OPENSTACK TECHNOLOGY101

Boston OpenStack Meet-Up

February 19, 2014

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CLOUD SOFTWARE

Theme: Open Source Cloud Computing

"The implications of a DYI approach are profound, organizations won't see the impact of their choice for months, or years. There are a growing number of IT organizations that embrace risk in a new way and reject the established approach to enterprise software."

Alessandro Perilli
Gartner

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Agenda

- What is OpenStack?
  - A brief history
  - The OpenStack Foundation
- The OpenStack projects
  - Compute: Nova, Glance
  - Storage – Swift, Cinder
  - Networks: Neutron
  - Tools: Horizon, Ceilometer, Heat, Oslo
  - Security: Keystone

OpenStack looks more attractive than most commercial solutions due to its inherent capability to mix and match different modules and deeply tweak the resulting cloud infrastructure stack.

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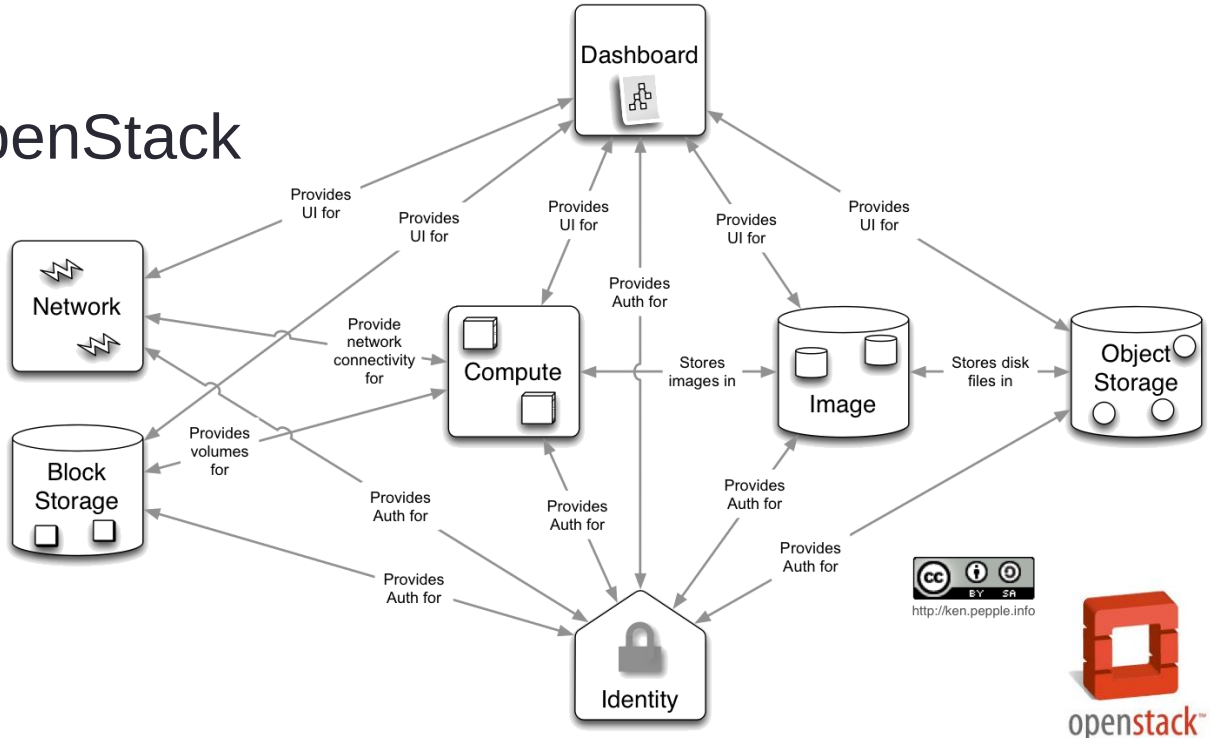
What is OpenStack?

Quick Start for the Terminally Busy…

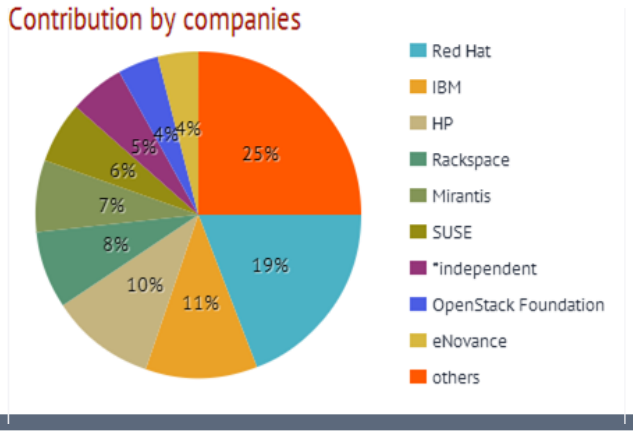
- Open Source Cloud software
- Launched by NASA and Rackspace in 2010
- Massively scalable
- Managed by the OpenStack Foundation
- Rapidly taking over the Cloud world!

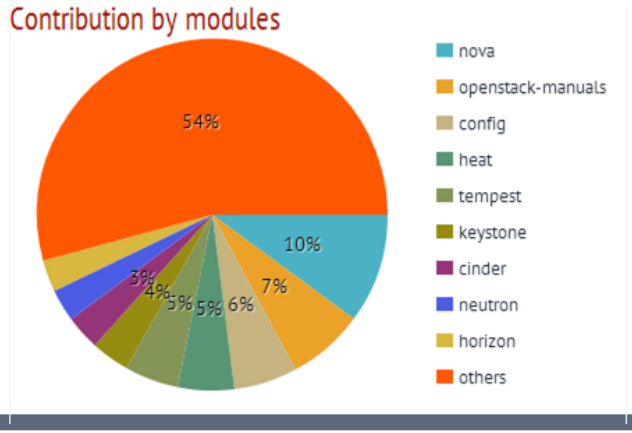


What is OpenStack?

A Brief History

- Jointly founded in July 2010 by Rackspace and NASA with merger of two projects:
  - Swift object storage based on Rackspace's Cloud Files platform
  - Nova based on Nebula compute platform
- Fastest growing Open Source project to date!
- Strong Community Support





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OpenStack Project Release History

Six Month Cycle – Currently working on Icehouse

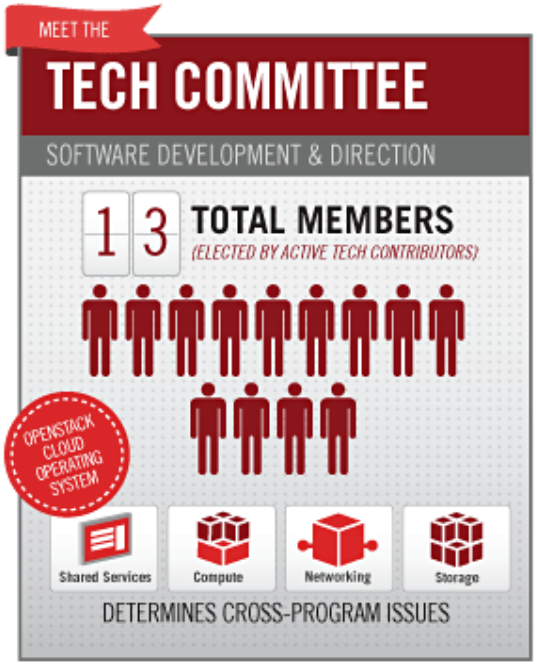
- Releases are timed to correspond with the developer Summit meeting
- Still no reliable upgrade paths between releases
- Expect large deltas between releases for the next year or so as new features and core functionality are added

Series	Status	Releases	Date
Icehouse	Under development	Due	Apr 17, 2014
Havana	Current stable release, security-supported	2013.2	Oct 17, 2013
		2013.2.1	Dec 16, 2013
Grizzly	Security-supported	2013.1	Apr 4, 2013
		2013.1.1	May 9, 2013
		2013.1.2	Jun 6, 2013
		2013.1.3	Aug 8, 2013
		2013.1.4	Oct 17, 2013
Folsom	EOL	2012.2	Sep 27, 2012
		2012.2.1	Nov 29, 2012
		2012.2.2	Dec 13, 2012
		2012.2.3	Jan 31, 2013
		2012.2.4	Apr 11, 2013
Essex	EOL	2012.1	Apr 5, 2012
		2012.1.1	Jun 22, 2012
		2012.1.2	Aug 10, 2012
		2012.1.3	Oct 12, 2012
Diablo	EOL	2011.3	Sep 22, 2011
		2011.3.1	Jan 19, 2012
Cactus	Deprecated	2011.2	Apr 15, 2011
Bexar	Deprecated	2011.1	Feb 3, 2011
Austin	Deprecated	2010.1	Oct 21, 2010

What is OpenStack?

An Open Source Foundation

Technical Committee



OpenStack Technical Committee members define and steward the technical direction of OpenStack software, including cross-program issues. The committee of 13 is fully elected by the project's Active Technical Contributors.

Board of Directors

The Board of Directors provides strategic and financial oversight of Foundation resources and staff. Alan Clark, Director of Industry Initiatives, Emerging Standards and Open Source at SUSE, was elected Chairman of the Board, and Lew Tucker, Vice President and CTO of Cloud Computing at Cisco, was elected Vice Chairman of the Board.

User Committee

Tim Bell, Operating Systems and Infrastructure Services Group Leader at CERN, was appointed by the Board of Directors to help establish a new User Committee, created to represent a broad set of enterprise, academic and service provider users with the Technical Committee and Board of Directors.

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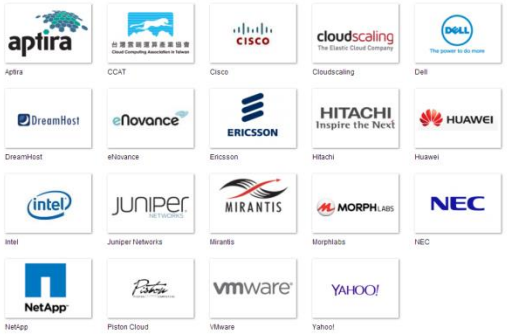
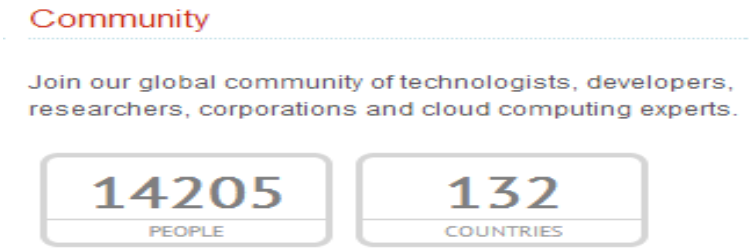
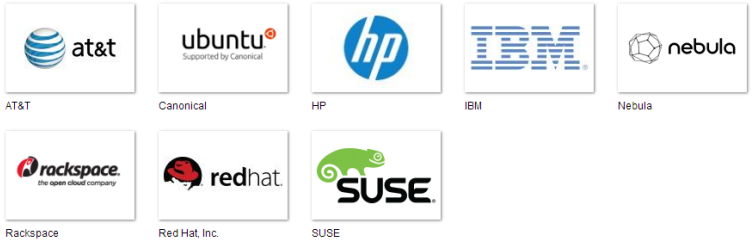
What is OpenStack?

