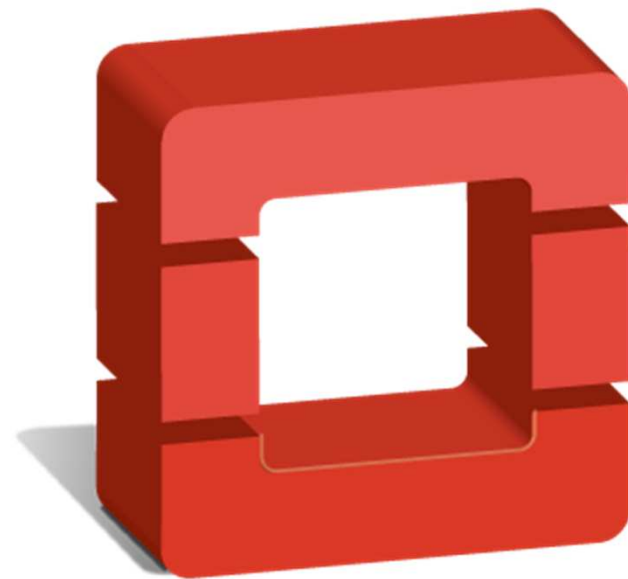


# Quantum

*Virtual Networks for Openstack*



openstack™

# Who is this chap talking to us?



**Salvatore Orlando**

@taturiello

*Pro procrastinator, SSC Napoli fanatic, developer/IT guy in sparetime. Doing cloudy networking stuff at Citrix. Tweets are either mine or from drunk me.*

Cambridge, UK · <http://www.linkedin.com/pub/salvatore-orlando/6/baa/431>

- Random guy trying to give you death by Powerpoint!
- No guru/expert whatsoever, just a sw engineer with an insane attraction to networking and network virtualisation
- Quantum 'core' developer and Openstack contributor
  - Proud to be a first generation 'NetStacker'
- Talking to you today on behalf of the Openstack developer and user communities

# Why is this chap here?

- Mainly to talk about Openstack and Quantum, current state and future developments
  - With some digressions here and there
  - And possibly some gritty technical details
- I will also try to position Quantum in the Software Defined Networking space

**Openstack**

# Openstack

OSS for building massively scalable private and public clouds. Ecosystem includes 5 core, 2 incubating, and several satellite projects.

Launched by NASA and RAX in July 2010, now counts more than 150 companies in the community

*For details: [www.openstack.org](http://www.openstack.org)*

# Openstack core

Credits to Syed Armani

[http://www.youtube.com/watch?v=dD80PDDn6gw&context=C31ba4d9AD0EgsToPDskJn\\_HO1uy2BQnrGy-crqhnz](http://www.youtube.com/watch?v=dD80PDDn6gw&context=C31ba4d9AD0EgsToPDskJn_HO1uy2BQnrGy-crqhnz)

