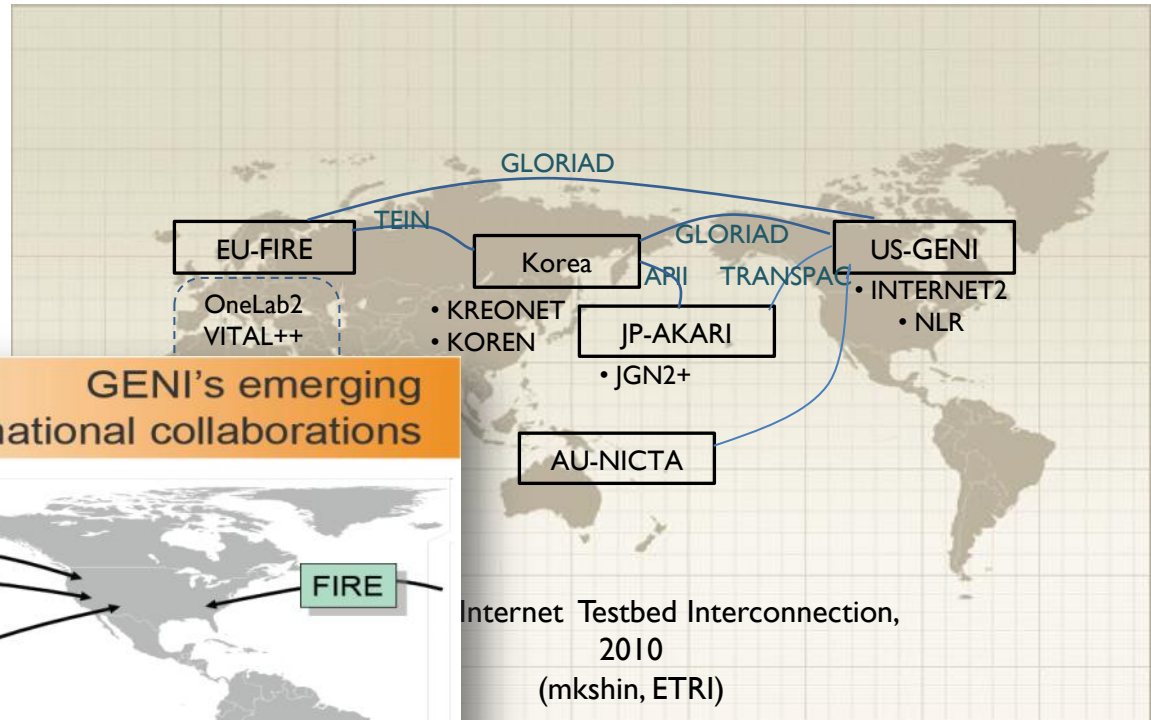# K-GENI
(+ Federated Network Operations)

Dongkyun Kim/KISTI
mirr@kisti.re.kr

March 8, 2011

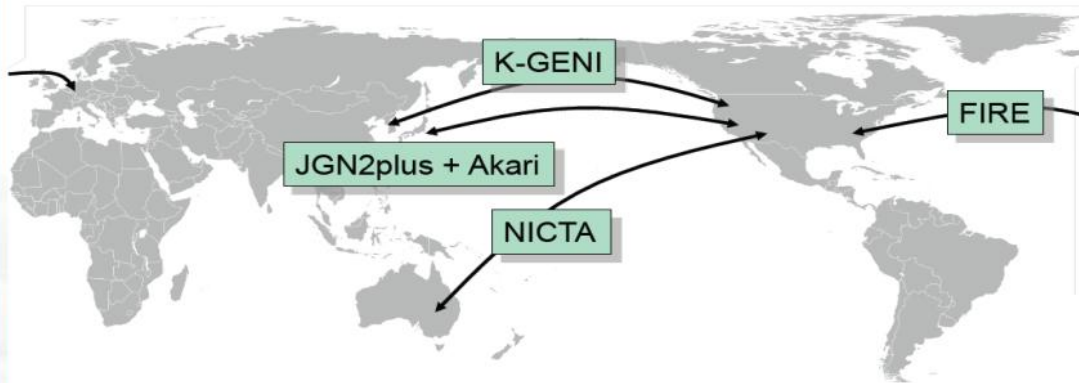**2011 Korean-German Workshop on Future Internet Research**

