Advanced Computer Networks

Network Virtualization

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The Network
The Network: A rich man’s world

http://mobilesyrup.com
The customer is always right

My application does not tolerate traffic co-location, give me a dedicated network.

My application is seeing heavy request traffic, start a new VM for it.

I want a special network policy between the VMs of my application.

My VM is getting too much contention with other VMs, move me to another server.

http://certmag.com/
ACN: Network virtualization

Application → x86 Environment → Server Hypervisor

Virtual Machine → Virtual Machine → Virtual Machine

Decoupled

L2, L3, L4-7 Network Services → Virtual Network → Virtual Network → Virtual Network

Workload → Workload → Workload

Requirement: x86

Physical Compute and Memory

Requirement: IP Transport

Physical Network
Network Virtualization

- Decoupling the services provided by a network from the physical infrastructure
- Virtual network is a platform with “containers” for network services
- Full support for software control
Network Virtualization: Features

- Faithful reproduction of services provided by a physical network
- Location independence: the where in the physical network
- Transparent to the state of the physical network
- NOT a Network Service Virtualization
Network Virtualization: Slicing

- Sharing the network
  - Different network views for different users/traffic
  - Isolation (bandwidth, table space, links)

Source: ONF
Network Virtualization: Slicing

- Multiple administrative groups
- Multiple customers
- Experiments vs. operational network
- Network leasing
- Multiple services or applications in one domain
Network Virtualization: Abstraction

- Abstracting the topology
  - Aggregation: One big virtual switch
  - Segmentation: Many virtual switches to one physical switch
- Arbitrary network topologies
Network Virtualization: Abstraction

- Simplicity
- Scalability
- Privacy
- Bridging deployments
- Experimentation

Source: Peter Overs
VMWare/ Nicira
Network Virtualization Platform
Basic concepts

- Network services defined in a policy and per application
- Network services in software on hypervisors with vSwitch
- Applications attach to vSwitch based on policy
Example: Security policy

Source: VMWare
Benefits

- Virtual networks are programmatically created, provisioned and managed
- New VMs are created with the necessary policies dynamically applied
- VMs are migrated with their networking services attached
- Basic forwarding to complex, multi-segment topologies
Non-disruptive solution

- Fabrics and topology agnostic
- Applications and workloads agnostic
- Incremental virtual network deployment
- Extended monitoring and management
Open vSwitch
Basic concepts

- Software switch within the hypervisor
- Connects virtual interfaces to physical interfaces
- Standard data plane operation
- Configurable interfaces
Architecture
Forwarding

- Fast data plane (kernel)
- Slow control plane (user)
  - Packet classifiers
  - Flow counters
Forwarding

- Fast data plane (kernel)
- Slow control plane (user)
  - Packet classifiers
  - Flow counters
- Micro- vs megaflows
- *Small scale SDN*
Simple fast path

- Limit code rewrite during kernel porting
- Ease migration to hardware accelerated forwarding
  - Moving switching to the NIC
Configuration

- Persistent switch configuration
- Bridge: sFlow, NetFlow, IPFIX
- Bridge: OpenFlow tables
- Port: QoS: Queue
- Manager: Port mirroring

http://openvswitch.org/ovs-vswitchd.conf.db.5.pdf
Interfaces: Configuration

- Read & write configuration state
  - QoS per interface
  - Port mirroring
  - Logging per port (VM)

- Set triggers for state changes

- Interface binding
  - Topology independent configuration
Interfaces: Forwarding path

- Remote configuration of the forwarding path
- Direct access to forwarding tables
- Rule-based forwarding model
  - Similar to OpenFlow
- Pipeline processing
Interfaces: Forwarding path

Example: ACL migration with VM
Interfaces: Forwarding path

Example: ACL migration with VM
Interfaces: Management

- Manage virtual connectivity
- Manage physical connectivity
- Mapping Open vSwitch to NIC
Placement: the VM spectrum
Placement: highly connected mesh
Reading

- **Obligatory**
  - Open vSwitch http://benpfaff.org/papers/ovs.pdf

- **For the interested**
  - VMWare/Nicira NVP Deep Dive https://www.youtube.com/watch?v=a1Ug9VomSvM
  - Open vSwitch website http://openvswitch.org/