Empowered by Innovation NEC

Talk: 18 minutes, Q&A: 2 minutes

ProgrammableFlow

OpenFlow and OpenStack components for GENI Racks

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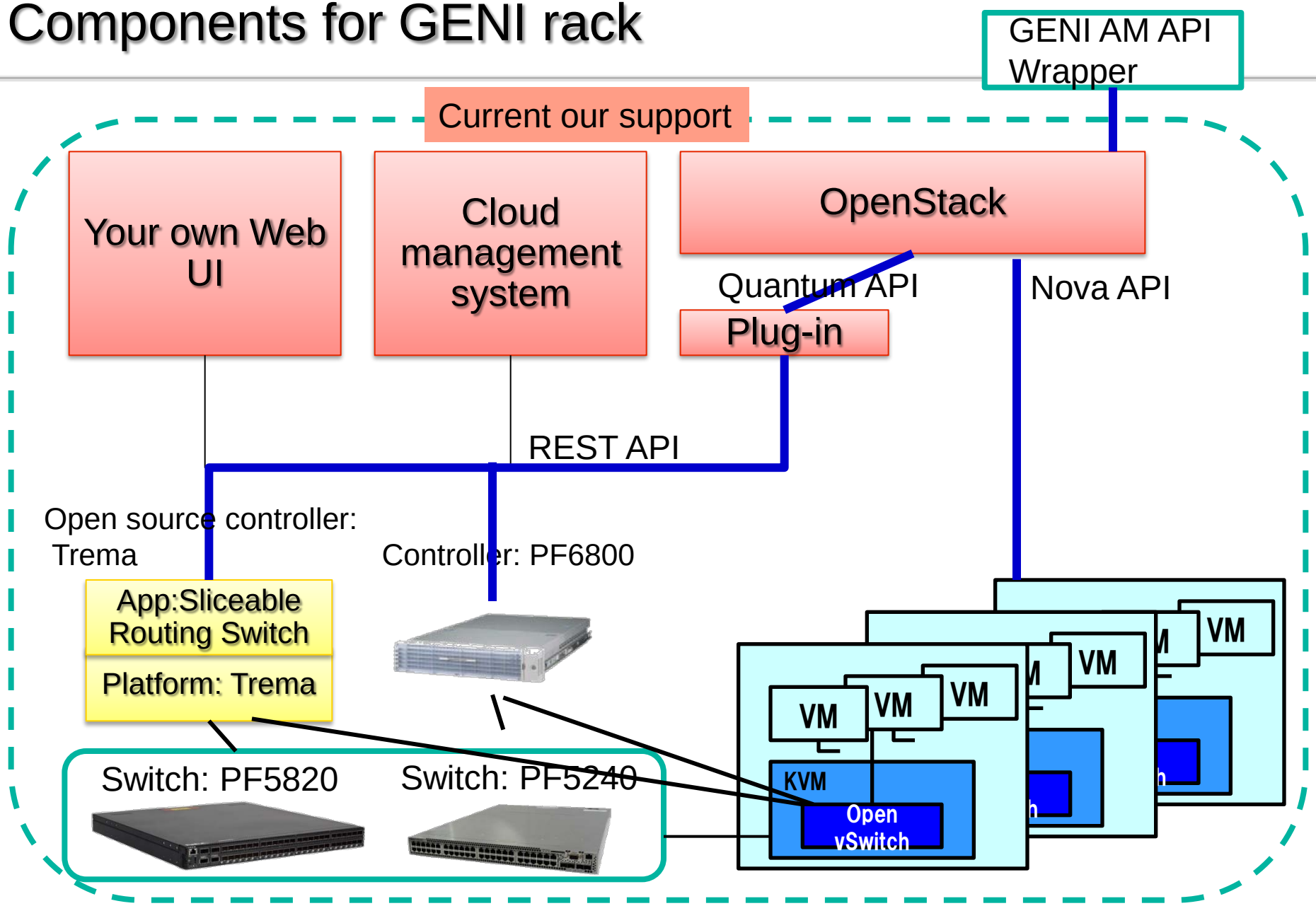
Outline

- Our position in GENI racks
- Components for GENI racks
  - OpenFlow switch and controller products
    - ProgrammableFlow series
  - OpenFlow controller Trema
    - for network experiments
  - OpenFlow plugin of OpenStack
    - for binding compute resources to OpenFlow network

Our position in GENI racks

- Contribution to open source communities
  - Open source of OpenFlow controller: Trema
  - Open source of OpenFlow plugin to OpenStack
- Support several customer trials using those software
- Explore how those software can be utilized in GENI community, including GENI rack
  - Seeking any open source contributors of wrapper from GENI Aggregate Manager API to OpenStack
    - E.g. ORCA : NEuca Extentions for OpenStack ?

Components for GENI rack



ProgrammableFlow

OpenFlow switch and controller products for GENI Racks
- ProgrammableFlow Products

Introducing ProgrammableFlow Products

Simple, scalable, secure, open networking

- First OpenFlow-enabled fabric
- Variety apps: Cloud services, network aggregation, monitoring, appliance pooling

BEST OF INTEROP 2011 Infrastructure PRESENTED BY: InformationWeek analytics

Univerge PF Series

ProgrammableFlow Controller (PFC)

PF6800

ProgrammableFlow Switch Family (PFS)

