International Collaborations:

Federated VNode / GENI

Packet Cache Demonstration

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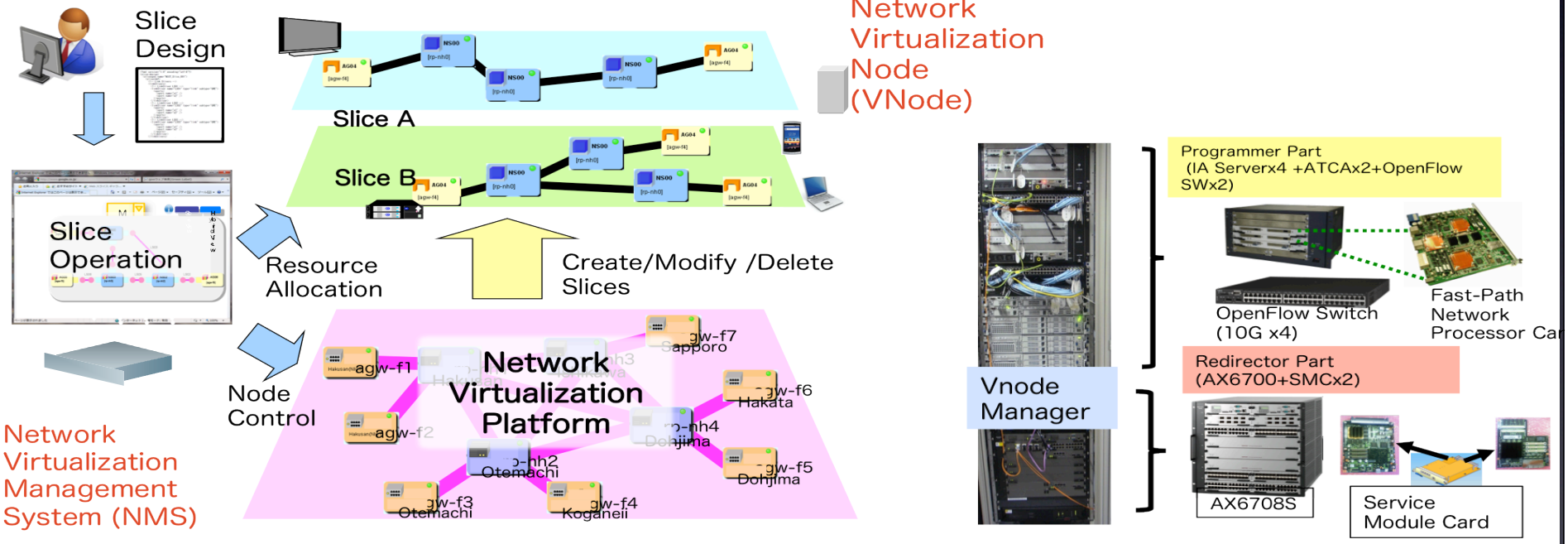
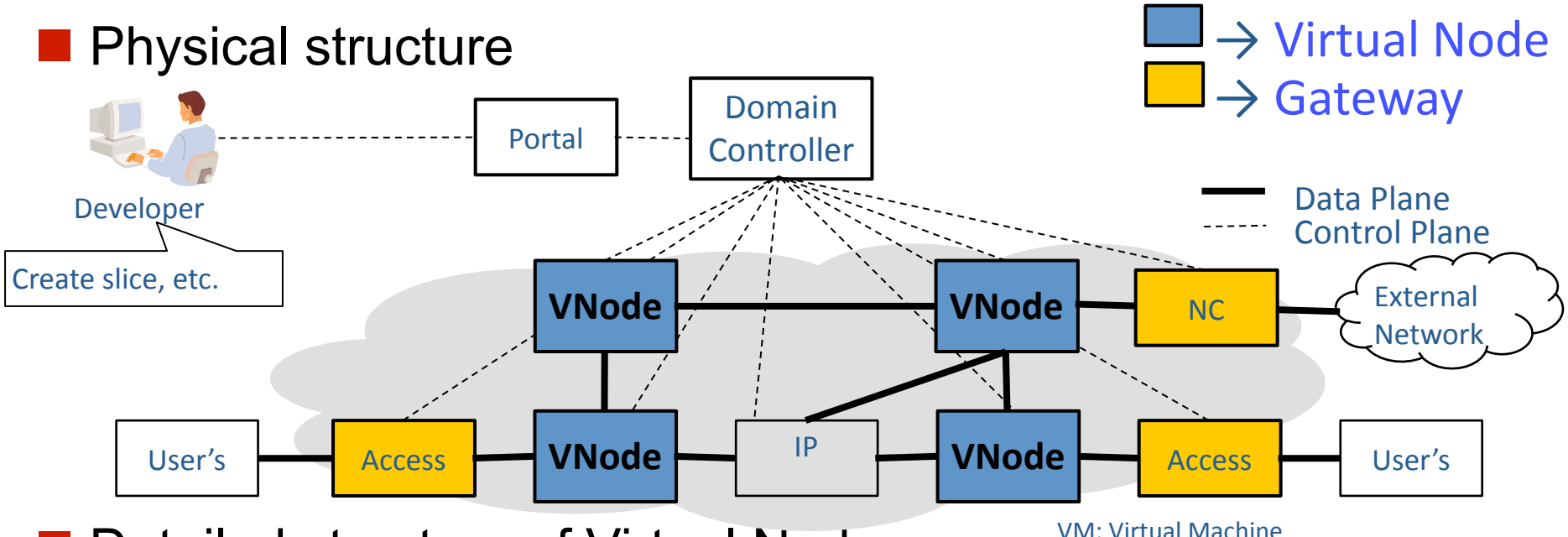
VNode Project in Japan

- VNode Infrastructure Enables Deeply Programmable Network
  (Project Leader: Aki Nakao)
- 2008-2010 Collaborative Research (NICT/Utokyo/NTT/NEC/Hitachi/Fujitsu)
- 2011-2014 Collaborative Research (Utokyo/NTT/NEC/Hitachi/Fujitsu/KDDI)