**HORIZON**

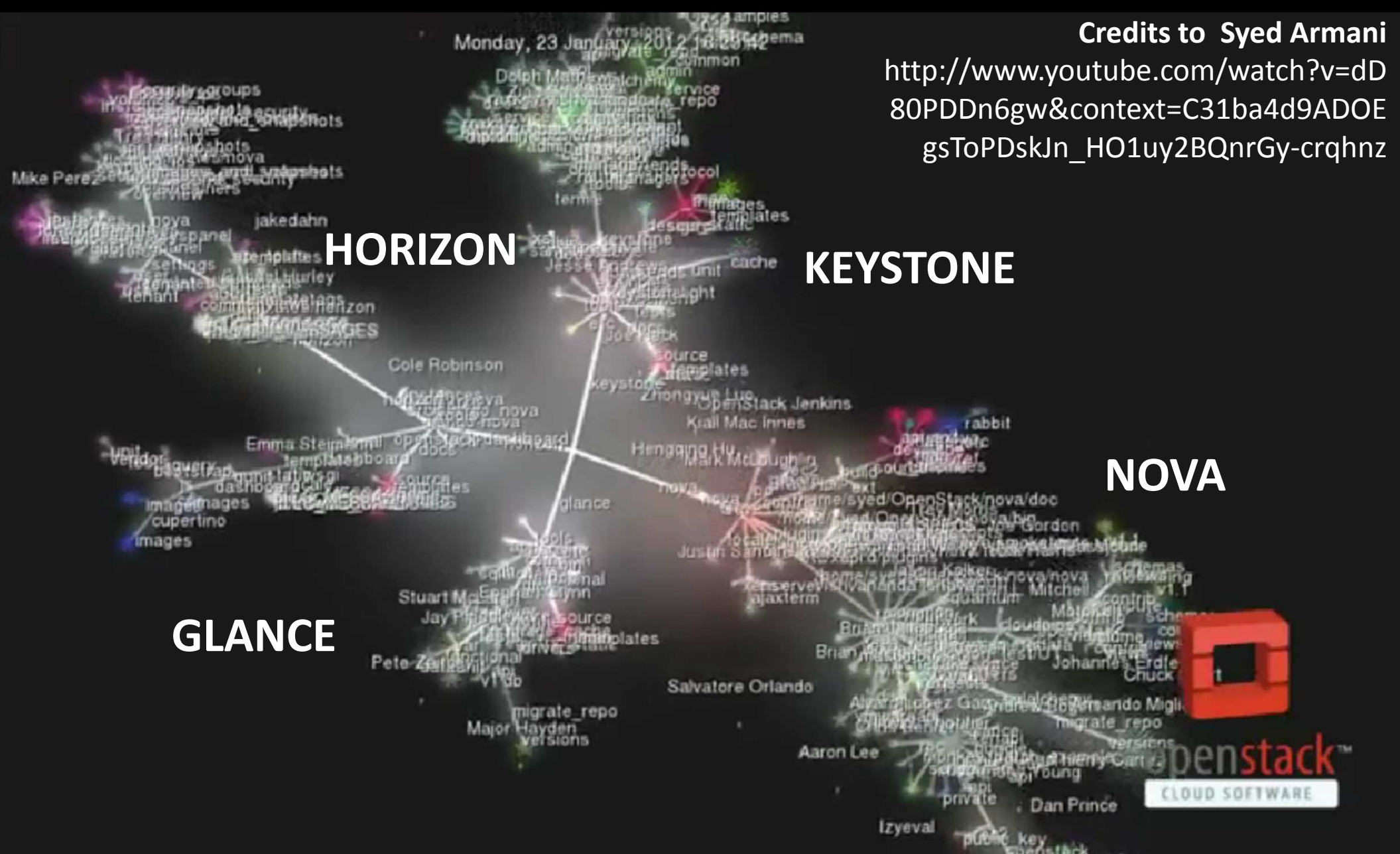
**KEYSTONE**

**NOVA**

**GLANCE**

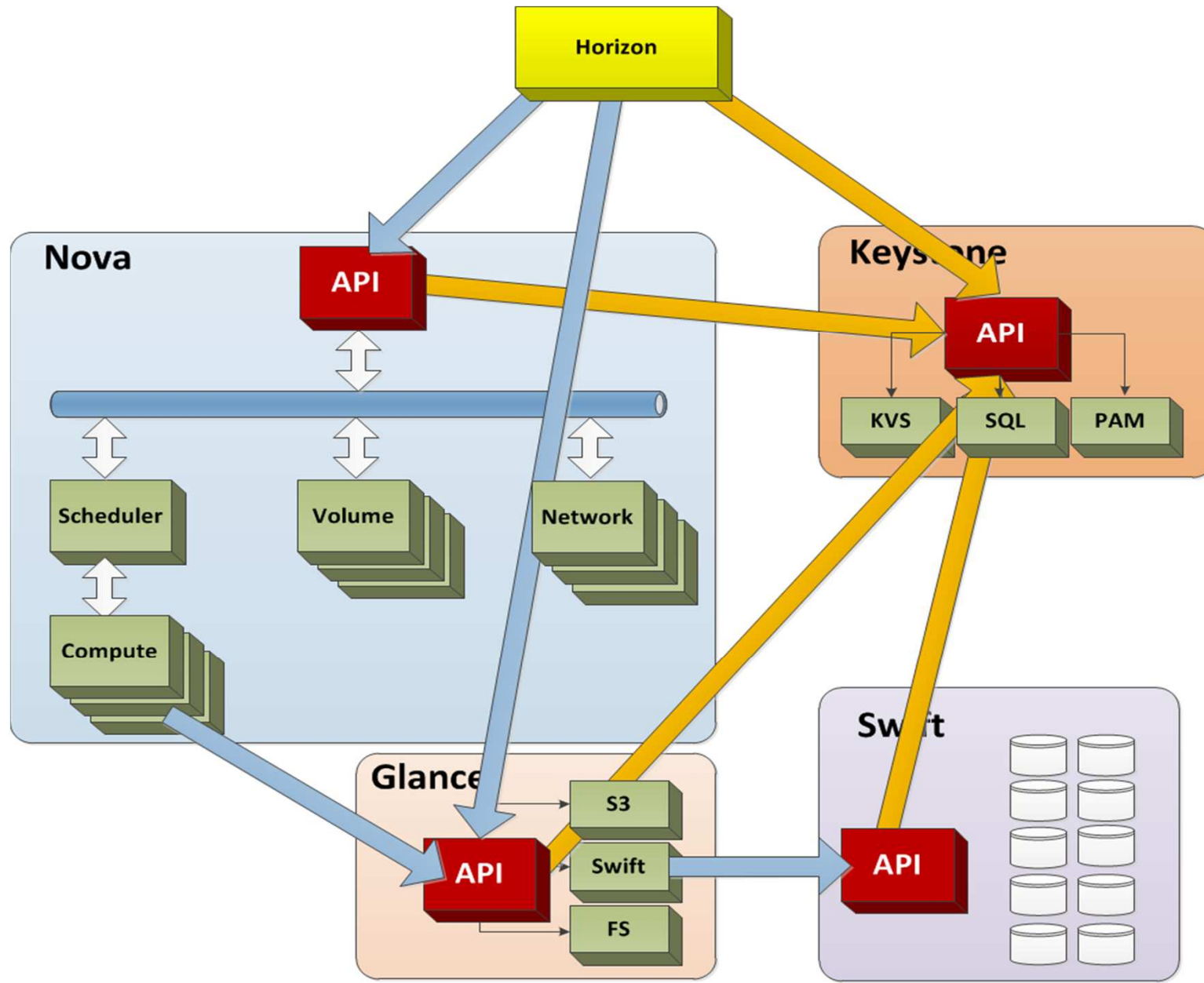


**openstack™**  
CLOUD SOFTWARE



# Openstack core

*(seen in a less fashionable way)*



# Openstack Services (and APIs)

Compute	->	Nova
Imaging	->	Glance
Object Storage	->	Swift
Identity	->	Keystone
Networking	->	?



**Quantum**

# Why Quantum?

MUST HAVE APIs



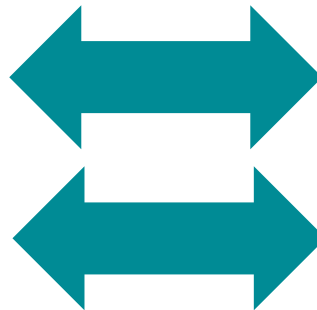
FOR ALL THE THINGS

# Seriously, why Quantum?

- 1) Tenant-facing APIs for nw management
- 2) Define rich network topologies
- 3) Leverage different nw virtualisation technologies

**Compute Service**

**Network Services**



**Virtual Servers**

**Virtual Networks**

# What is Quantum?

«Quantum is an incubated Openstack project to provide "network connectivity as a service" between interface devices (e.g., vNICs) managed by other Openstack services (e.g., nova).»

*source: [wiki.Openstack.org/Quantum](http://wiki.Openstack.org/Quantum)*

«Provides a “building block” for sophisticated cloud network topologies»

*@danwendlandt*

# Digression: Quantum history

02/11 : 6 distincts blueprints for *'virtual networking services'* in Openstack

03/11 : First community-wide discussion

04/11 : Openstack diablo summit

06/11 : First Quantum prototype

**10/11: Quantum 'Diablo' ships!**

02/12: Quantum approved for Openstack core

03/12: Quantum Essex-4 milestone released

**04/12: Quantum 'Essex' ships!**

# Quantum tenets

Quantum controls network virtualisation just like compute controls server virtualisation. It advocates multitenancy in a technology-agnostic fashion and is loosely coupled with the compute service.

