ProgrammableFlow: OpenFlow Network Fabric

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Introducing ProgrammableFlow

Software Defined Network Suite
- First OpenFlow-enabled network fabric
- Design, deploy, monitor and manage secure, multitenant networks
- Programmatic control of traffic flows for agility and productivity

ProgrammableFlow Controller

ProgrammableFlow Switch Family
- PF5820 (10G/40G)
- PF5240 (1G/10G)

V2.0

Best of INTEROP Awards 2012
Grand Prize

Best of INTEROP Awards 2012
Management, Monitoring & Testing

BEST OF SHOW AWARD
INTEROP 2011

BEST OF SHOW AWARD
INTEROP 2011

Best of INTEROP Infrastructure 2011

Special Prize

Empowered by Innovation NEC
Network Architecture

- **Application Layer**
- **Network Control Layer**
- **Infrastructure Layer**

- **API**
  - Network Information
  - Network Control

- **NEC ProgrammableFlow Controller**

- **Network Services**

- **Control Data Plane Interface** (e.g., OpenFlow)

- **Network Aware Applications**
Functionality

Flow-level Traffic Information
Topology Information
Network Link Usage
Station mapping
Switch Port status
Congestion Alerts

Create Network (L2/L3)
End-point mapping
ACLs
Rerouting policies
QoS Control

Network Information
API

NEC ProgrammableFlow Controller

Network Virtualization
Multipath Routing
Multiclass Routing
Flow Table Optimization
End-to-end Reliability
Network-assisted Monitoring

Control Data Plane Interface
(e.g., OpenFlow)

Network Device

Infrastructure Layer

Network Device

Network Control Layer

Network Device

Network Device

Network Device

Network Device
Virtual Network Programming Framework

- Hides physical switches, ports, network topology, protocols
- Zero switch/port level configuration on deployment
- Automatically optimizes underlying network resources

Virtualized Physical Network

Automated Deployment on Physical Network
Create Multiple Virtual Networks

Network Virtualization Plane
One aggregated network view and control
Layer-2 and Layer-3 Packet Forwarding

L2 Network

VTN-1

- vlan-10
- VM1
- VM2

L3 Network

VTN-2

- vlan-20
- vlan-30
- VM3
- VM4

Full Separation

Network Virtualization Plane
One aggregated network view and control

Network Fabric
Multipath Supporting East-West Fabric Traffic

Multipath without HW vendor lock-in
Support any interconnect topology
No complex distributed protocols

• Automatically discovers multiple paths (8-way ECMP)
• Automatically avoids loops
• No route flapping
Multiclass Path Policy

Creating Non-interfering traffic lanes for different traffic class

- Class -1 traffic: FTP and large bulk data transport
- Class -2 traffic: Messaging – latency sensitive

Use composite Packet header fields Condition to define Traffic classes

Path 1
Path 2
End-to-End Fast Recovery

Pre-computed backup paths
Migrating flows to end-to-end backup paths
Supports scheduled switch maintenance
Robust Service/Appliance Failover

IDS
Load balancers
Firewalls

In traffic to appliance
Out traffic from appliance
Out traffic from appliance
Centralized Management and Visualization
QoS Policy Application on Virtualized Network

QoS features: Traffic Shaping, TOS Marking, COS Marking
Application: (Matching rule, QoS Policy, Virtual Endpoints)

Unit of Policing
- vExternal, vBridge, vRouter, VTN
- If you set policing to VTN, all of vExternal belong to that VTN is set policing together.
Dynamic ACLs and Conditional Routing

- Define matching criteria (v-Filter)
- Define Action
- Map to direction (v-Redirect)

Traffic → VTN → Pass (Eg. To destination Port)

→ Redirect (Eg. To selected Appliance Port)

→ Drop
Dynamic Service Insertion using Conditional Routing

WAN
To Internet
Example Case of Service Insertion: Radware DoS/DDoS Attack Mitigation

- **PFLOW Controller**
- **DoS Detector**
- **OpenFlow Network**
- **WAN Internet Enterprise Network**
- **Servers**

Traffic Statistics
Network Path Control
MONITOR
CONTROL

1. 2. 3.
Interworking of OpenStack and OpenFlow

- **OpenStack Quantum**
  - OpenStack sub-project
  - Managing virtual network

- **OpenFlow Plugin**
  - The plugin to use OpenFlow from Quantum
  - Download from [https://github.com/nec-openstack/quantum-openflow-plugin](https://github.com/nec-openstack/quantum-openflow-plugin)

- **Supported NEC OpenFlow Controllers**
  - ProgrammableFlow PF6800
Lab Trial and Production Deployments

Private/Public Cloud
- Nippon Express
- Genesis Hosting Solutions
- NTT Communications

Data Center
- Tervela
- Selerity

Campus Networks
- Stanford University
- Georgia Tech

Nationwide Research Networks
- Internet2
- ESnet
- BBN Technologies
Create your own Network Aware Applications leveraging

• Rich set of Northbound APIs (Information and control)
• High performance network fabric
• End-to-end reliability
• Network-assisted failover
• Conditional routing
• Dynamic QoS policies
• Multi-vendor interoperability
• Field proven system

And more …