Contents

- K-GENI Initiative & Testbed
- Federated Network Operations on GENI
  - GMOC-KR Deployment in Korea
  - Collaborative Efforts for GMOC-dvNOC Federation
- Conclusion and Further Works

K-GENI & FI Testbed Interconnections

GLORIAD

TEIN

| EU-FIRE | | Korea | | | US-GENI |

GLORIAD

APII   TRANSPAC

OneLab2
VITAL++

• KREONET
• KOREN

JP-AKARI

• INTERNET2
• NLR

• JGN2+

AU-NICTA

Internet Testbed Interconnection,
2010
(mkshin, ETRI)

GENI's emerging
international collaborations
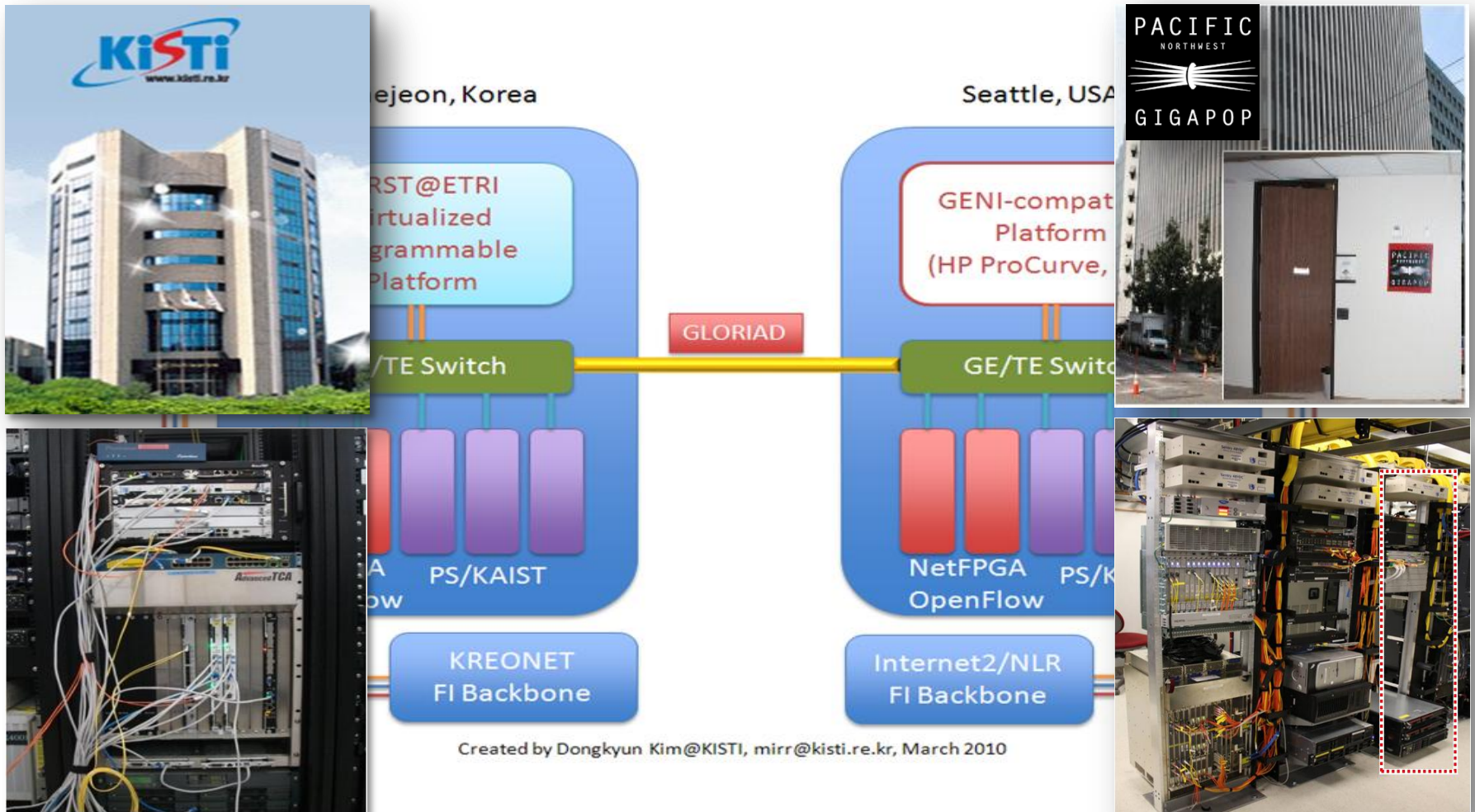
K-GENI

FIRE

JGN2plus + Akari

NICTA

The GENI Project Office is interested in federation with
peer efforts outside the US, based on equality and arising
from direct, "researcher to researcher" collaborations.

