Openstack Quantum:
Virtual Networks for OpenStack

Dan Wendlandt – dan@nicira.com

Outline

What is Quantum?
Why do we want Quantum?
Architecture Basics
Current project status
Roadmap?

What is Quantum?

A standalone Openstack service

Provides <u>network connectivity</u> between a set of network "interfaces" from other service (e.g., vNICs from compute service, interfaces on a load-balancer service).

Exposes API of logical abstractions for describing network connectivity + policy between interfaces.

Uses a "plug-in" architecture, so multiple technologies can implement the logical abstractions.

Provides a "building block" for sophisticated cloud network topologies.

What is Quantum: Overview

Nova : virtual server
Quantum : virtual network

Both:

- Expose a logical API for automated provisioning by cloud tenants.

- Manage physical devices in the data center to implement the logical model.

- Provide a "plugin" architecture to leverage support using different back-end technologies.

Why Quantum?

1) <u>Rich Topologies</u>: Cloud tenants deploying enterprise workloads often require flexibility to define sophisticated network topologies

2) Cloud operators want to leverage <u>Advanced Technology</u> in their network infrastructure (i.e., more than L2 bridging + VLANs).

3) Integrate Advanced Services (LBaaS, FWaaS, etc.)

Why Quantum?: Rich Topologies

Existing Nova-only Network Provisioning Model:

Cloud operator statically determines a type of connectivity (flat, private) that will be statically applied to all VMs.

Tenant VMs get connectivity based on static model.

Why Quantum?: Rich Topologies

New Nova + Quantum Network Provisioning Model:
Tenant can dynamically create networks via API:

create-network dmz-net, web-net, db-net

When creating VMs, tenant can specify the # vNICs and the networks they connect to:

create-server image=fw-img nics=dmz-net,web-net

create-server image=web-img nics=web-net,db-net

create-server image=db-img nics=db-net

**Try it yourself:
http://wiki.openstack.org/QuantumOVSDemo**

Advanced Tech: QoS to meet SLAs

Cloud operators may want to be able to guarantee the a tenant VM or portion of the physical NIC capacity, just like they provide a portion of CPU + Memory.

Such properties can be exposed as additional port attributes using Quantum API extensions.

Cisco Quantum plugin enables leveraging properties of UCS hardware to provide QoS guarantees.

Advanced Tech: Avoid VLAN Limits

Many limitations when using VLANs for network isolation:
> Limited # of VLANs supported, limited to single physical subnet, requires configuring physical switches, etc....

Open vSwitch Quantum plugin can support L2-in-L3 tunneled networks without needing to use VLANs.

At summit, Cisco, Red Hat, Citrix & Nicira discussed plans to add support for VXLAN tunneling proposal.

Insert Additional Services

Other services want to be on the same networks, share the same address spaces with compute nodes.

FWaaS

LBaaS

VPNaaS

What is Quantum: Scope

Current focus is on defining Layer-2 Ethernet topologies.

Already (partially) integrated with Nova.

Higher level network services can be added:
    as new APIs within Quantum (e.g., Layer-3 routing)

    as stand-alone services (e.g., Atlas Load-balancing service)

Virtual Network Abstractions (1)

Services (e.g., nova, atlas) expose **interface-IDs** via their own tenant APIs to represent any device from that service that can be "plugged" into a virtual network.
Example: nova.foo.com/<tenant-id>/server/<server-id>/eth0

Tenants use Quantum API to create **networks**, get back UUID:
Example: quantum.foo.com/<tenant-id>/network/<network-id>

