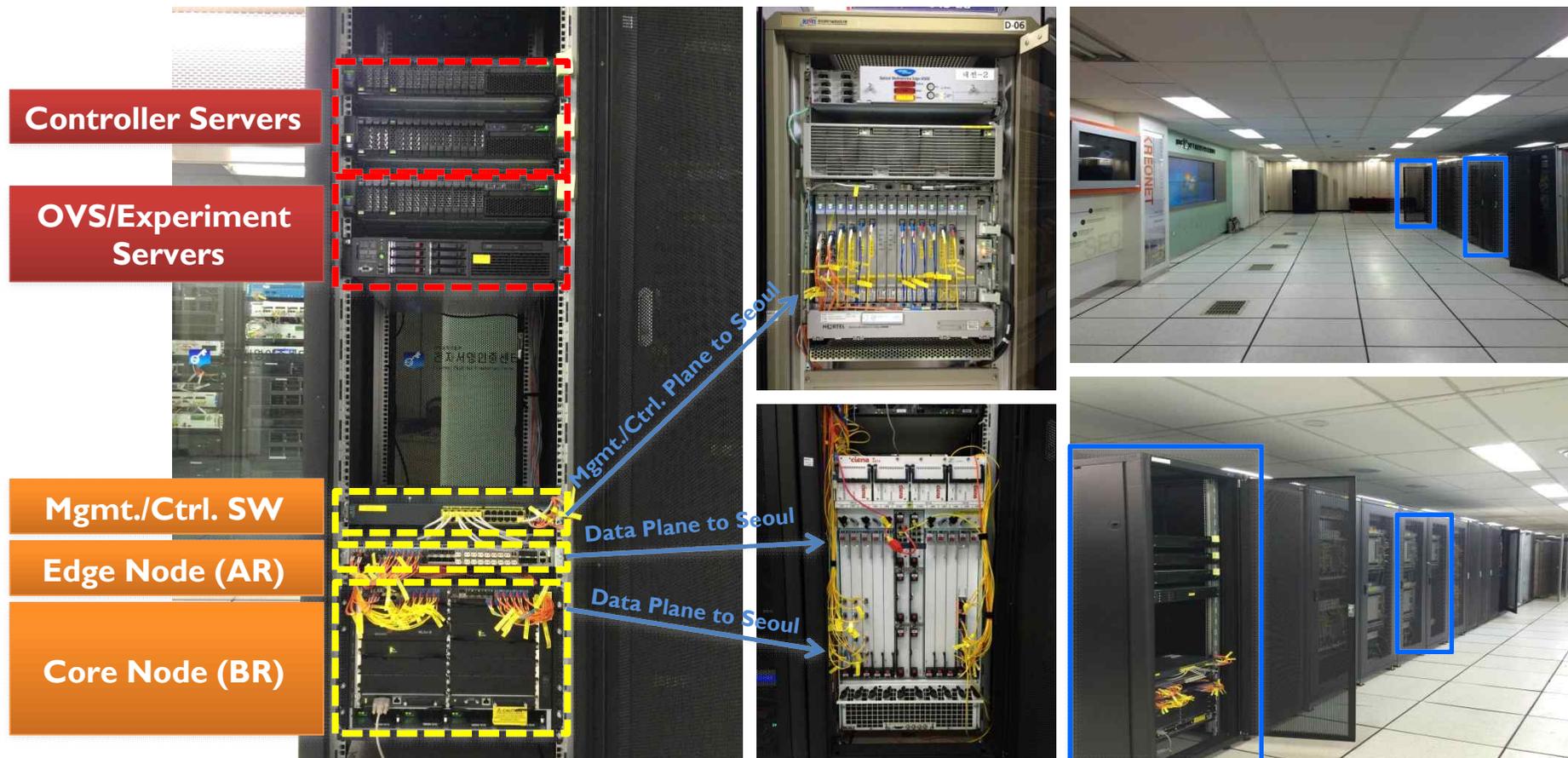
- Inter-SDN Connectivity & Federated Resources
- Virtually Isolated Networks on Inter-Cluster SDN
- Deterministic Guarantee of QoS & Performance
- Enhanced Security & New User Experiences
- Extended Connectivity with SDN-IP