July 20, 2010

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K-GENI Initiative

- Purpose
  - K-GENI : Establishment of operational linkage between GENI and KISTI/ETRI-Korea for international federation

- Principal Investigator Information:
  - PI: James G. Williams/Indiana University
  - Co-PIs: Myung Ki Shin/ETRI, Dongkyun Kim/KISTI

- Scope of the work
  - Provision a dedicated international connection between Korea and the US to facilitate an investigation into international federation strategies for operations between the GENI Meta-Operations Center (Indiana University) and dvNOC in Korea (KISTI and ETRI).
  - Support tests for methods of interoperability between GMOC and the dvNOC system.
  - Develop an external networking report to help guide other GENI projects with future external connectivity.
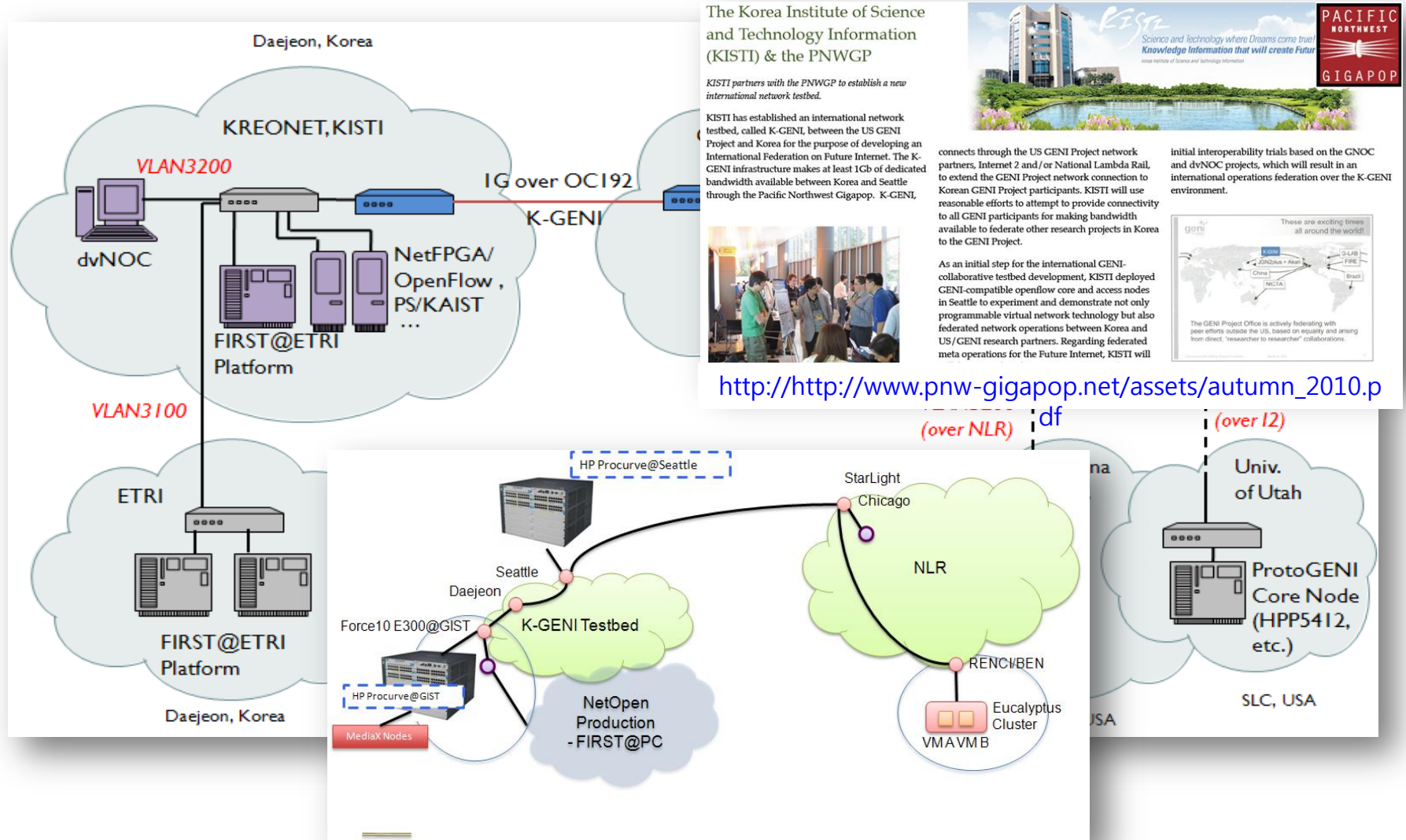
K-GENI Testbed (1)