An Open Source Foundation

- Independent home for the OpenStack project
- Uses the Apache licensing model
- Serves developers, users, and the entire ecosystem by providing:
  - Shared resources
  - Enable technology vendors targeting the platform
- Individual membership is free and accessible to anyone







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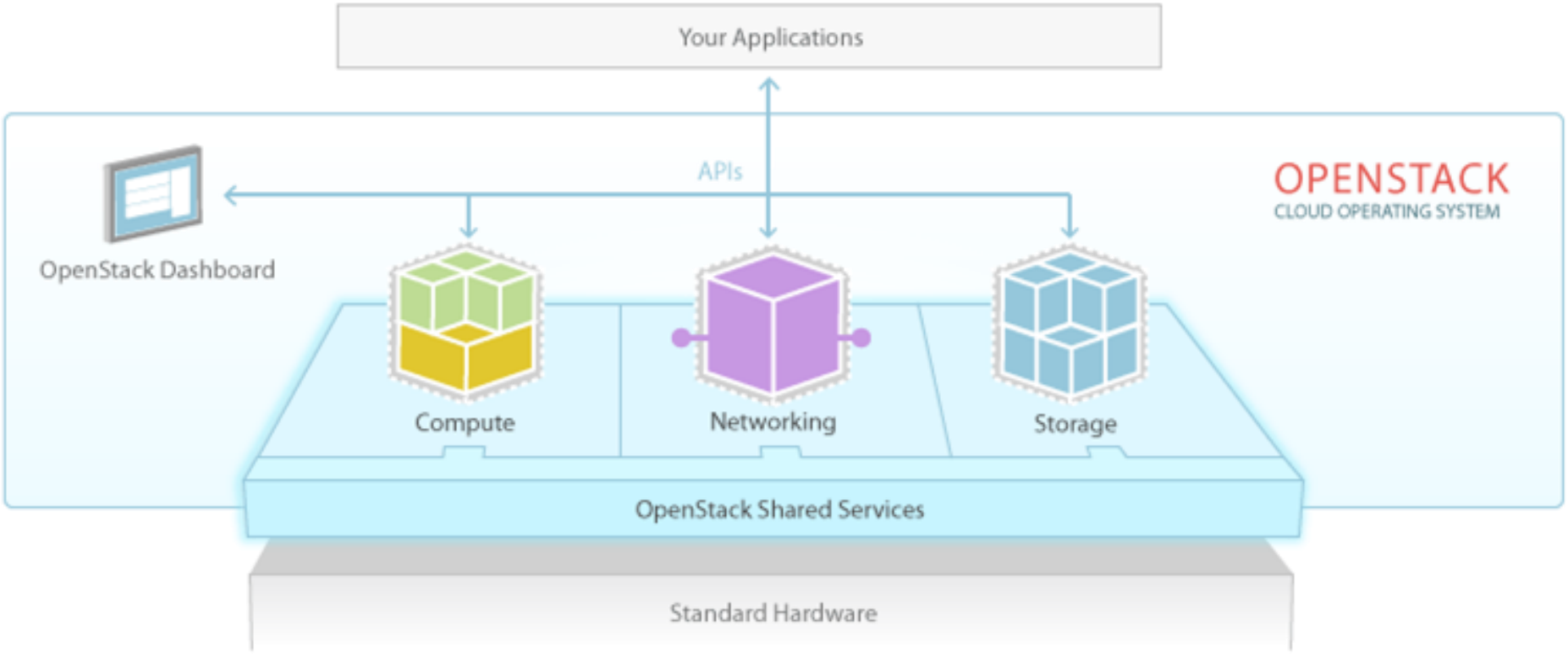
What is OpenStack?

Open Source Cloud Platform

- Open source software for building private and public clouds
  - Designed for flexibility and many different use cases
  - Mix and match components
  - Kit of administrative tools
- Enables multi-tenancy
  - Quota for different users
  - Users can be associated with multiple tenants
- Provides virtual machines (VM) on demand
  - Self service provisioning
  - Snapshotting capability
- Storage volumes
  - Block storage for VM images
  - Object storage for VM images and arbitrary files

OpenStack: The Open Source Cloud Operating System



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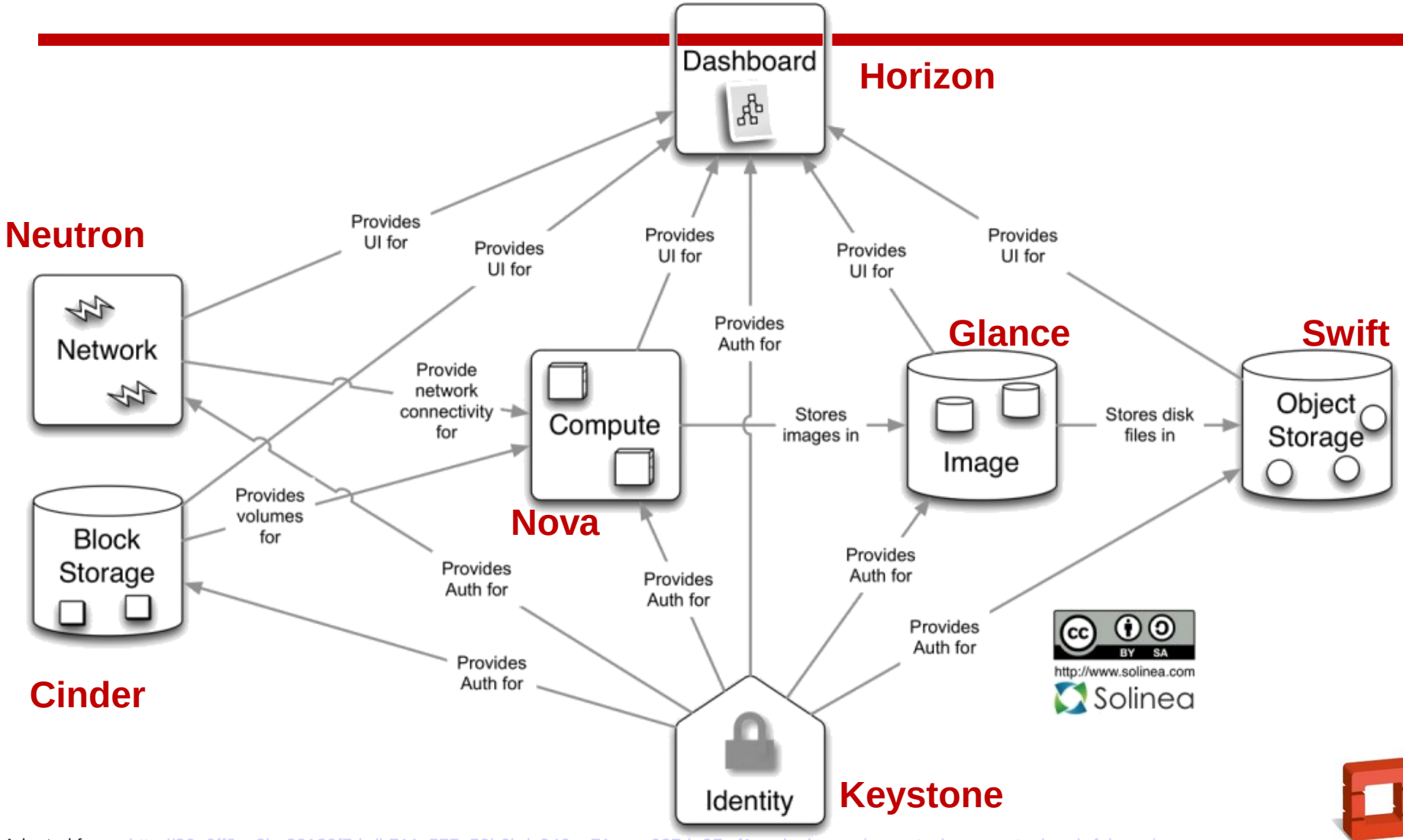
High Level Architecture - Havana



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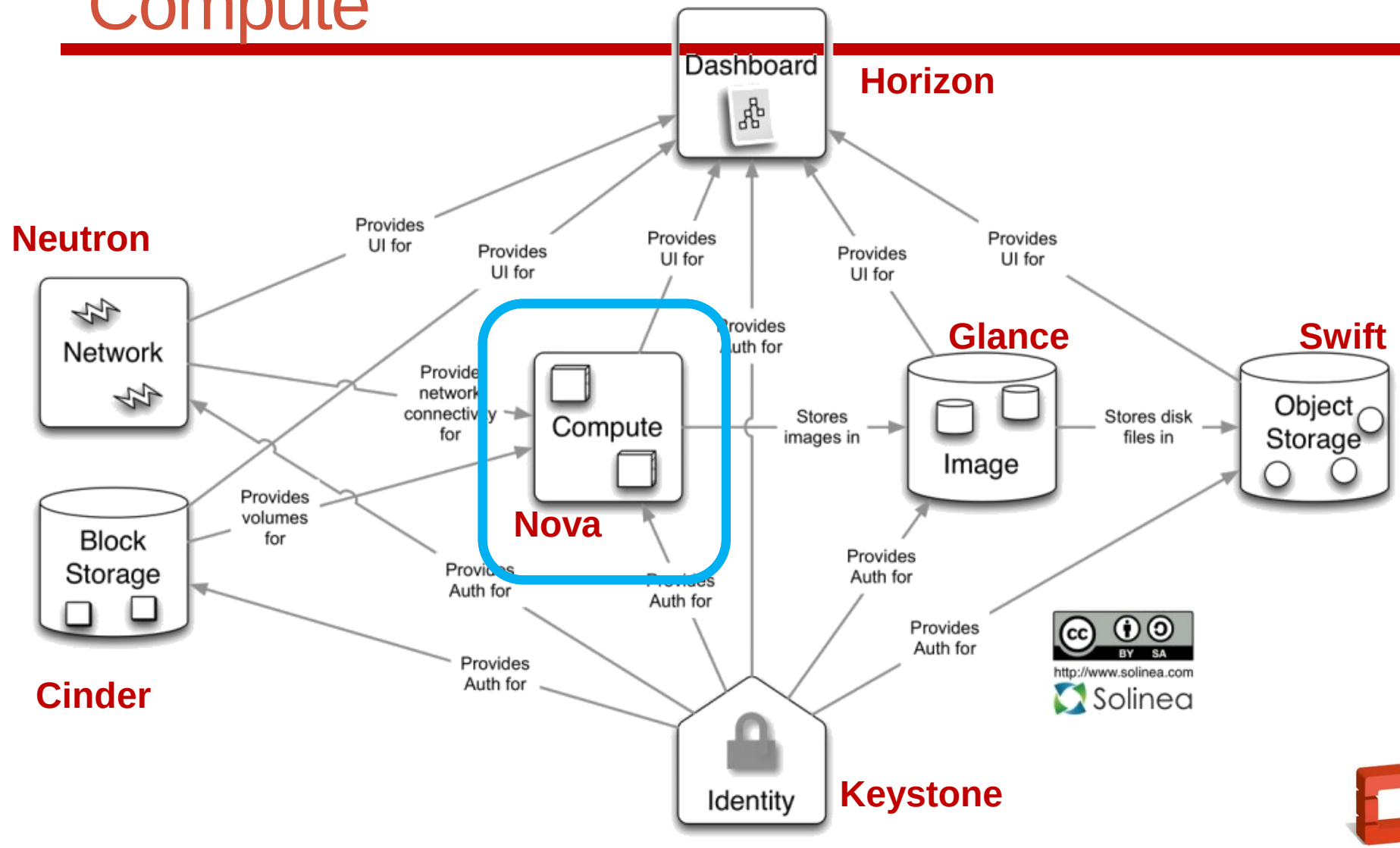
What is OpenStack?