# Deployment 2015 - Overall Design



# Deployment 2015

- Softwarization of KREONET: Daejeon and Seoul Centers

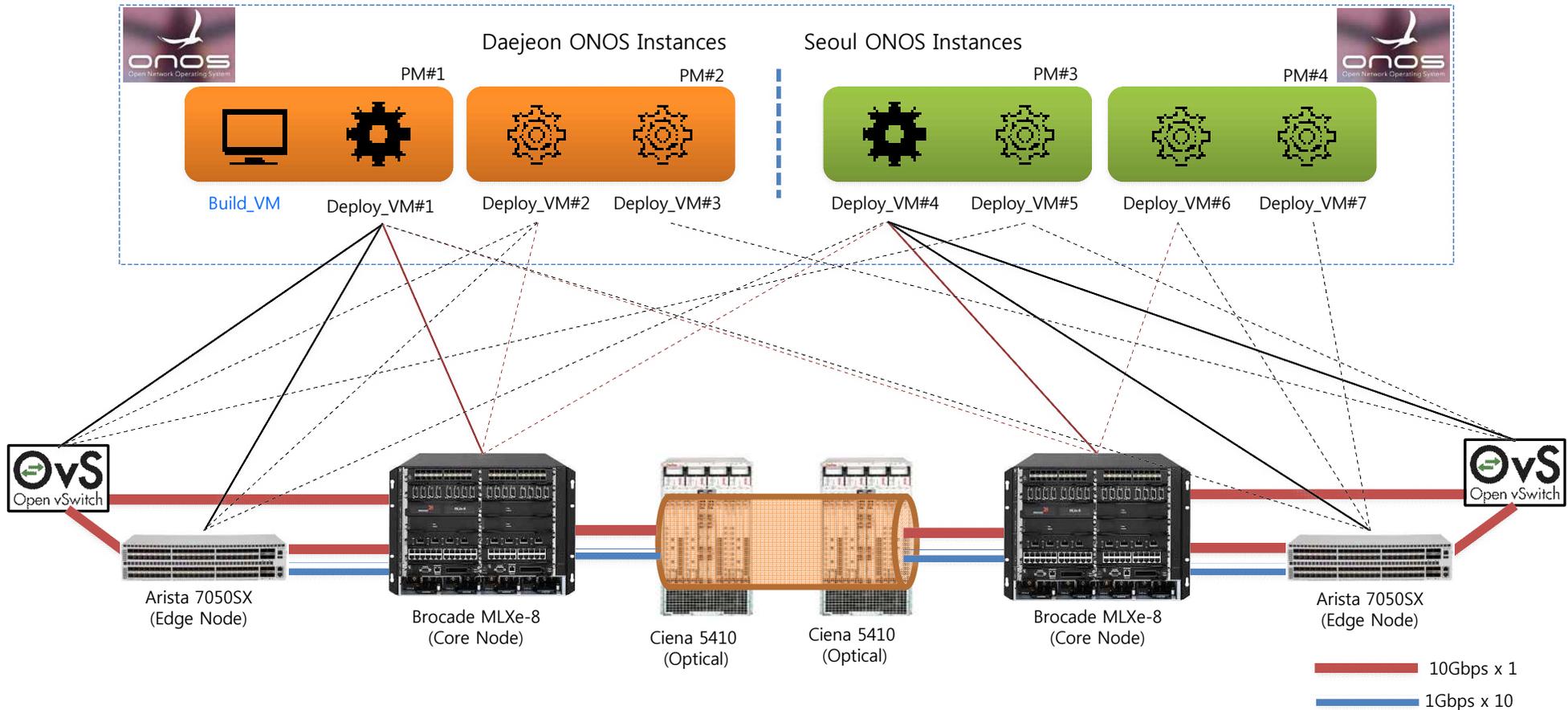


# Deployment 2015

- Deployment Status as of Today

KREONET-S\* 7-Node ONOS Cluster: Distributed Controls

⚙ Master    ⚙ Stand-by (slave)