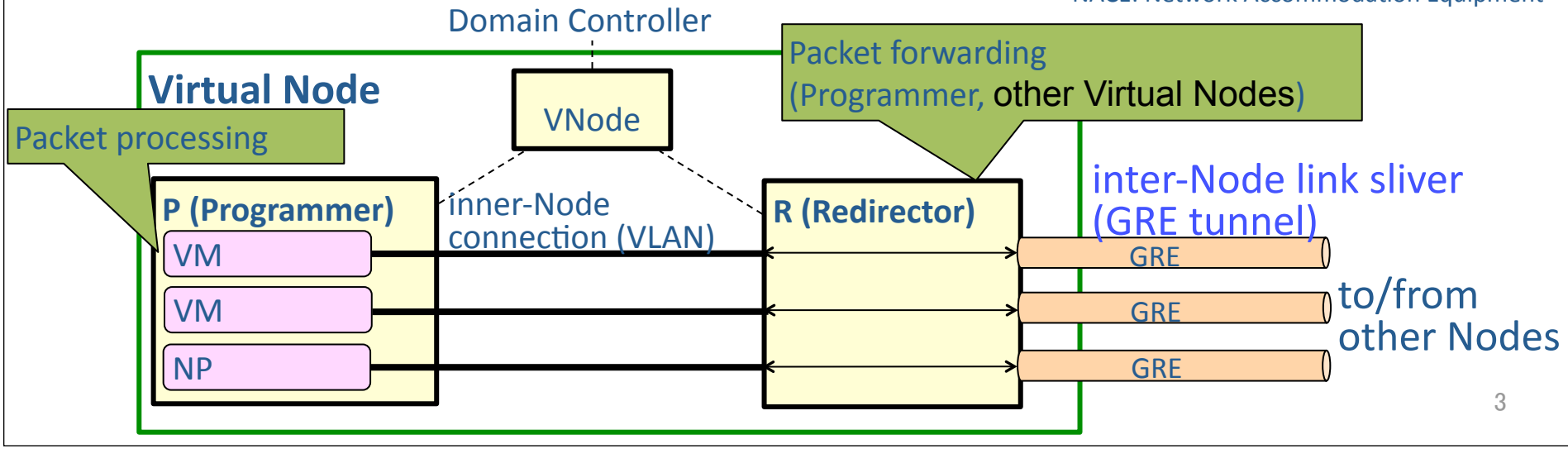
VNode architecture

- Physical structure



- Detailed structure of Virtual Node

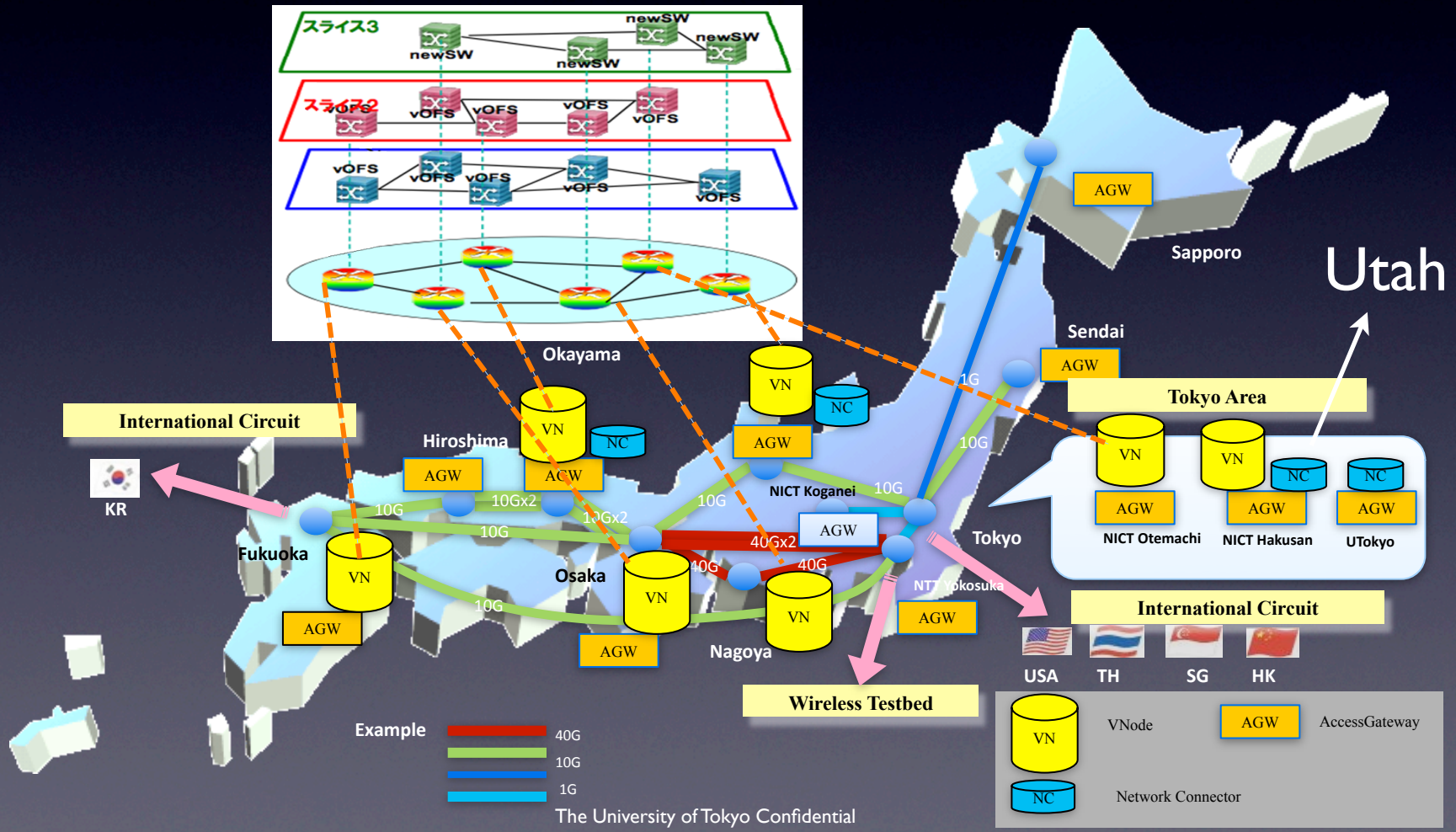
VM: Virtual Machine
NP: Network Processor
GRE: Generic Routing Encapsulation
NACE: Network Accommodation Equipment



VNode Infrastructure

VNode Infrastructure (extended to US!)

- 7 VNodes, 4 Network Connectors, 11 Access Gateways
- Deep Programmability for Experimenting with Arbitrary Protocols (Non-
- Slice-Around-The-World Project (A VNode in U of Utah)

