KREONET SOFTWARIZATION

KREONET-S/SD-WAN Deployment and Interoperations

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Contents

- ONOS-based KREONET-S Deployment
- Virtual Dedicate Network Development
- Interoperations with KREONET-S
- Conclusions

Background & Introduction

≪ **Nationwide 17 GigaPoPs in Korea (~100Gbps), 4 International Connections to the US, China, Europe (~20Gbps),** Global Research Network Collaborations (StarLight & GENI, GLIF, GLORIAD), ~200 member institutions, Supercomputing/Advanced Applications Research ≫

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

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

KREONET & GLORIAD

KREONET-S (1)

- **KRE**O**NET-S as an Open Science Cloud WAN**
  - **Carrier-grade Reliable "Open 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**, TL1, NETCONF, etc.
  - East-Westbound: **Distributed Controls/ONOS**
    - KISTI/KREONET - ONOS Affiliate (in a joint effort with KAIST), ONOS Ambassador, ONOS Brigades, ONOS-Korea Core Member
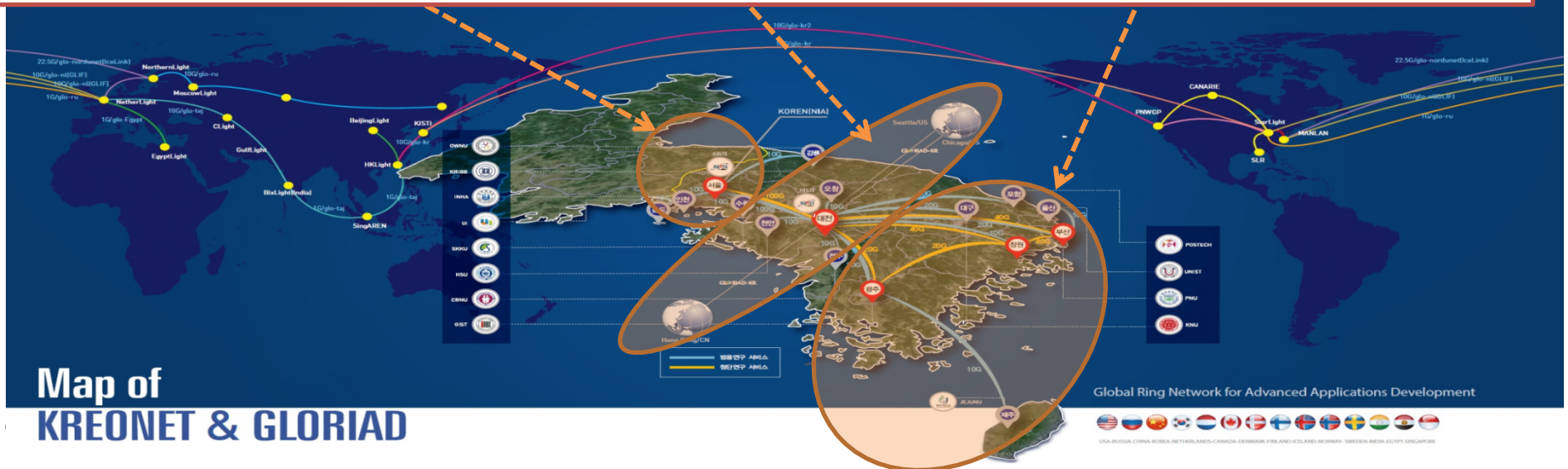 - Service Composition: SDN-IP, Federation, Packet-Optical, …

KREONET-S (2)

KRE O NET-S Applications & Services: *Virtual Dedicate Network and User-oriented Visibility with SDN-IP*

VDN (Virtual Dedicate Network)   **UoV (User oriented Visibility)**   **vSciZ (Virtual Science DMZ)**   **KREONET COREEN**

SDN-IP | Multi-Layer | NFV/ NFaaS | NMS, etc.