48x10GbE+4x40GbE

PF5820

48xGbE+4x10GbE

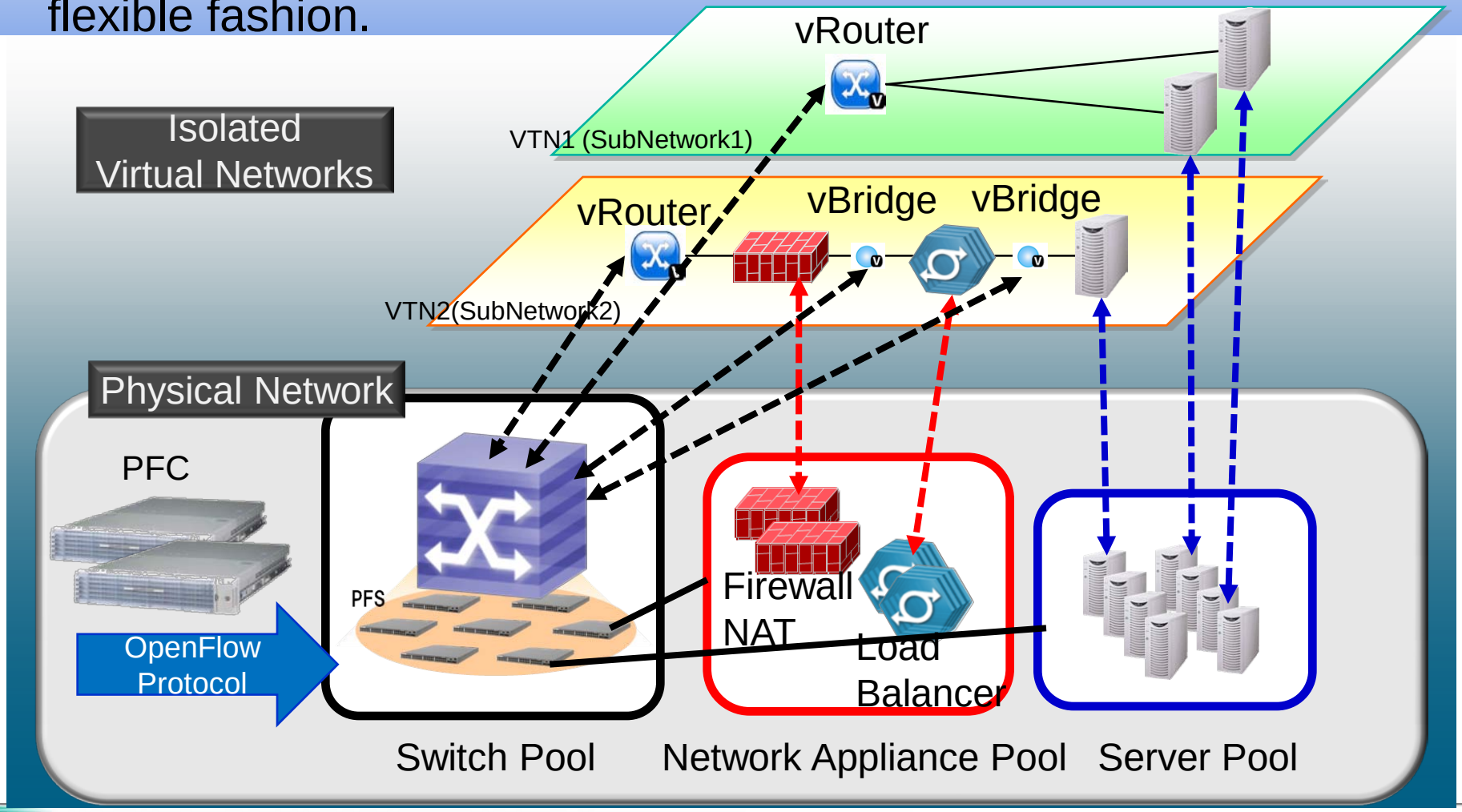
PF5240

BEST OF SHOW AWARD INTEROP Grand Prix

BEST OF SHOW AWARD INTEROP Special Prize

Virtual Network Design for L2/L3 to L4/L7

- Allows us to design any L2/L3 to L4/L7 network by components of vRouters, vBridges, Network appliances, and server/terminals in any flexible fashion.



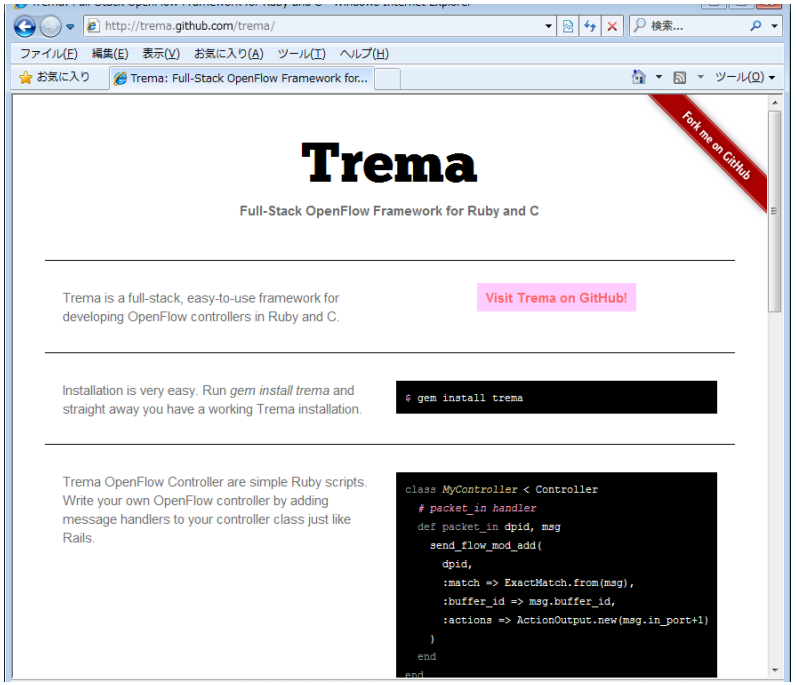
OpenFlow network slice control via OpenFlow Controller “Trema”

Trema: Full-Stack OpenFlow Framework for Ruby/C

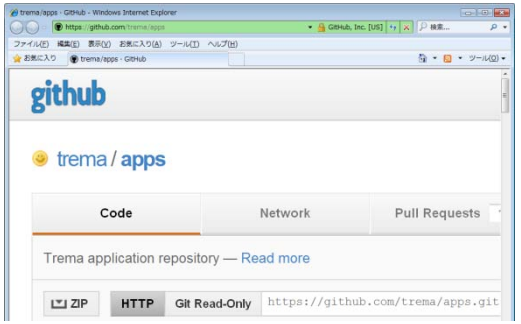
- A software platform for OpenFlow Controller developers

- EASY
  - All-in-one package
  - Integrated developing environment
  - Sophisticated APIs for Ruby and C
- Many sample controllers/parts
  - Useful samples @/src/examples/
  - Practical samples @TremaApps
- Fully tested and supported
- Open community
  - Free software (GPLv2)
  - Community participation (even for commercial product)