# Deployment 2015 – ONOS GUI

The screenshot displays the ONOS GUI interface. At the top, there are three location tabs: Seoul, Daejeon, and Seoul. Below these are six colored boxes representing nodes with their IP addresses and switch counts. The main area shows a network topology with various devices including Arista 7050sx, Brocade MLXe-8, and OVS. A blue callout bubble on the left says "KREONET-S \* Operations & Simulation Seoul". An orange callout bubble on the right says "VDN/UoV Experiments". A red arrow points to a link between two nodes, labeled "Multiple links (10G \* 1, 1G \* 10)". On the right, an "ONOS Summary" panel shows statistics: Devices: 16, Links: 95, Hosts: 11, Topology SCCs: 2, Intents: 0, Tunnels: 0, Flows: 113, Version: 1.2.1.kreonet. Below that is a panel for "08:00:27:EC:4D:87/-1" showing MAC, IP, and VLAN information. At the bottom right, a terminal window shows the ONOS command prompt and a list of installed packages.

**ONOS Summary**

Devices : 16  
 Links : 95  
 Hosts : 11  
 Topology SCCs : 2

Intents : 0  
 Tunnels : 0  
 Flows : 113  
 Version : 1.2.1.kreonet

**08:00:27:EC:4D:87/-1**

MAC : 08:00:27:EC:4D:87  
 IP : 0.0.0.0, 10.10.50.2, 10.10.2.0.2  
 VLAN : none

Latitude :  
 Longitude :

```

Welcome to Open Network Operating System (ONOS)!

Hit '<tab>' for a list of available commands
and '[cmd] --help' for help on a specific command.
Hit '<ctrl-d>' or type 'system:shutdown' or 'logout' to shutdown ONOS.

onoss> list
START LEVEL 100 , List Threshold: 50
ID | State | Lvl | Version | Name
-----
37 | Active | 80 | 0.0.0 | samples
41 | Active | 80 | 2.0 | Commons Lang
42 | Active | 80 | 3.2.2 | Apache Commons Lang
43 | Active | 80 | 1.10.0 | Apache Commons Configuration
44 | Active | 80 | 18.0.0 | Guava: Google Core Libraries for Java
45 | Active | 80 | 3.9.2.Final | The Netty Project
46 | Active | 80 | 4.0.23.Final | Netty/Common
47 | Active | 80 | 4.0.23.Final | Netty/Buffer
48 | Active | 80 | 4.0.23.Final | Netty/Transport
49 | Active | 80 | 4.0.23.Final | Netty/Handler
50 | Active | 80 | 4.0.23.Final | Netty/Codec
51 | Active | 80 | 4.0.23.Final | Netty/Transport/Native/Epoll
52 | Active | 80 | 1.0.0 | Commons Pool
53 | Active | 80 | 3.2.0 | Commons Math
54 | Active | 80 | 2.5 | Joda-Time
55 | Active | 80 | 3.1.0 | Metrics Core
56 | Active | 80 | 3.1.0 | Jackson Integration for Metrics
57 | Active | 80 | 0.9.1 | minimal-json
58 | Active | 80 | 3.0.0 | Kryo
59 | Active | 80 | 1.10.0 | ReflectASM
  
```

# KREONET-S\* Applications

- **Virtual Dedicate Network (VDN) & User-oriented Visibility (UoV)**
  - **VDN**: OpenFlow/ONOS-based Dedicate Bandwidth Provisioning Network for User Groups on Demand
  - **UoV**: Virtual Network Visualization & Monitoring
- **Virtual ScienceDMZ**
  - Very High Performance Distributed Science Cloud & Advanced Experimental Environment (being designed)
- **ONOS SDN Apps & Use Cases**
  - **SDN-IP** (being experimented & deployed)
  - Packet-Optical, Segment routing (planning)