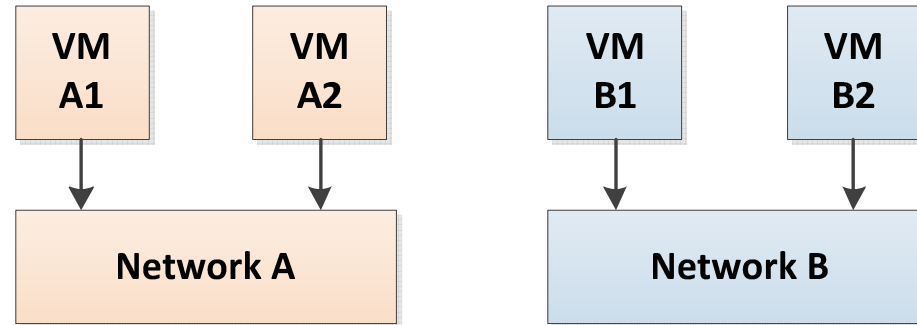
- **Multitenancy:** Isolation, Abstraction, Full control over virtual networks
- **Technology-agnostic:** API specifies service, vendor provides its implementation. Extensions for vendor-specific features.
- **Loose coupling:** standalone service, not exclusive to Openstack

# What does Quantum provide?

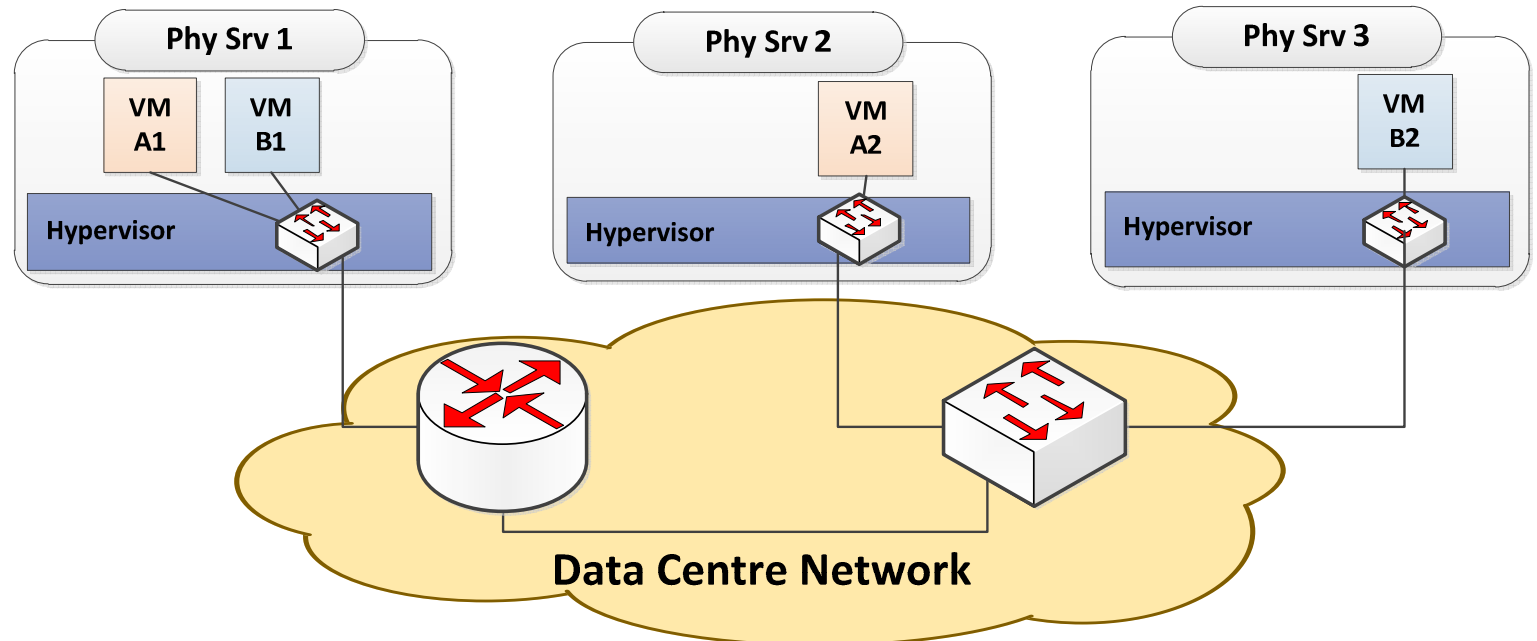
- Decouples “Logical” (tenant) view of the network from “Physical” (provider) view
- Simple APIs for creating and managing virtual networks
- L2 networking
- Nova integration