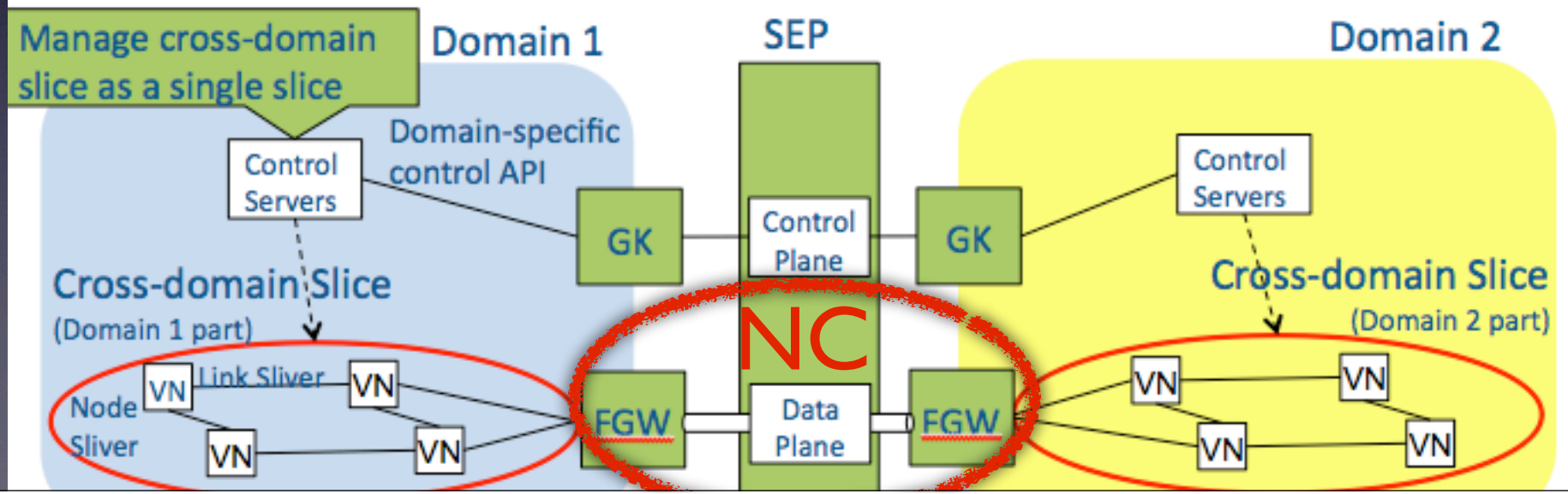


C/D Plane Federation

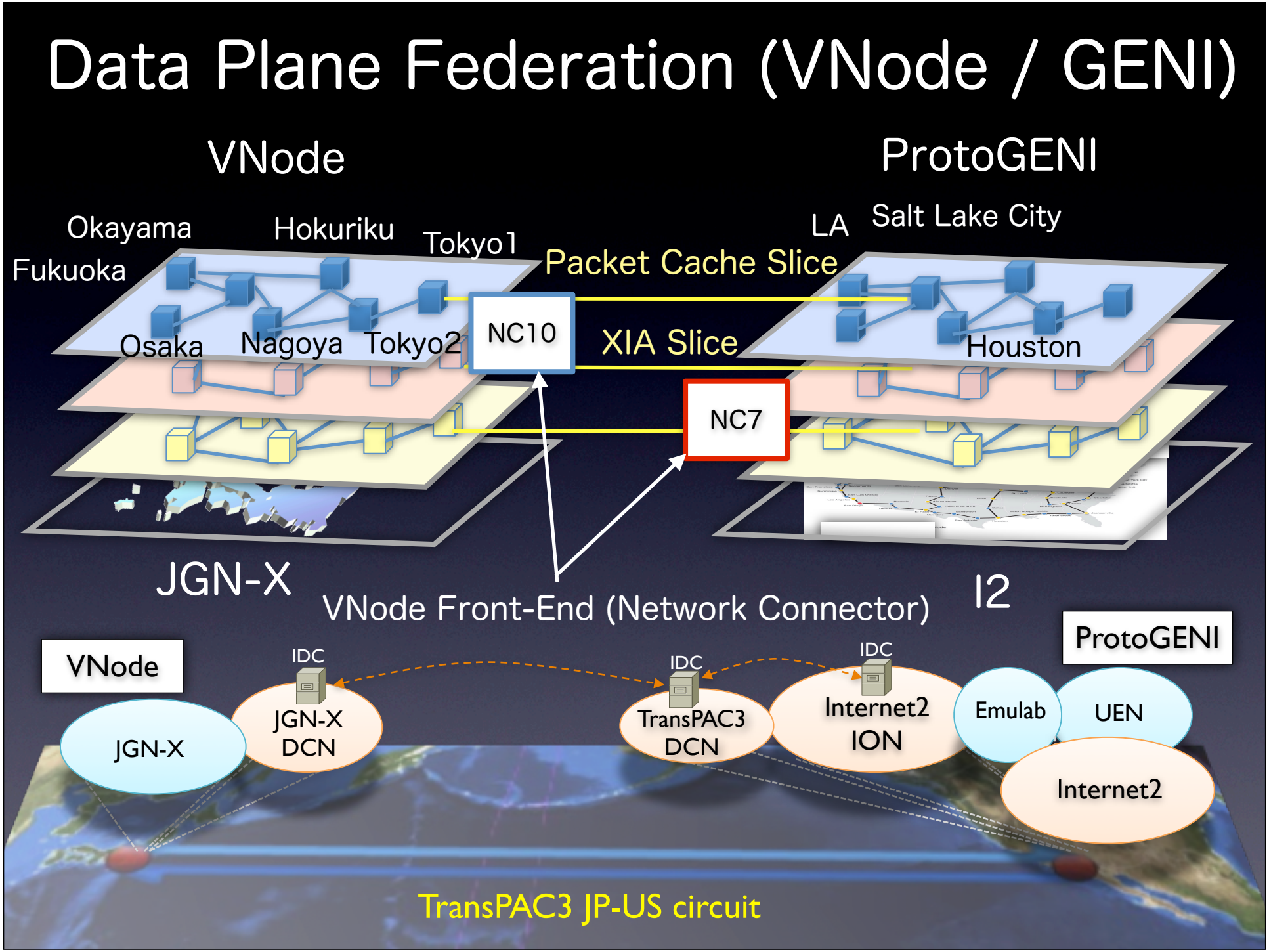
1. Basic Federation Architecture

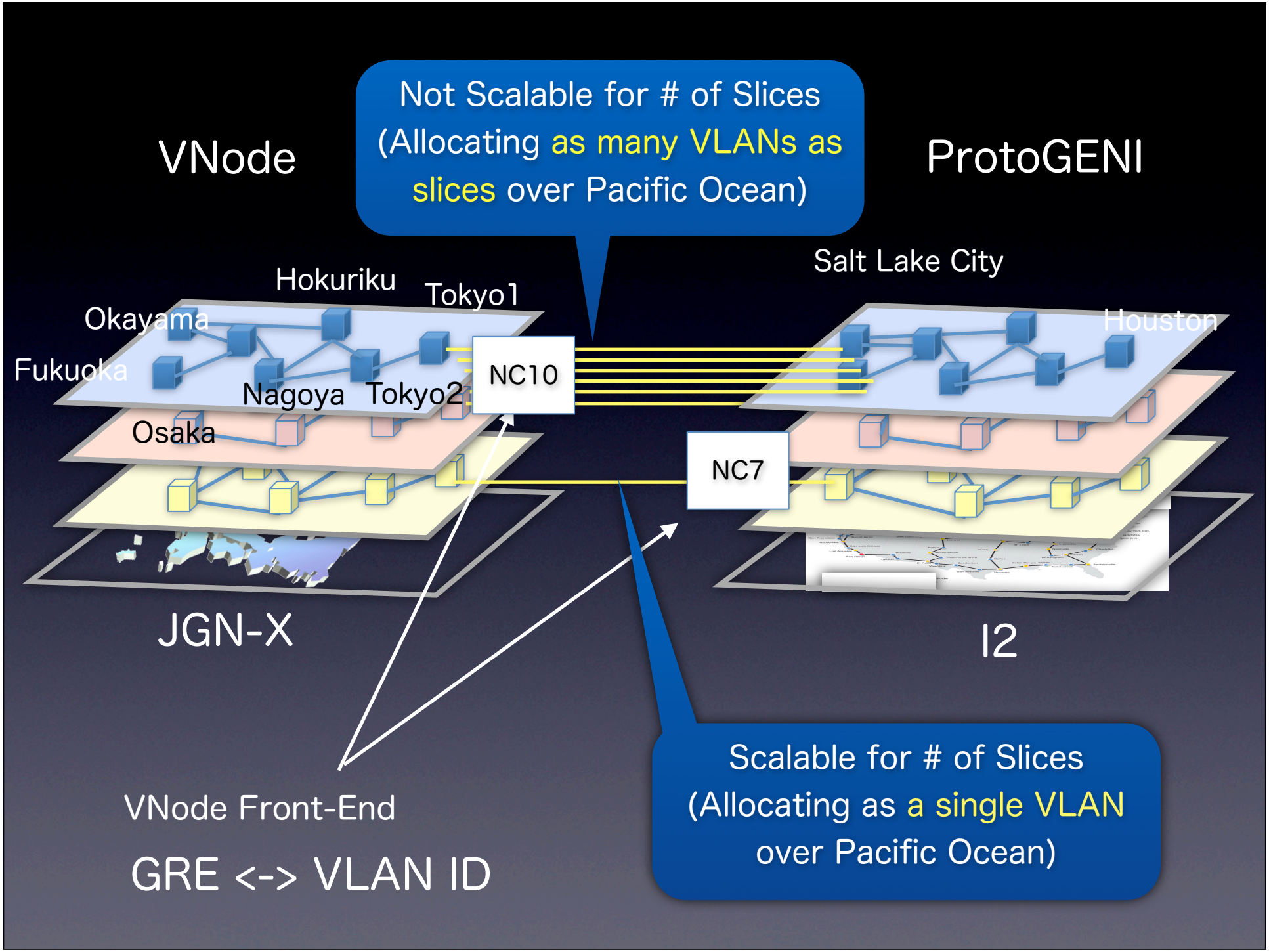
- General federation architecture between different virtualization platforms (different concept, API)
- Gatekeeper (GK) / Federation Gateway (FGW)
  - Translate API / data to common API / packet format
- Slice Exchange Point (SEP)
  - Bridge commands, control frameworks, policies etc.

Command sequence, Slice expiration, etc.

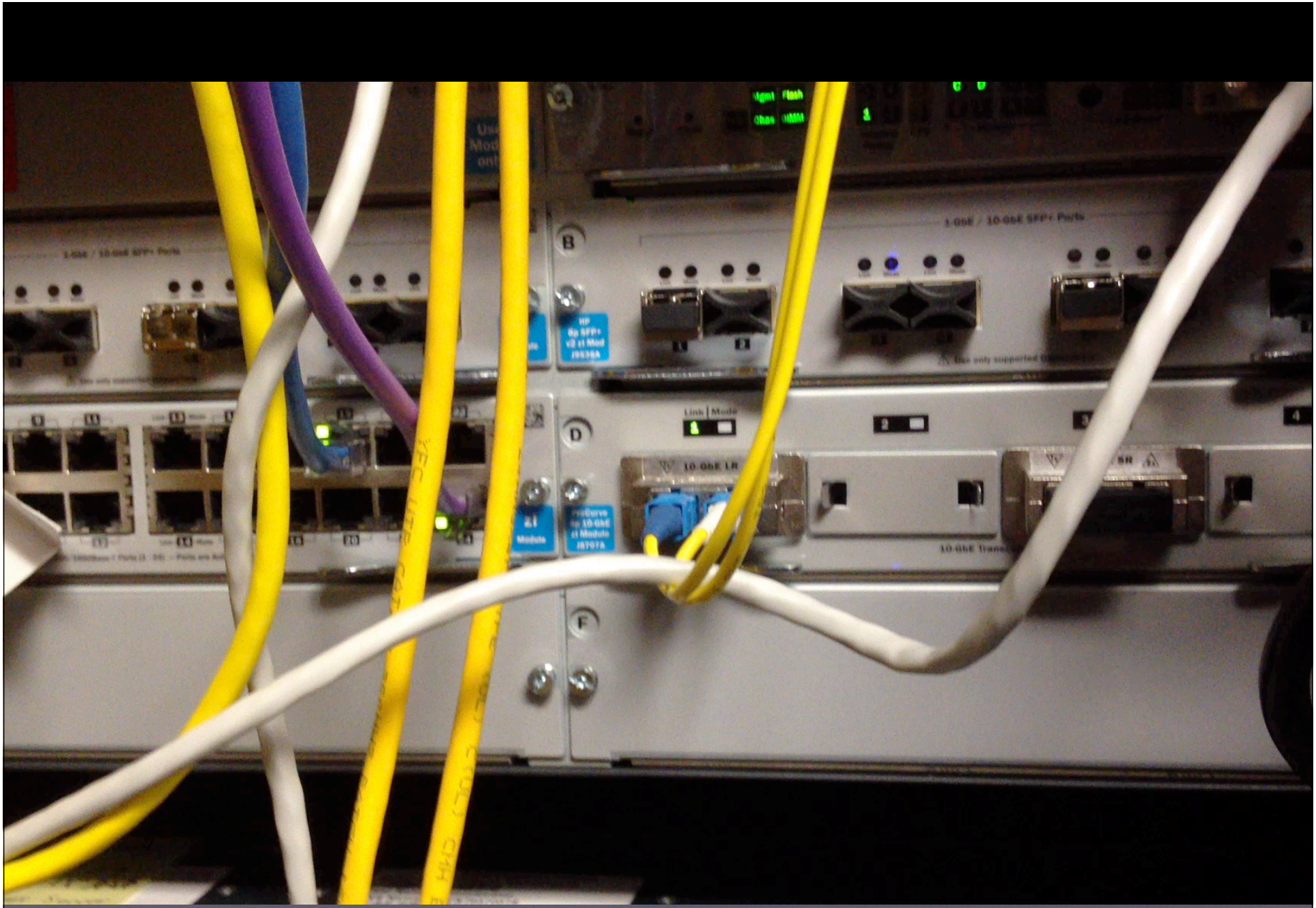


Data Plane Federation (VNode / GENI)

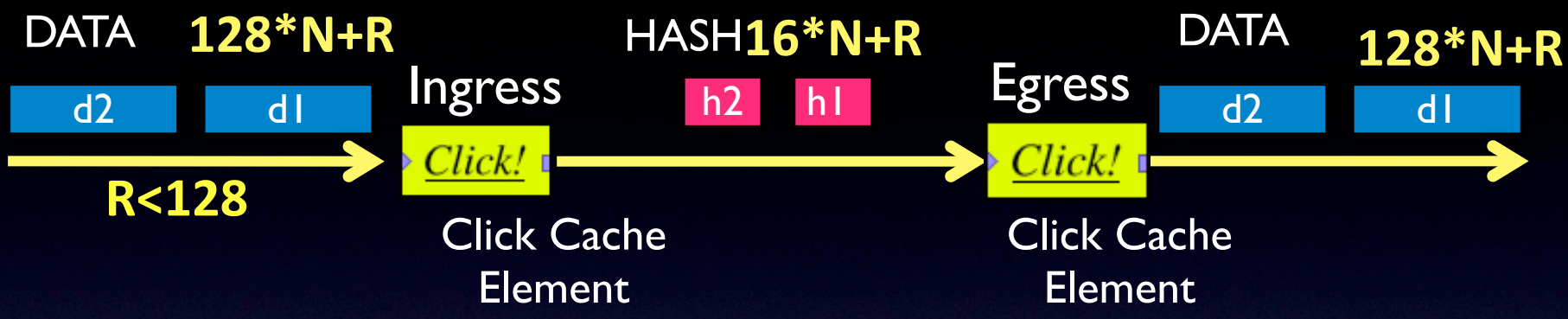



VNode
ProtoGENI
Not Scalable for # of Slices
(Allocating as many VLANs as slices over Pacific Ocean)
Hokuriku
Tokyo1
Okayama
Fukuoka
Nagoya
Tokyo2
Osaka
NC10
NC7
Salt Lake City
Houston
JGN-X
I2
VNode Front-End
GRE <-> VLAN ID
Scalable for # of Slices
(Allocating as a single VLAN
over Pacific Ocean)