Tenants can create **ports** on a network, get a UUID, and associate config with those ports (APIs for advanced port config are TBD, initially ports give L2 connectivity):
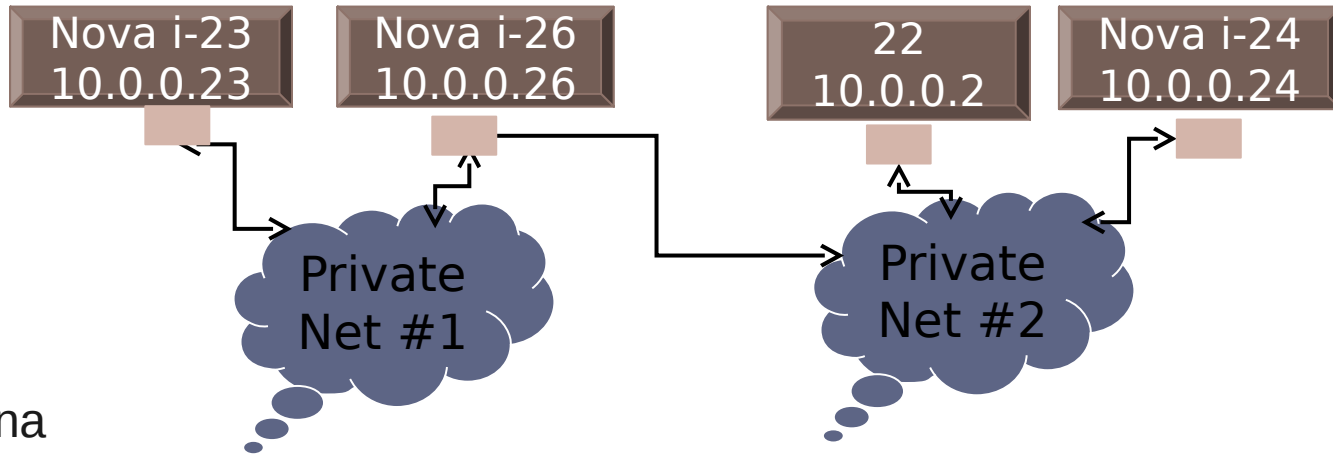Example: quantum.foo.com/<tenant-id>/network/<network-id>/port/<port-id>