# Tenant view vs Provider view

Tenant View

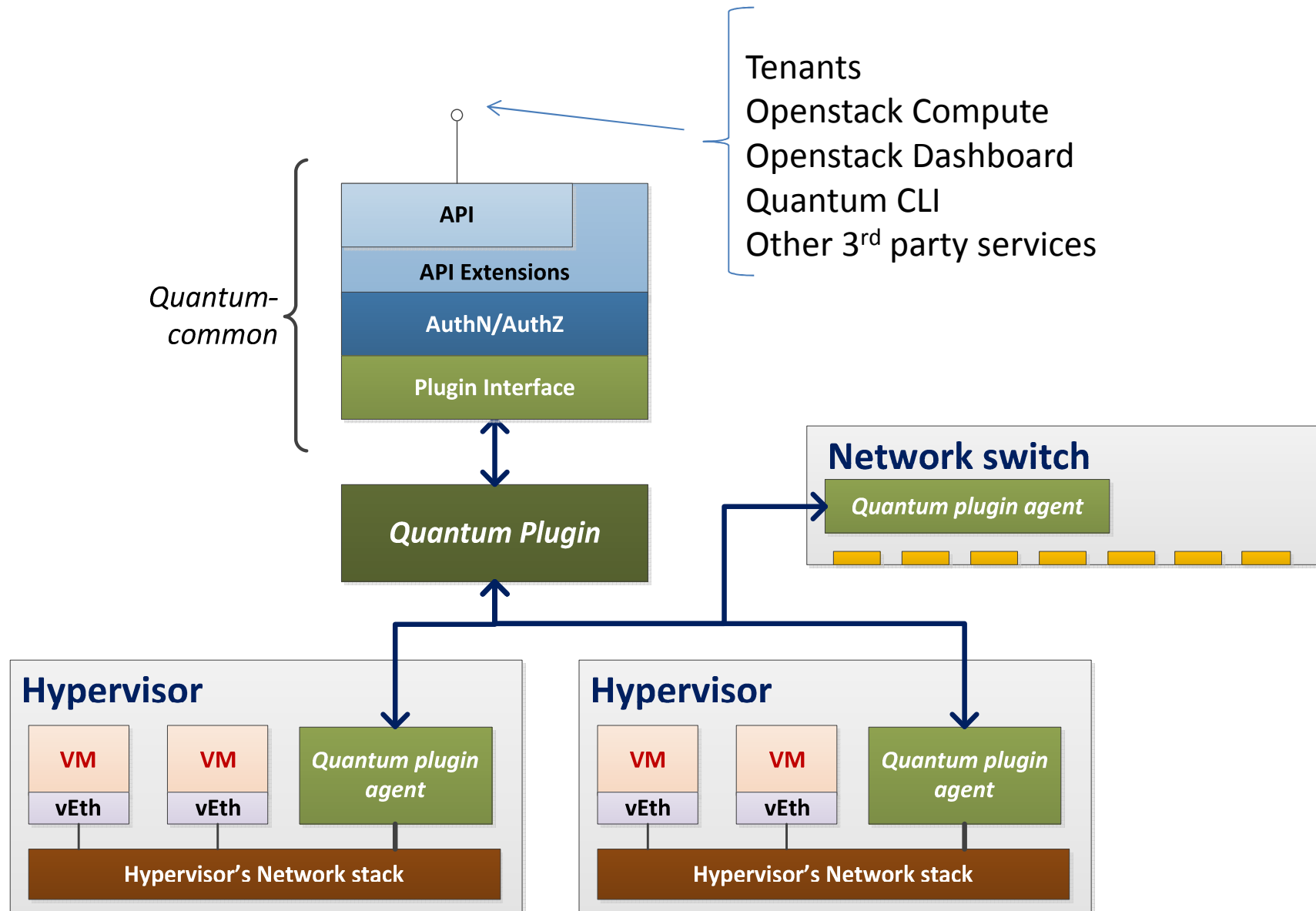


Provider View

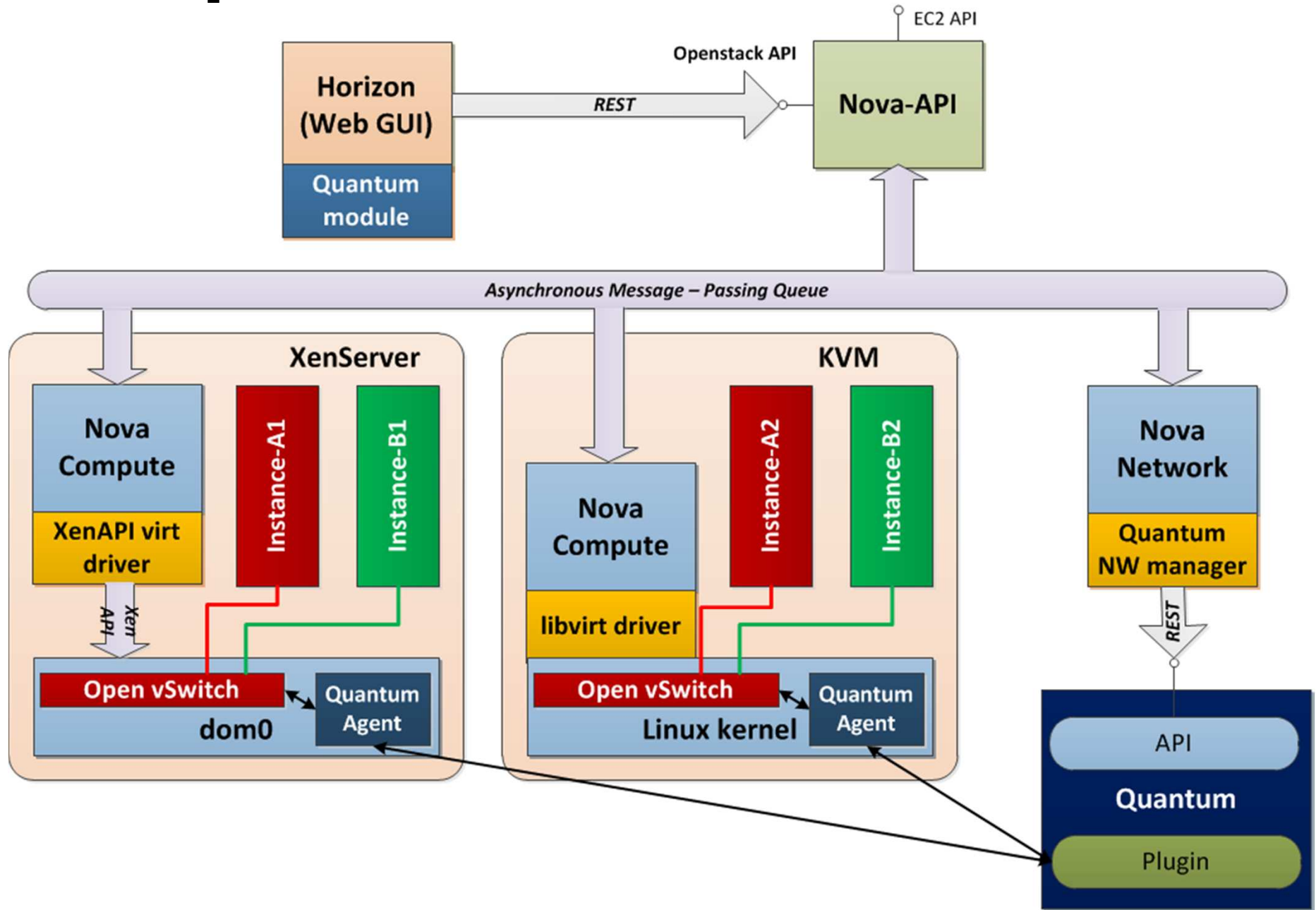




# The Quantum Service



# Openstack with Quantum



# Quantum's Numbers

- **90** blueprints (**63** implemented)
- **199** bugs (**173** fixed)
- **20** active contributors
- **463** git-clones in the past 4 weeks
  - **3169** clones for the client library
- Diablo Release: API v1.0, 2 plugins
- Essex Release: API v1.1, 5 plugins

# The API layer - concepts

- Network, port, and attachment resources
- Resources have administrative and operational state
- Synchronous or asynchronous? That's up to the plugin!