An Open Source Set of Cloud Technologies

- Compute (codenamed "Nova") provides virtual servers upon demand.
- Image (codenamed "Glance") provides a catalog and repository for virtual disk images. These disk images are mostly commonly used in OpenStack Compute.
- Dashboard (codenamed "Horizon") provides a modular web-based user interface for all the OpenStack services. Used to perform most operations like launching an instance, assigning IP addresses and setting access controls.
- Identity (codenamed "Keystone") provides authentication and authorization for all the OpenStack services. It also provides a service catalog of services within a particular OpenStack cloud.
- Object Store (codenamed "Swift") provides object storage. It allows you to store or retrieve files (but not mount directories like a fileserver).
- Block Storage (codenamed "Cinder") provides persistent block storage to guest VMs.
- Network (codenamed “Neutron") provides "network connectivity as a service" between interface devices managed by other OpenStack services.

OpenStack Overall Architecture - Compute

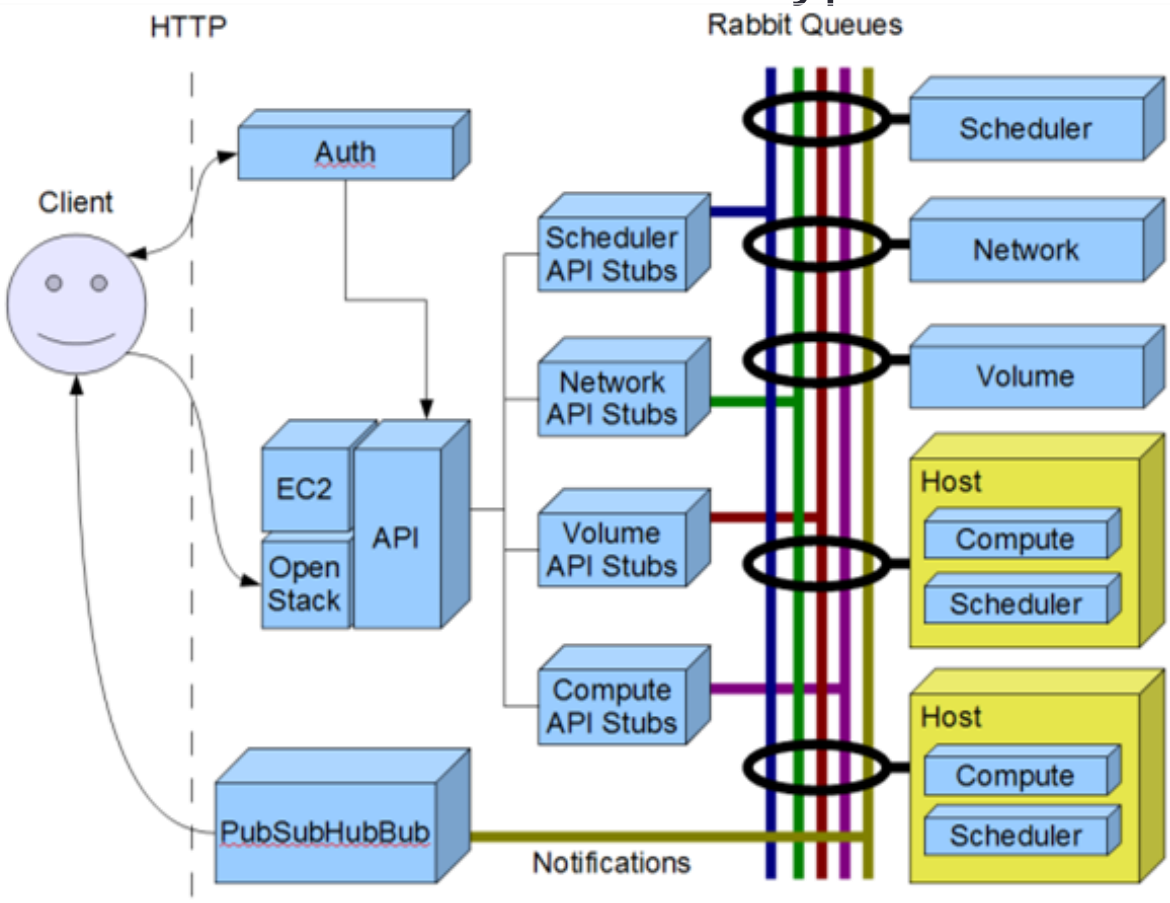


OpenStack Nova Compute - Introduction

- OpenStack Compute is a tool to orchestrate a cloud, including running instances, managing networks, and controlling access to the cloud through users and projects.
- The underlying open source project's name is Nova, and it provides the software that can control an Infrastructure as a Service (IaaS) cloud computing platform.
- It is similar in scope to Amazon EC2 and Rackspace Cloud Servers.
- OpenStack Compute does not include any virtualization software; rather it defines drivers that interact with underlying virtualization mechanisms that run on a host operating system, and exposes functionality over a web-based API.

OpenStack Nova Compute – Message Queue

- Nova-compute is a worker daemon, which primarily creates and terminates VMs via hypervisor API.



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OpenStack Nova Compute – Supported Hypervisors

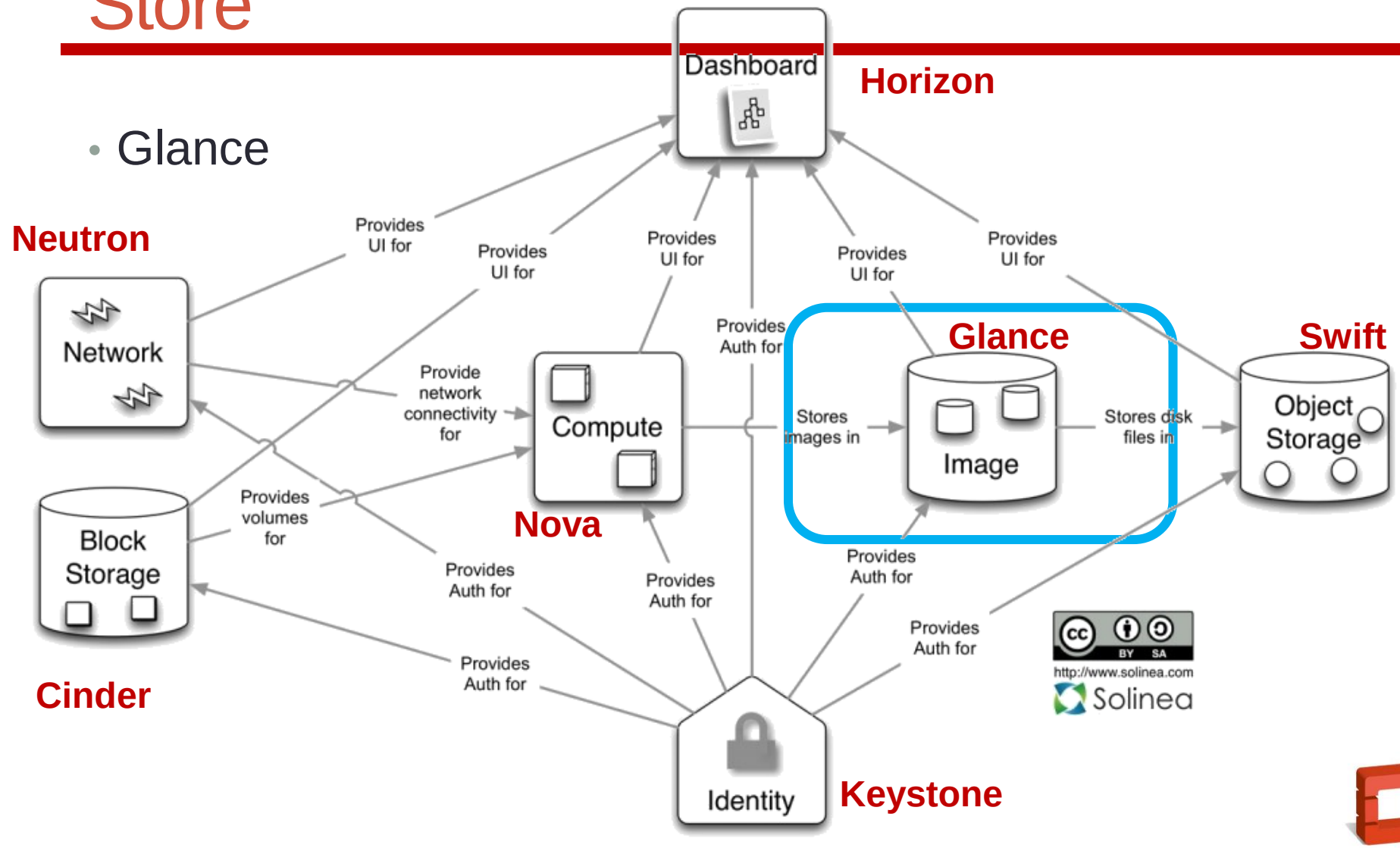
- The process for selecting a hypervisor usually means prioritizing and making decisions based on budget and resource constraints as well as the list of supported features and required technical specifications.
  - Most development is done on KVM and Xen-based hypervisors
- With OpenStack Compute, you can orchestrate clouds using multiple hypervisors in different zones.
- KVM - Kernel-based Virtual Machine. The virtual disk formats that it supports it inherits from QEMU since it uses a modified QEMU program to launch the virtual machine. The supported formats include raw images, the qcow2, and VMware formats.
- LXC - Linux Containers (through libvirt), use to run Linux-based virtual machines.
- QEMU - Quick EMUlator, generally only used for development purposes.

OpenStack Nova Compute – Supported Hypervisors

- UML - User Mode Linux, generally only used for development purposes.
- VMWare vSphere 4.1 update 1 and newer, runs VMWare-based Linux and Windows images through a connection with a vCenter server or directly with an ESXi host.
- Xen - XenServer, Xen Cloud Platform (XCP), use to run Linux or Windows virtual machines. You must install the nova-compute service in a para-virtualized VM.
- PowerVM - Server virtualization with IBM PowerVM, use to run AIX, IBM i and Linux environments on IBM POWER technology.
- Hyper-V - Server virtualization with Microsoft's Hyper-V, use to run Windows, Linux, and FreeBSD virtual machines. Runs nova-compute natively on the Windows virtualization platform.
- Bare Metal - Not a hypervisor in the traditional sense, this driver provisions physical hardware via pluggable sub-drivers (eg. PXE for image deployment, and IPMI for power management).