SD-WAN Technology & NOC

KRE O NET-S SDN Controls: *Distributed ONOS Cluster (5-Instance) for HA and Scalability*

onos Open Network Operating System

KRE O NET-S High Performance Data Plane Networks via **Open & Standard Protocol (***OpenFlow 1.3***)**

Map of KREONET & GLORIAD

Global Ring Network for Advanced Applications Development

25th

KREONET-S R&E USERS

High Energy Physics

Deterministic Network Performance and QoS for ~100G Data Transfer

Weather & Climate

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
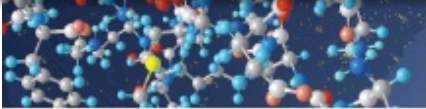
New Medicine/Bio

Culture & Art

Constructions

Supercomputing

KREONET**S** 6

KREONET-S Services
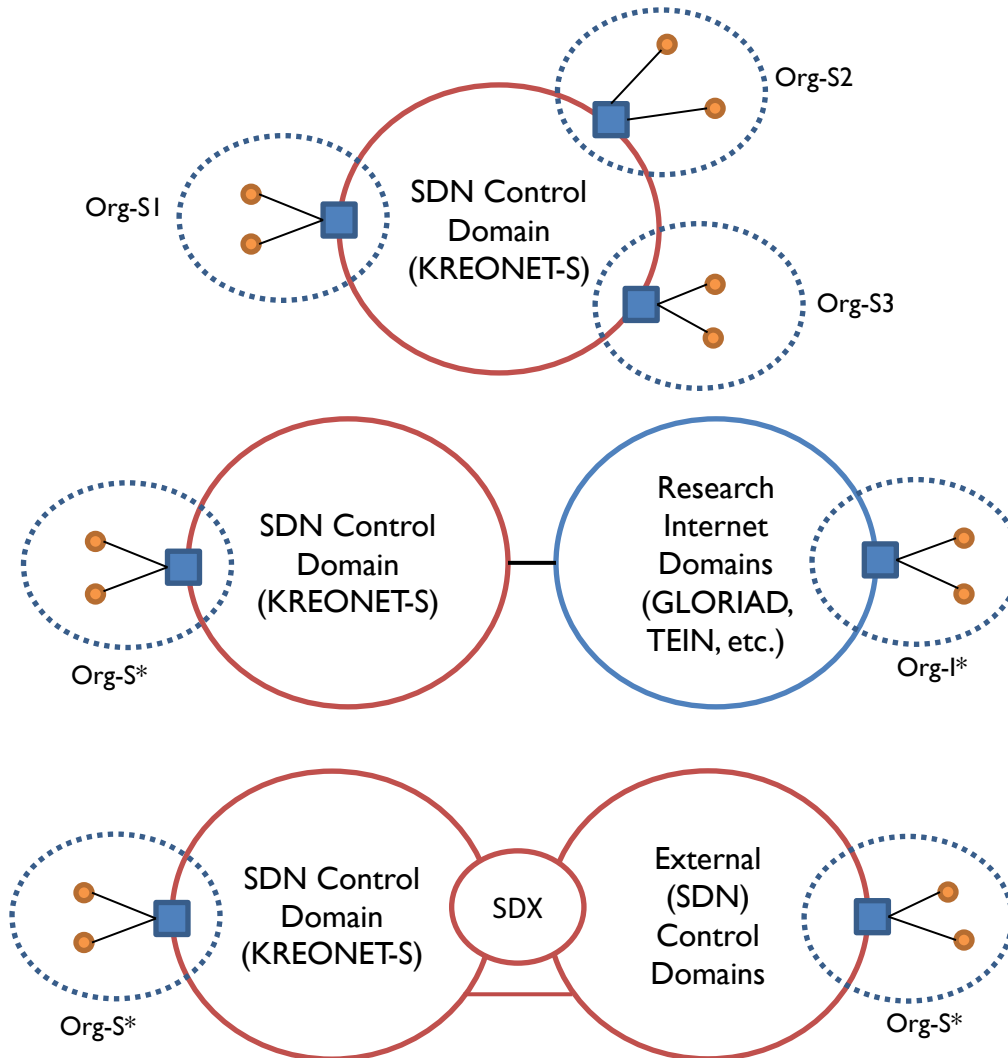
Pure SDN Services

- Deterministic QoS & Performance
- **Virtually Isolated User Group Networks**
- Enhanced Security & New User Experiences
- OpenFlow-based Science Cloud WAN