FIRST Core Node
(Daejeon, Korea)

OpenFlow Core Node
(Seattle, USA)

K-GENI Testbed (2)

The Korea Institute of Science and Technology Information (KISTI) & the PNWGP

KISTI partners with the PNWGP to establish a new international network testbed.

KISTI has established an international network testbed, called K-GENI, between the US GENI Project and Korea for the purpose of developing an International Federation on Future Internet. The K-GENI infrastructure makes at least 1Gb of dedicated bandwidth available between Korea and Seattle through the Pacific Northwest Gigapop. K-GENI, connects through the US GENI Project network partners, Internet 2 and/or National Lambda Rail, to extend the GENI Project network connection to Korean GENI Project participants. KISTI will use reasonable efforts to attempt to provide connectivity to all GENI participants for making bandwidth available to federate other research projects in Korea to the GENI Project.

As an initial step for the international GENI-collaborative testbed development, KISTI deployed GENI-compatible openflow core and access nodes in Seattle to experiment and demonstrate not only programmable virtual network technology but also federated network operations between Korea and US/GENI research partners. Regarding federated meta operations for the Future Internet, KISTI will

initial interoperability trials based on the GNOC and dvNOC projects, which will result in an international operations federation over the K-GENI environment.

http://http://www.pnw-gigapop.net/assets/autumn_2010.pdf

GIST-RENCI OpenFlow Demos@GEC9 over K-GENI

OpenFlow Testbed on KREONET (OF@KREONET)

- Nation-wide OpenFlow testbed for network researchers
- OpenFlow switches
  - 3 HP Procurve 3500 switches (OF ver. 1.0)
  - Based on PBB(Provider Backbone Bridge), VLAN
- OpenFlow controllers
  - NOX (including a developed flow routing component)
  - FlowVisor, SNAC
- Campus OpenFlow networks, K-GENI will be connected to OF@KREONET this year
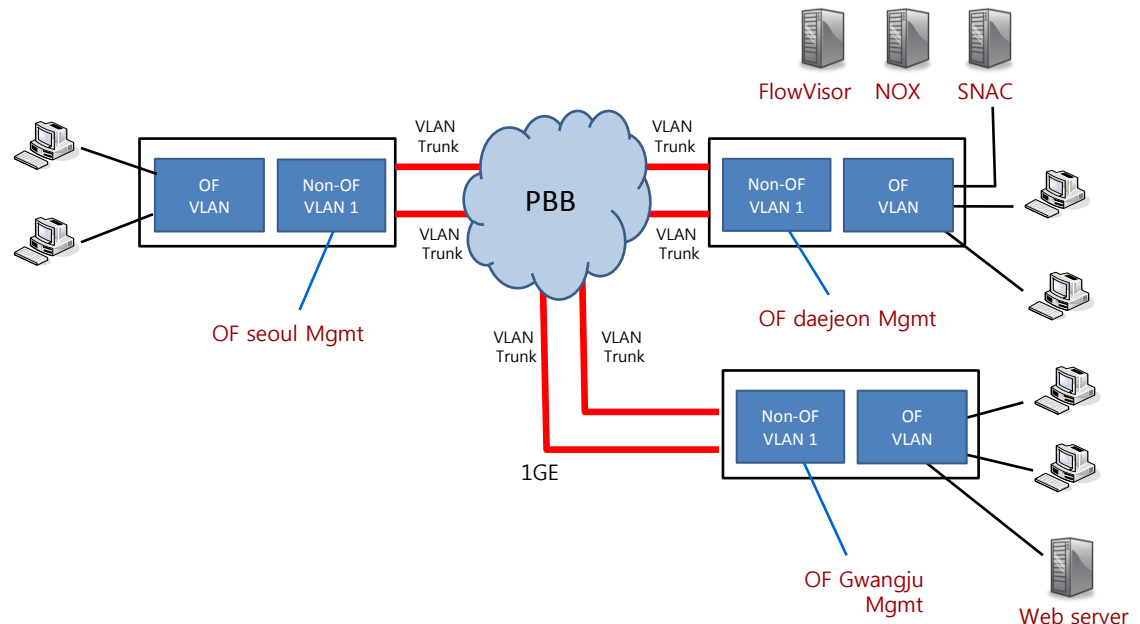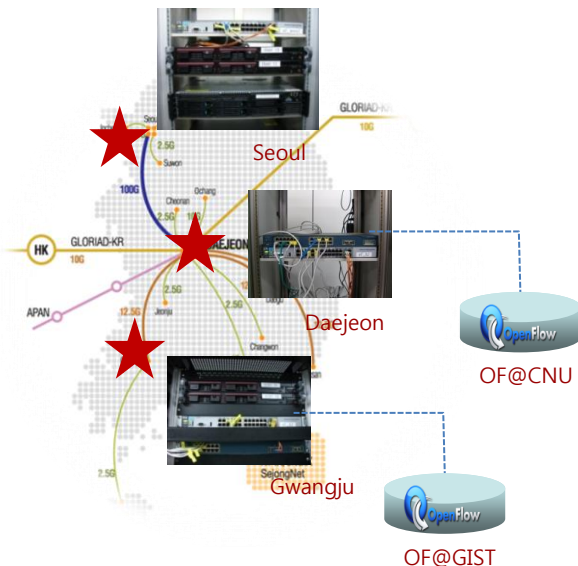
Experiments over OF@KREONET