VNode in instGENI Rack@Emulab

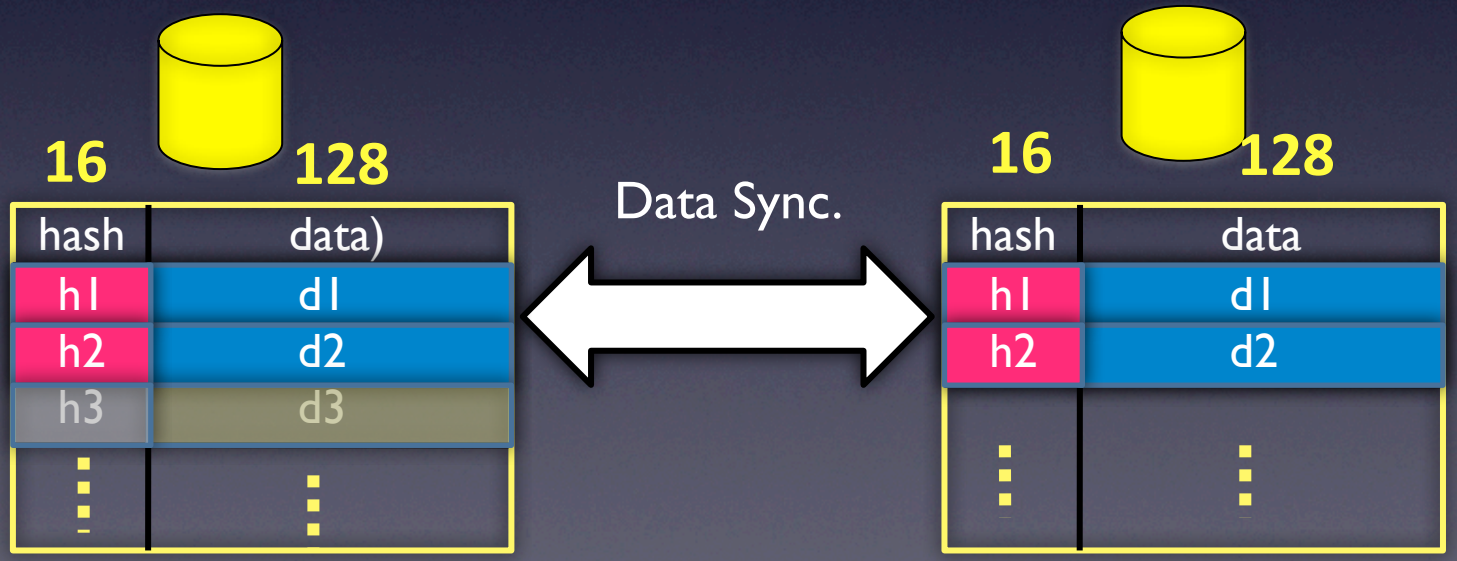


Packet Cache

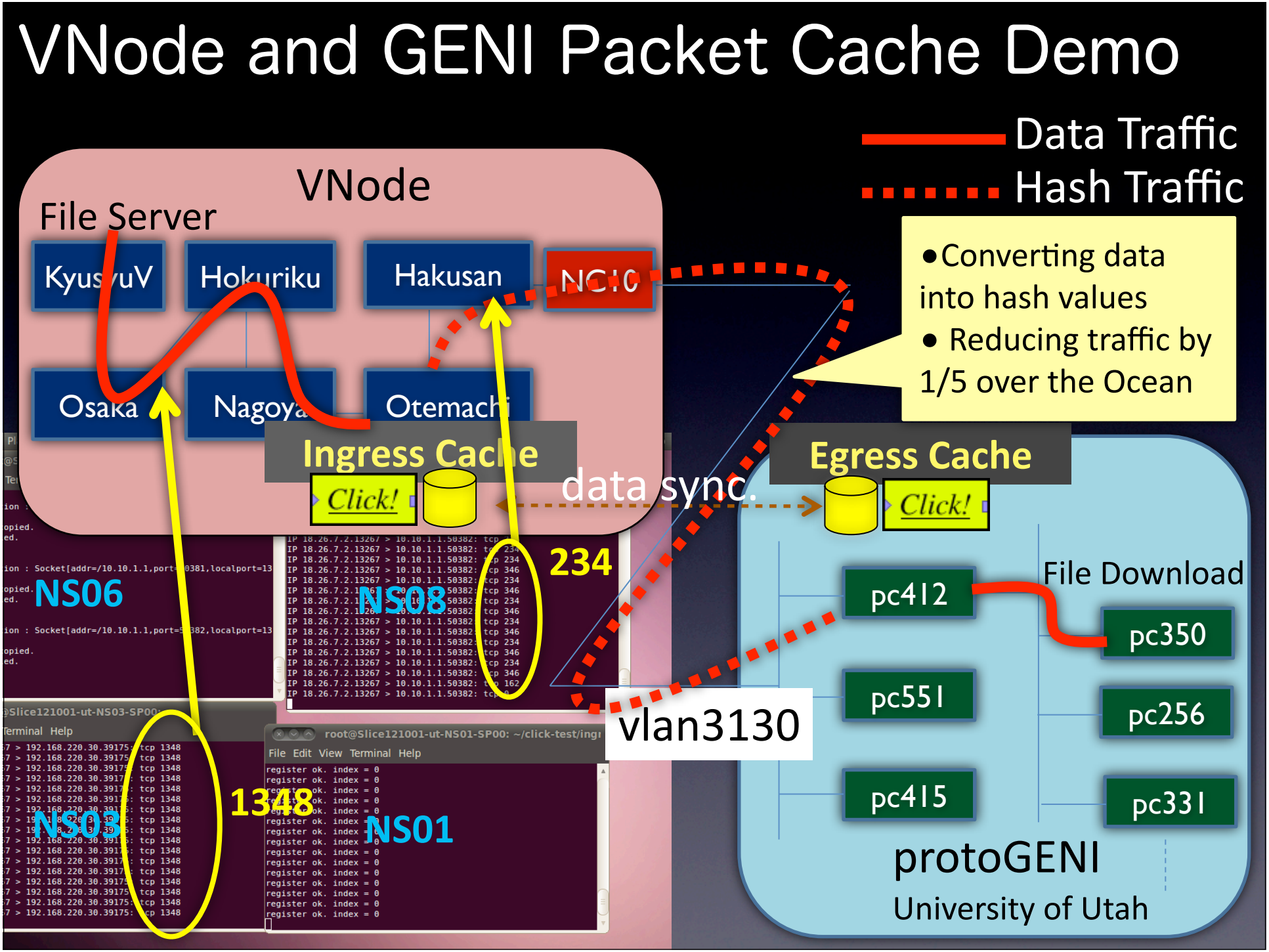


Ingress Cache

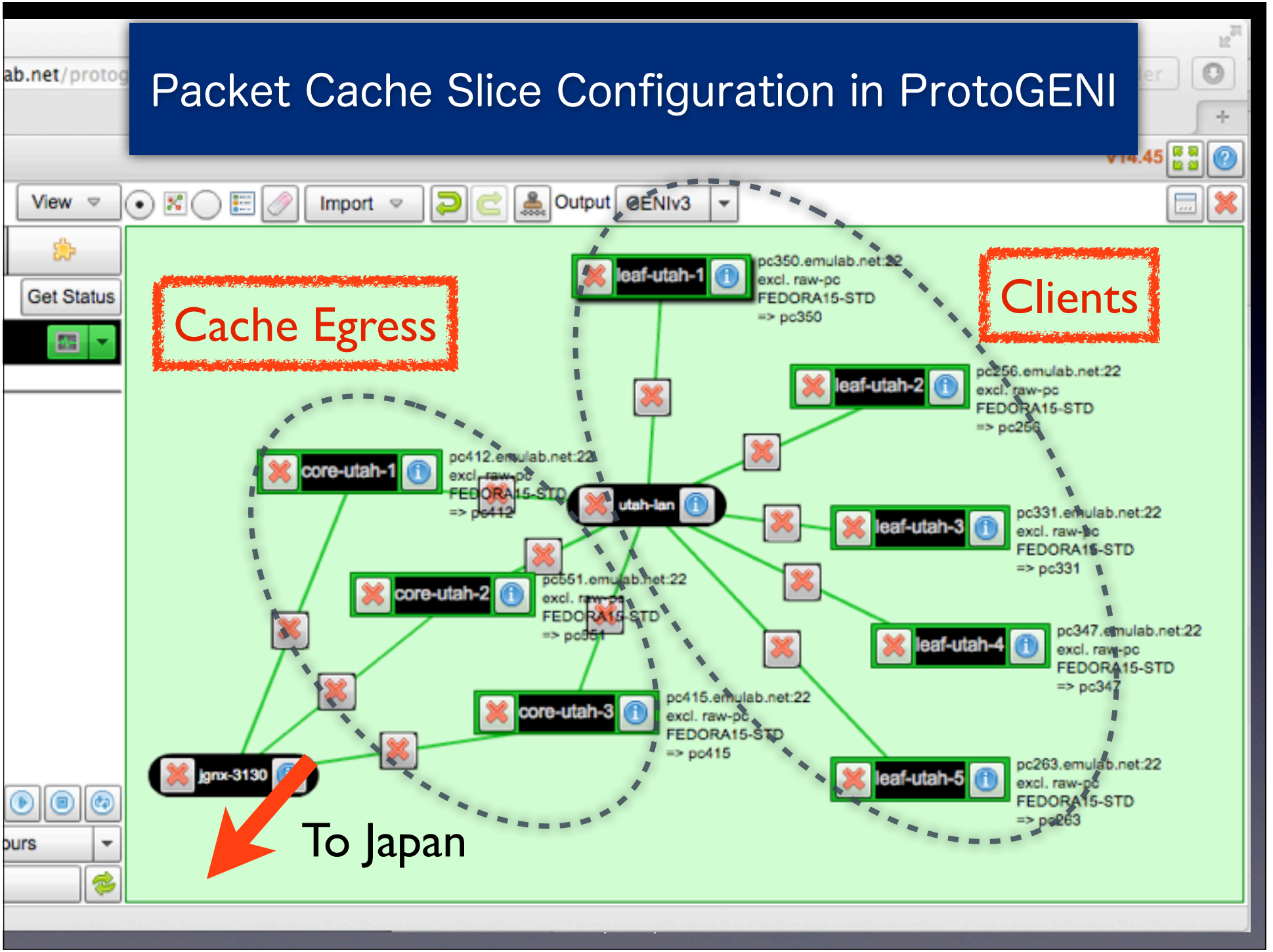