OpenStack Overall Architecture – Image Store

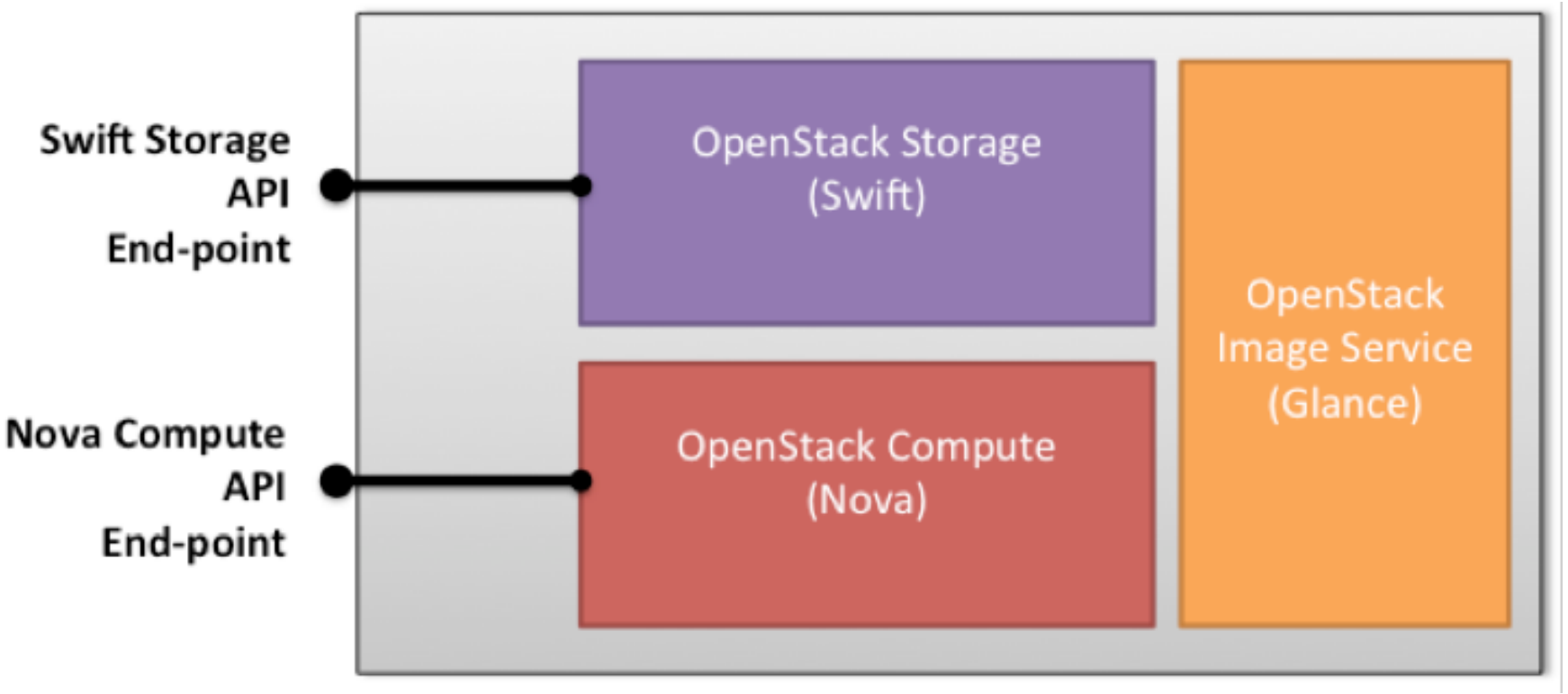
- Glance



OpenStack Glance – Introduction

- The Glance project provides services for discovering, registering, and retrieving virtual machine images. Glance has a RESTful API that allows querying of VM image metadata as well as retrieval of the actual image
- Basically a database and some tools
- VM images made available through Glance can be stored in a variety of locations:
  - Simple filesystems like ZFS, LVM, etc.
  - Direct attached storage
  - Object-storage systems like OpenStack Swift project or S3
  - Block storage like OpenStack Cinder project

OpenStack Glance – Reference Architecture



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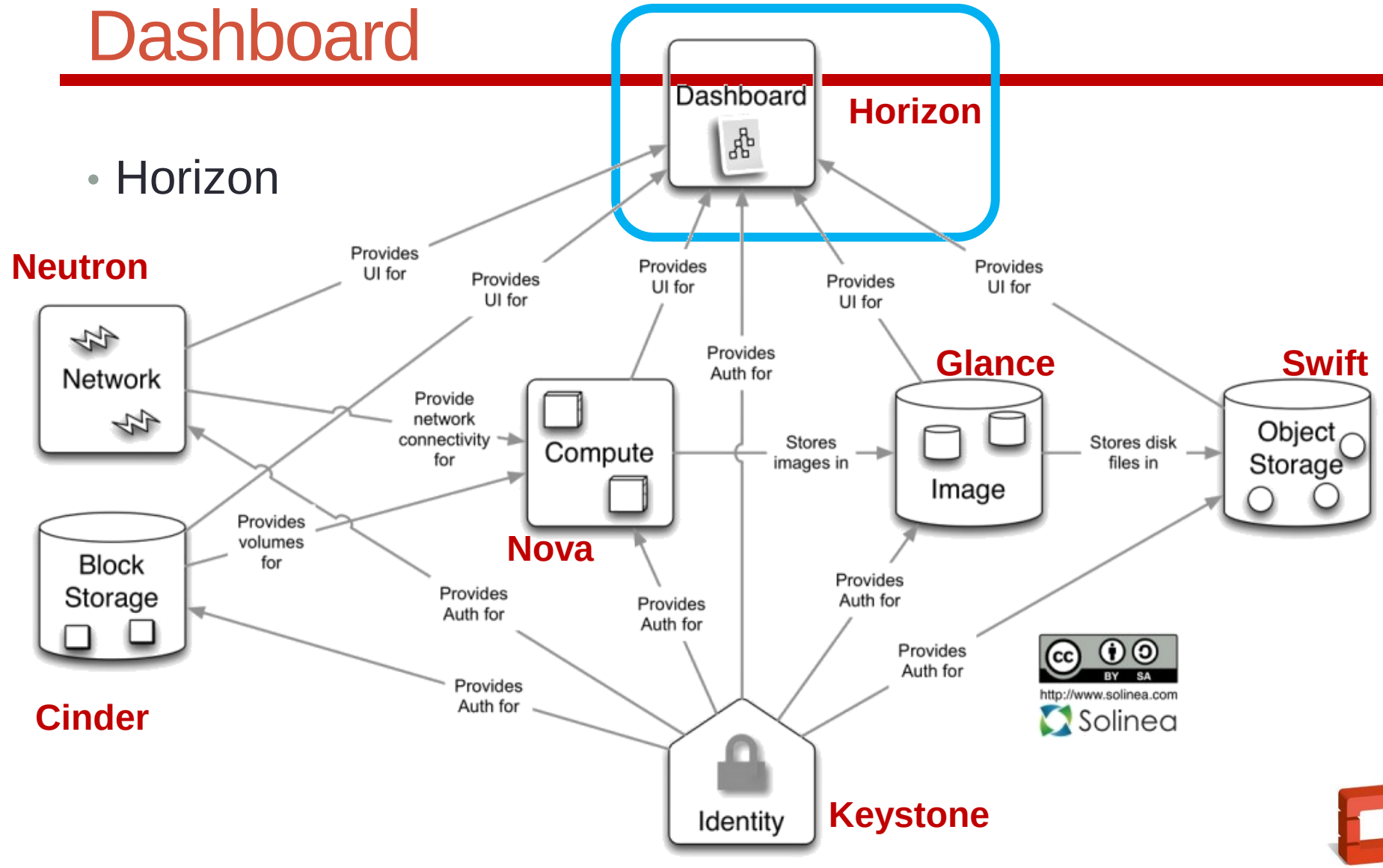
OpenStack Overall Architecture - Dashboard

- Horizon



OpenStack Horizon Dashboard – Introduction

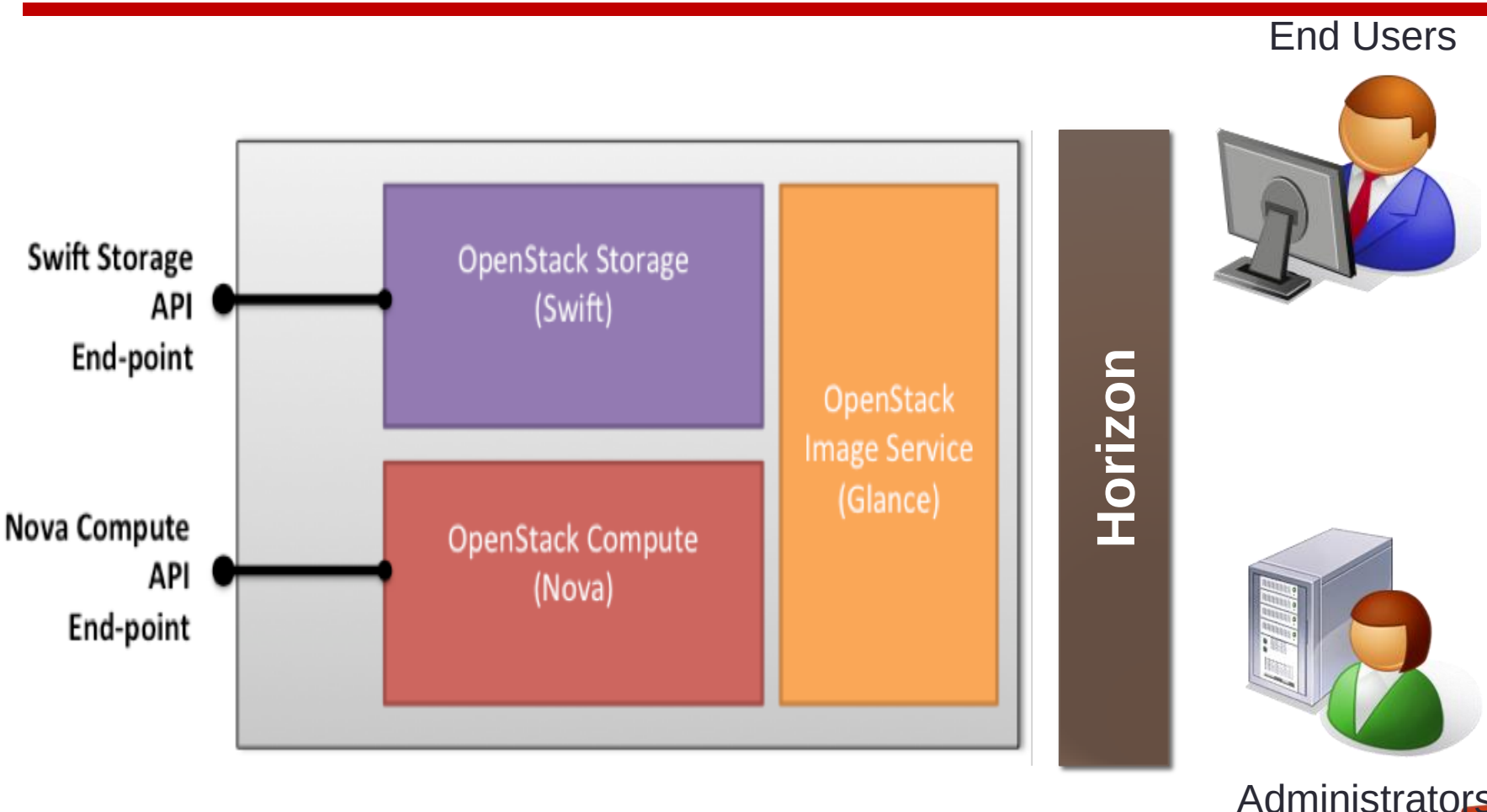
Horizon

- Provides a baseline user interface for managing OpenStack Services
  - Stateless
  - Error handling is delegated to back-end
  - Doesn't support all API functions
  - Can use memcached or database to store sessions
  - Gets updated via nova-api polling