Trema @http://trema.github.com/trema/

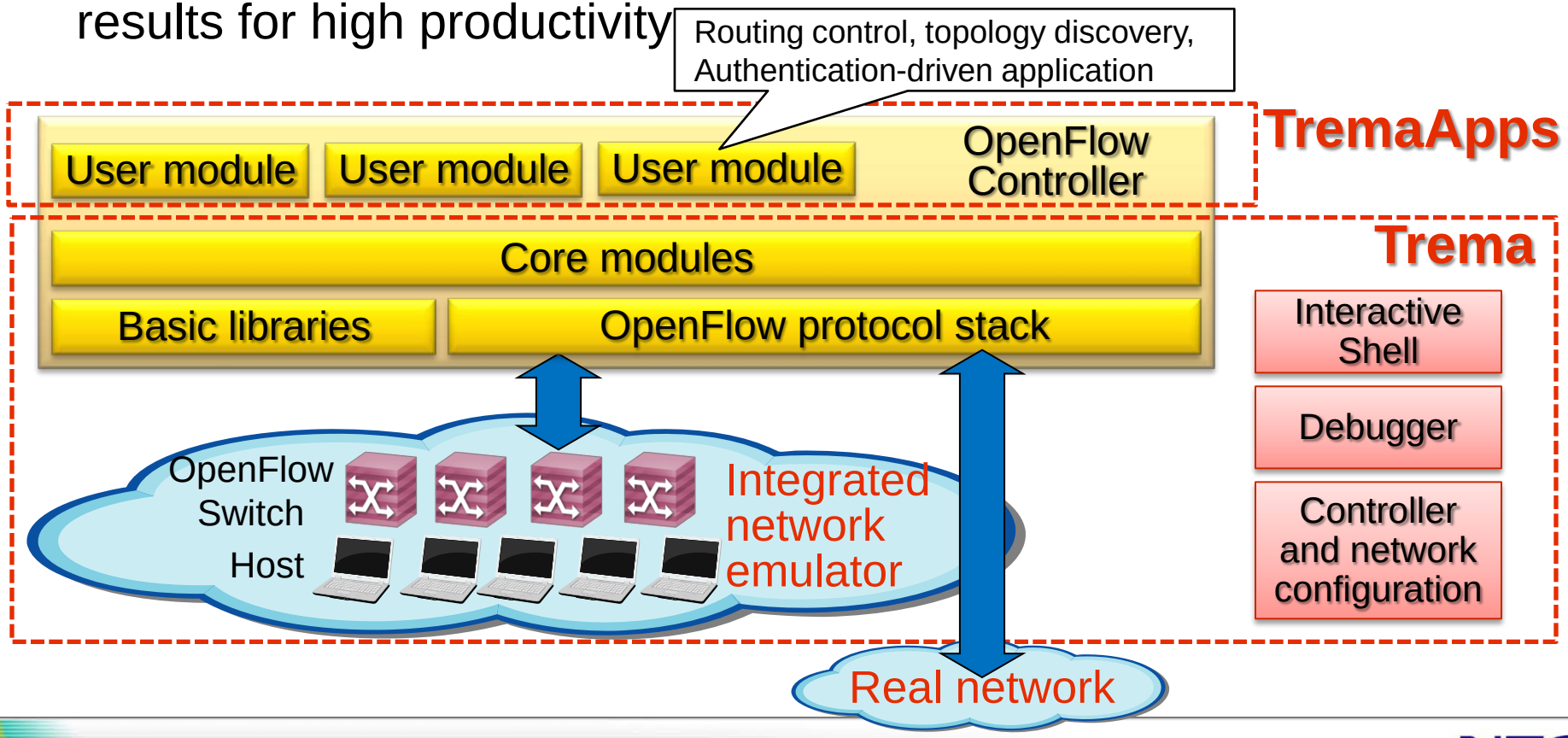


TremaApps
@https://github.com/trema/apps

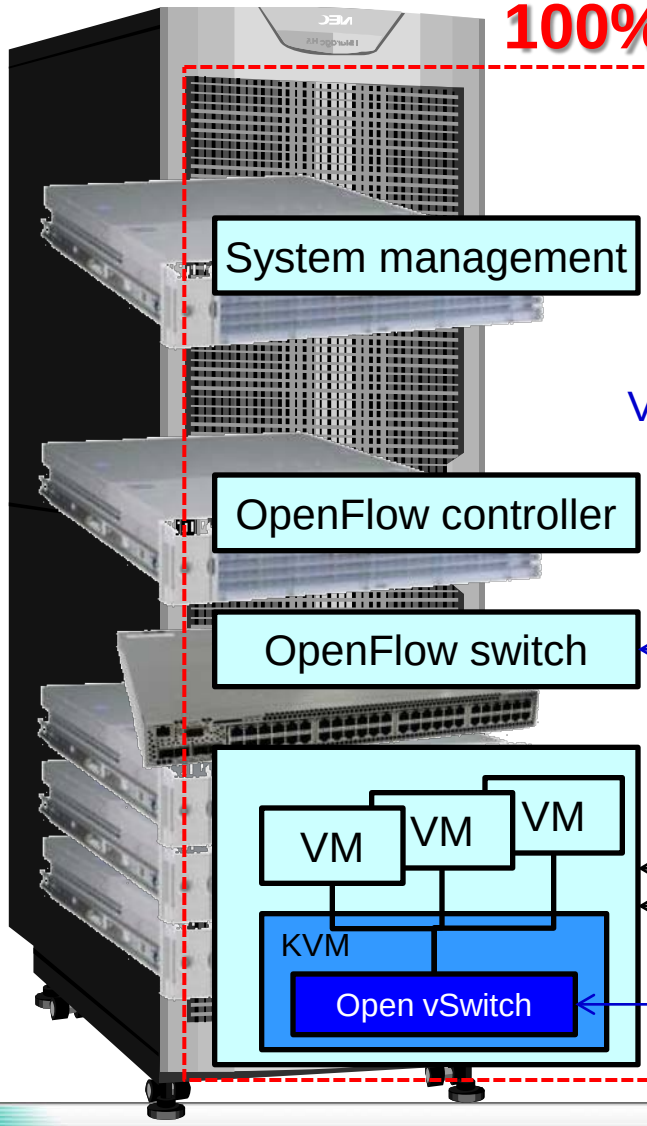


Scope of Trema

- Trema = OpenFlow framework
  = controller platform + integrated network emulator + debugger + etc…
- Why framework? - Tight loop of "coding, testing, and debugging“ results for high productivity



“Trema Rack” : 100% Free Software of GENI Rack



100% free software

VM-network unified management system

OpenStack

SandVox

System management

Quantum API

Nova API

Plug-in

Virtual network mgmt. API (REST)

SliceableRoutingSwitch

Trema

OpenFlow controller

OpenFlow switch

OpenFlow network control

Virtual machine management

VM

VM

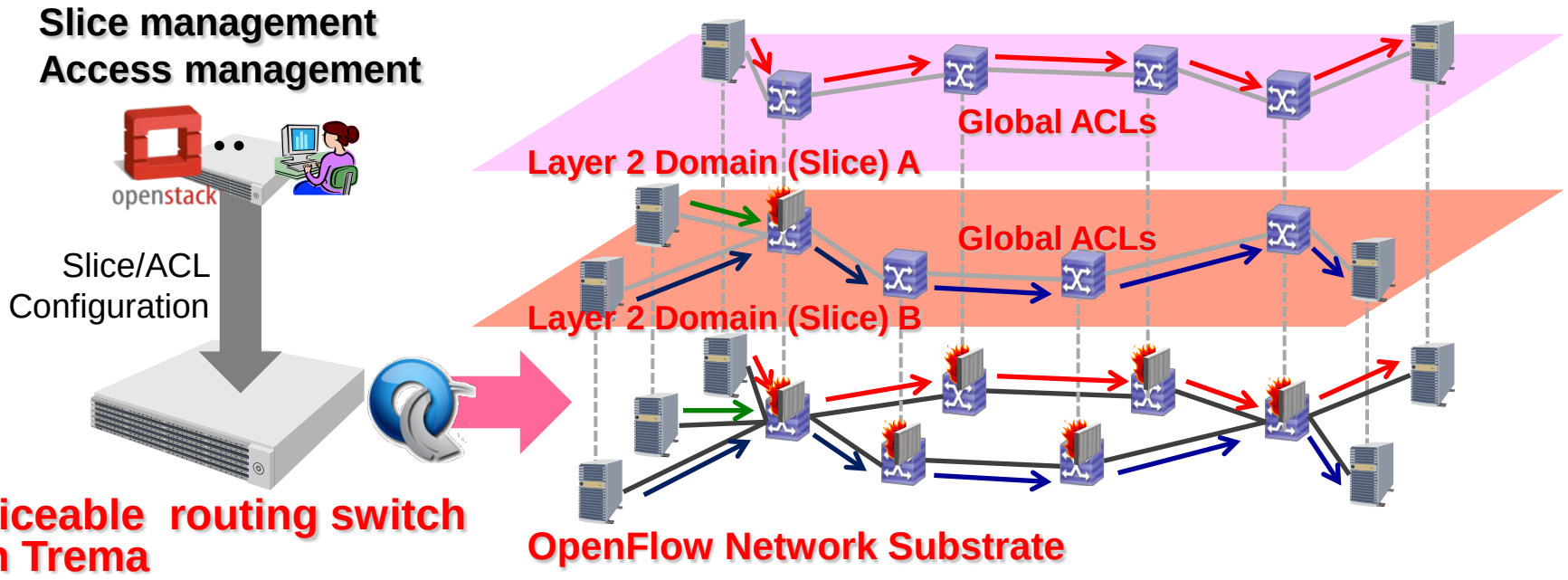
VM

KVM

Open vSwitch

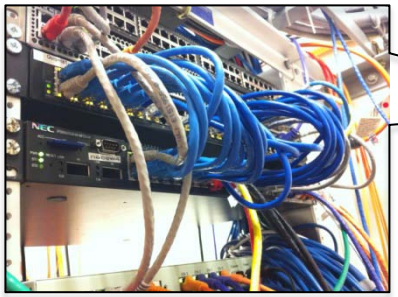
Trema Apps: Sliceable routing switch

- Trema application – free software (GPLv2)
- Functions
  - Layer2 network virtualization
    - Virtual flat L2 network domains + L1-4 access control list
  - Simple REST-API to create/remove/change slices
    - Create slice with slice name and attach host by port or MAC



OpenFlow Wireless Network setup at Stanford Gates Building

- **32 OpenFlow Switches** (3 x Vendor Switches, 29 x WiFi APs)
- **About 100 unique clients/day** (~20 clients use simultaneously)
- Run in parallel with Stanford's official WiFi
- Carries daily regular traffic (Web, Mail, etc.)