Egress Cache



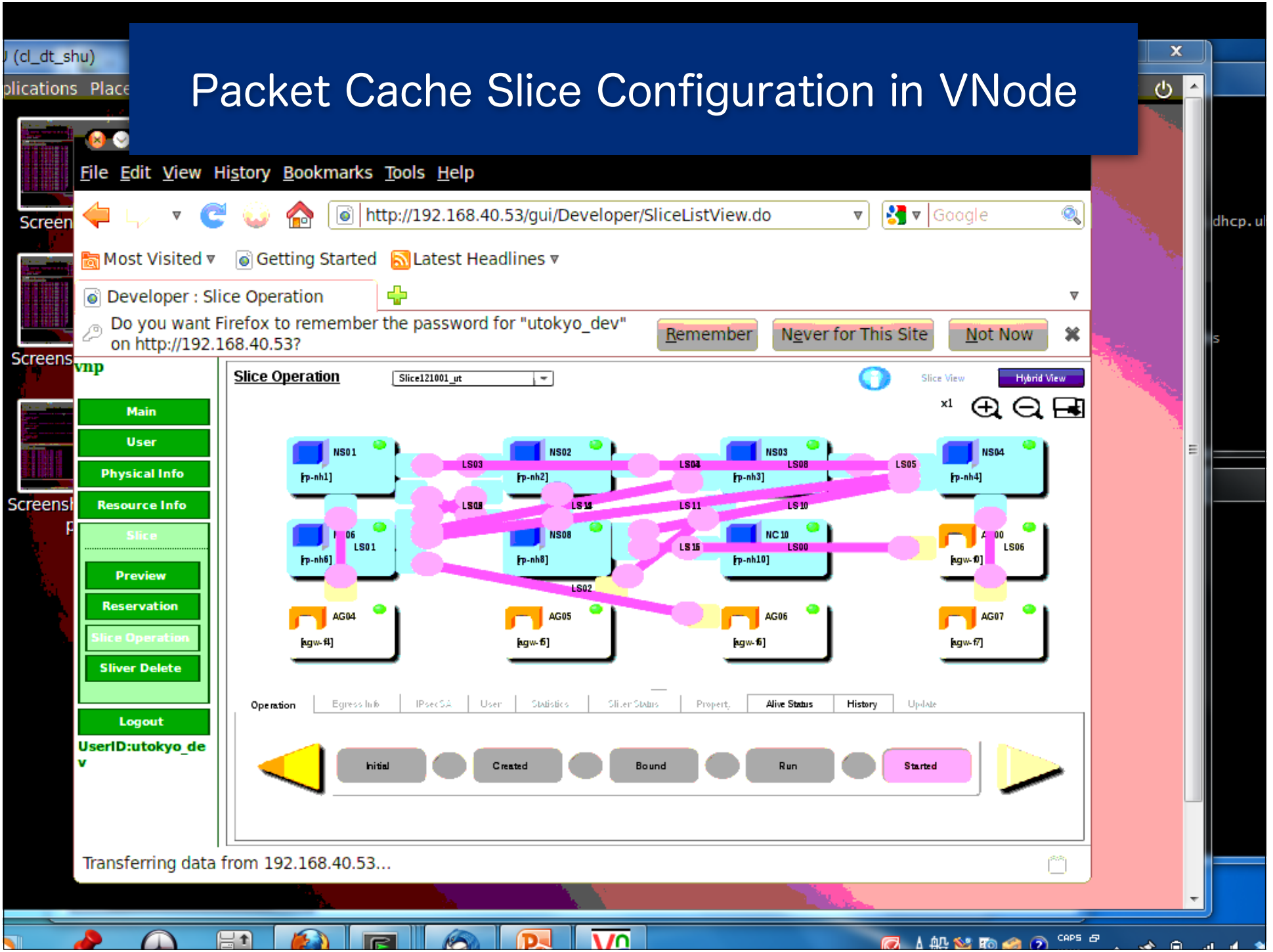
VNode and GENI Packet Cache Demo



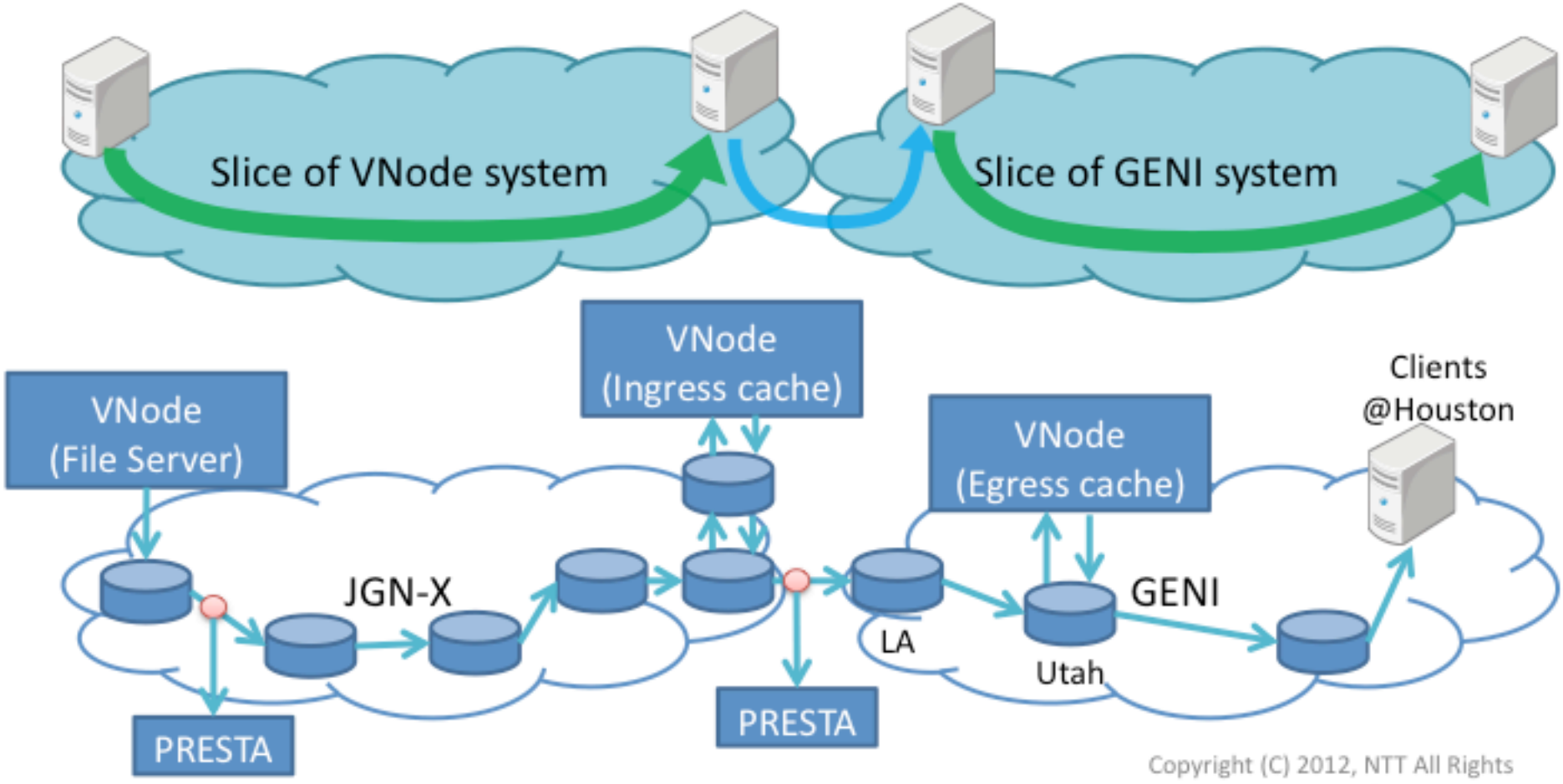
Packet Cache Slice Configuration in ProtoGENI