# Virtual Dedicate Network

- Design Principles

- User-Group based Authentication/Authorization

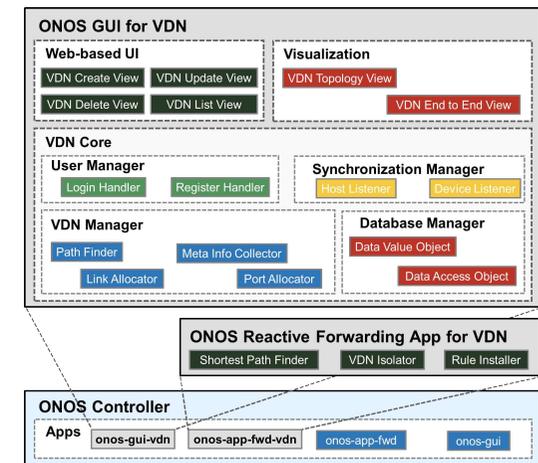
- Root user \*controls\*, General users \*use\*

- Easy-to-Use User Interface

- Simple and Rapid: several-click Easy, ms Fast

- User-oriented Network Visualization and Monitoring

- Virtual Network Topology and Operational Attrs



# Virtual Dedicate Network

Open Network Operating System

172.16.1.10 # Switches: 2  
172.16.1.11 # Switches: 2  
172.16.1.5 # Switches: 1  
172.16.1.6 # Switches: 2  
172.16.1.7 # Switches: 0  
172.16.1.8 # Switches: 7  
172.16.1.9 # Switches: 1

### ONOS Summary

Devices :	16
Links :	95
Hosts :	11
Topology SCCs :	2
Intents :	0
Tunnels :	0
Flows :	113
Version :	1.2.1.kreonet

### 08:00:27:EC:4D:87/-1

MAC :	08:00:27:EC:4D:87
IP :	0.0.0.0, 10.10.50.2, 10.10.20.2
VLAN :	none
Latitude :	
Longitude :	