- Development of a flow routing technique based on traffic load
  - Selection of normal routing or CSPF-based QoS routing
  - Periodically gathering topology and bandwidth information

- Deployment of SNAC controller
  - User authentication through captive portal mechanism
  - Useful to provide admission control for new users

Slice 1

Slice 2
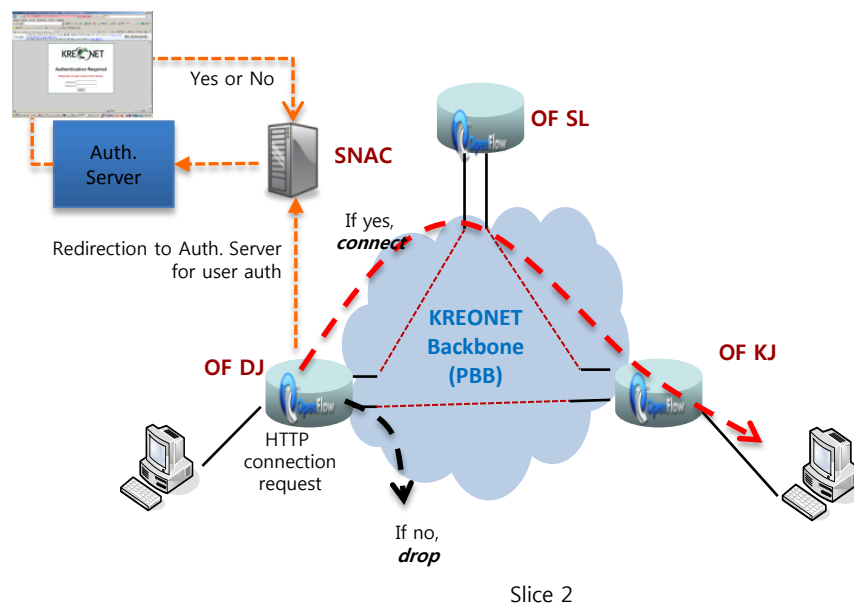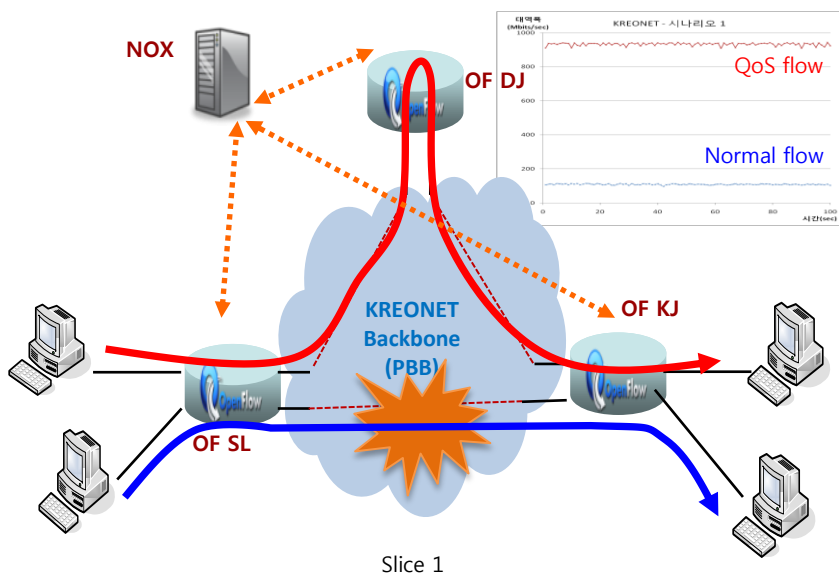
Federation