*For the details:* <http://docs.openstack.org/incubation/openstack-network/developer/quantum-api-1.0/content/>

# The API layer - operations

- Networks
  - List, get, add, update, remove
- Ports
  - List, get, add, update, remove
- Attachments
  - Get, plug, unplug

*For the details:* <http://docs.openstack.org/incubation/openstack-network/developer/quantum-api-1.0/content/>

# The API layer - extensions

- API can be extended to provide additional features
- Generic (e.g.: QoS) or plugin specific (e.g.: UCS port profile)
- Quantum API core == minimum common operation set
- Everything else is an extension

# Digression: The API “backstage”

Quantum API is fairly ‘simple’... or ‘simplistic’ if you want. This is by design, and that’s the reason why the project is called ‘Quantum’

Anything else deemed not common enough to be implemented by every plugin should be an extension

# The Plugin

It's the component where the 'virtual networking' magic happens. Fulfils API contract by implementing the 'Plugin Interface'

Tenants can expect the same behaviour from Quantum API regardless of the particular plugin employed



# Available Quantum Plugins

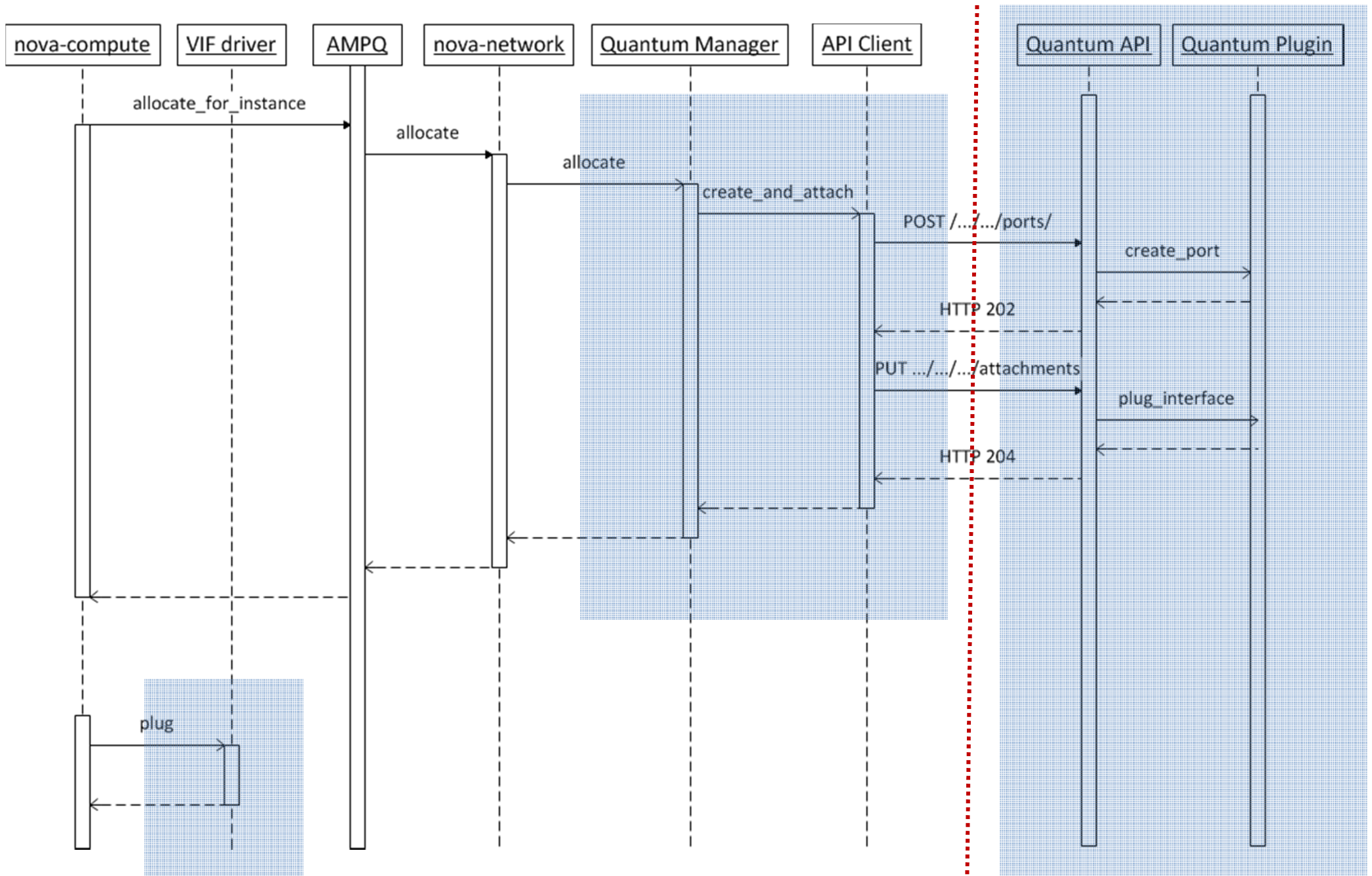
- **Open vSwitch**
  - *Builds isolated networks with OVS and L2-in-L3 tunnels.*
- **Cisco UCS**
  - *Isolation based on VLAN and net-profiles applied to Cisco UCS converged network adapters*
- **Linux Bridge**
  - *Build isolated networks with VLAN interfaces and linux bridge*
  - *Works with every Linux Distro*
- **NTT-Data Ryu**
  - *Acts as a proxy for the NTT Ryu platform*
- **Nicira NVP**
  - *Acts as a proxy for the Nicira NVP platform*

# The Quantum Manager

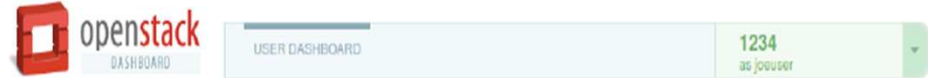
Nova's network manager for Quantum. Forwards network related requests.

Also, provides other network services such as IP address management, DHCP, NAT, Floating Ips...