SDN-IP Services

- **SDN-to-Internet Connectivity & VDN opt-in**
- 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

Virtual Group Networks: VDN (1)

- ## Designs & Core Functionalities

  - **Dynamic On-demand Virtual Networks Manipulations**
  - **Logically Isolated Group Networks w/ High Performance (~100Gbps)**
  - **ONOS-based Event (e.g., link up/down) Detection & Recovery**
  - **GUI-based Intuitive Virtual Network Creation, Update and Deletion**
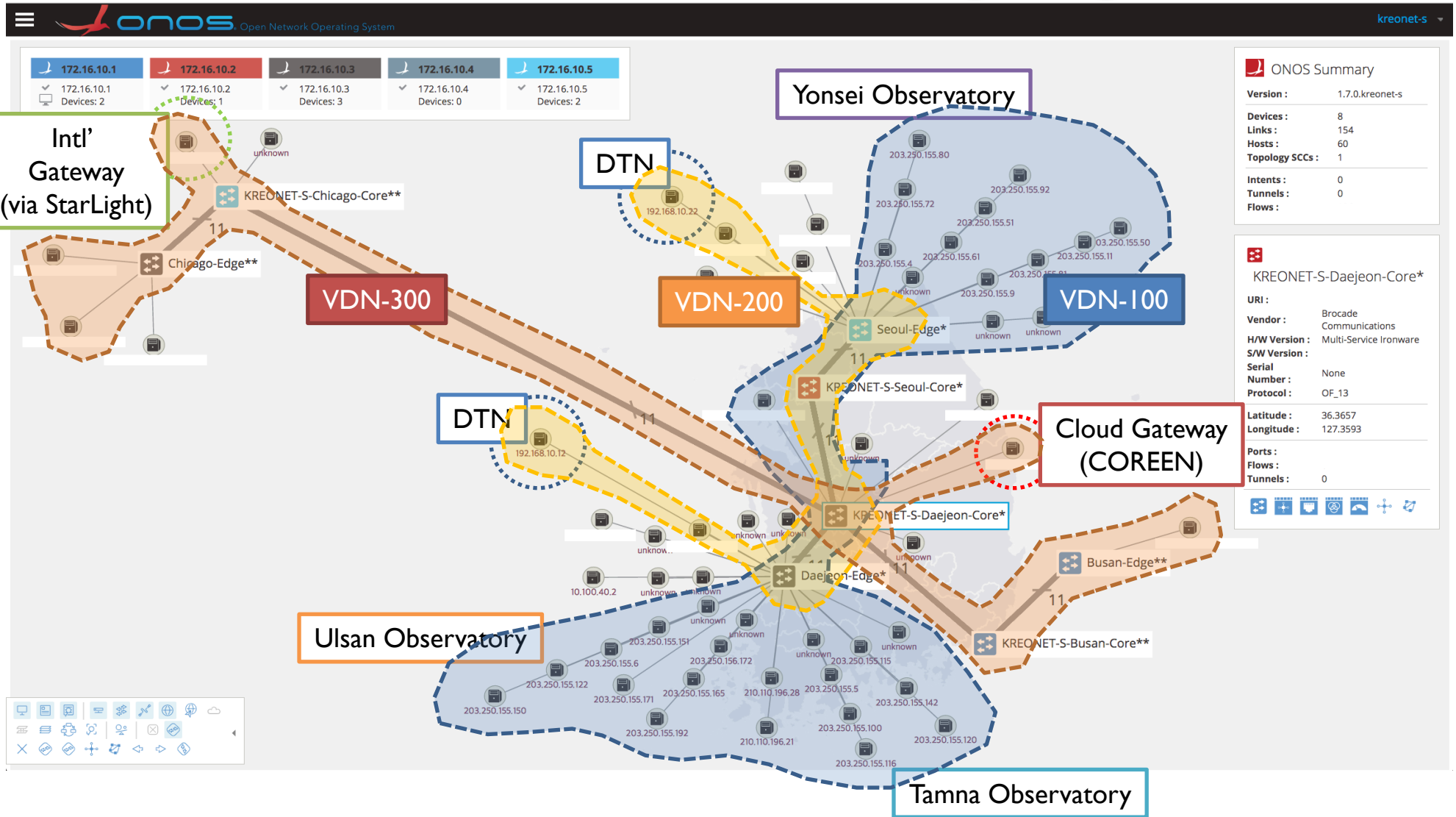 - **User-oriented Virtual Network Visibility & _Interoperable REST-APIs_**
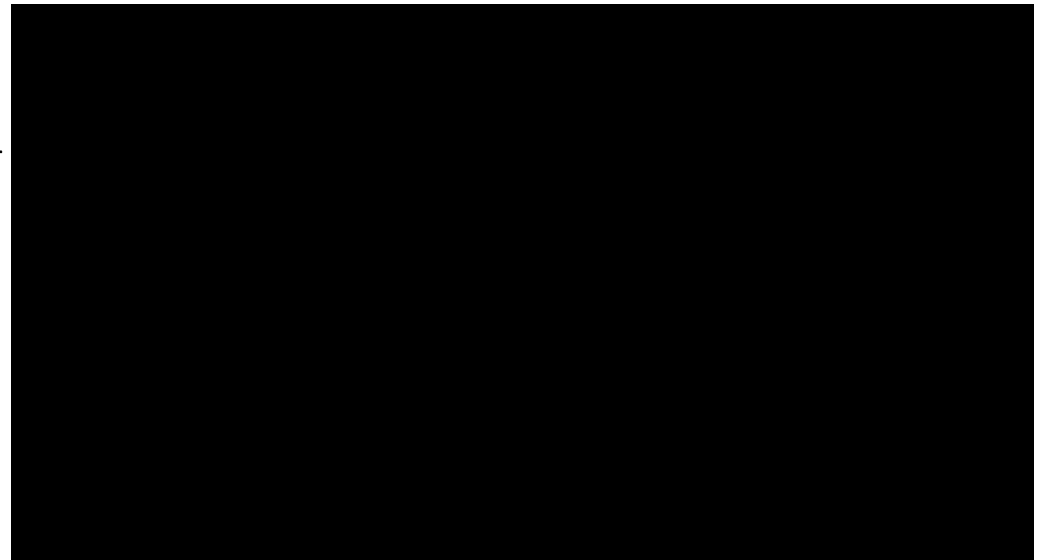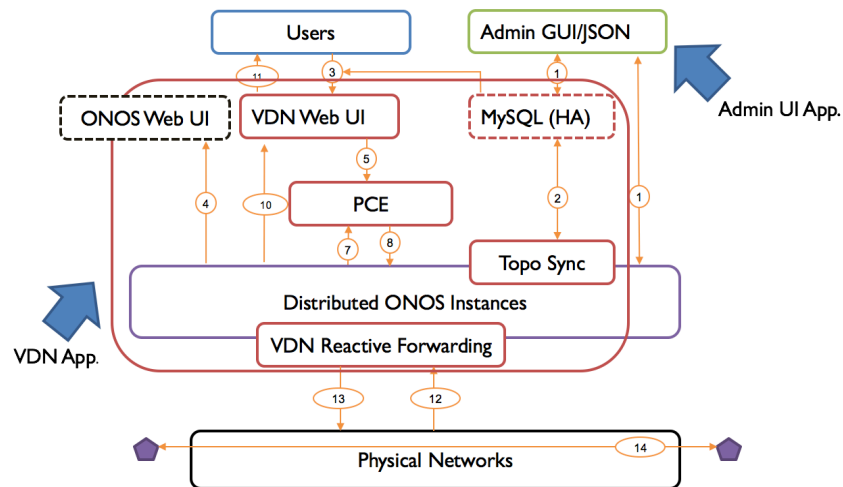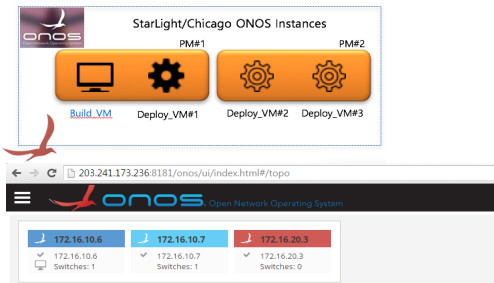
Virtual Group Networks: VDN (2)