Seoul

VDN-I

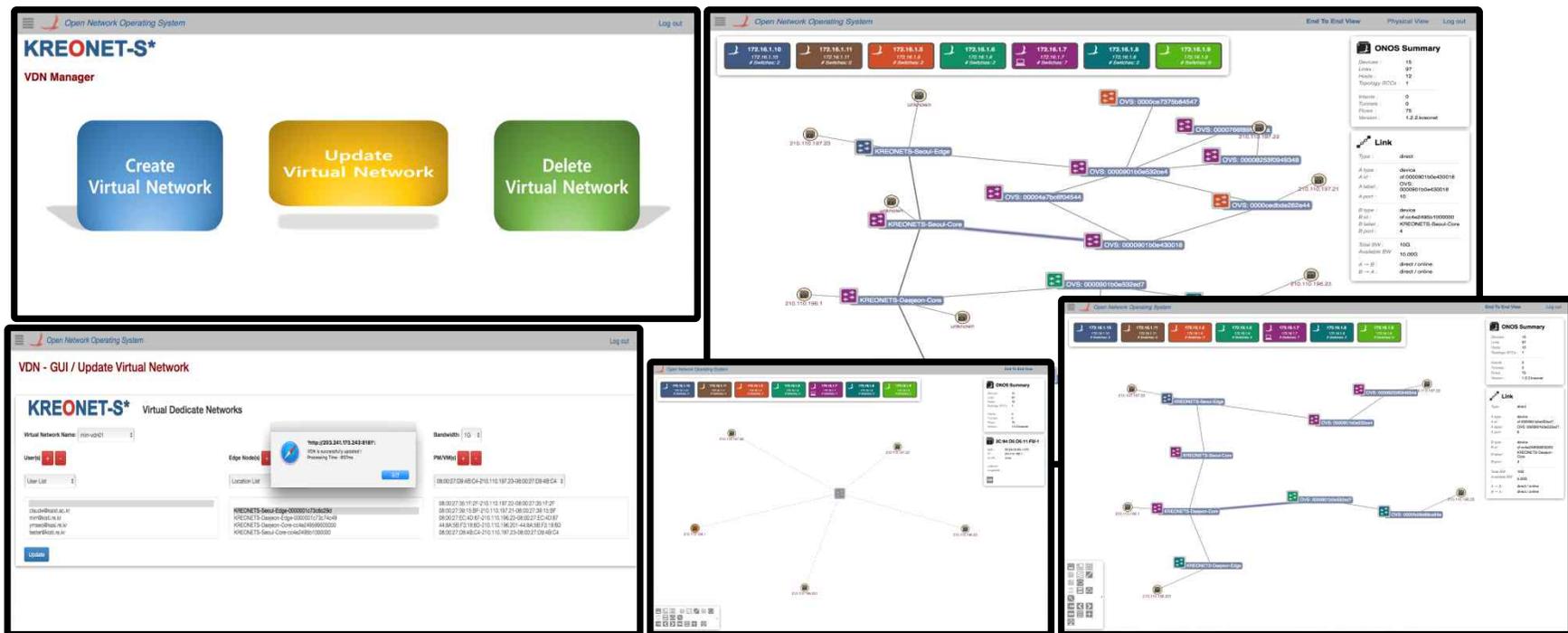
Daejeon

VDN-2

Each User Group can See & Manipulate ONLY their own VDN

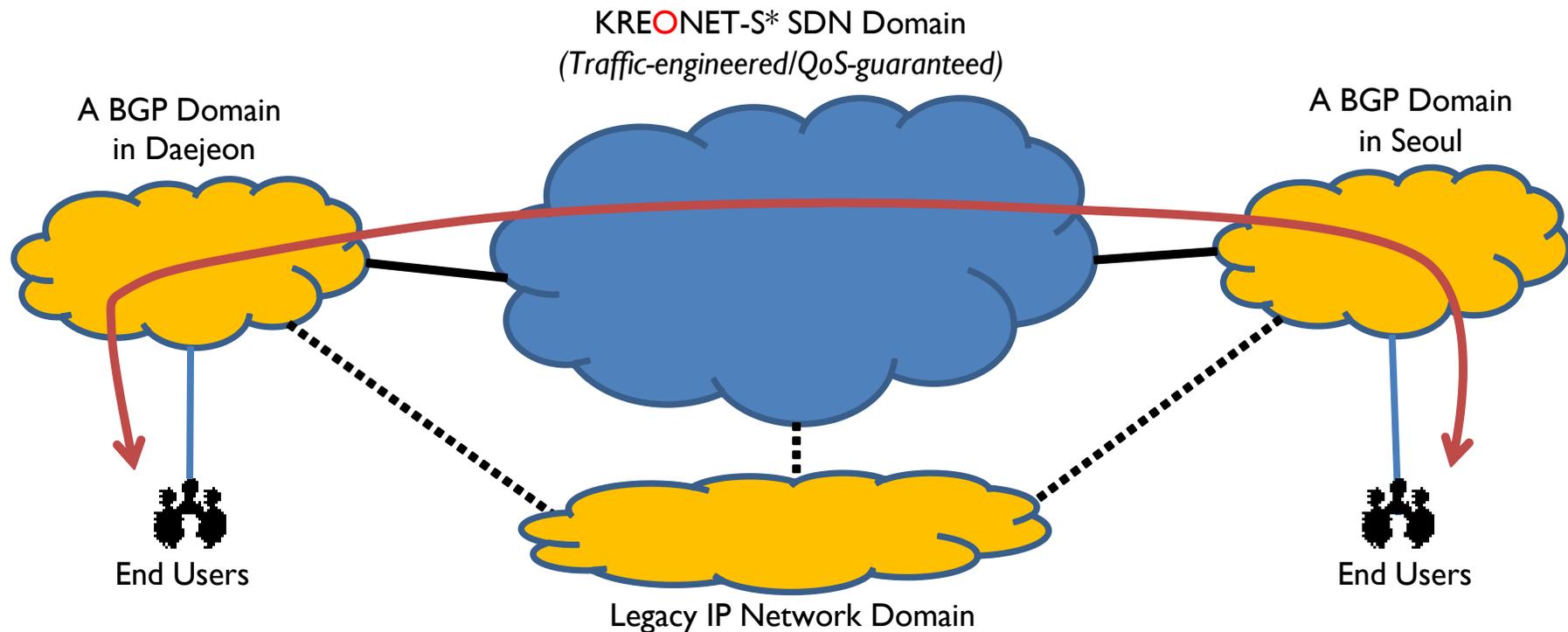
# Virtual Dedicate Network

- KISTI-KAIST Joint Development
  - VDN Prototype I Design and Implementation (2015)
  - VDN management modules, dedicate & isolated network allocation: being applied to KREONET-S\*