OpenFlow Switch (necsw4)

OpenFlow Switch (necsw5)

OpenFlow Switch (hpsw3)

OpenFlo
w
WiFi AP

OpenFlo
w
WiFi AP

OpenFlo
w
WiFi AP

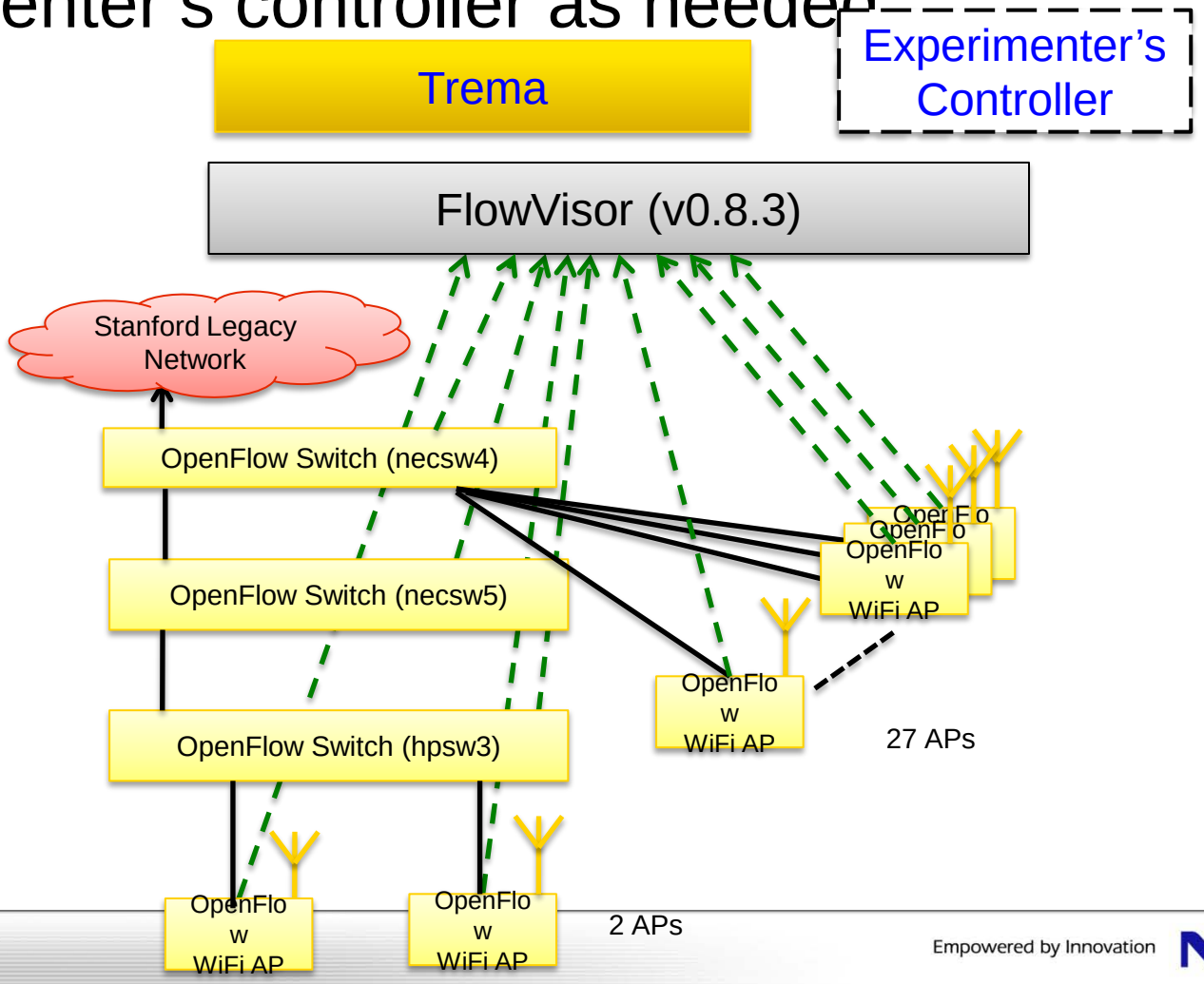
OpenFlo
w
WiFi AP

27 APs

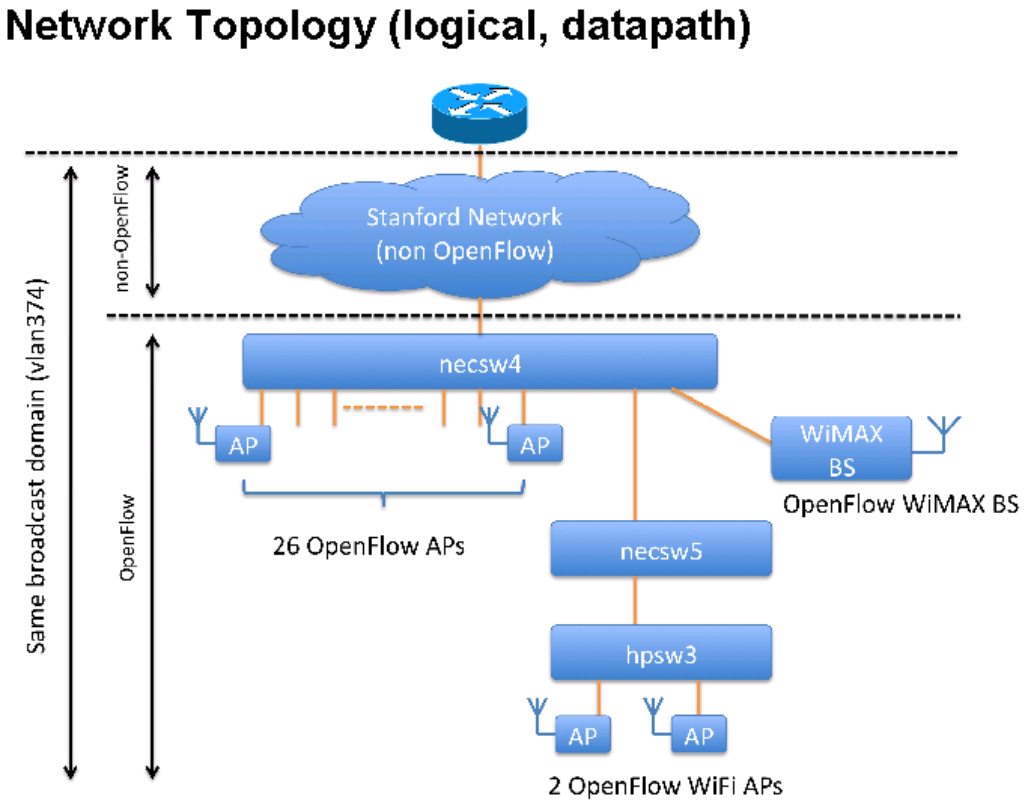
2 APs

OpenFlow Controller Setup: Trema

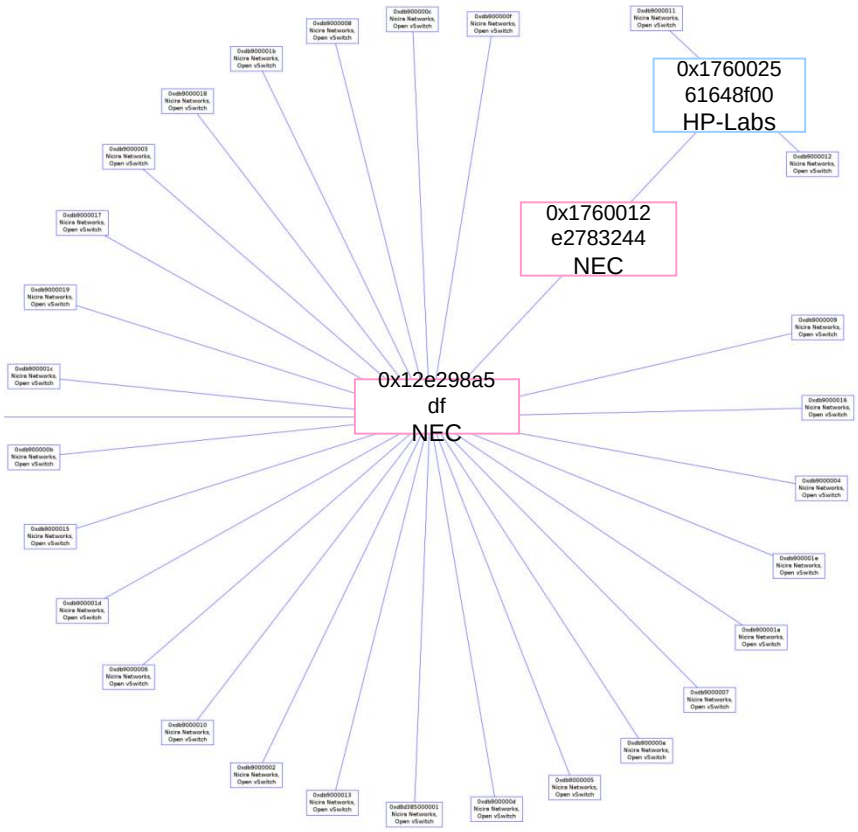
- Controls 32 OpenFlow Switches on top of FlowVisor
- Serves as a “default” controller
- Adds experimenter’s controller as needed