- Wikipedia
  (http://en.wikipedia.org/wiki/Federation_(information_technology))
  - A Federation is multiple computing and/or network providers agreeing upon standards of operation in a collective fashion. e.g. Yahoo messenger and MSN messenger would be interoperable
  - The internal *modus operandi* of the different systems is irrelevant to the existence of a federation

- Federated Network Operations
  - Multiple distributed network domains agreeing upon standards of network operations...
  - Internal network operation of each domain is

LLR on GENI Federation

- Legal, Law Enforcement & Regulatory Requests *(document v0.2 at COMIS WG,* *http://bit.ly/h5O90e)*
  - GENI LLR representative is required for federation inside GENI as a facilitator to route LLR requests
    - Scenarios: DMCA takedowns, contraband downloads, seized system, criminal defense

- Capabilities & Responsibility
  - GMOC as an information provider for LLR requests
    - GENI LLR representative
    - MA or Aggregate Operators
    - Clearing House / Slice Authorities
    - PI or Slice Creator
    - Campus IT Department

GENI Meta Operations Center
(PI: Jon-Paul Heron at IU)

- **Meta Operations** on GENI: GMOC
  - GENI is made up of many loosely affiliated projects
  - Many projects have existing means to provide operations
  - Combination of complete distributed operations and centralized operations on GENI
- **Objectives**
  - Give GENI-wide view of operational status: maps & graphs
  - Give Scientists access to their data
  - Emergency Shutdown
- **Challenges**
  - Federation
  - Layers of Visibility
  - Virtualized Operations

dvNOC-GMOC Collaborations

- **GMOC Collaborations over K-GENI**
  - Deployment of GMOC-KR in Korea
  - Sharing operational data between GMOC-US and GMOC-KR
    - First International Trial/Experiments of GENI Meta Data Sharing
  - Demonstration at GEC8 with Indiana University
- **dvNOC-GMOC International Federated Operations**
  - dvNOC development and local data collection in Korea
  - Sharing operational dataset between GMOC and dvNOC
    - Wrapper on dvNOC: conforms to GMOC data exchange formats
  - Successful Global View & Federation Demo@GEC9
- **Discussion on Operational Data Sharing Issues**
  - What/When to Share?
  - Technical/Political Challenges

GMOC-KR Deployment & Experiments

- GMOC-KR Deployed by Joint Efforts, IU-KISTI-SNU
  - Korea-USA (GENI) Operations Data Sharing Experiments Started in July, 2010

International GMOC Data Sharing Experiments@GEC8

dvNOC-GMOC Federated Operations

Federated Network Operations

GENI Meta Operations System (GMOC)