# Inside Quantum



# Quantum from the Openstack GUI (Horizon)



**Manage Compute**

- Overview
- Instances
- Images
- Keypairs
- Networks**

### Compute: Networks

— Networks are virtual quantum networks that provide L3 connectivity to your instances

#### Create Network

Network Name

Create Network

#### Networks

ID	Name	Ports	Available	Used	Action
dd6a6195-e646-4a51-9bb8-1aa74105b57d	test network	3	2	1	<a href="#">Delete</a> <a href="#">Rename</a>

### Ports

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

Attach port to a virtual interface

# Getting involved with Quantum

1. Start here: <http://wiki.openstack.org/Quantum>
2. Get the code:
  - git clone <https://github.com/openstack/quantum.git>
  - git clone <https://github.com/openstack/python-quantumclient.git>
3. Start hacking!
  - For the API layer, use 'Fake' plugin on your dev machine
  - For plugin development or nova integration, devstack is the right tool for you (<http://www.devstack.org> )

# **Quantum within the Virtual Networking Space**

# Quantum and Virtual Networking

«“Virtual-Networking” Is as Meaningless  
a Term as “Cloud” Now.»

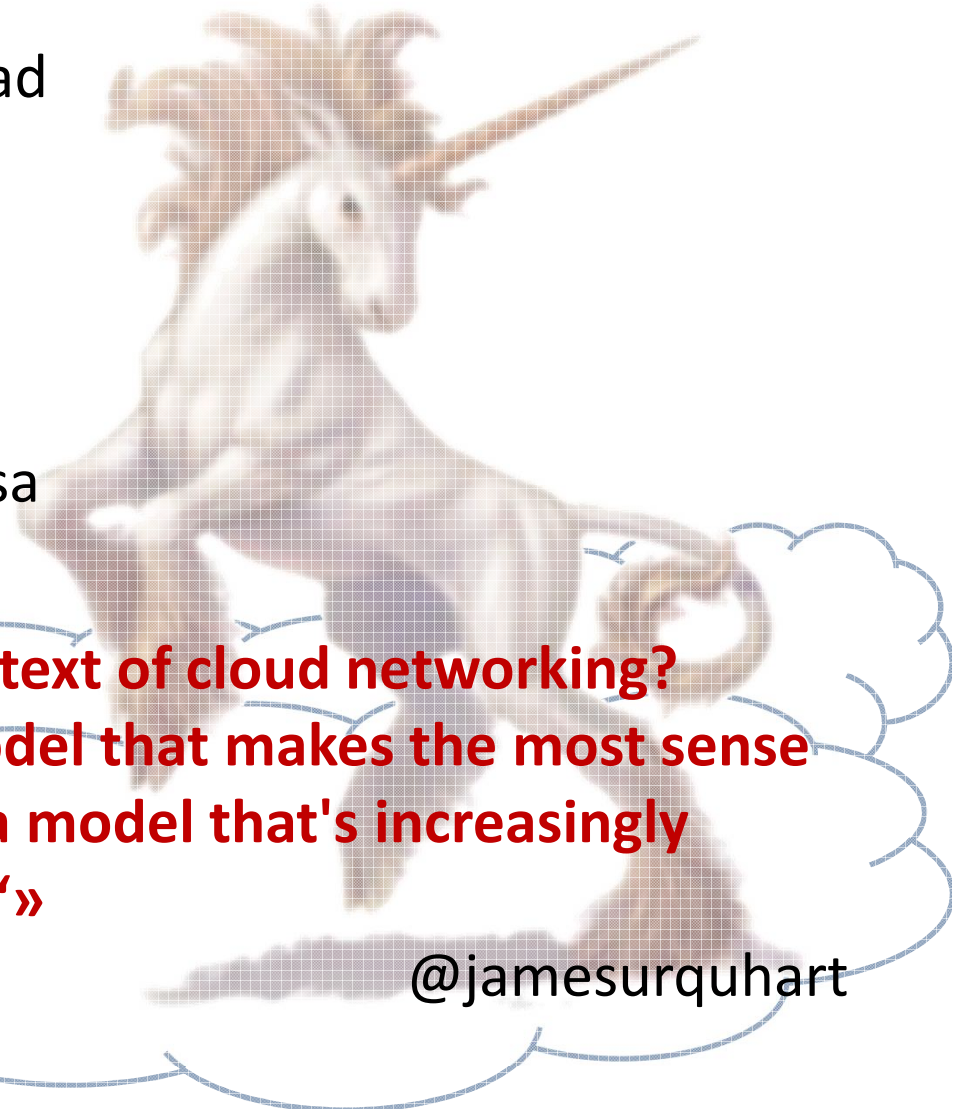
@cloudtoad

«Network Virtualization is as  
meaningless as Storage Virtualization.  
Load of bollocks»

@reillyusa

«Why is Quantum important in the context of cloud networking?  
Because, I believe, it represents the model that makes the most sense  
in cloud infrastructure services today--a model that's increasingly  
become known as "virtual networking.”»

@jamesurquhart



# Virtual Networking

A label nowadays applied to too many solutions and products

It essentially boils down to:

- Securely partitioning the network
- Defining virtual network topologies
- Automating network provisioning



# Software Defined Networking (SDN)

- Novel model for network control
  - *packet forwarding and network topologies are made programmable*
- An external 'controller' component and sets up flows and/or topologies for network traffic
  - *Openflow, but not only*
- Particularly suitable for virtual networking in massively scalable environments