Packet Cache Slice Configuration in VNode



Demonstration NW configuration



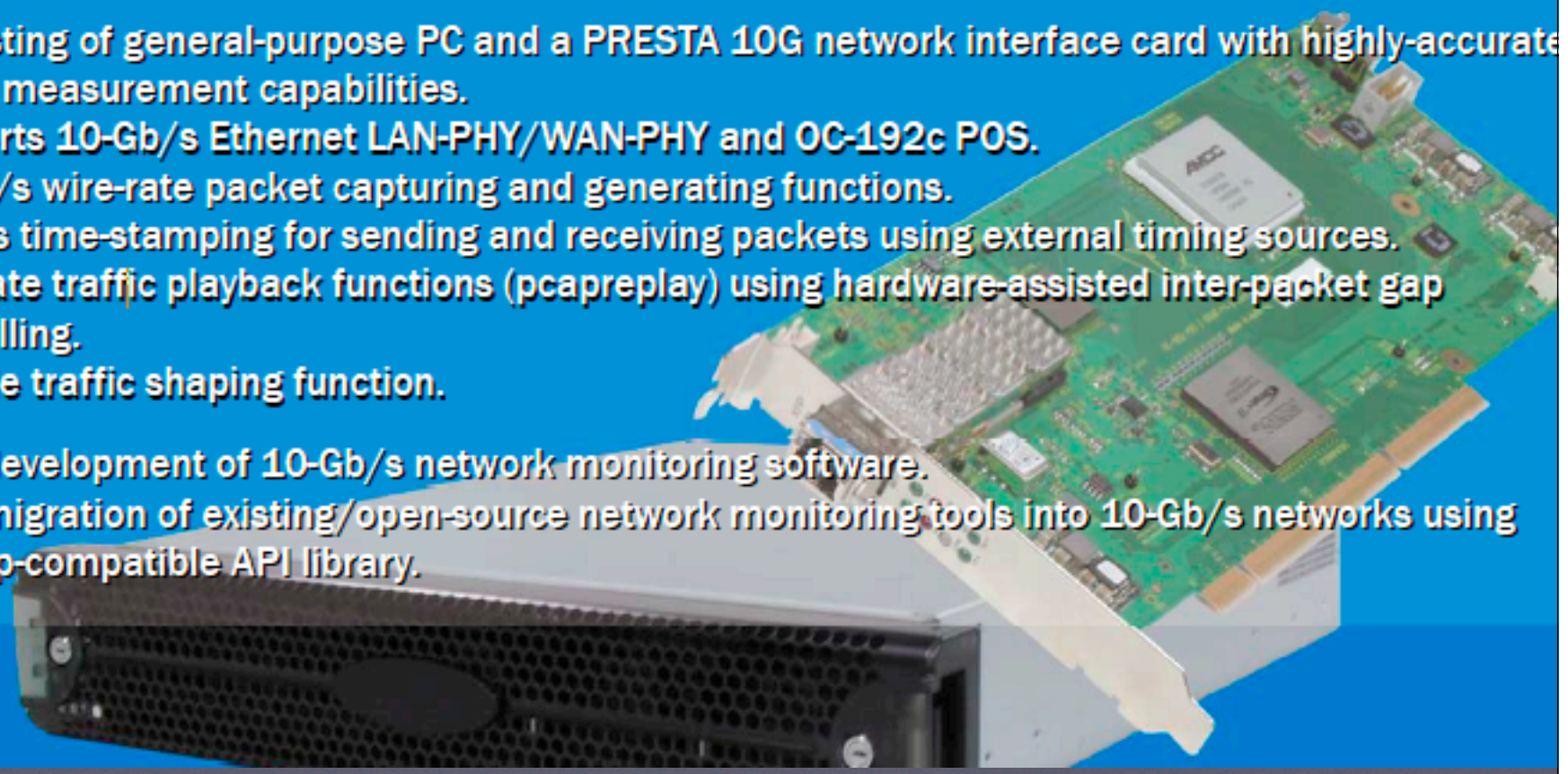
PRESTA 10G Platform:

for high-accuracy 10-Gb/s network monitoring

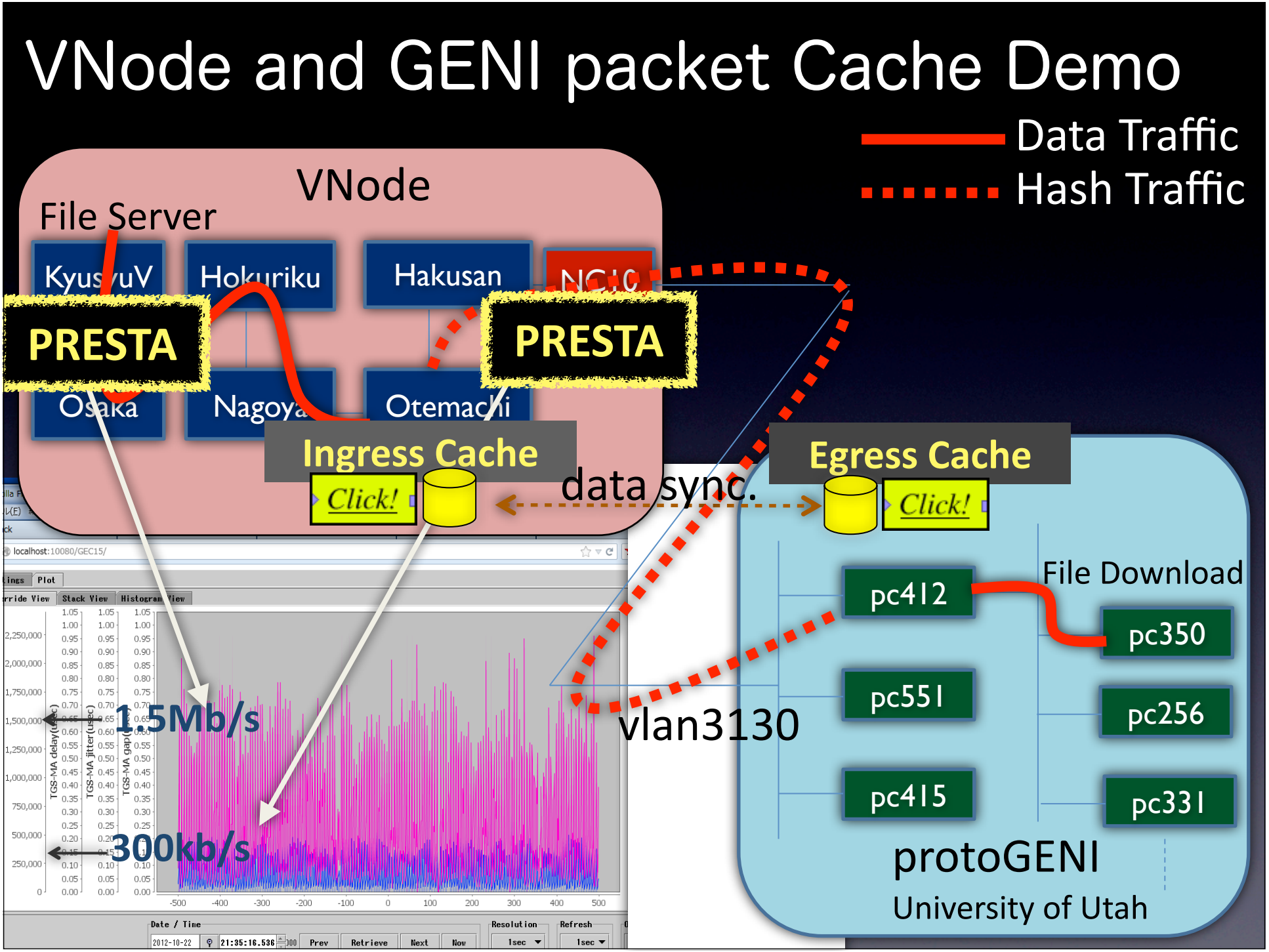
powered by i-Visto technolog

- Consisting of general-purpose PC and a PRESTA 10G network interface card with highly-accurate traffic measurement capabilities.
- Supports 10-Gb/s Ethernet LAN-PHY/WAN-PHY and OC-192c POS.
- 10-Gb/s wire-rate packet capturing and generating functions.
- 100-ns time-stamping for sending and receiving packets using external timing sources.
- Accurate traffic playback functions (pcapreplay) using hardware-assisted inter-packet gap controlling.
- Flexible traffic shaping function.

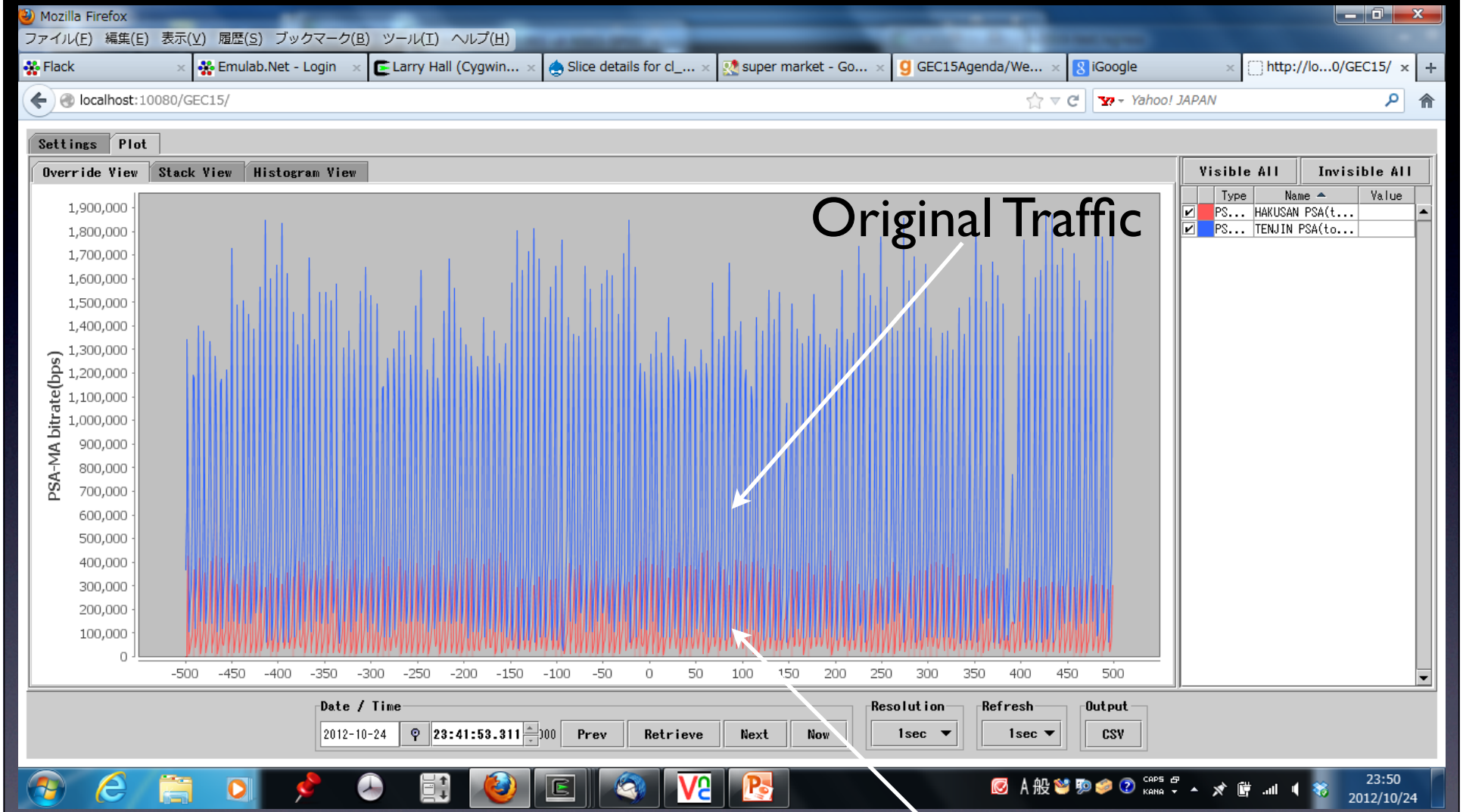
- Easy development of 10-Gb/s network monitoring software.
- Easy migration of existing/open-source network monitoring tools into 10-Gb/s networks using libpcap-compatible API library.



