Cloud Networking Solutions: OpenStack and OpenFlow

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Challenges in Today’s Data Center and Cloud Networks

**Performance scaling concerns**
- Reduced end-to-end bandwidth
  - *From spanning tree constraints*
- Reduced End-to-end reliability
  - *From High convergence time for SPT*
- Reduced server utilization
  - *From VM Migration constraint to single subnet*
- Reduced end-to-end bandwidth
  - *Bandwidth decreases with server-server distance*

**Complexity scaling concern**
- Switch and port-wise configuration
- Architecture/Policy design
  - *Protocol, Application dependent*
- Multi-Protocol Handling
  - *STP, MSTP, LAG, IS-IS, TRILL, …*
- Appliance Integration
  - *Adds layers and routing complexity*

**Difficult to Scale Out and high Capex**
**Difficult to Automate and high Opex**

Can Network Virtualization solve the challenges
Defining Network Virtualization

Create abstract layer defining virtual networks
Hide physical network and protocol details
Automate network creation and deletion

Network Virtualization Plane
One aggregated network view and control
Simplified Network | Any Legacy functionalities including ACLs | Advanced Intelligent Routing | Multi-tenancy
Virtualization of the network resource

Aggregation and Control plane

Controller

Logic

Control plane (Network OS and protocol processing)

Logic

Forwarding plane (Forwarding table/Engine)

Logic

Physical Network Resource (backplane, ports, links)
High Level Virtualization Architecture

Network Virtualization Plane

Virtual Network 1

Virtual Network 2

Virtual Network 3

OpenFlow Control

NEC OpenFlow Controller (PFC/Trema)

NEC OpenFlow Switch (PFS)
-48 port 1G / 4 port 10G

OpenFlow Enabled Switch | From Any vendor
NEC OpenFlow Control Architecture

- **Open API Framework**
- **Network Management Interface**
  - GUIs for virtual and physical network
  - Flow and traffic visualization
- **Virtual Tenant Network Plane**
  - Virtual network management on OpenFlow network
- **Network Core**
  - Topology discovery
  - Flow setup & management

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**OpenFlow protocols**

- **OpenFlow Enabled Switches**
Interworking model

Quantum Managers & NEC Plugin
- Offer OSS-based network design tool
- Extract virtual network configuration
- Manage the network configurations
- Deploy the configuration

NEC OpenFlow
- Deploys virtual networking capabilities on the physical network
- Establishes flows for the networking capabilities and virtual machines
- Reroutes flows when a network failure happens
- Distributes flows when physical configuration changes
# NEC Quantum Plug-in Development status

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<thead>
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<th>Demo</th>
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<td>Remove attachment from port</td>
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<td>18</td>
<td>List VM (Vendor specific)</td>
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</table>
Interworking ProgrammableFlow with OpenStack

- Quantum NEC Plug-in is under development, currently followed by Quantum API (rev59).
- Trema is NEC's open source OpenFlow platform.
  - The platform includes controller and developing/testing/debugging environment.
  - The specification can be found at [http://trema.github.com/trema/](http://trema.github.com/trema/)
- Virtual networks and ports are instantiated over the physical and virtual OpenFlow switches.

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A part of this work was supported by Ministry of Internal Affairs and Communications of the Japanese Government. This project has been supported by Ministry of Internal Affairs and Communications (MIC).
Demo
Further issues for future OpenStack

OpenStack project should define virtual networking platform.

NEC proposes OpenFlow as networking platform
- Both physical and virtual switches are controlled via Quantum plug-in.
- Interworking between OpenStack and OpenFlow enables E2E network virtualization.

OpenStack should consider
- Multi vendor interoperability in Quantum plug-in
- L2 first, should consider L3

If we consider scalability of OpenStack, following issues should be studied.
- Collaborations between multiple data centers
- Virtualized network over wide area networks
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