Tenants can "plug" an interface into a port by setting the **attachment** of a port to be the appropriate interface-id.
Example: set quantum.foo.com/<tenant-id>/network/<network-id>/port/<port-id>/attach to value "nova.foo.com/<tenant-id>/server/<server-id>/eth0" .
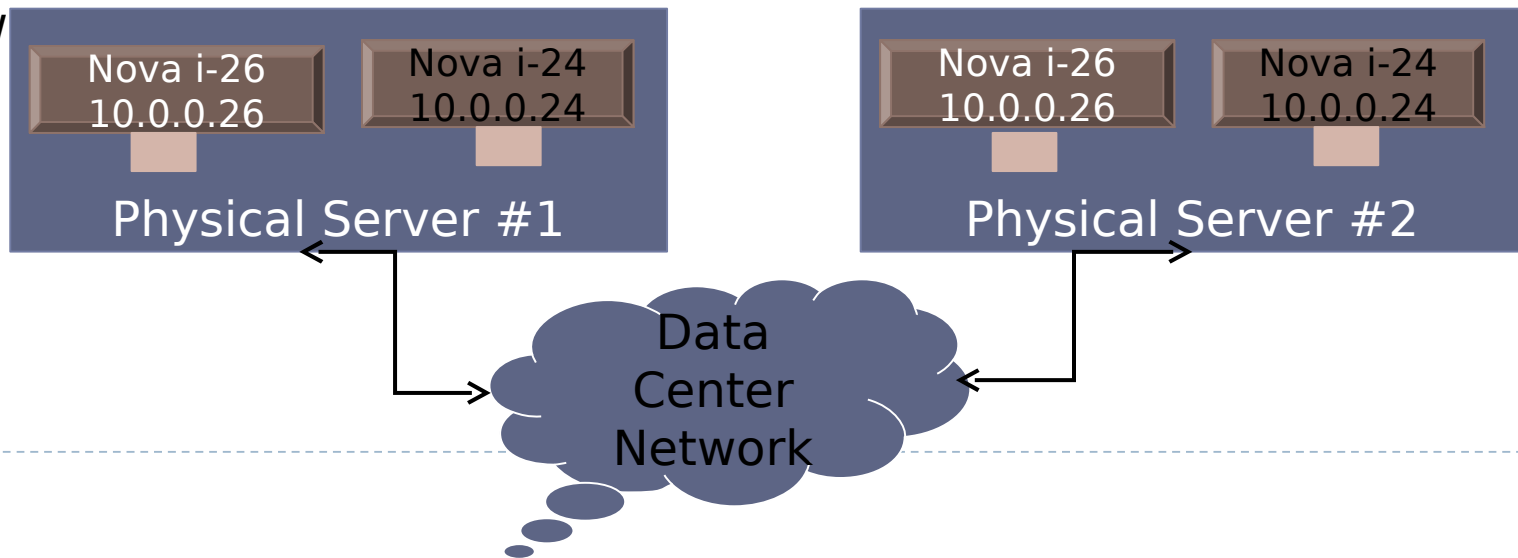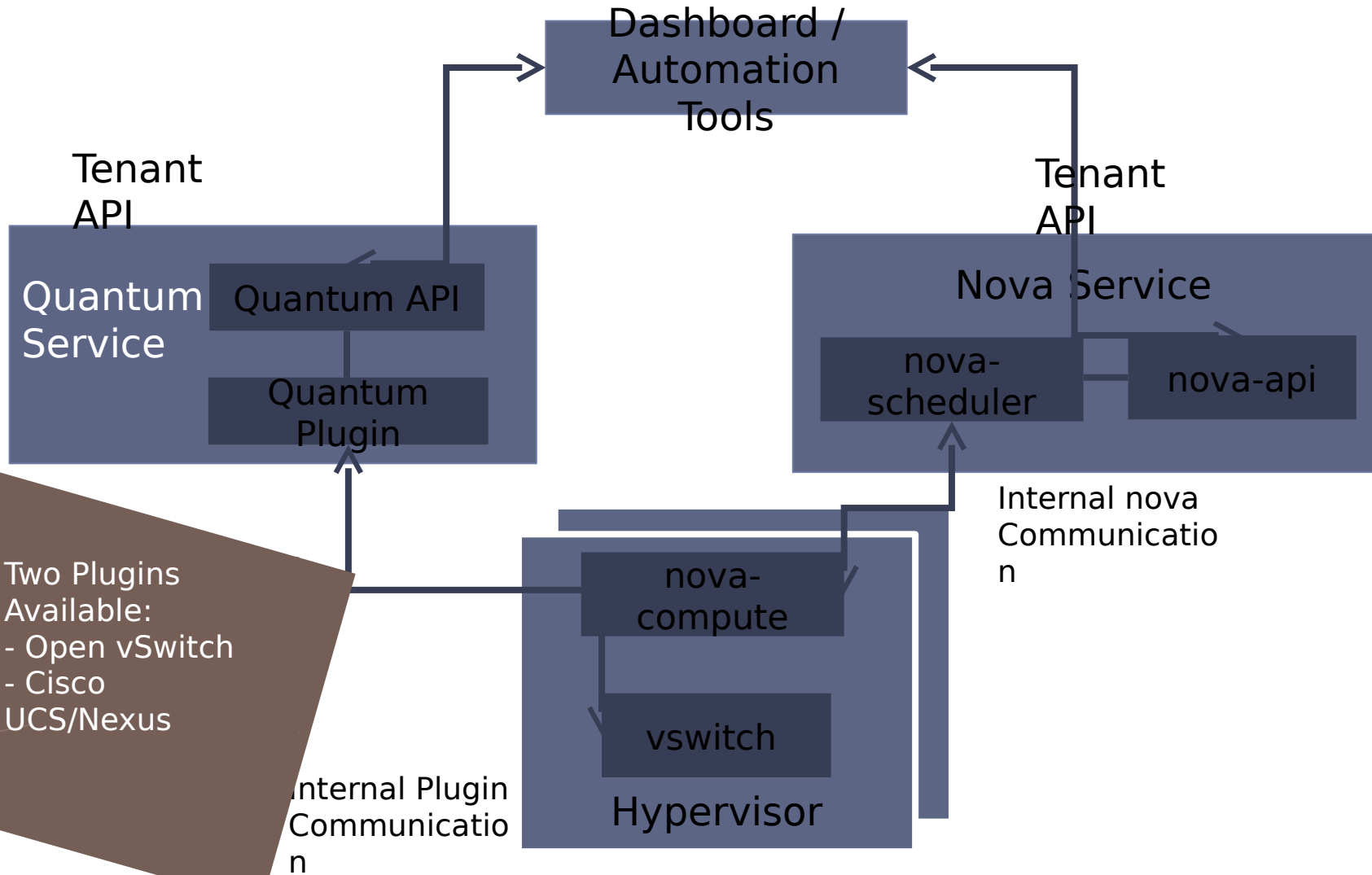
What is Quantum: Example Scenario:

What is Quantum: Example Architecture

Manage Compute

Overview

Instances

Images

Keypairs

Networks

Compute: Instances

— Instances are virtual servers launched from images.

Instances

Search...

ID	Name	Image	Private IP	Public IP	State	Actions
1	instance1		10.0.0.3	N/A	Build	• Terminate • Reboot • Log • VNC Console

USER DASHBOARD

openstack
DASHBOARD

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Compute: Networks

— Networks are virtual quantum networks that provide L2 connectivity to your instances

Create Network

Network Name

[   ]

Create Network

Networks

🔍 Search...

ID	Name	Ports	Available	Used	Action
dd6a6195-e646-4a51-9bb8-1aa74105b57d	test network	3	2	1	• Delete • Rename

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Create Ports

Number of Ports

[   ]

[Create Ports]

Ports

ID	State	Attachment	Actions	Extensions
b2bb8996-677c-415b-9f83-4fff8365e920	ACTIVE	None	• Attach • Delete • Port	QoS
ae6f79b6-bac7-49bf-8670-26b16bb22533	DOWN	None	• Attach • Delete • Port UP	QoS
11a61d72-02e1-4ab5-957b-875b712ee57c	DOWN	None	• Attach • Delete • Port UP	QoS
29964ed5-3579-4e15-8821-a40c00623f74	DOWN	None	• Attach • Delete • Port UP	QoS

Attach port to a virtual interface

Click to edit Master text styles
Second level
Third level
Fourth level
Fifth level

Select virtual interface ✕

instance1 VIF 1 ▾

Instance Name	*instance1*	Instance Id	*1*
VIF id	*1*	Network	*private*

Attach

Project Status: Diablo Release

Started at Diablo summit
6 months of dev resulted in Diablo release:

v1.0 of the Quantum L2 API

API extensibility framework

API client library and CLI

Nova Integration via the QuantumManager

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Available at: http://launchpad.net/quantum
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Project Status: Who should use Quantum?

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<u>Caution:</u> deployments are by people who understand the limitations of Quantum and are looking to improve the platform by running/testing it.
Some aspects of the traditional Nova networking model are not yet integrated with Quantum (e.g., floating IPs, DHCP)
This will improve significantly over the Essex time frame, watch for updates on the OpenStack list + IRC meetings.

Quantum Essex Roadmap

Top Priority: production quality + usability:
>   Automated functional, integration & scale testing

>   Parity/integration with all existing Nova network capabilities.

>   Dashboard + client enhancements for ease of use.

>   API auth with Keystone (mostly done)

>   Packaging & distribution

Essex is target for production quality.
Some will deploy pre-production using Essex milestones.
Strategic Directions:
>   Implementing L3 service for "virtual routers"

>   Advanced RBAC for API

>   VXLAN/NVGRE, and much, much more…

Questions / Comments?