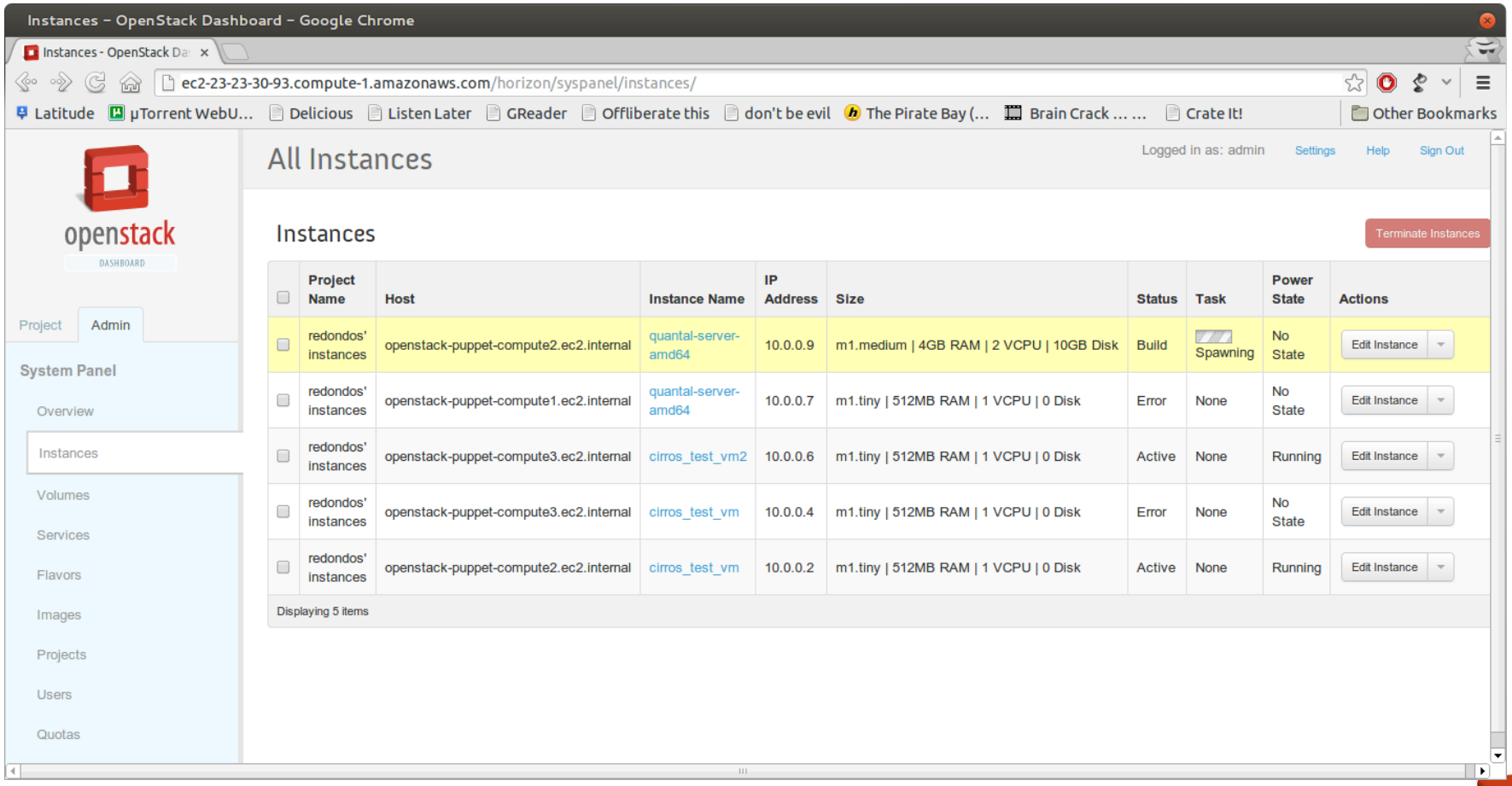
Basic Operations

- From UI
  - Login in to Horizon
  - Specify parameters of VM in "create VM" form
  - Hit "create" button
- Under the Hood
  - Form parameters are converted to Post data
  - "Create" request initiates HTTP POST request to back-end
    - To Keystone if authorization token is not cached
    - To nova-api if authorization token has not yet expired

OpenStack Horizon Dashboard – Reference Architecture



OpenStack Horizon Dashboard – Example



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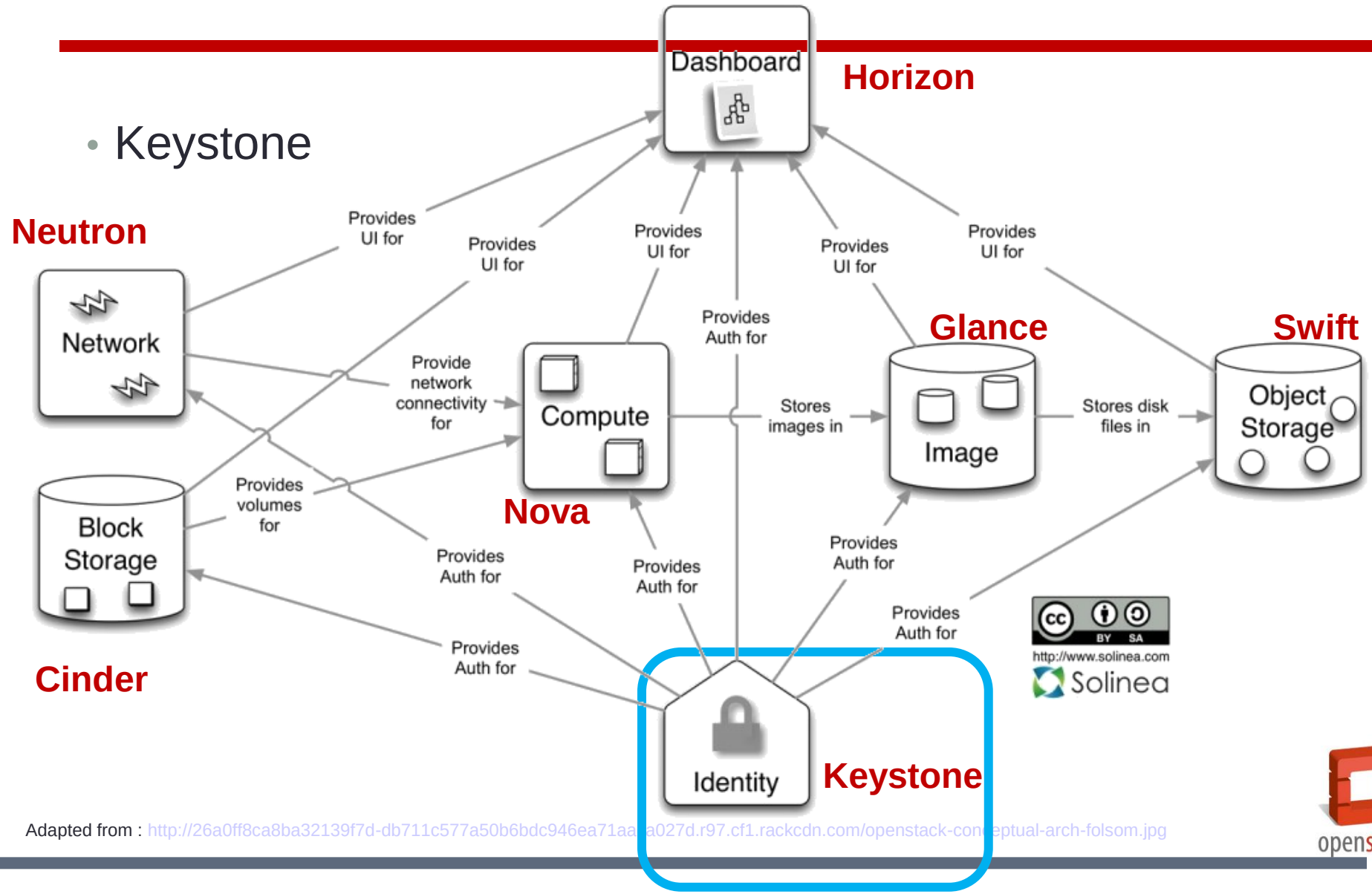
OpenStack Overall Architecture - Security

- Keystone



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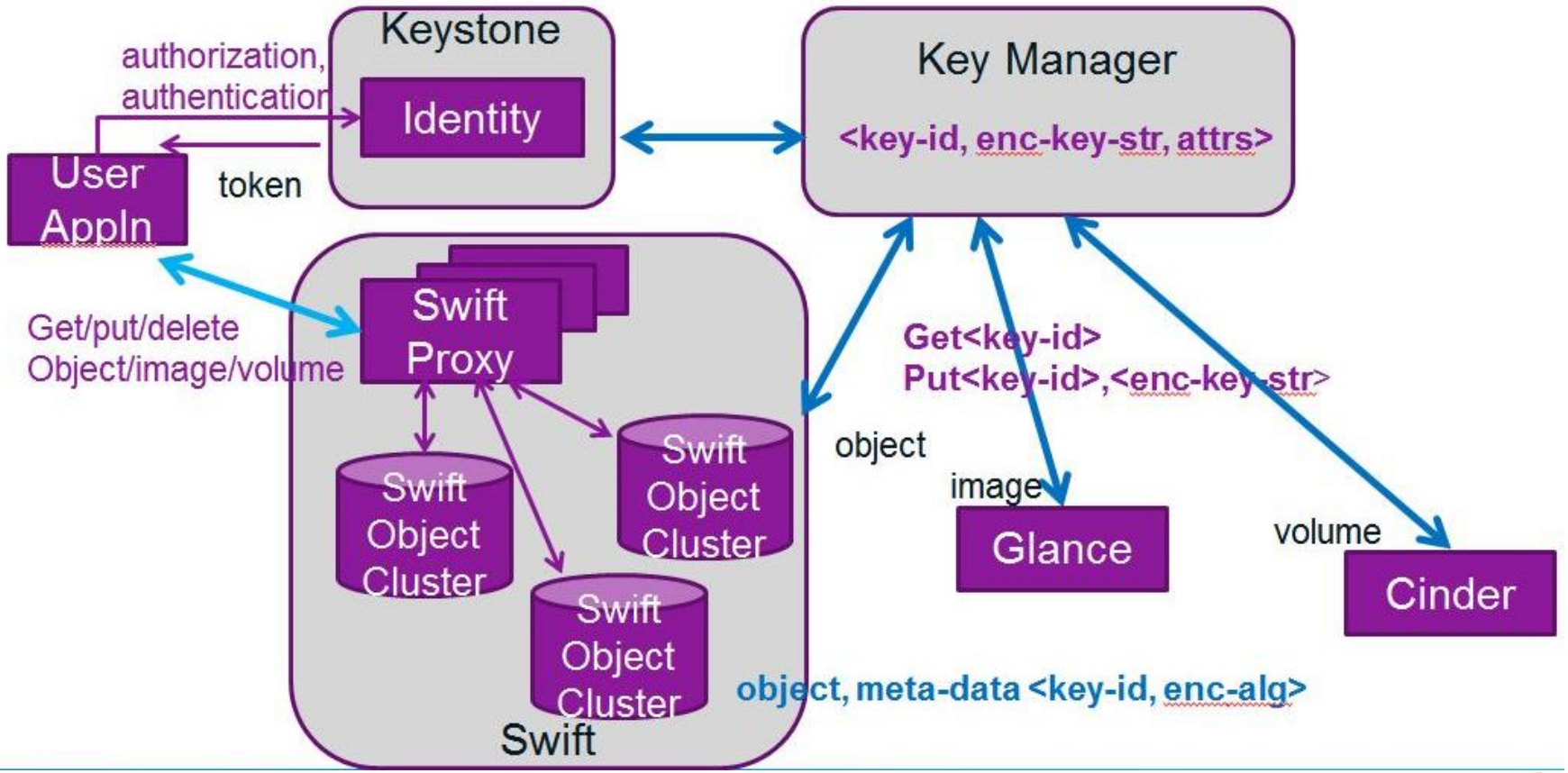
OpenStack Security - Keystone Introduction