Trema: Topology view in Stanford trial

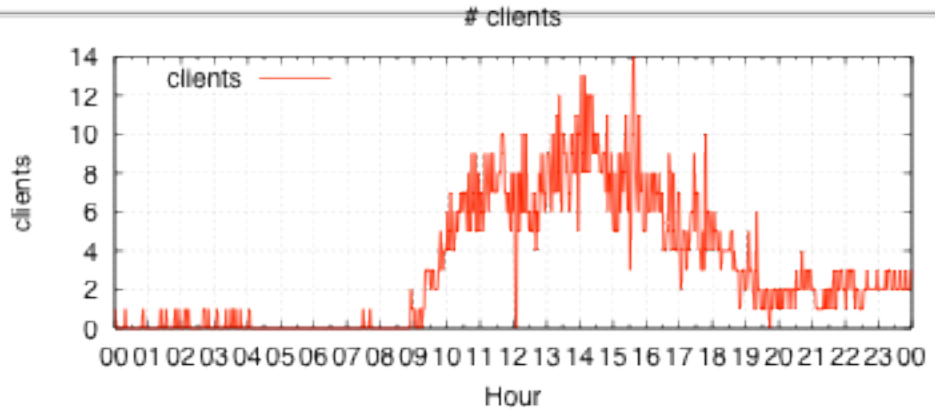


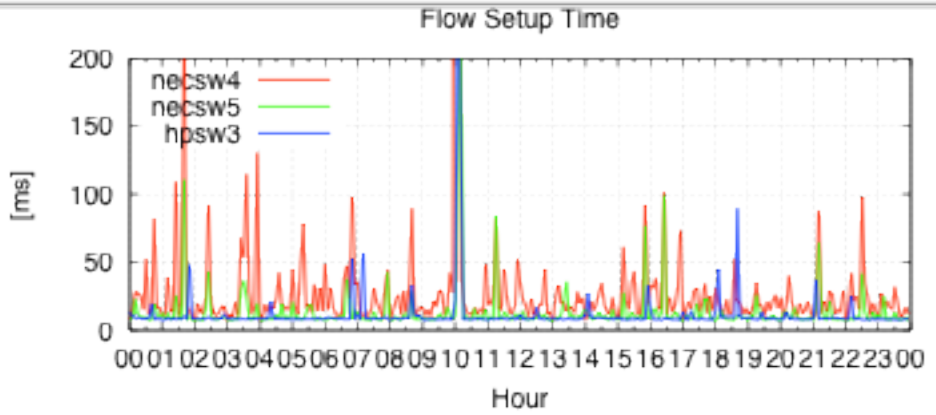
Physical network topology in Stanford

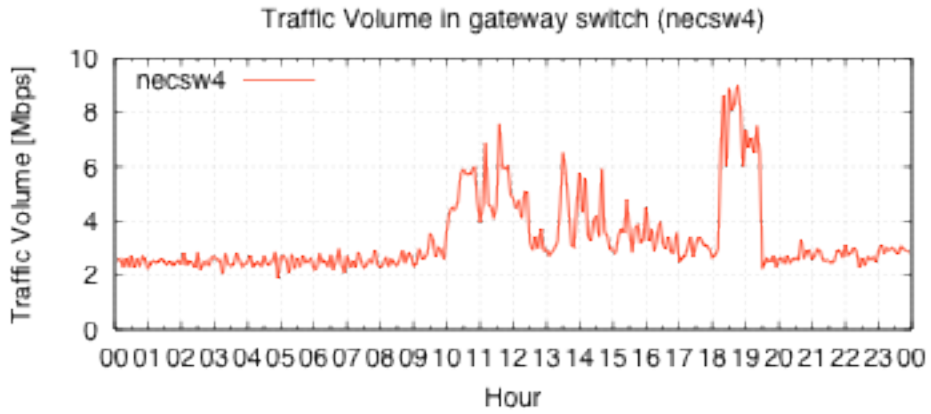


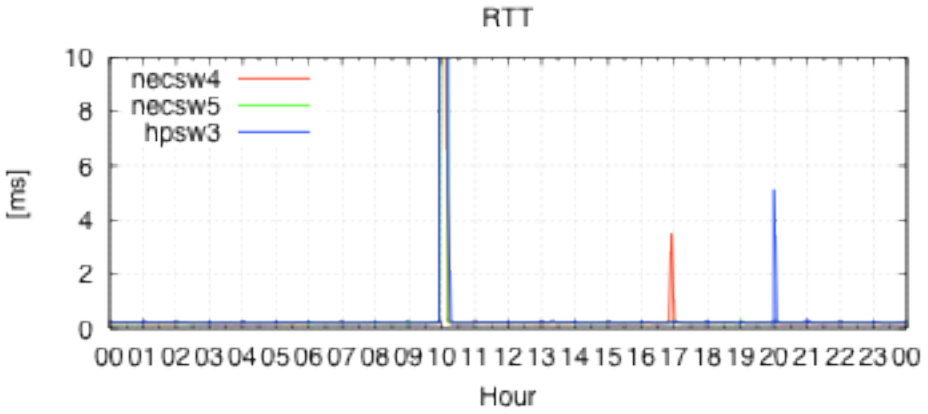
Topology Discovery Results in Trema

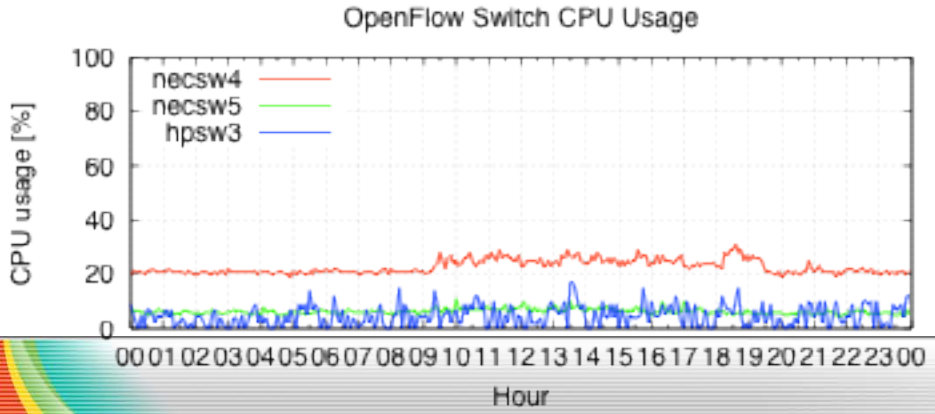
Usage & Performance Stats (3/7/2012)