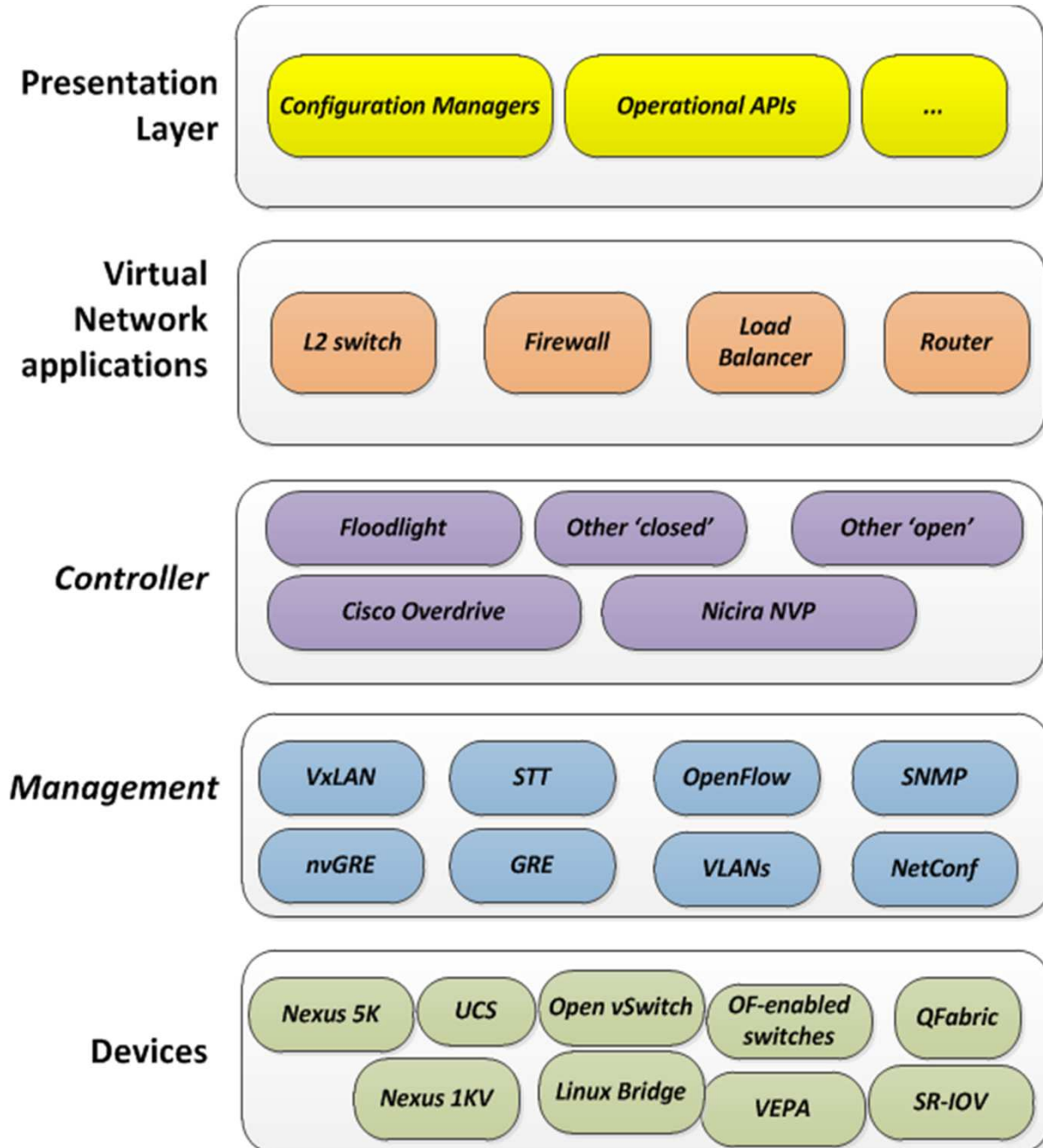
# Quantum and SDN

- Provides a standardized interface for building and managing virtual networks
- Plugin can implement or interface with any kind of SDN
  - OpenFlow, Orchestration, Tunneling, Network Interface virtualization, 'legacy', etc...

«[...] the point is that you shouldn't ever need to deal with this *[SDN]* stuff, unless you are a network engineer. Quantum hides the complexity of the network from the application developer's perspective.»