Korea Meta Operations System (dvNOC)
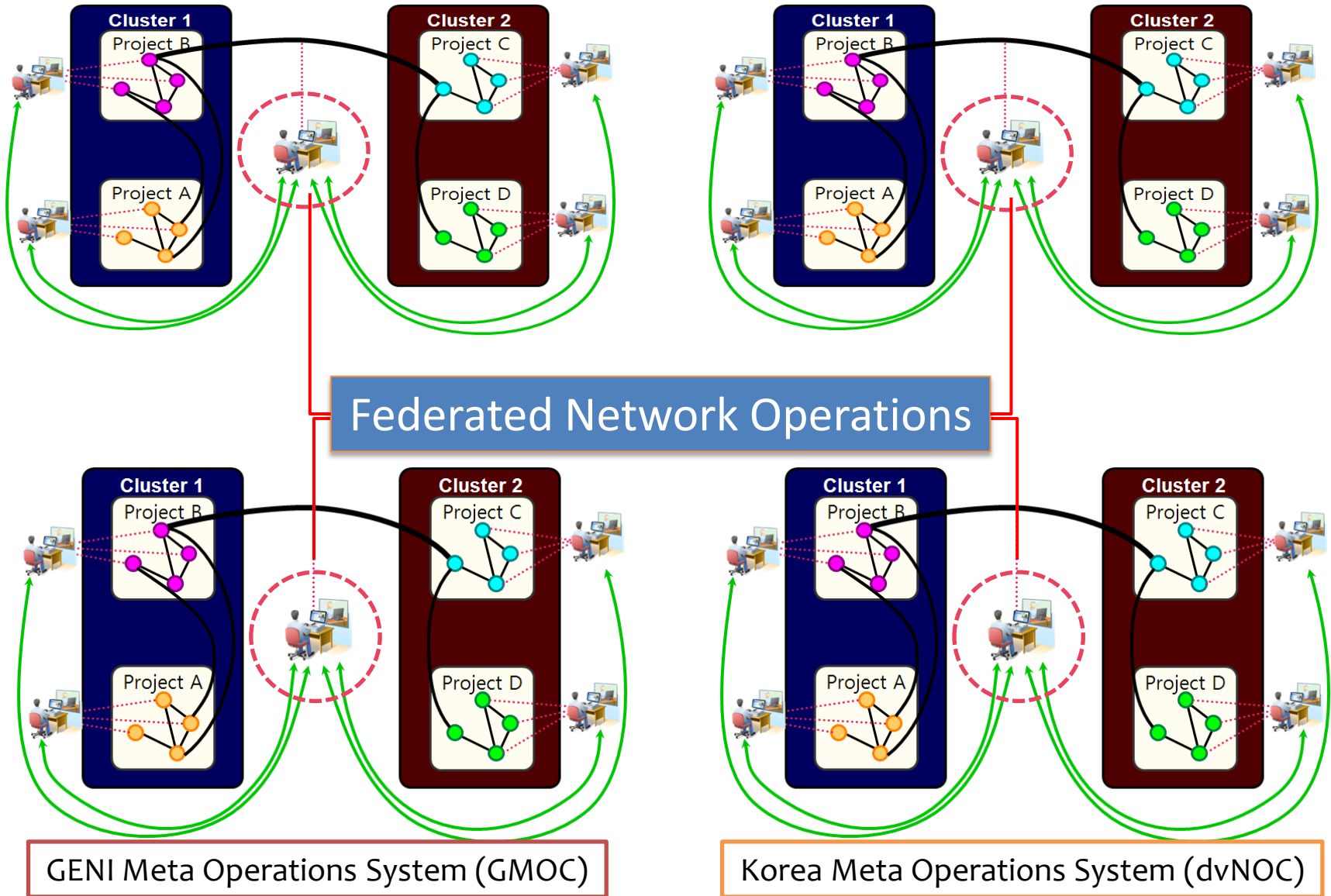
dvNOC
(Distributed virtual Network Operations Center)

- Enabling Global Collaborative Network Operations
  - GLORIAD/IRNC Award (Global Ring Network for Advanced Applications Development) and K-GENI Initiative
- Two Elements
  - Distributed NOCs on (Autonomous) Network Domains/Countries/...
  - Virtual NOC for Globally Sharing/Federating Operational Datasets
- International Collaborators
  - K-GENI: Indiana University/USA
  - GLORIAD: USA, China, Korea, Canada, European/African Countries, etc.
- System Developments
  - Step 1 : Meta Data (Core) Schema and Data Collection
  - Step 2 : Data Exchanges and Federation
  - Step 3 : User based Virtual Network Views & Management