- VDN Architecture and Key Components

ONOS GUI

VcN/VDN GUI

VcN/VDN Super-User GUI

RESTful Interface

Super-User CLI

UoV User oriented Visibility

Event Listener

Command

Query & Command

Notify

Notify

Query & Command

VcN PCE (Path Computation Engine)

Control Message Manager

ONOS Dist. Core

Topology Sync

VDN Recovery

Report

Restore

External Data Store

ID Federation

Request/ Response

VcN/VDN Reactive Forwarding

command

sensing

register & unregister

Provider Module

Control Message Provider (OpenFlow)

Protocol

Request/ Response

CACTI (Network Traffic Monitoring)

VDN Virtual Dedicate Network

ONOS Open Network Operating System

KREONET-S SDN Data Plane Network

VDN Virtual Dedicate Network

UoV User oriented Visibility

KREONET**S**

KREONET-S/VDN Deployment

International KREONET-S Connections to StarLight: SD-WAN Federations
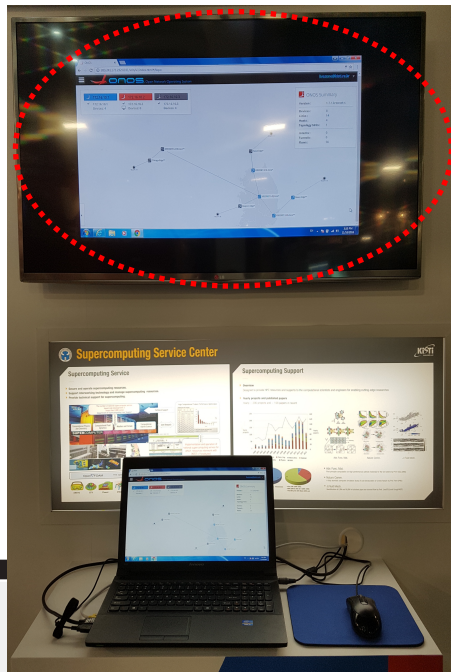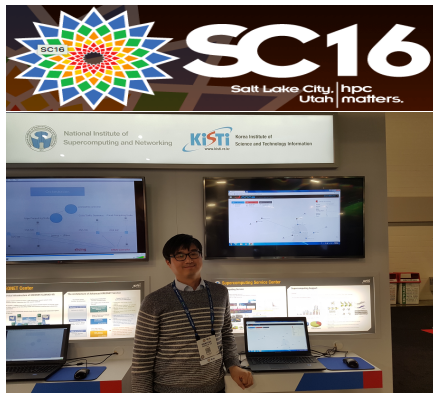

3-node ONOS Cluster at StarLight in USA
(Experimental)

