Open vSwitch: Extending Networking into the Virtualization Layer

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Outline

- Virtualization and Networking
- Open vSwitch approach
- Applications
- Implementation
Virtualization Will Be Pervasive

Gartner:
12% of workloads are virtual today.
61% by 2013.

Intel:
All end hosts should be virtualized.
Networking in Virtual Environments is Important

One cloud is planning to run 128 VMs per host. That's 2+ full racks in one machine.
Networking in Virtual Environments is Different

Challenges
• Scalability ($10^5$ VMs)
• Isolation
• Mobility
• ...

Conveniences
• Hypervisor info
• Introspection
• Leaf nodes
• ...
Networking in Virtual Environments is Different

Challenges
- Scalability \((10^5\) VMs\)
- Isolation
- Mobility
- ...

Conveniences
- Hypervisor info
- Introspection
- Leaf nodes
- ...

Open vSwitch
Distribute the Switch
Centralized Control
Take Advantage
Basic Design (Xen)

Xen host (physical machine)

Virtual machines (DomUs)
- VM 1
  - VNIC
- VM 2
  - VNIC
- VM 3
  - VNIC

Control domain (Dom0)
- NIC

Controller

...other Xen hosts...

ovs-vswitchd

XAPI

NIC

Administrative CLI/GUI
Open vSwitch

• Controller:
  - Configuration
  - OpenFlow
• Features:
  - VLAN
  - Port mirroring
  - ACLs
  - NetFlow
  - Bonding
  - QoS
  - Anything*
Open vSwitch Application: Single Distributed Switch

VM host 1

VM host n

Controller

Web UI
Open vSwitch Application: Multiple Distributed Switches

Physical

VM host 1

... 

VM host n

GRE

Physical vSwitch

Logical

VM 1

... 

VM n

Tenant #1 (switched)

VM 1

... 

VM n

Tenant #2 (routed)

Controller

Web UI

Web UI
Open vSwitch Application: Extending Data Center into Cloud

- VM host 1
- VM host n
- Managed Cloud
- “Cloud access server”
- GRE
- GRE/IPSEC/SSL
- Customer Data Center

Controller
Implementation (Xen)

Physical machine

Virtual machines (DomUs)
- VM 1
  - VNIC
- VM 2
  - VNIC
- VM 3
  - VNIC

Control domain (Dom0)
- XAPI
- ovs-vswitchd

Xen hypervisor

Controller

NIC

Kernel

User
Open vSwitch is Fast

As fast as Linux bridge with same CPU usage

<table>
<thead>
<tr>
<th>Bandwidth</th>
<th>Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast Path: &gt; 1 Gbps</td>
<td>Fast Path: &lt; 1 µs</td>
</tr>
<tr>
<td>ovs-vswitchd: 100 Mbps</td>
<td>ovs-vswitchd: &lt; 1 ms</td>
</tr>
<tr>
<td>Controller: 10 Mbps</td>
<td>Controller: ms</td>
</tr>
</tbody>
</table>

With same CPU usage
Open vSwitch is Fast
Hardware Acceleration

- Inevitable
- Netronome: right approach
- VN-Tag: wrong approach
- VEPA: powerless
Future Directions

- Physical switches
- Upstream kernel integration
- Anything*
Questions?