Thanks!

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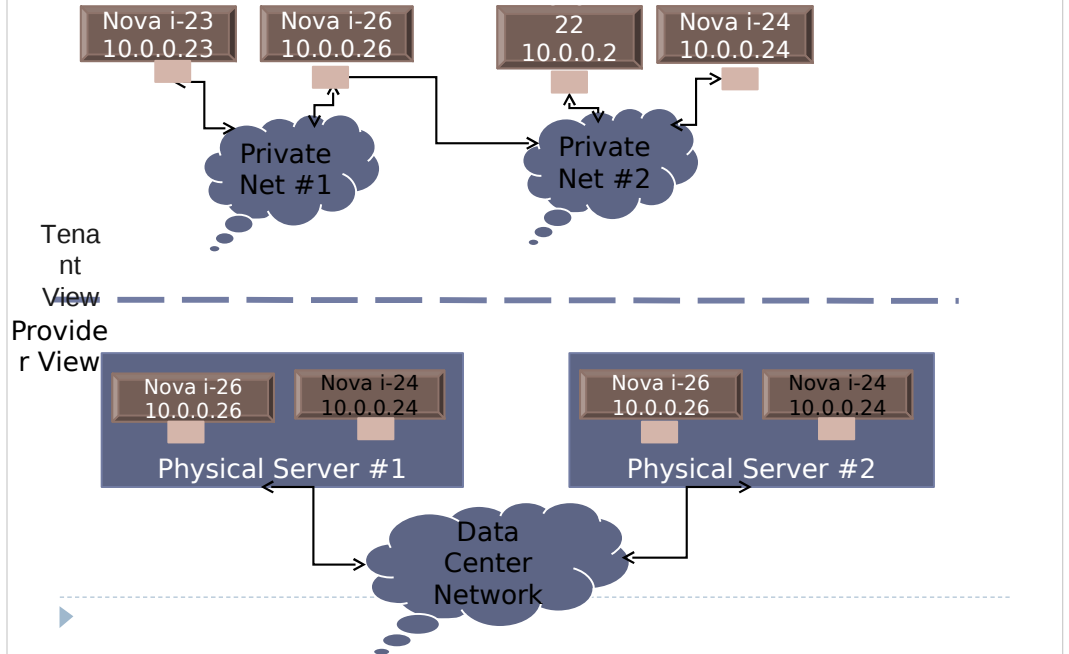   Example: quantum.foo.com/<tenant-id>/network/<network-id>/port/<port-id>

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What is Quantum: Example Scenario:

Nova i-23
10.0.0.23

Nova i-26
10.0.0.26

22
10.0.0.2

Nova i-24
10.0.0.24

Private
Net #1

Private
Net #2

Tena
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View

Provide
r View

Nova i-26
10.0.0.26

Nova i-24
10.0.0.24

Nova i-26
10.0.0.26

Nova i-24
10.0.0.24

Physical Server #1

Physical Server #2

Data
Center
Network

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DASHBOARD

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DASHBOARD

1234
as joeuser

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Fourth level
Fifth level

Create Po...

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Create Ports

Ports

Select virtual interface ✕

instance1 VIF 1 ▾

| Instance Name | instance1 | Instance Id | 1 |
| VIF id | 1 | Network | private |

Attach

id				Attachment	Actions	Ext...
b3bb8586-				None	Attach / Delete / Port DOWN	QoS
ab8f5ab6-bac3-43bf-8850-58818bb3ab33	DOWN		None	Attach / Delete / Port On	QoS
41b91073-02e1-43b5-8520-875b7168e57c	DOWN		None	Attach / Delete / Port On	QoS
5366dec8-3576-4e15-8625-af0e0d5a3f54	DOWN		None	Attach / Delete / Port Up	QoS

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