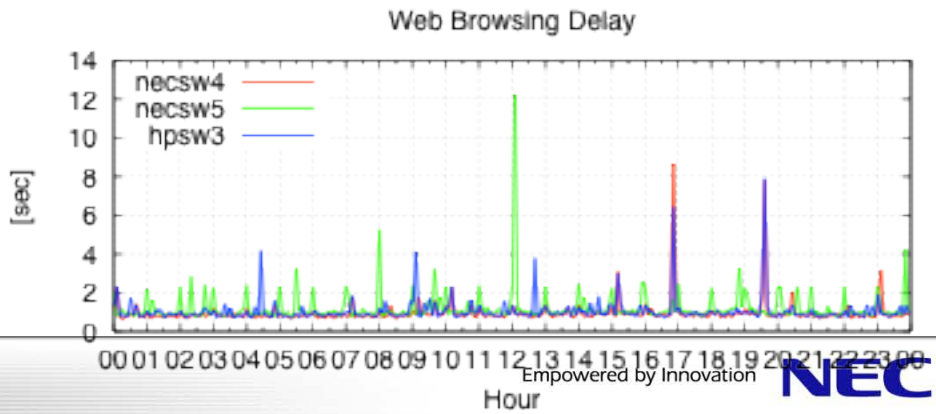












Computing/Network resource control via OpenStack/OpenFlow interface

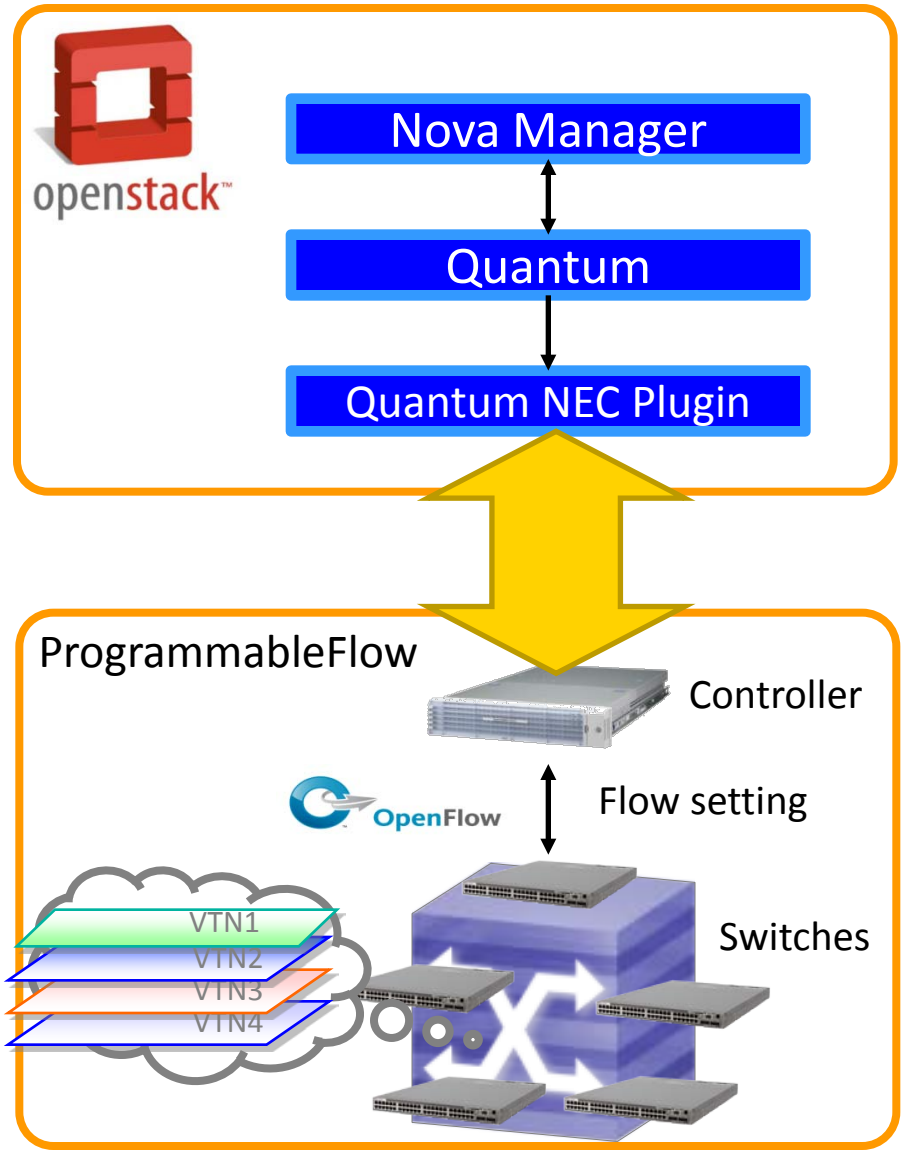
Interworking OpenStack with OpenFlow

Quantum & NEC OpenFlow Plugin

- Provides OSS-based network design tool
- Extracts virtual network configuration
- Manages the network configurations
- Deploy the configuration

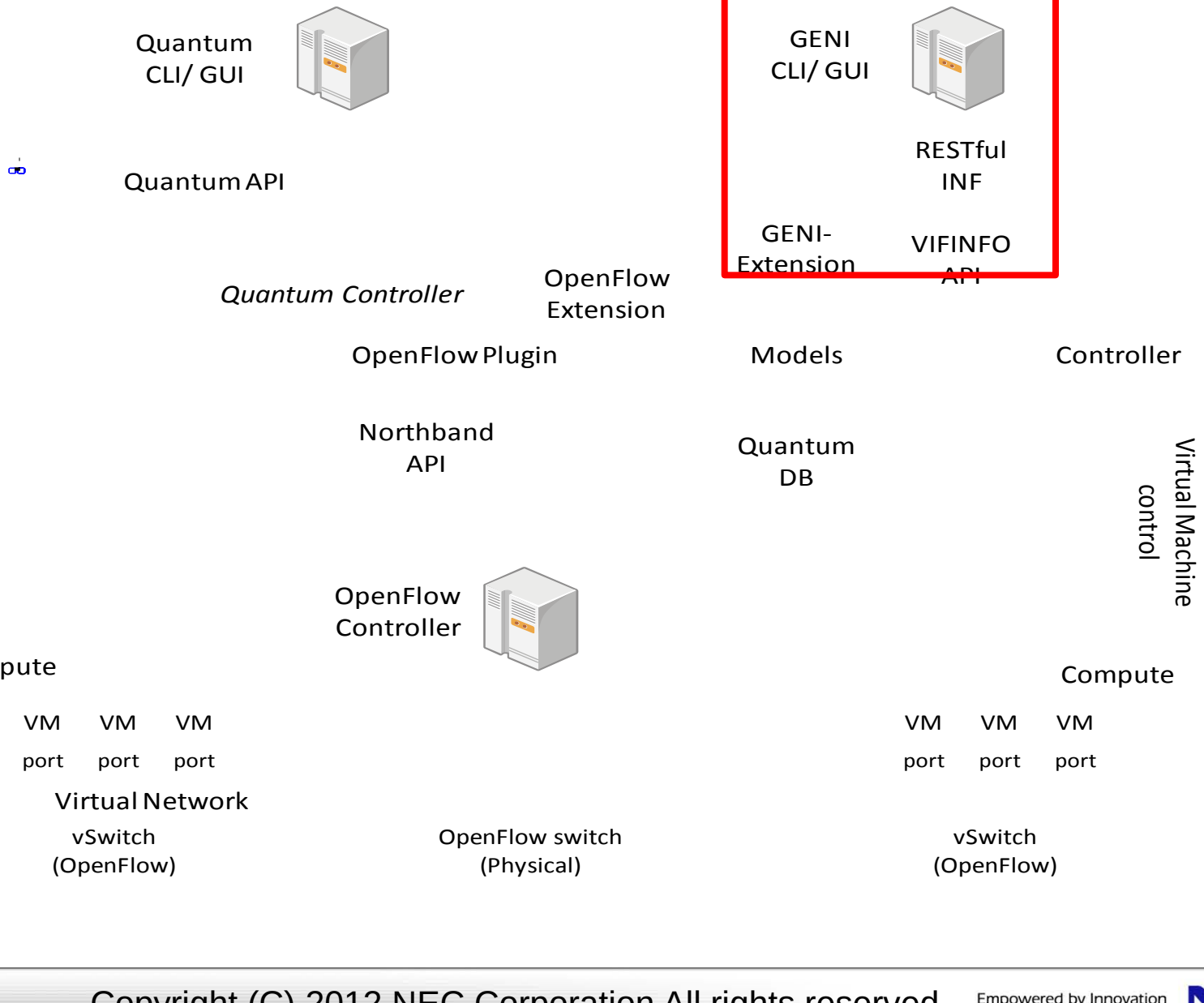
ProgrammableFlow

- Deploy virtual networking capabilities on the physical network
- Establishes flows for the networking capabilities
- Reroute flows when a network failure happens
- Distribute flows when physical configuration changes



System configuration

Not implemented yet
(Seek volunteer to implement)



OpenStack plug-in for OpenFlow controller

OpenStack Quantum plug-in (Download from):

- https://github.com/nec-openstack/quantum-openflow-plugin
- https://blueprints.launchpad.net/quantum/+spec/quantum-nec-of-plugin