5-node ONOS Cluster in Daejeon, Korea
(Production)
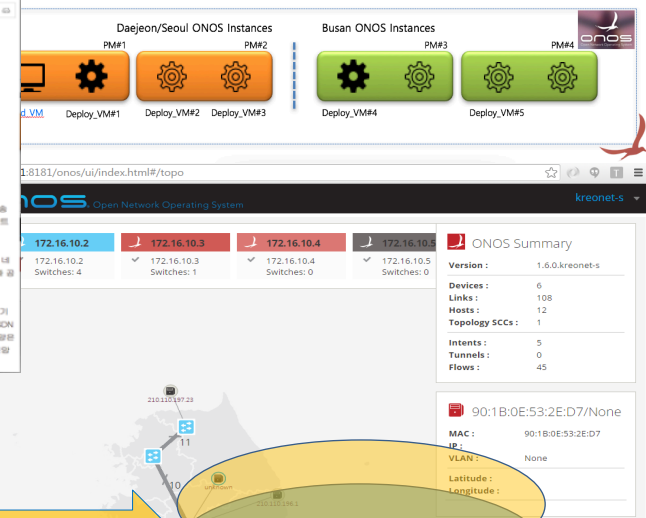
Inter-Cluster Virtual Dedicate Network
Provisioning based on SD-WAN Federation

Long-distance SD-WAN network:
~10,500km, 155-165ms (RTT)
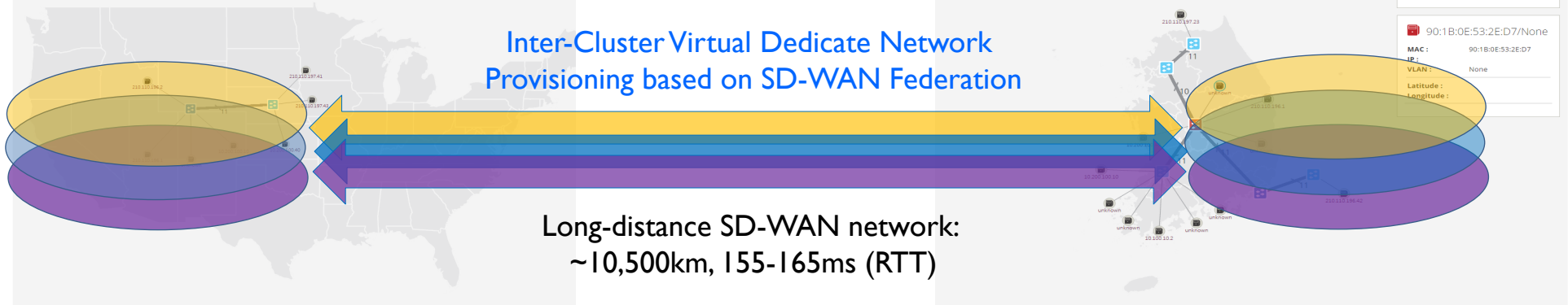
Demos@SC16 in Salt Lake City & KREONET2016 in Daejeon

SD-WAN/VDN Provisioning for SC16: Korea-US (Chicago)-US (Salt Lake City)

KR-SC16 Data Transfer & Measurement

KREONET-S in Chicago, IL

Conclusions

- **KREONET-S is Making HAPPEN**
  - New (Public) SD-WAN Deployment in Korea
    - Distributed Controls and Resilient SDN Operations
  - New Application Services and Experiences for R&E Users
    - Virtual Dedicate Network & User-oriented Visibility

- **Further Work 2017**
  - Development: *Virtual Network Federation*, VNF add-on, etc.
  - Deployment: Two more Locations to current Four Cities
    - *Chicago (StarLight)*, Daejeon, Seoul, Busan, Gwangju, Changwon
  - Active Participations in ONOS Project
    - ON.Lab Collaborations: VPLS, Packet-Optical, Inter-Cluster SDN, CORD, etc.

Thank You!

Questions and/or Comments to
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