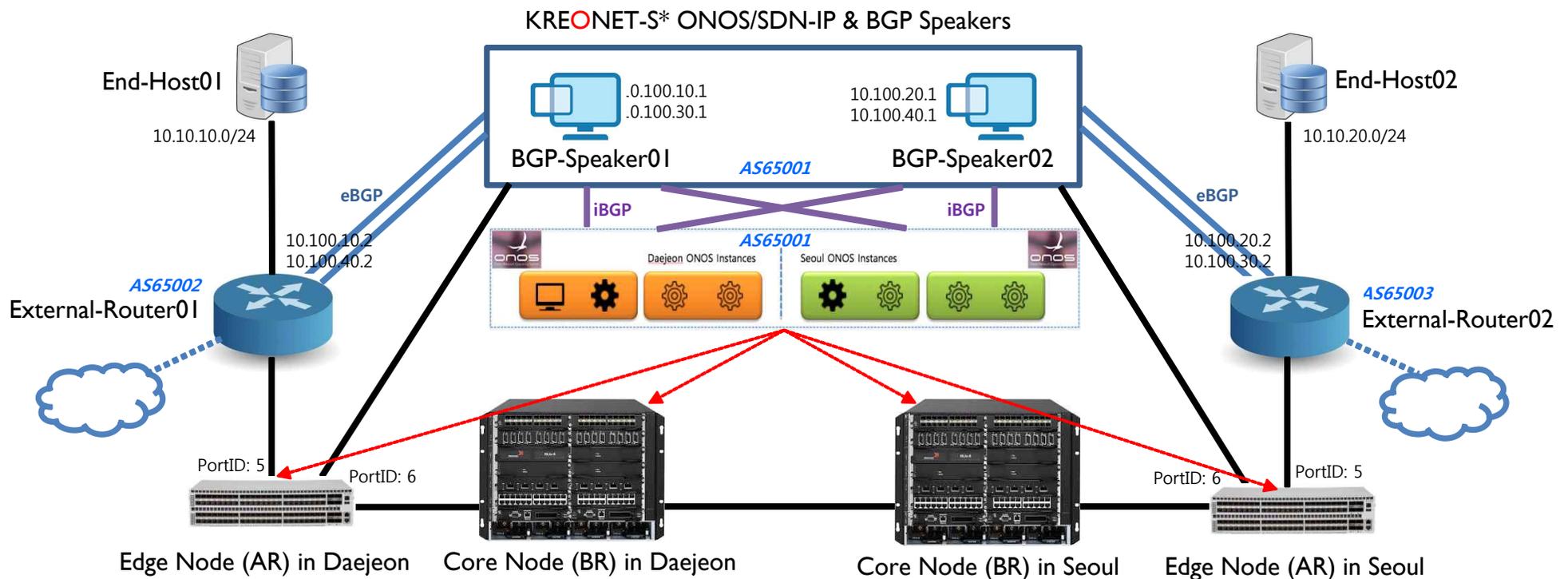
# SDN-IP

- KISTI-ON.Lab Joint Deployment & Experiment
  - Daejeon-Seoul Experimental Testbed (2015)
  - End-to-End Communications via KREONET-S SDN and BGP Network Domains