Dashboard: Networks

Dashboard: Ports on your virtual network

Step1
Create a network

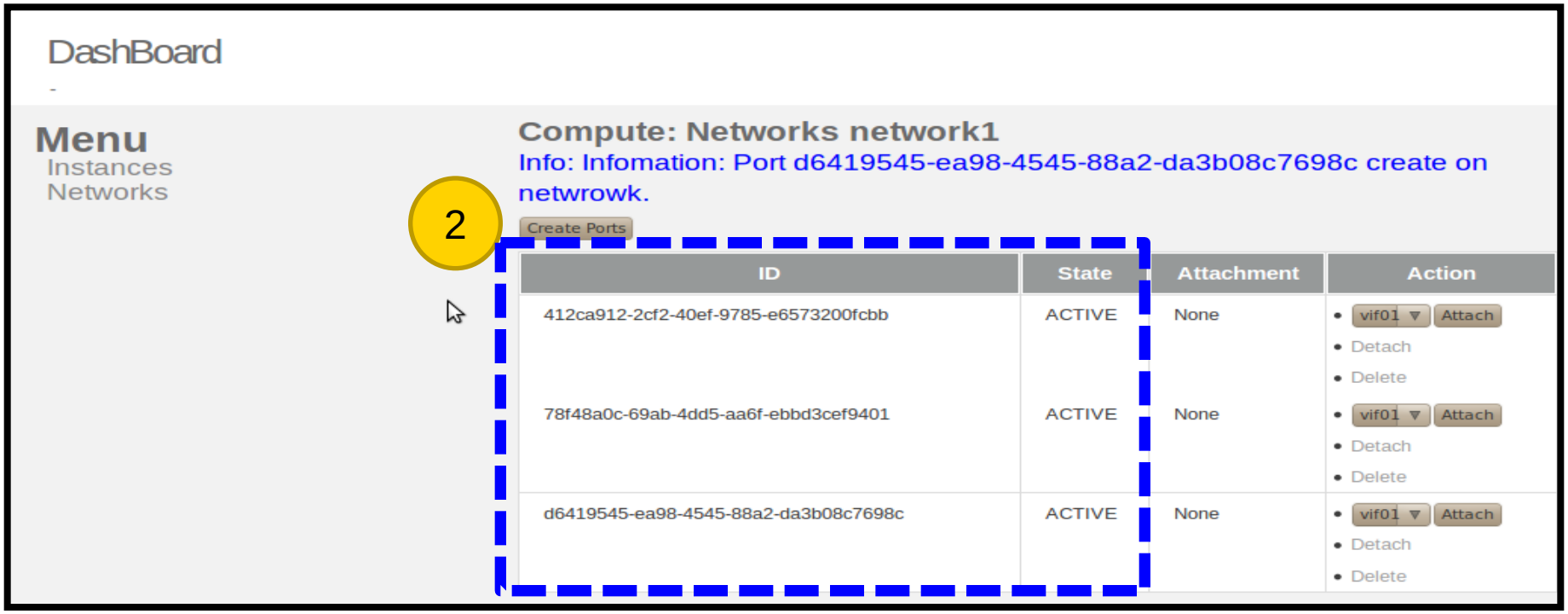
Step2
Create a port

Step3
Select a machine,
Attach

Create a port for your virtual network.

Quantum assigns a port ID for your network port.

Three network ports (virtual switch ports) are created in this scenario.



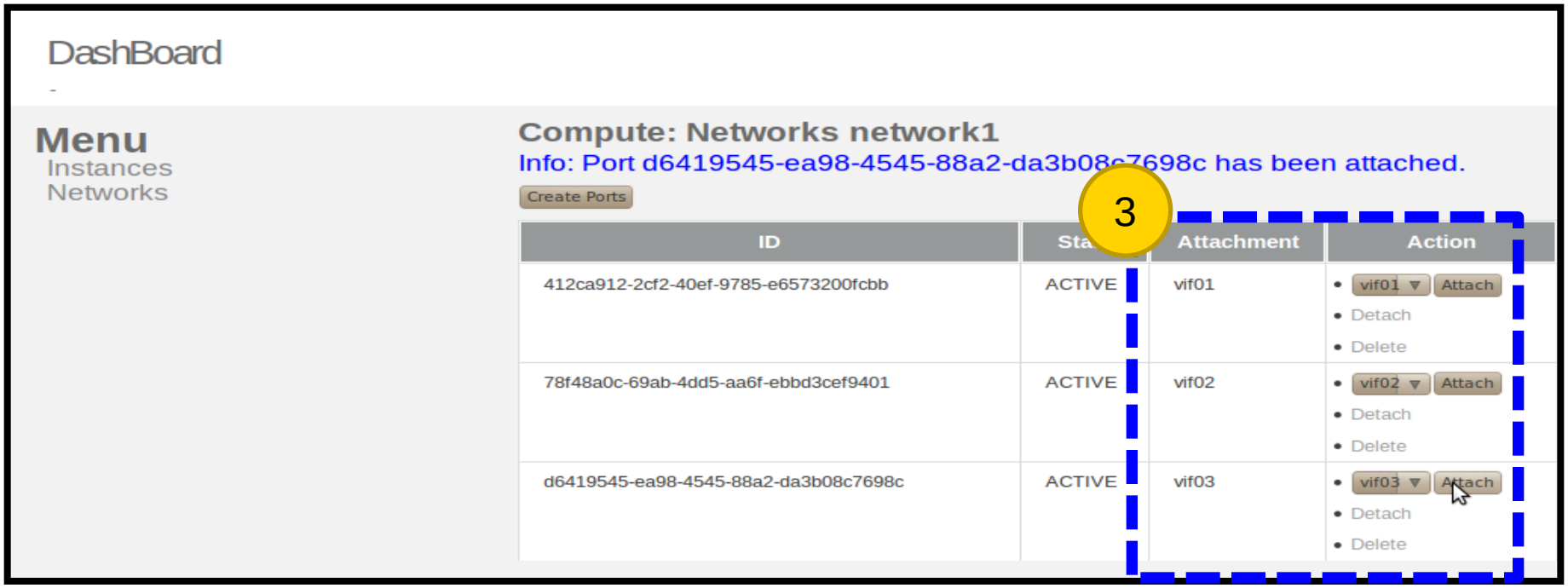
Dashboard: Attach/ Detach

Step1
Create a network

Step2
Create a port

Step3
Select a machine,
Attach

Sselect and attach a virtual machine.
“Attachment “ on a port shows the machine connected to the port.