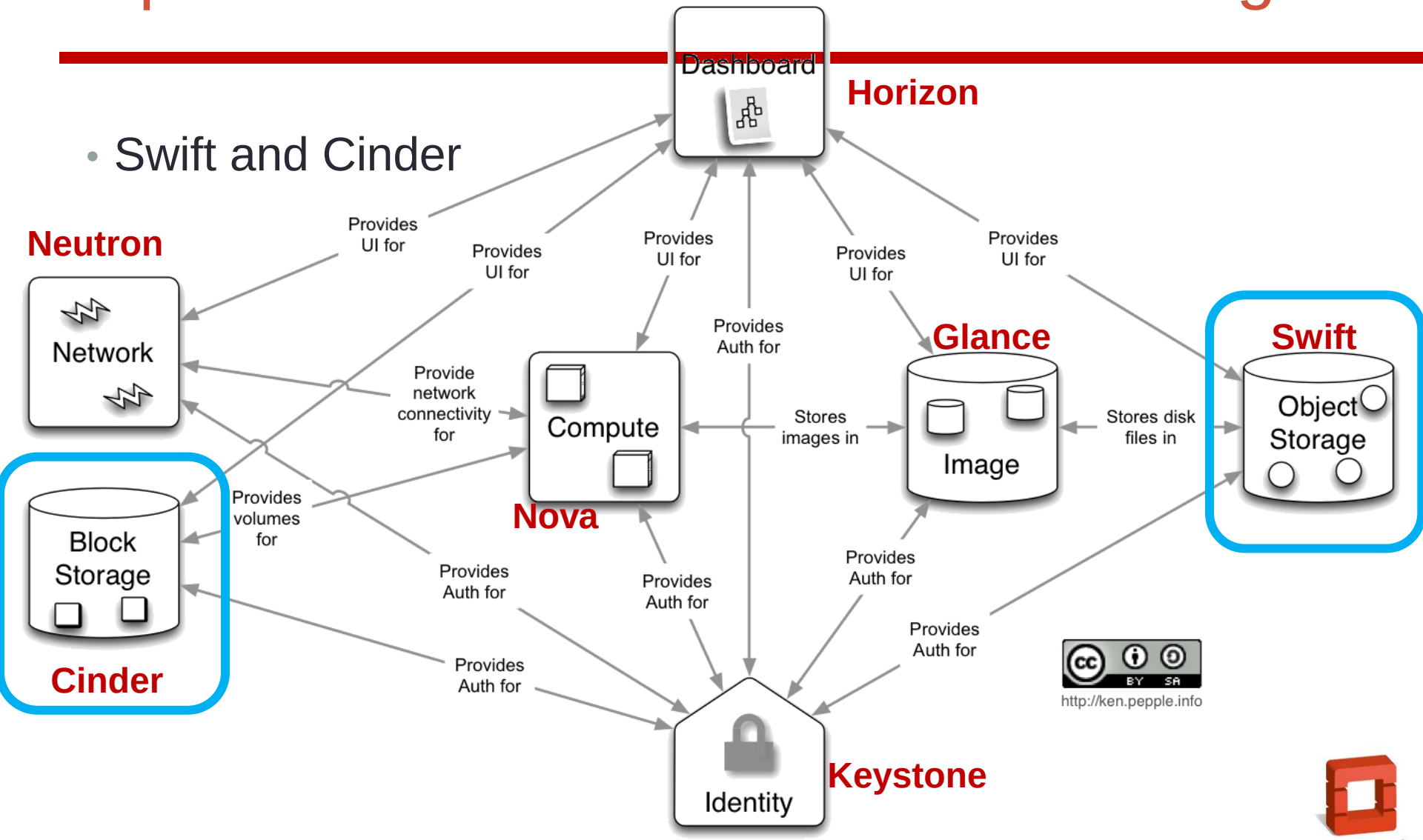
- Keystone provides a single point of integration for OpenStack policy, catalog, token and authentication.
  - Keystone handles API requests as well as providing configurable catalog, policy, token and identity services.
- Communicates via OpenStack Identity API (version 2)
- Each Keystone function has a pluggable backend which allows different ways to use the particular service.
  - Standard backends include LDAP or SQL, as well as Key Value Stores (KVS).
- Most commonly used in delegated authorization deployments
- Most people will use this as a point of customization for their current authentication services.

Keystone relationship to other OpenStack Elements



OpenStack Overall Architecture - Storage

- Swift and Cinder



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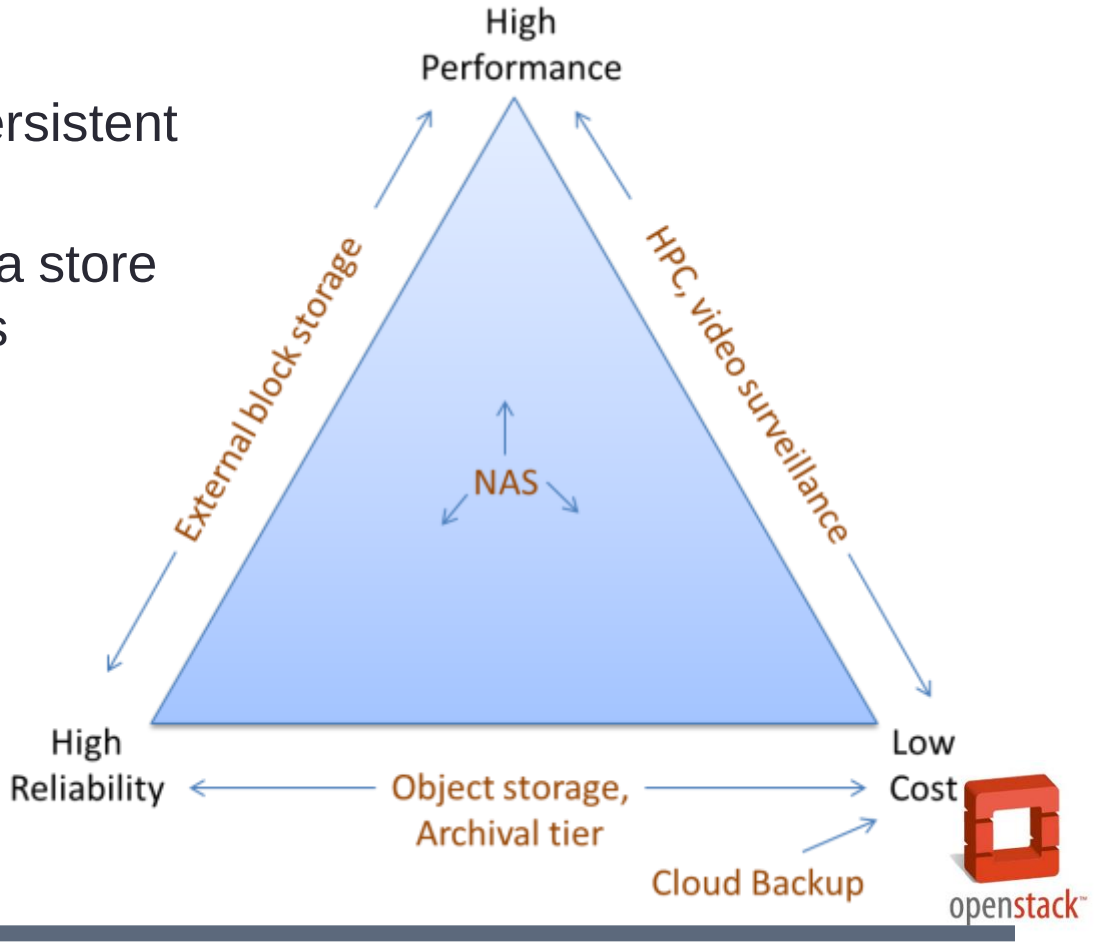
OpenStack Storage - Introduction

- Storage is found in many parts of the OpenStack stack, and the differing types can cause confusion to even