VNode and GENI packet Cache Demo

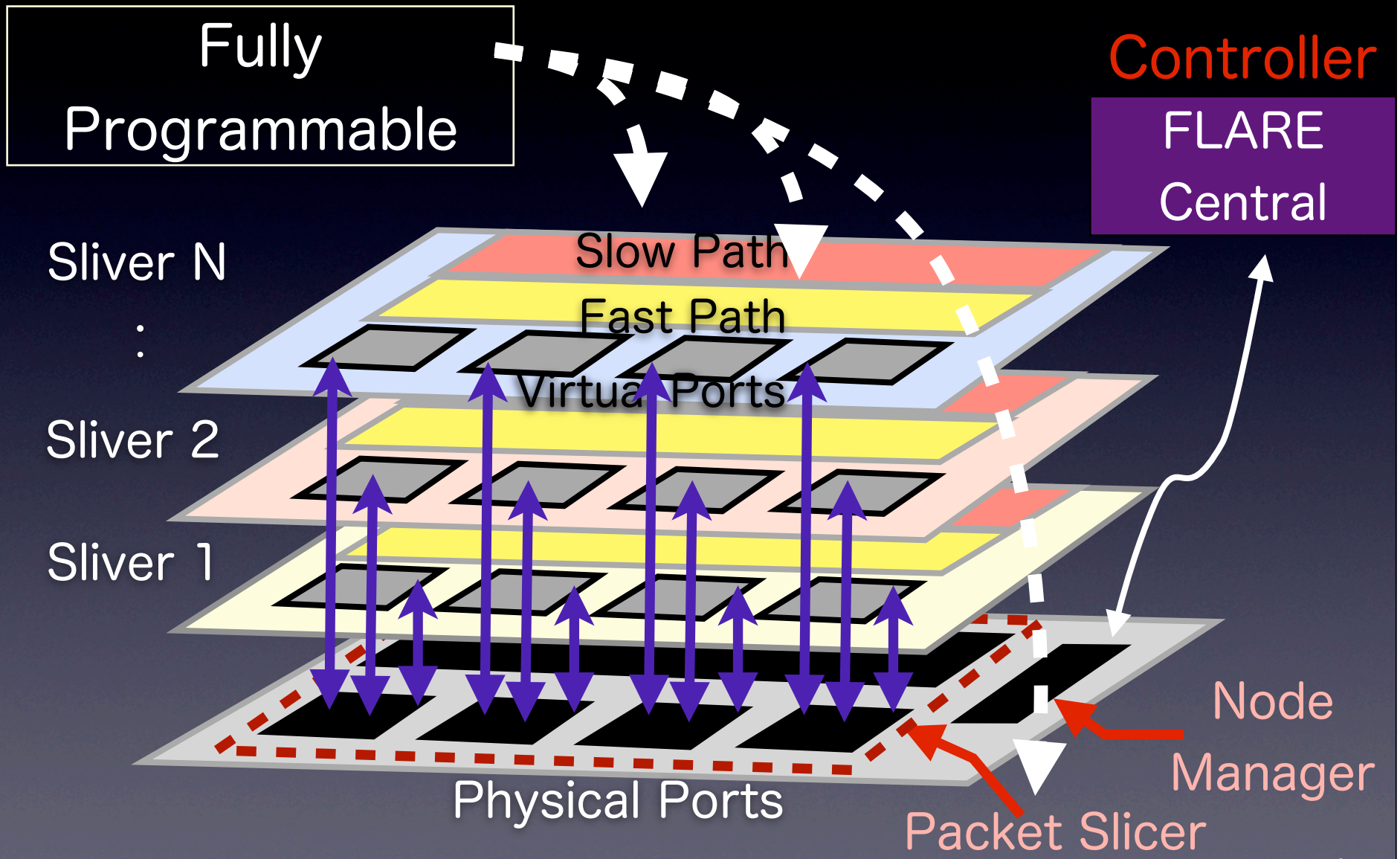


Live Demonstration

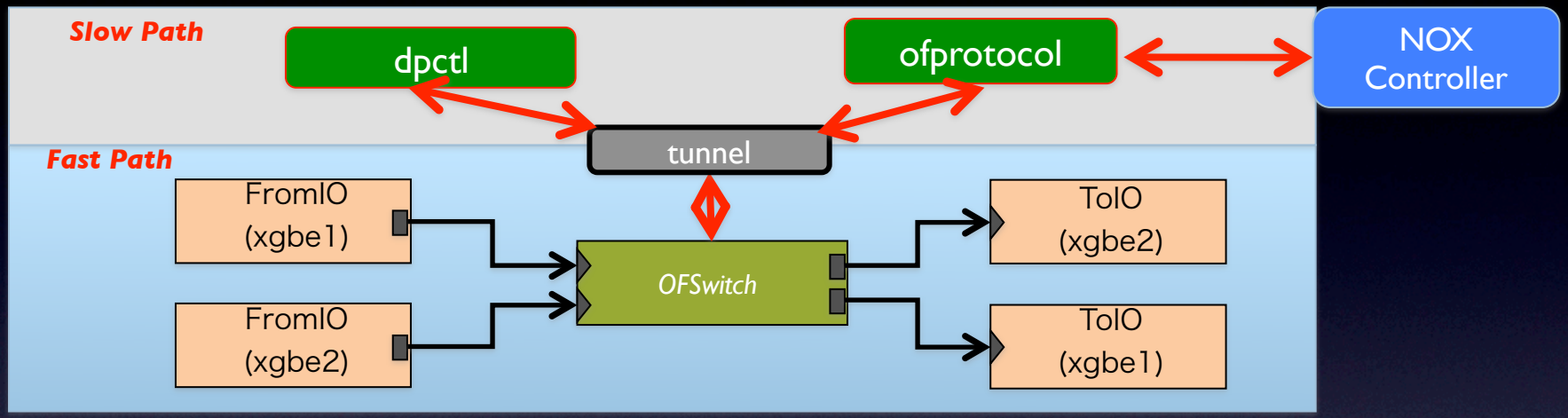

Mozilla Firefox
localhost:10080/GEC15/
Settings
Plot
Override View
Stack View
Histogram View
Visible All
Invisible All
Type
Name
Value
PS...
HAKUSAN PSA(t...
TENJIN PSA(to...
PSA-MA bitrate(bps)
Original Traffic
Hash Traffic
Date / Time
2012-10-24
23:41:53.311
Prev
Retrieve
Next
Now
Resolution
1sec
Refresh
1sec
Output
CSV
23:50
2012/10/24

