Underneath OpenStack Quantum: Software Defined Networking with Open vSwitch

Thomas Graf <tgraf@redhat.com>
Principal Software Engineer
Red Hat, Inc.

April 24, 2013
Part One
Why Open vSwitch?

Open vSwitch enables Linux to become part of a **Software Defined Networking** architecture.
Switched Networks

Switches **learn** from the network traffic they observe and **decide independently.**

![Diagram of switched networks with nodes and tenants connected through bridges and switches.](image-url)
Dynamically update flow tables in a universal language.

In the Software Defined Networking architecture, the control and data planes are decoupled, network intelligence and state are logically centralized, and the underlying network infrastructure is abstracted from the applications.
Software Defined Networking

A logically centralized controller decides what is best for the network based on a global view of the network.
Software Defined Networking

An attempt to create a well-known API for applications of the Network that did not succeed yet. OpenDaylight on its way to make this happen.
OpenFlow

The Open Standard behind it.

1. Match on arbitrary bits in packet (header)

2. Execute actions
   - Forward to port
   - Drop
   - Send to controller
   - Mangle packet

OpenFlow enables networks to evolve, by giving a remote controller the power to modify the behavior of network devices, through a well-defined "forwarding instruction set". The growing OpenFlow ecosystem now includes routers, switches, virtual switches, and access points from a range of vendors.
OpenFlow Capable Devices

• Software Switches
  • Open vSwitch, Cisco Nexus 1000V
  • VMware vSphere, NEC Hyper-V, ...

• Hardware Switches
  • Brocade, Cisco, HP, IBM, Juniper Networks, NEC, ...

• Switching ASICs
  • Indigo – Open source firmware leveraging Ethernet switch ASICs to support up to 48x 10G ports
  • Mellanox SwitchX-2 chip
Is it production ready?

Google's Software Defined WAN
Open vSwitch is a virtual switch for hypervisors providing network connectivity to virtual machines.
Open vSwitch Project

- Primarily used as a virtual switch for VMs
- Multi Platform (Linux, Microsoft, and Silicon)
- Developed by Nicira & Community
- Apache License (User Space), GPL (Kernel)
- OpenFlow 1.1 + extensions
- Any netdevice (physical/virtual) can be added as uplink port
How does it work?

Open vSwitch **maintains a flow table** that defines what to do with each flow.

Open vSwitch maintains a flow table that defines what to do with each flow.
Feature

Fine Grained Flow Table Control

• Extensive flow matching capabilities
  • Layer 1 – Tunnel ID, In Port, QoS priority, skb mark
  • Layer 2 – MAC address, VLAN ID, Ethernet type
  • Layer 3 – IPv4/IPv6 fields, ARP
  • Layer 4 – TCP/UDP, ICMP, ND

• Possible chain of actions
  • Output to port (port range, flood, mirror)
  • Discard, Resubmit to table x
  • Packet Mangling (Push/Pop VLAN header, TOS, ...)
  • Send to controller, Learn
Feature
Security / L2 Segregation

VLAN isolation enforces VLAN membership of a VM without the knowledge of the guest itself.

Caveat: MAX(VLAN_ID) limited

# ovs-vsctl add-port ovsbr port2 tag=10
Feature Tunneling

Tunneling provides **isolation** and reduces **dependencies** on the physical network.
Feature Visibility

Supports *industry standard technology* to monitor the use of a network.

- **sFlow**
- **NetFlow**
- **Port Mirroring**
  - **SPAN**
  - **RSPAN**
  - **ERSPAN**
Feature
Quality of Service

- Uses **existing Traffic Control Layer**
  - Policer (Ingress rate limiter)
  - HTB, HFSC (Egress traffic classes)
- Controller (Open Flow) can select Traffic Class

```
# ovs-vsctl set Interface port2 \n  ingress_policing_rate=1000
```
Modifying the Flow Table


```
# ovs-ofctl add-flow ovsbr \\

# ovs-ofctl dump-flows ovsbr
[...]
cookie=0x0, duration=36.24s, table=0, n_packets=0, n_bytes=0, idle_age=36, dl_src=11:22:33:44:55:66
actions=strip_vlan,output:1
```
Questions?

• Open vSwitch
  • http://www.openvswitch.org/

• OpenFlow
  • http://www.openflow.org/

• Open Networking Foundation
  • http://www.opennetworking.org/

• sFlow
  • http://www.sflow.org/

• Going with the Flow: Google’s Secret Switch to the Next Wave of Networking
  • http://www.wired.com/wiredenterprise/2012/04/going-with-the-flow-google/