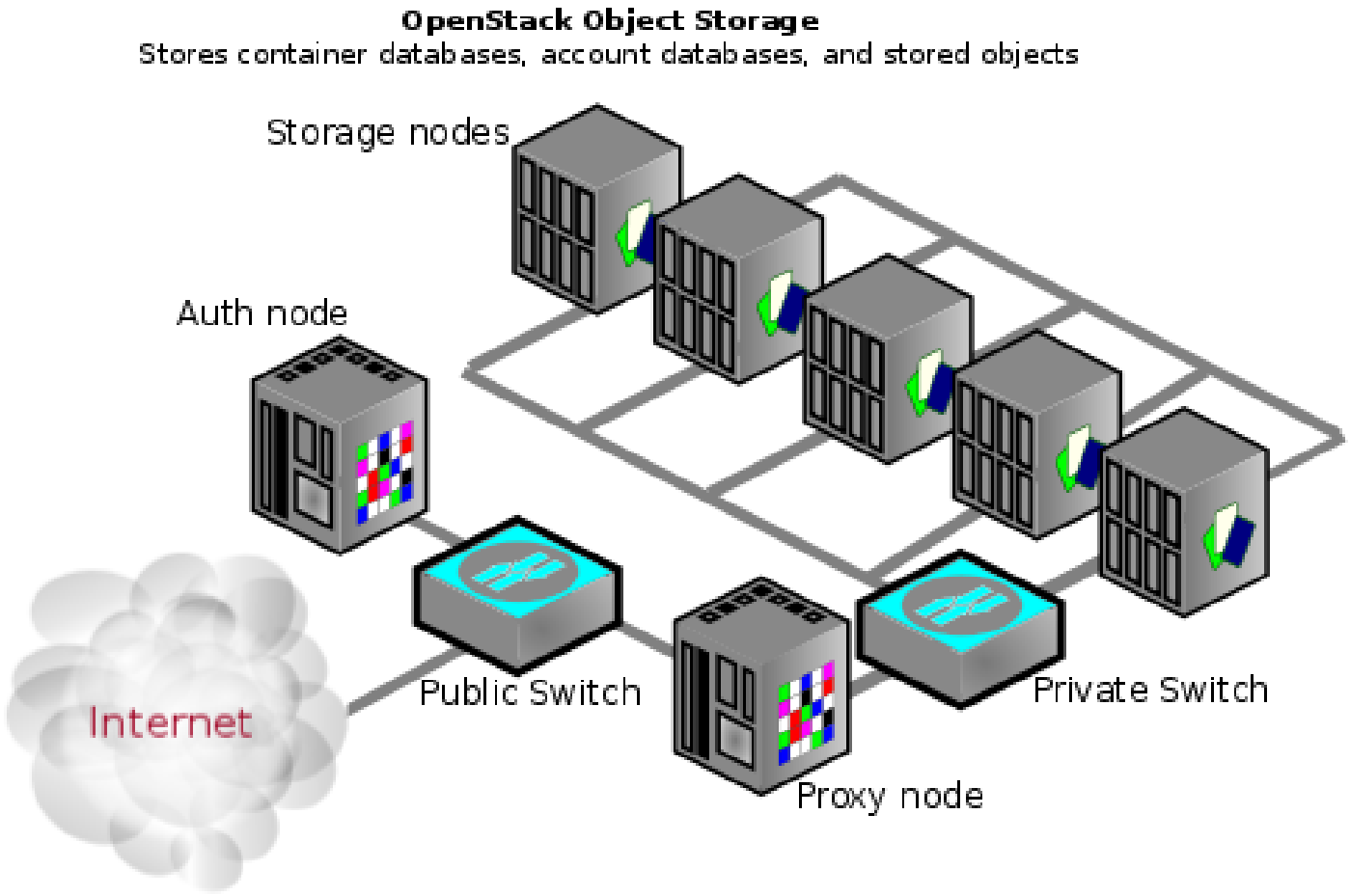
On-instance / ephemeral	Volumes block storage (Cinder)	Object Storage (Swift)
Used for running Operating System and scratch space	Used for adding additional persistent storage to a virtual machine (VM)	Used for storing virtual machine images and data
Persists until VM is terminated	Persists until deleted	Persists until deleted
Access associated with a VM	Access associated with a VM	Available from anywhere
Implemented as a filesystem underlying OpenStack Compute	Mounted via OpenStack Block-Storage controlled protocol (for example, iSCSI)	REST API
Administrator configures size setting, based on flavors	Sizings based on need	Easily scalable for future growth
Example: 10GB first disk, 30GB/core second disk	Example: 1TB "extra hard drive"	Example: 10s of TBs of dataset storage

OpenStack Storage - Uses

- The two common use cases for providing object storage in a compute cloud are:
  - To provide users with a persistent storage mechanism
  - As a scalable, reliable data store for virtual machine images



OpenStack Storage - Swift Key Features



OpenStack Storage - Swift Architecture

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Single Node Cluster

Disks are "as-unique-as-possible"

Disk

Small Cluster

Storage Nodes are "as-unique-as-possible"

Server/Node

Large Cluster

Storage Racks are "as-unique-as-possible"

Zone

Multiple zones make up a Region

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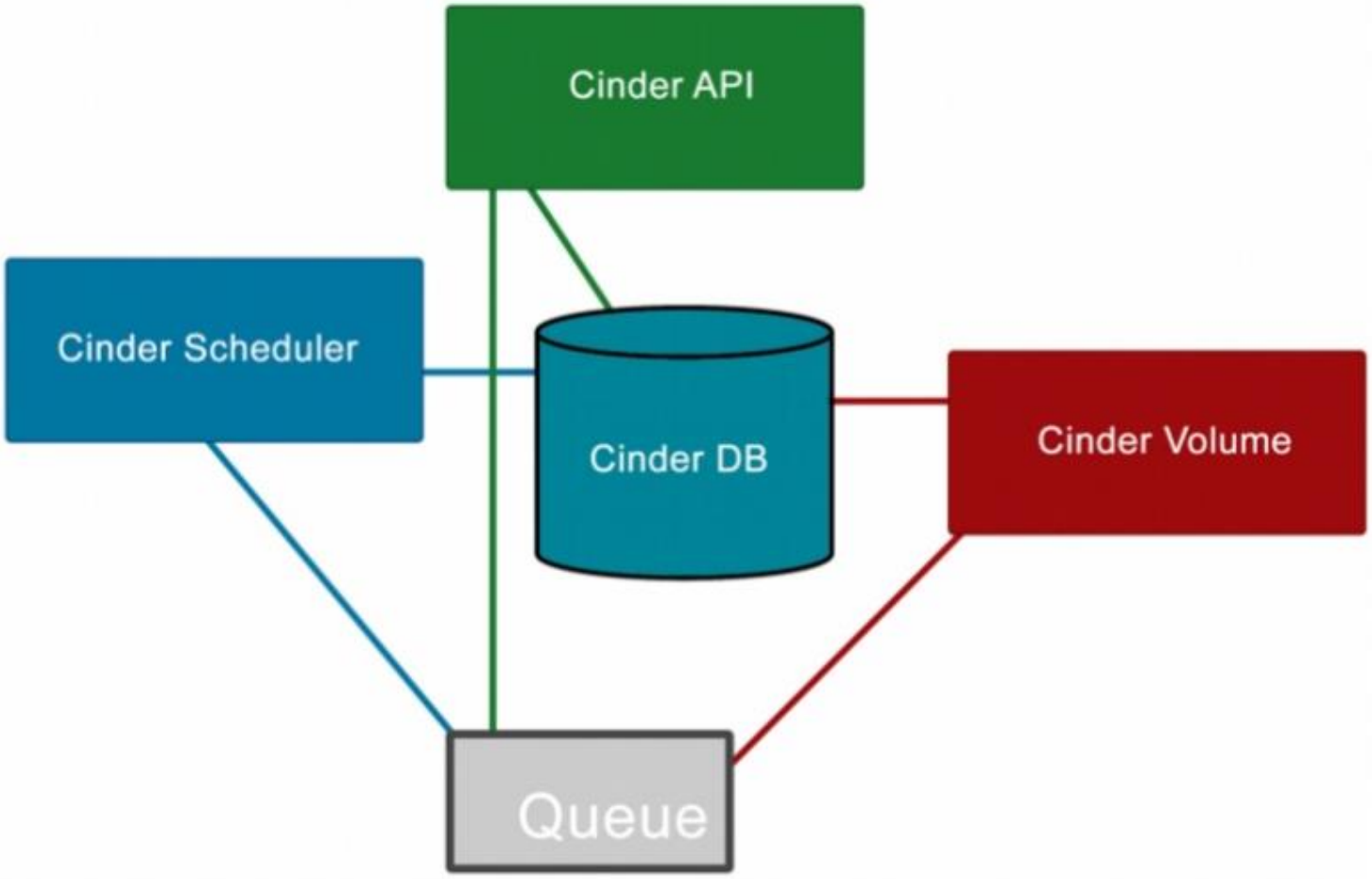
OpenStack Storage – Cinder Architecture



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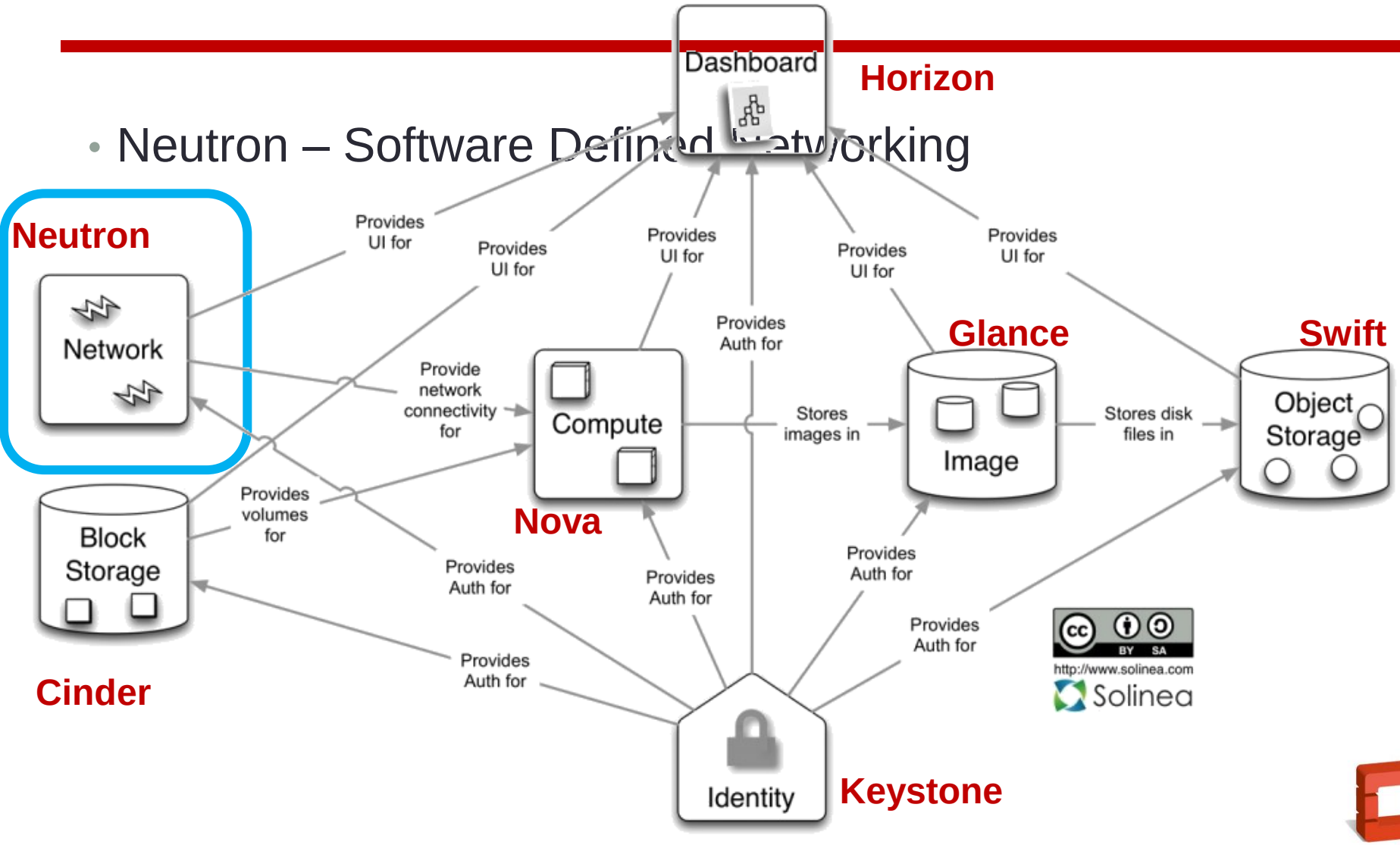
OpenStack Storage – Cinder Introduction

- Cinder separates out the persistent block storage functionality that was previously part of OpenStack Compute into its own service.
- The OpenStack Block Storage API allows for manipulation of volumes, volume types (similar to compute flavors) and volume snapshots.
  - cinder-api accepts API requests and routes them to cinder-volume for action.
  - cinder-volume acts upon the requests by reading or writing to the Cinder database to maintain state, interacting with other processes (like cinder-scheduler) through a message queue and directly upon block storage providing hardware or software.
  - It can interact with a variety of storage providers through a driver architecture.
  - Available drivers: IBM, SolidFire, NetApp, Nexenta, Zadara, linux iSCSI and other storage providers.
  - Much like nova-scheduler, the cinder-scheduler daemon picks the optimal block storage provider node to create the volume on.
- Cinder deployments will also make use of a messaging queue to route information between the cinder processes as well as a database to store volume state.
- Like Neutron, Cinder will mainly interact with Nova, providing volumes for its instances.