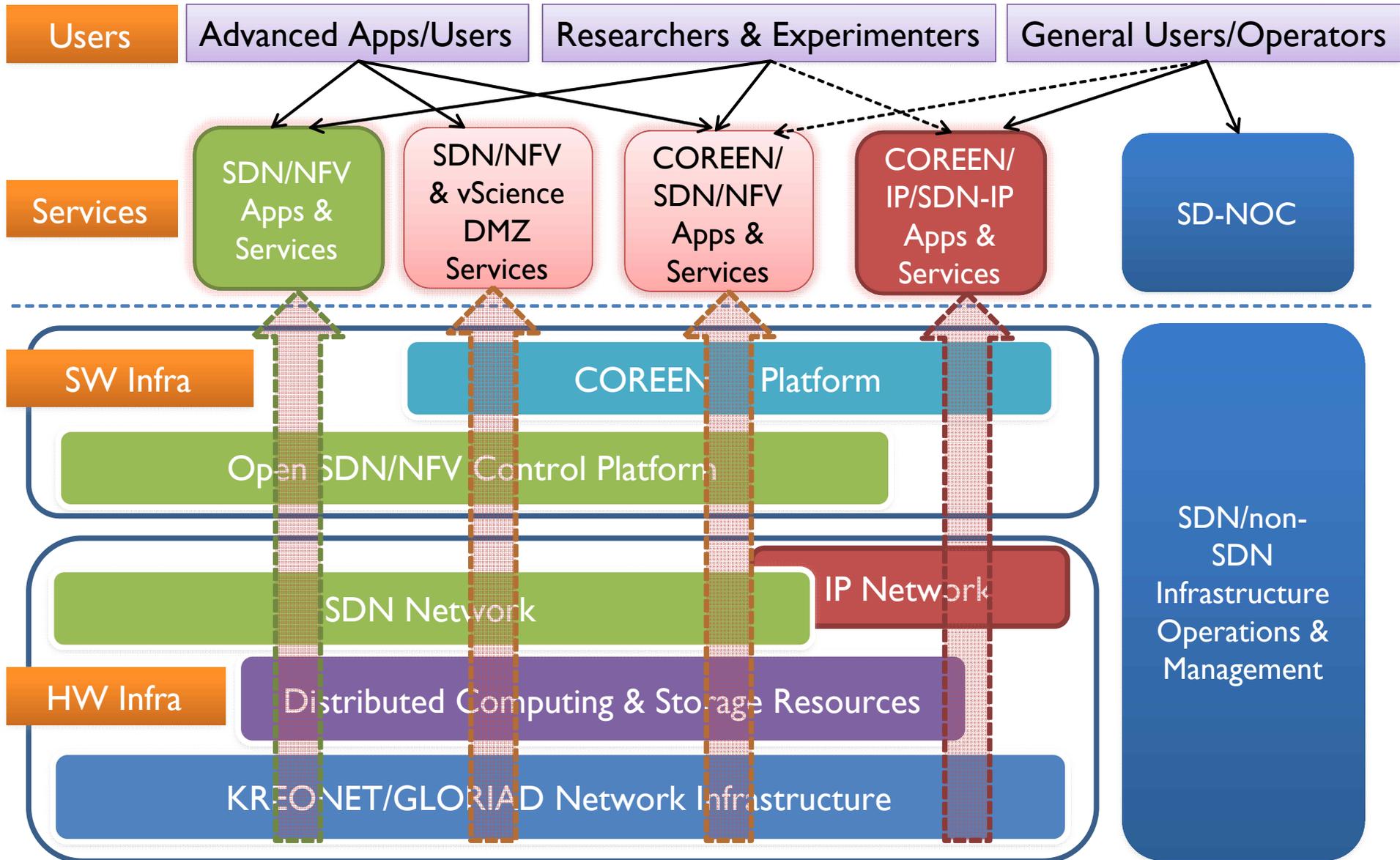


# SDN-IP Testbed

- Testbed Configurations in Detail
  - eBGP and iBGP peerings between BGP speakers, external routers & ONOS SDN-IP applications



# KREONET-S\* (Plan)



# Conclusions

- **KREONET-S\* Making HAPPEN**
  - New SDN Service Provider Network Deployment
  - Distributed Controls and Resilient SDN Operations
  - VDN & UoV for New User Services and Experiences
- **Further Work**
  - Keep Testing and Experimenting on Distributed Controls
    - Failover & Operational Issues, Performance, etc.
  - VDN & UoV Enhancement: UI, Performance, Stability
  - New Technology Deployment & Experiments with ON.Lab
  - Global Project & Testbed Participations with KAIST, PRP, etc.

# Thank You!

Questions and/or Comments to  
[mirr@kisti.re.kr](mailto:mirr@kisti.re.kr)