FLARE Update

FLARE Architecture



Programming Model



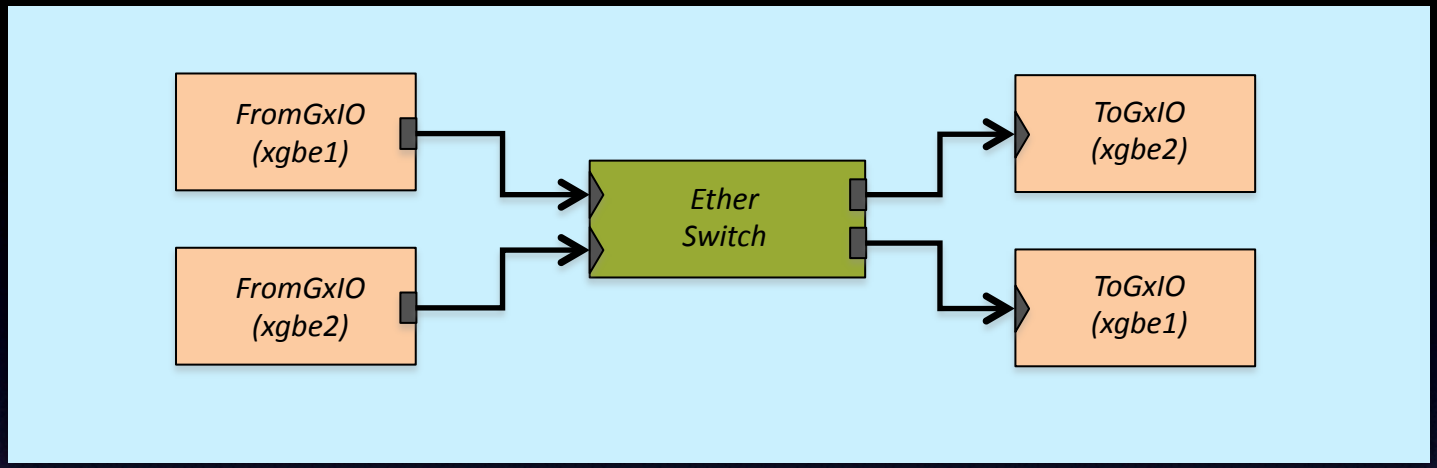
Multi-Threaded Modular Programming

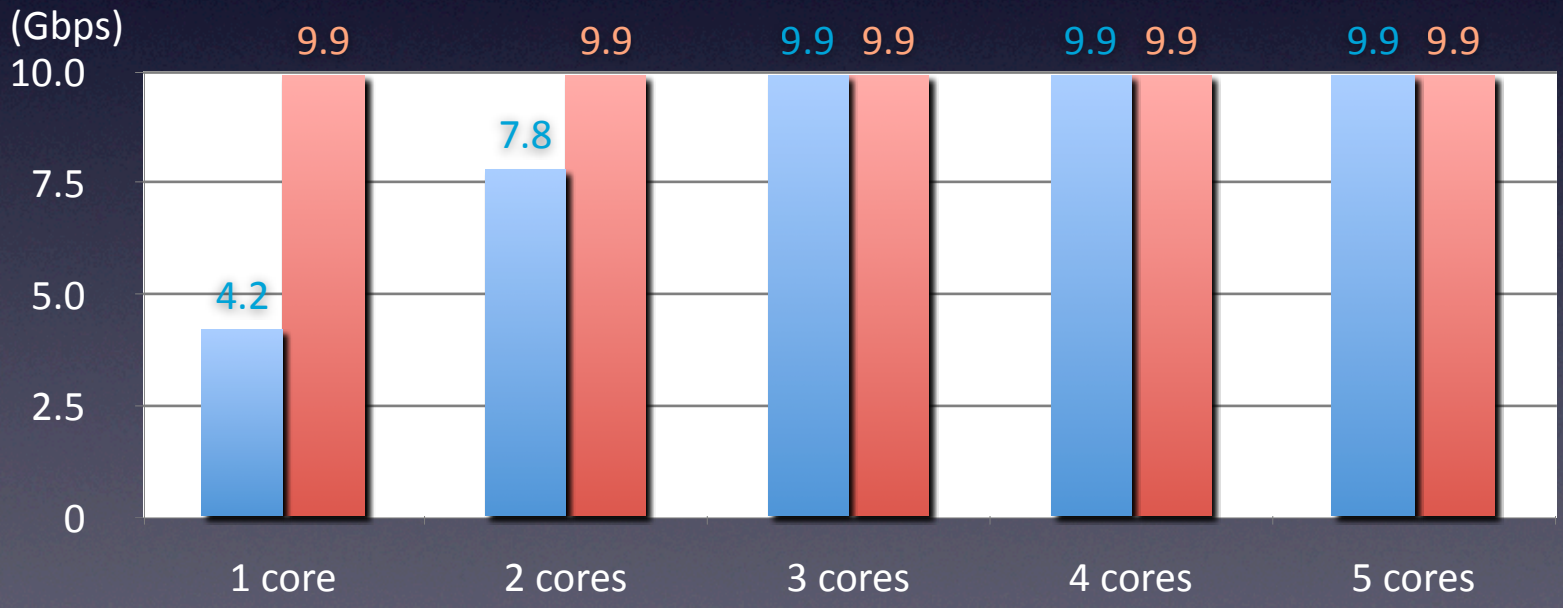
e.g., Click Software Modular Router (multi-threaded)

・Arbitrary switch logic(s) can be implemented in fast-path, slow-path and slicer sliver

(e.g., OpenFlow switch logic can be modified/refined)

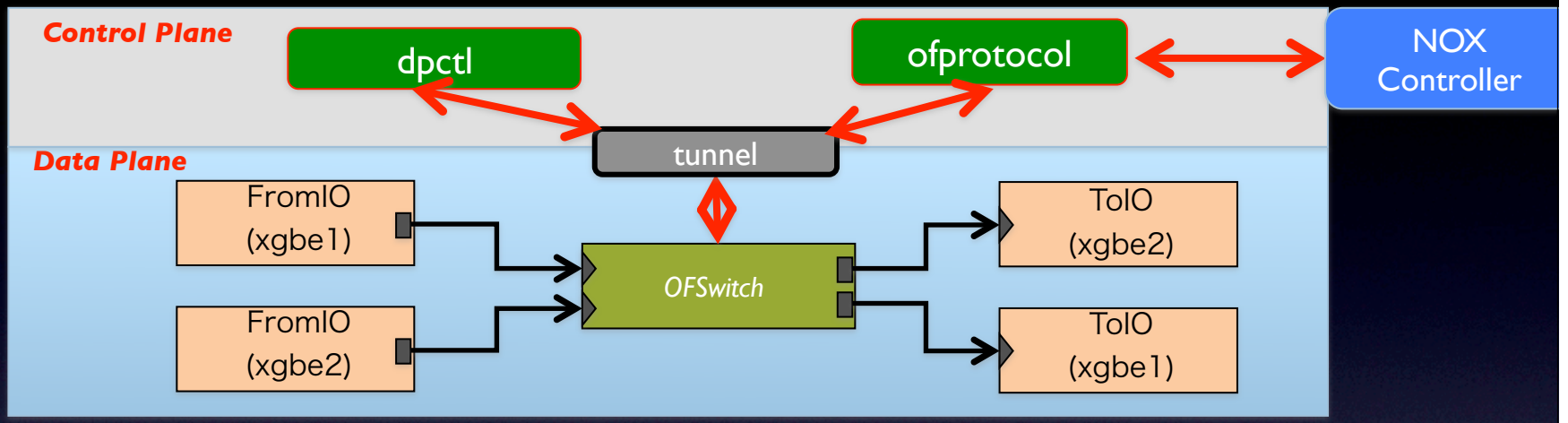
Ethernet Switch

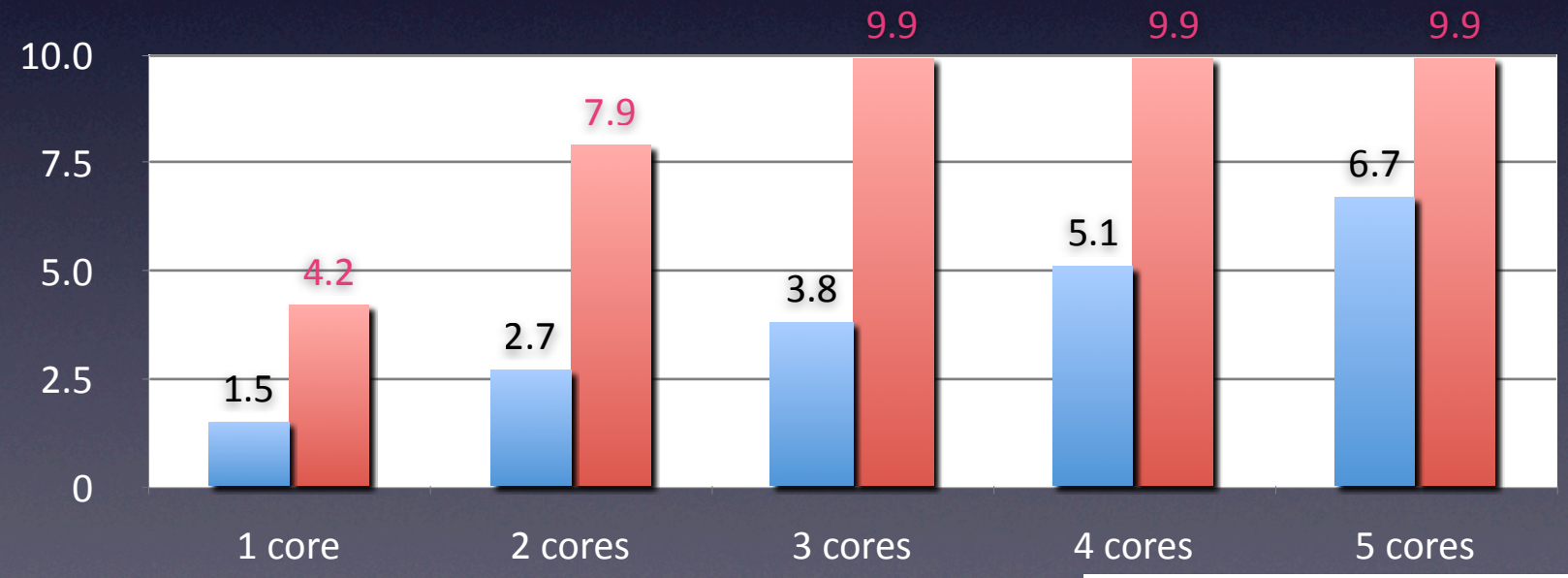




Switching Performance

OpenFlow Switch





Switching Performance

Summary

- Data Plane Federation just started
- Control Plane Federation (NC->SEP)
- More Geographical Distribution
- More Applications(Packet Cache, XIA, ...)
- FLARE Switch in ProtoGENI :-)

Credits

- VNode Team (NICT, UTokyo, NTT, Hitachi, KDDI, NEC, Fujitsu)
- PRESTA Team (NTT)
- ProtoGENI Team
- XIA Team
- NICT / JGN-X & KDDI
- Ministry of Internal Affair and Communications (MIC)
- GENI Project Office
- iCAIR/Starlight
- instaGENI / HP Labs
- UTokyo NakaoLab (FLARE-dev Team)