OpenStack Overall Architecture - Network

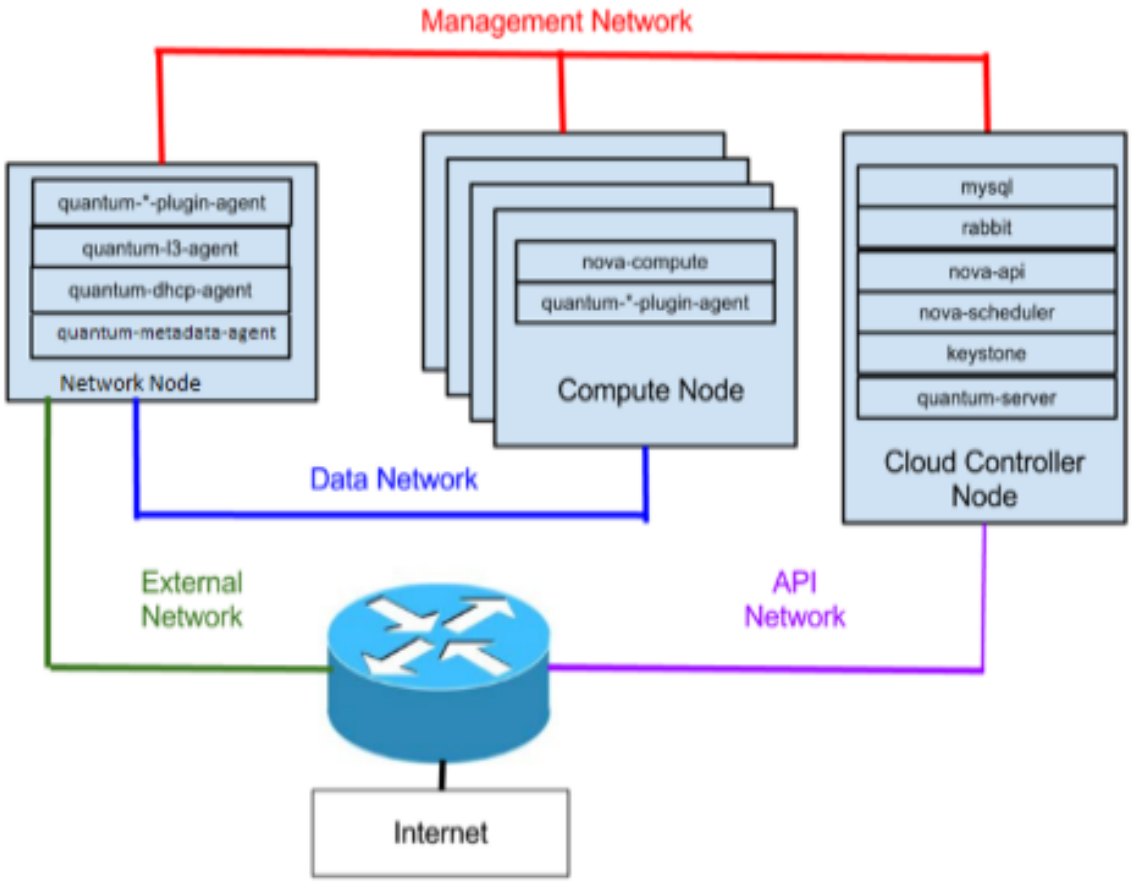
- Neutron – Software Defined Networking



OpenStack Network – Neutron Introduction

- Neutron is an OpenStack project to provide "networking as a service" between interface devices (e.g., vNICs) managed by other OpenStack services (e.g., nova).
- Starting in the Folsom release, Neutron is a core and supported part of the OpenStack platform

OpenStack Network - Neutron Deployment



- **Management network**. Used for internal communication between OpenStack Components. The IP addresses on this network should be reachable only within the data center.
- **Data network**. Used for VM data communication within the cloud deployment. The IP addressing requirements of this network depend on the Quantum plugin in use.
- **External network**. Used to provide VMs with Internet access in some deployment scenarios. The IP addresses on this network should be reachable by anyone on the Internet.
- **API network**. Exposes all OpenStack APIs, including the Quantum API, to tenants. The IP addresses on this network should be reachable by anyone on the Internet. This may be the same network as the external network, as it is possible to create a quantum subnet for the external network that uses IP allocation ranges to use only less than the full range of IP addresses in an IP block.

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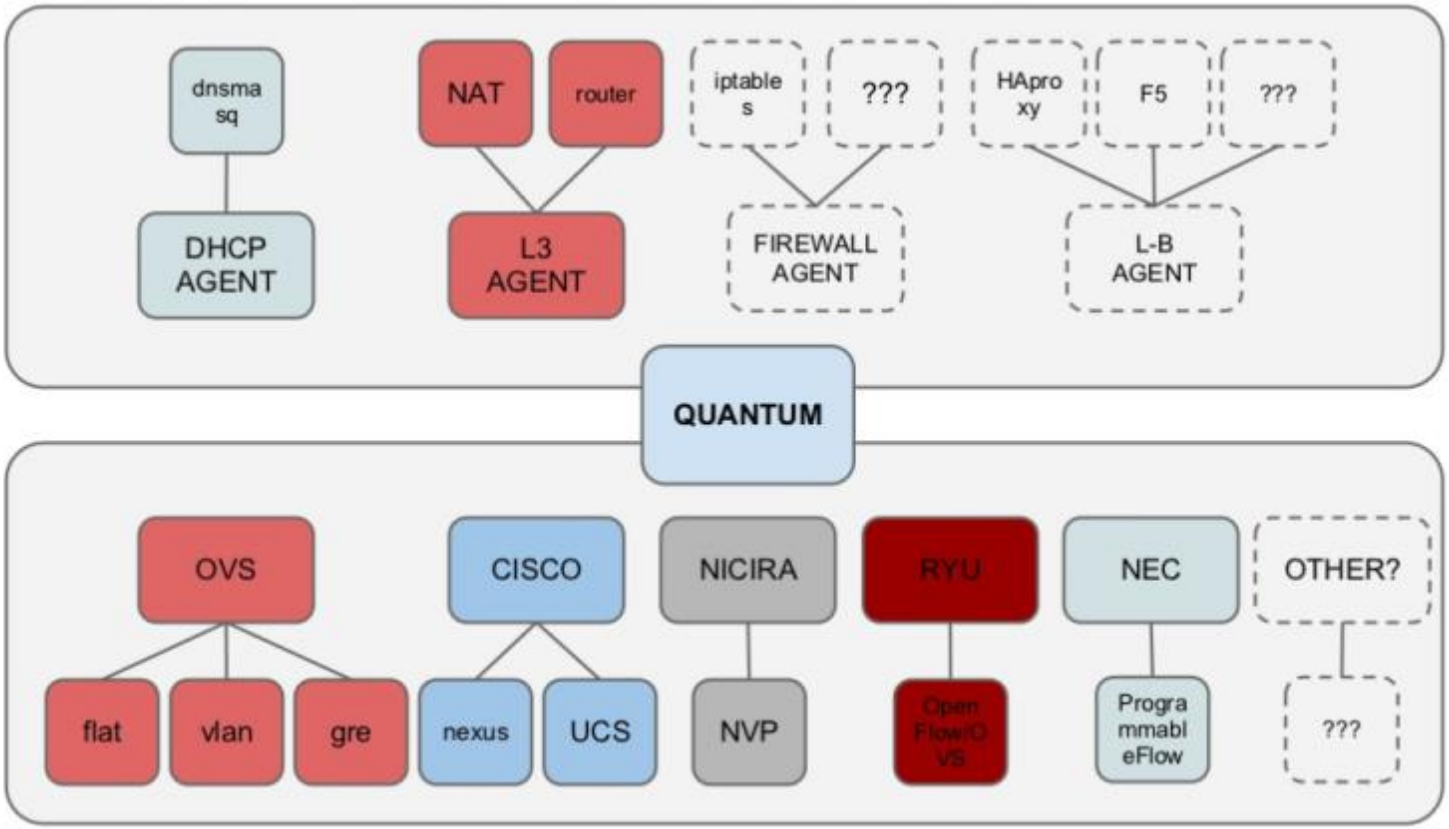
OpenStack Network - Neutron Architecture

- Plugin and Agent Summary



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Icehouse Official Projects

- Integrated Projects (Icehouse release)
  - OpenStack Compute (nova): https://launchpad.net/nova
  - OpenStack Object Storage (swift): https://launchpad.net/swift
  - OpenStack Image Service (glance): https://launchpad.net/glance
  - OpenStack Identity (keystone): https://launchpad.net/keystone
  - OpenStack Dashboard (horizon): https://launchpad.net/horizon
  - OpenStack Networking (Neutron): https://launchpad.net/Neutron
  - OpenStack Block Storage service (cinder): https://launchpad.net/cinder
  - Ceilometer: https://launchpad.net/ceilometer
  - Heat: https://launchpad.net/heat

OpenStack Icehouse Roadmap Highlights

- Database Service (Trove) - Scalable and reliable Cloud Database as a Service provisioning functionality for both relational and non-relational database engines
- Bare Metal (Ironic) - Provides an API for management and provisioning of physical machines.
- Queue Service (Marconi) - message queueing API and service for distributed application messaging
- Data Processing (Savannah) – Hadoop on OpenStack
- Icehouse Release Features and Status: http://wiki.openstack.org/releasestatus/

Additional Resources

- http://www.openstack.org/ - Main site
- http://docs.openstack.org/trunk/openstack-compute/admin/content/ch_getting-started-with-openstack.html
- http://docs.openstack.org/trunk/openstack-compute/admin/bk-compute-adminguide-trunk.pdf - Current OpenStack computer Administration Manual – Dec 18, 2012
- http://www.openstack.org/software/start/ - How To Get Started With OpenStack
- https://github.com/mseknibilel/OpenStack-Folsom-Install-guide/blob/master/OpenStack_Folsom_Install_Guide_WebVersion.rst - OpenStack Folsom Install Guide
- http://www.packtpub.com/openstack-cloud-computing-cookbook/book -
- OpenStack Cloud Computing Cookbook
- http://www.openstack.org/blog/tag/training/ - Tag: Training

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Questions?