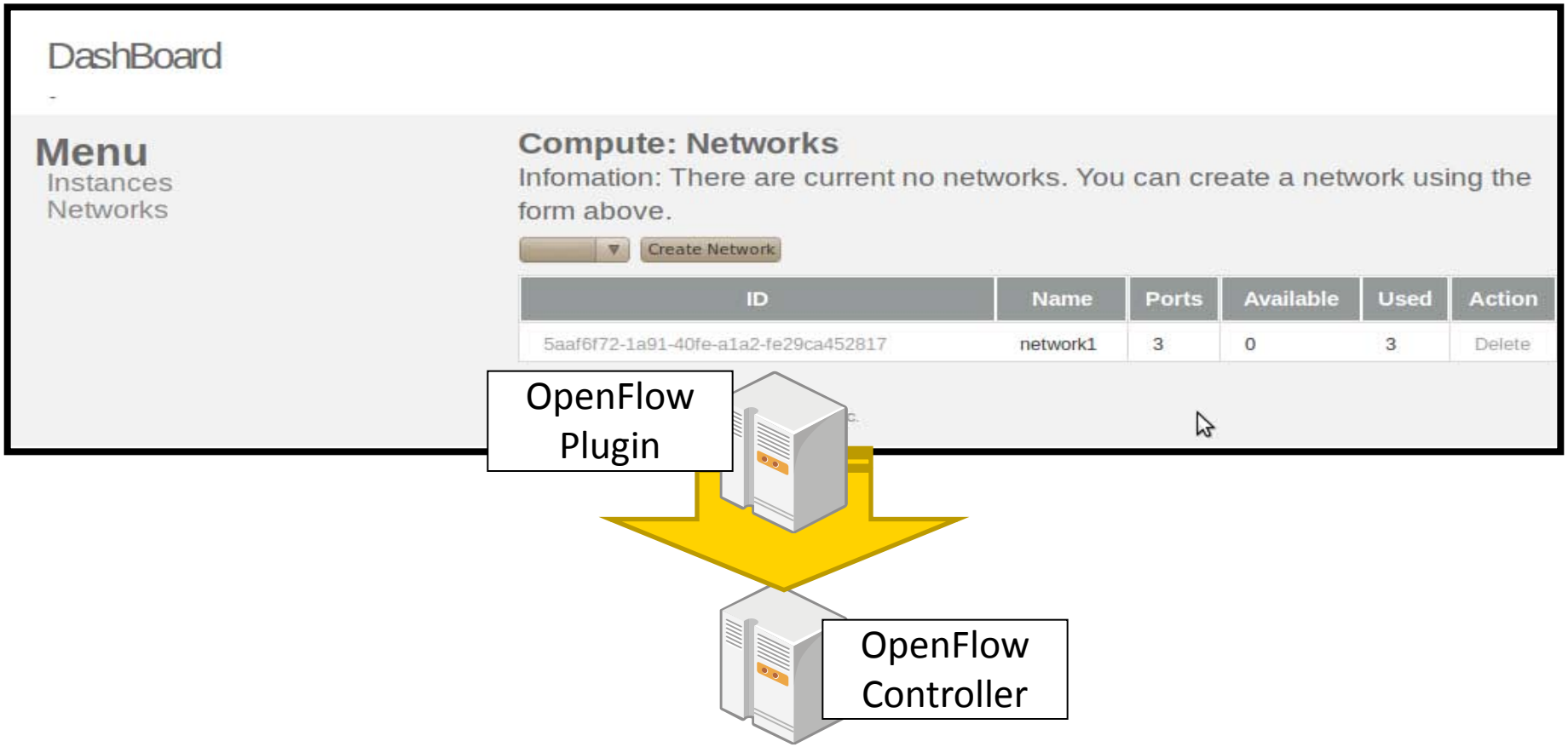


Dashboard: After configuration

Step1
Create a network

Step2
Create a port

Step3
Select a machine,
Attach



Your virtual network is deployed on the physical network

Offer to GENI Universities

- NEC OpenFlow Switches : PF5240, PF5820
  - OpenFlow Spec 1.0 compliant
- NEC OpenFlow Controller : PF6800
  - OpenFlow Spec 1.0 compliant
- Open source
  - OpenFlow controller: Trema
  - Quantum plugin for OpenFlow

If you have any interests or inquiries, please contact to

Contacts

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Empowered by Innovation

Appendix

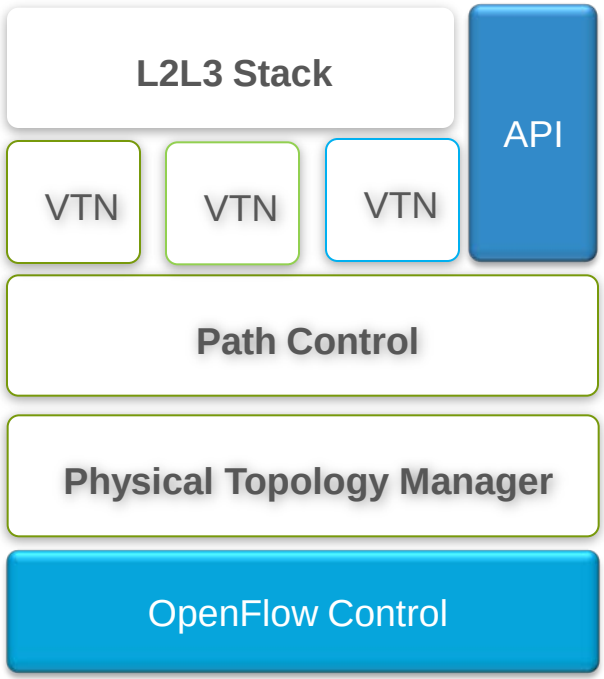
NEC ProgrammableFlow Controller : PF6800

- First generally-available OpenFlow controller
- OpenFlow 1.0.0
- Linux appliance

PF6800
ProgrammableFlow Controller Appliance

Benefits

- Dramatically reduces network operation costs through simplified network management
- Increases service agility by providing network control through a single pain of glass
- Improves return on investment by Increasing network and server utilization
- Reduces power and space requirements verses chassis deployments
- Achieves greater resiliency to network equipment failures
- Foundation for multi-vendor network hardware environment



NEC ProgrammableFlow Switch: PF5240, PF5820

PF5240-48T4XW

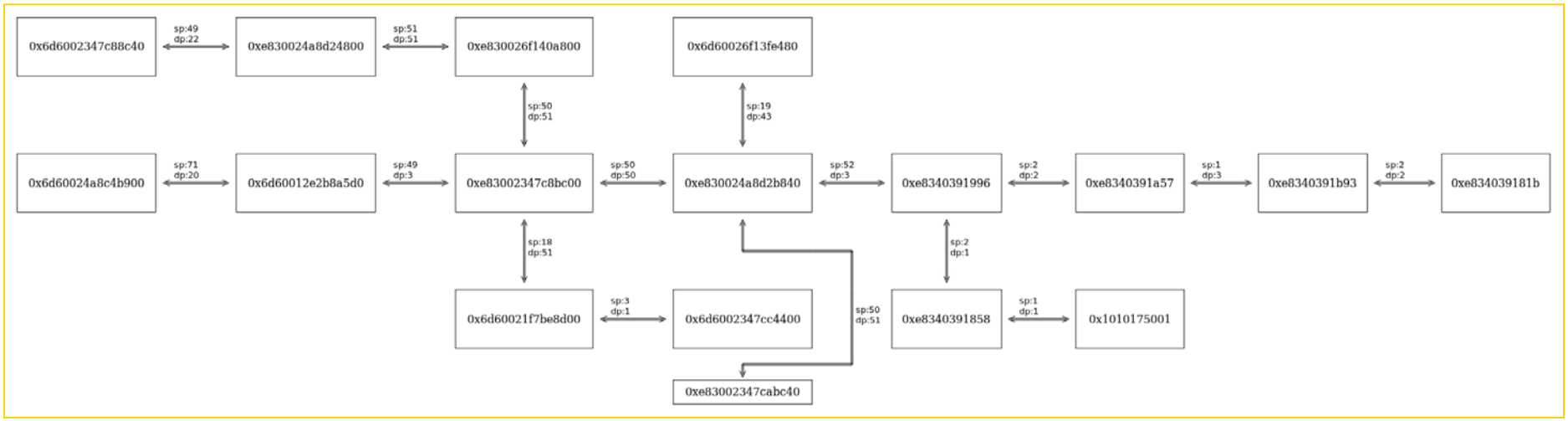
- Features
  - 48 10/100/1000 ports + 4 1/10GbE ports 176Gbps fully non blocking switching in 1U
  - Supports OpenFlow 1.0
  - Hybrid switch (Legacy and OpenFlow)
    - Connects OpenFlow to L2/L3 Networks
    - Virtual switch instance for running OpenFlow and distributed protocols on the same equipment
  - Data Center Ready
    - Modular design with internal redundant hot–swappable power supplies and fan
    - 4 SFP+ ports supporting cost effective SFP+SR
    - Front to Back/Back to Front Airflow

PF5820

- Features
  - 10GbE(SFP/SFP+) x 48 ports +40GbE(QSFP+) x 4 ports, 1.28Tbps fully non blocking switching in 1U
    - Up to 64 x 1GbE/10GbE SFP+ ports with optional breakout cables
  - Supports OpenFlow 1.0
  - Redundant hot swappable power supplies

Trema experimental results for GENI backbone network

- Evaluated GPO-lab OpenFlow testbed (TangoGENI)
  - Tested Trema with “ShowTopology” application along with “RoutingSwitch”
  - Sent LLDP (over IP) to all the links and discovered active topology



ACTIVE GENI backbone network topology found by Trema Topology Discovery
[as of Aug. 2nd, 2001]

OpenStack Quantum plug-in (Download from):

- https://blueprints.launchpad.net/quantum/+spec/quantum-nec-of-plugin
- https://github.com/nec-openstack/quantum-openflow-plugin