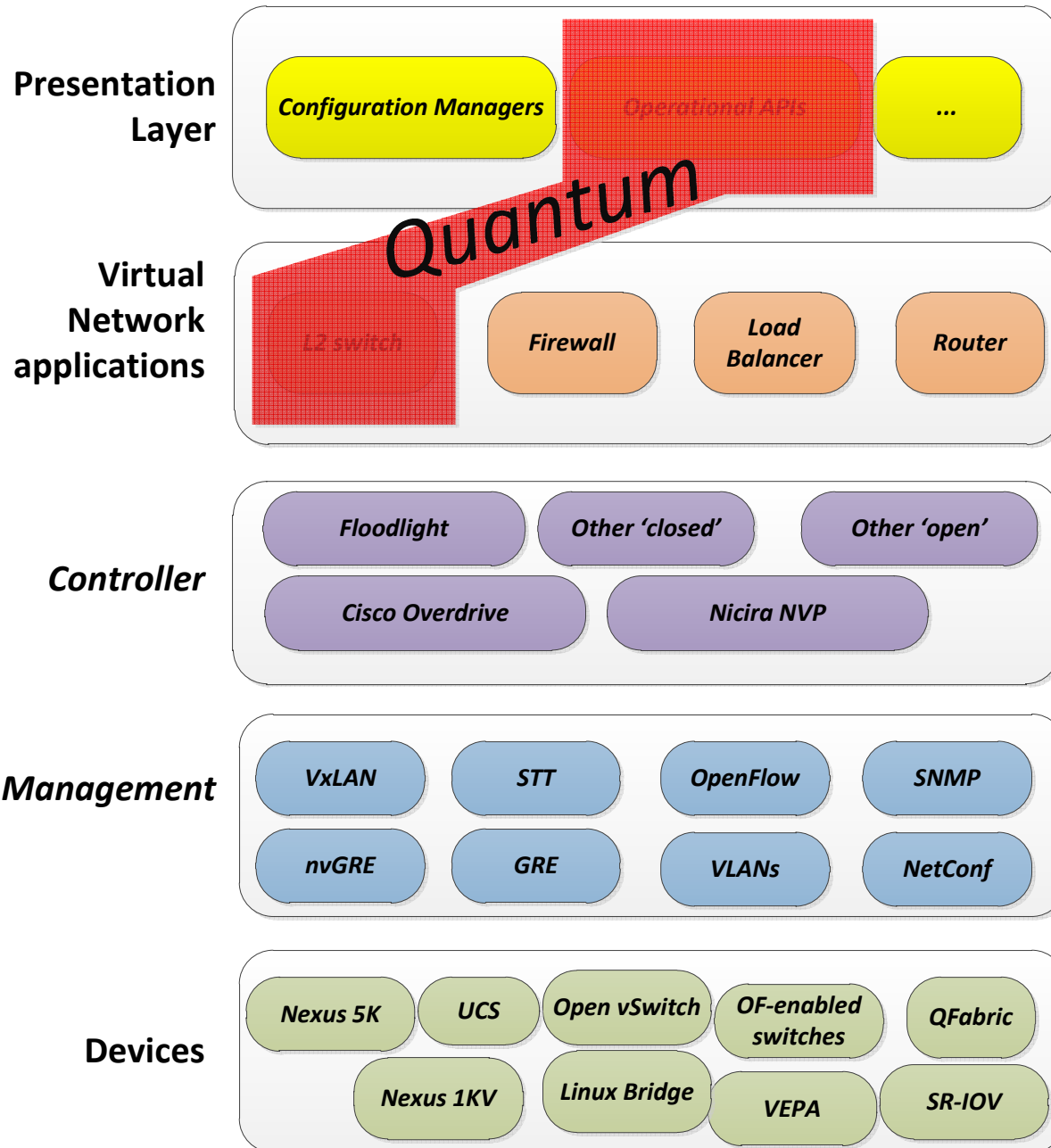
**@jamesurquhart**

# Quantum in the SDN space



Derived from Greg Ferro's (@etherealmind) webinar on SDN and Openflow: <http://demo.ipspace.net/get/OpenFlow>

# Quantum in the SDN space



*Quantum plugins can implement or interface with one or more components in these layers*

# Quantum's future

# The near future (Folsom)

- **Caveat: Not committed yet!**
- Became a core Openstack project
- Merge with Melange IP Address Management service
- Improve API quality and documentation
- Improve GUI, i.e.: Quantum Horizon plugin
- Possibly more plugins

# Looking a bit further...

Build more network services on top of the basic building block

- IP routing, Distributed Firewall, LB, NAT, VPN, bridging, ...
- Each service with its own tenant-facing API

*How are these services implemented?*

I have no idea, but that should not be of any concern to tenants, as they will always use the same API

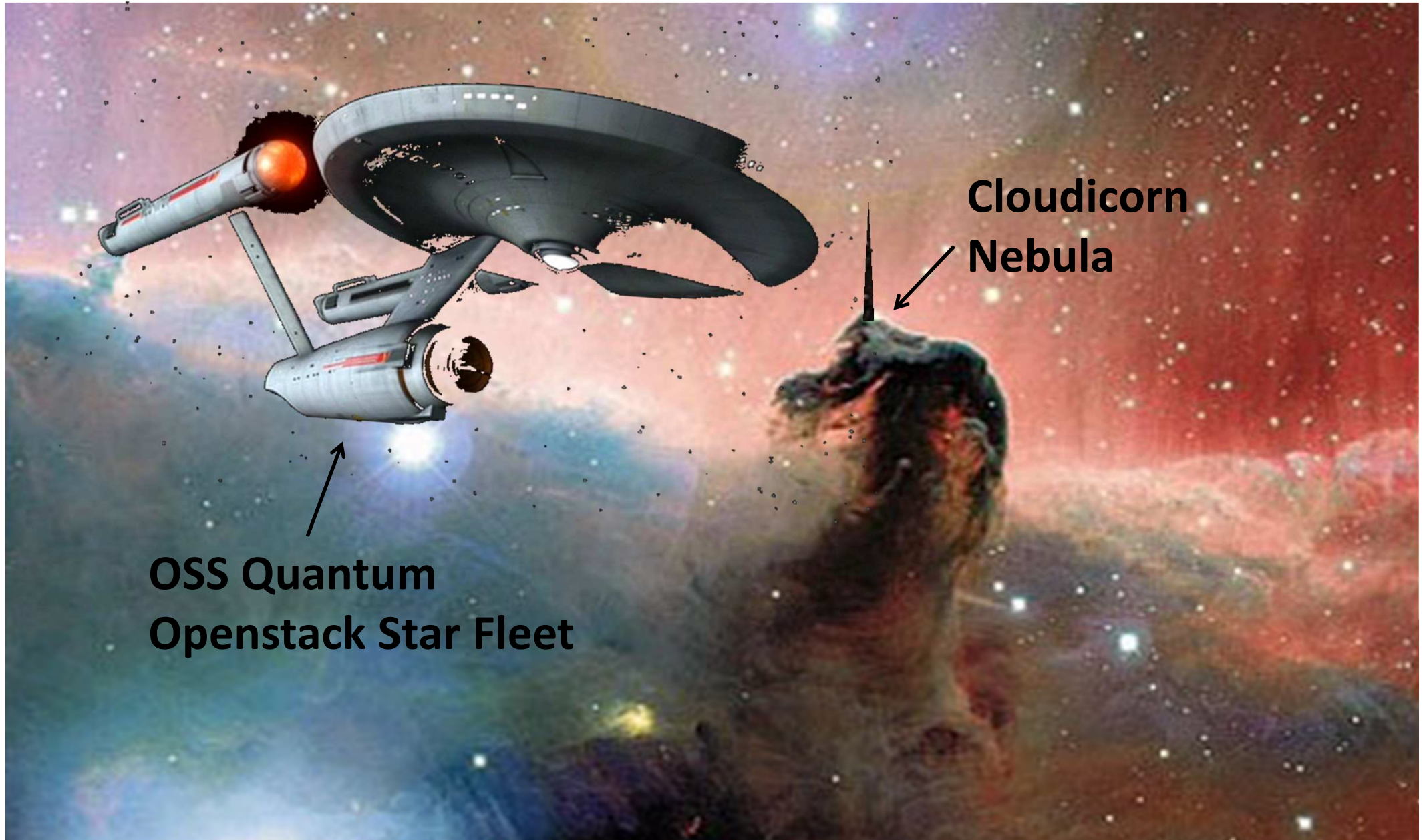
# Looking even further...

- Stop talking about infrastructure, start talking about apps
- Apps are all that matter at the end of the day
- Provision virtualised network resources for satisfying applications' requirement

That's probably the place where we all want to end up.  
However, that is likely to be...



# Quantum next frontier: stardate 12342.5



Cloudicorn  
Nebula

OSS Quantum  
Openstack Star Fleet

# Summarizing

Quantum is a technology-agnostic API for building and managing OS networks. Will become a core project for Folsom release.

Quantum is NOT SDN, but in theory can transform anything into SDN. Just provide a plugin for it.

**Question Time!**

*Thanks for your patience...*