dvNOC Developments

- dvNOC-KR: http://211.232.58.61:8080/client.action
  - Meta Data Core Schema
  - Repository Management & Local Data Collector
  - Federation and Basic Local/Global Views
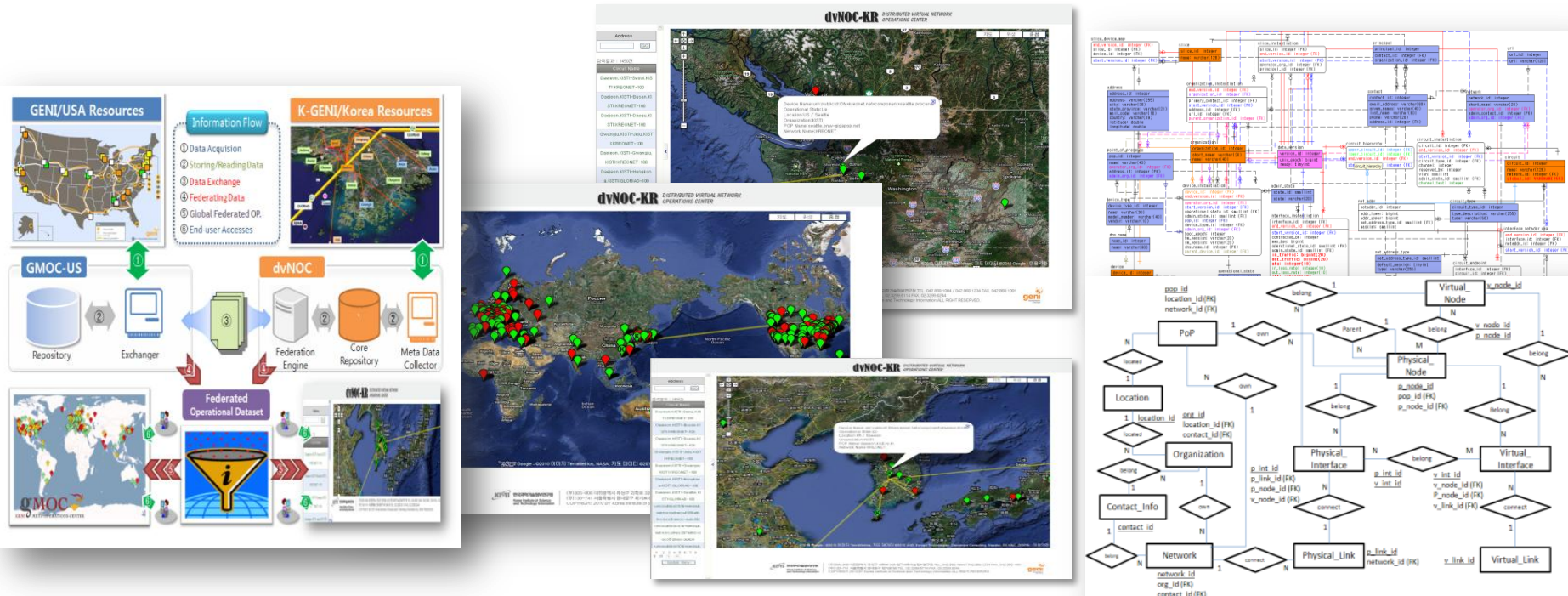
Federated Meta Operations on GMOC and dvNOC

Core Schema Developments

Demo at GEC9 (November 2, 2010)
Federated Meta Operations (GMOC - dvNOC)

GMOC-dvNOC Federated Meta Operations Demo@GEC9

Conclusion & Further Works

- K-GENI and Federated Network Operations
  - GMOC and dvNOC began to exchange operational datasets for federation on K-GENI environment
- Further Works
  - Reliable & Scalable Operational Data Federations
  - Wish to Work with German FI Research Group(s)
  - Collecting Local Operational Dataset from OpenFlow
  - Figuring out Technical/Political Challenges
  - Sharing Meta Operations Data for E2E Slice
    - A form of federated identity for end-to-end meta operations required, e.g. Global ID across domains/nations

Thank You for Your Attention

As GENI begins to ramp up support for experiments, operations becomes more and more important – in fact, we believe it will be the central challenge for future internet testbeds around the world. It will clearly dominate Spirals 3, 4, and beyond for GENI.

Your work in federated operations is leading the rest of the world, and we expect that all of us will follow the path that you are creating.

- Chip Elliott, Director of GENI Project