Fog and Cloud Computing
Lab

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RiSING (Robust and Secure Distributed Computing)
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Lab Resources

- Shared Etherpad: https://annuel2.framapad.org/p/6s5u416vo7-9t4b
- White Board: https://tinyurl.com/2p8j7yra
- Interaction:
  - Etherpad
    - *Exercises check, Share Troubleshooting, Questions and Logs*
  - Zoom Chat (for those remotely connected)
    - *Discuss with your colleagues during exercises or directly/privately with me*
  - Rise your Hand (also via Zoom)
    - *If you need my attention or want to speak, don't be shy !!!*
  - Course Forum: https://tinyurl.com/27vmd9pj
    - *Questions and answers could be useful to others, be collaborative*

Lab Resources

- Slides
  - Uploaded before any lesson in Moodle
- Repositories of exercises
  - https://gitlab.fbk.eu/dsantoro/fcc-lab-2022
- Lab Virtual Machine:
  - **Lab VM on Azure (reference for exercises)**
  - Vagrant and VirtualBox on your laptop (possible choice)
    - https://www.virtualbox.org/, https://www.vagrantup.com/ and https://gitlab.fbk.eu/dsantoro/fcc-lab-2022

Exercise 16 – Run a custom Docker Service with persistency

- **Time:** ~40 minutes
  - 40 minutes: *Try by yourself*

- **Description:** Install OpenStack using DevStack on a dedicated virtual machine.

- **Instructions:**
  https://gitlab.fbk.eu/dsantoro/fcc-lab-2022/-/tree/master/e17

Today Lesson

- Setup of OpenStack Environment
- Recap of missing exercise (e16)
- IaaS and OpenStack intro
  - OpenStack Dashboard (Horizon) + CLI
  - OpenStack Identity Management (Keystone)
  - Compute service (Nova)
    - Flavors
    - SSH Access
    - Cloud Init
    - Security Group
  - Networking service (Neutron)
  - Image service (Glance)
  - Block Storage service (Cinder)
  - Object Storage Service (Swift)

Cloud Computing

- Cloud computing is a model for enabling ubiquitous, convenient, on- demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.
- This cloud model is com- posed of five essential characteristics, three service models, and four deployment models.

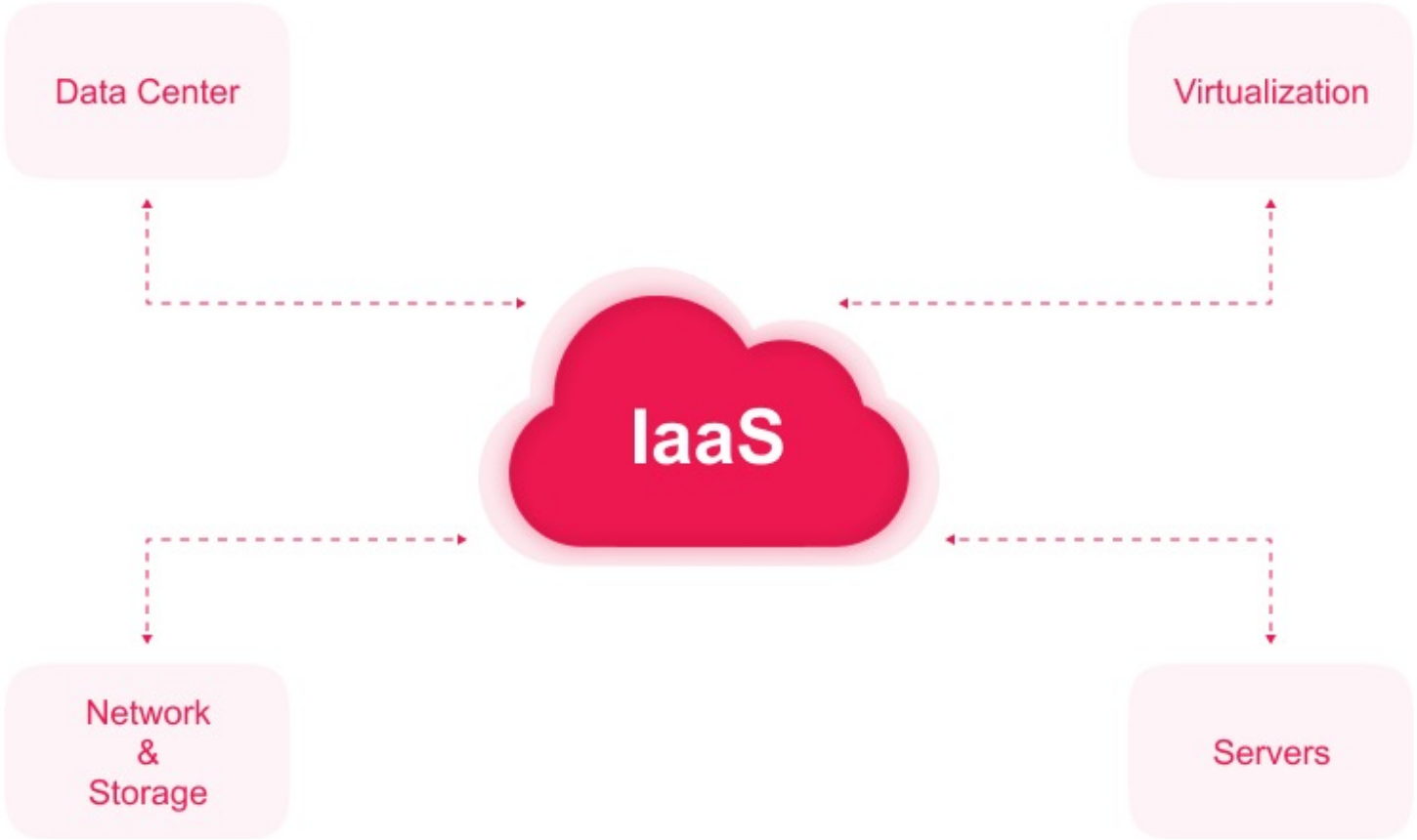
- http://nvlpubs.nist.gov/nistpubs/Legacy/SP/nistspecialpublication800-145.pdf

Essential Characteristics
– On-demand self-service
– Broad network access
– Resource pooling
– Rapid elasticity
– Measured service

Service Models
– Software as a Serice (SaaS)
– Platform as a Service (PaaS)
– Infrastructure as a Service (IaaS)

Deployment Models
– Private Cloud
– Community Cloud – Public Cloud
– Hybrid Cloud

IaaS



OpenStack (https://openstack.org/)

- Open source software for creating private and public clouds.
- OpenStack software controls large pools of compute, storage, and network-ing resources throughout a datacenter, managed through a dashboard or via the OpenStack API. OpenStack works with popular enterprise and open source technologies making it ideal for heterogeneous infrastructure.

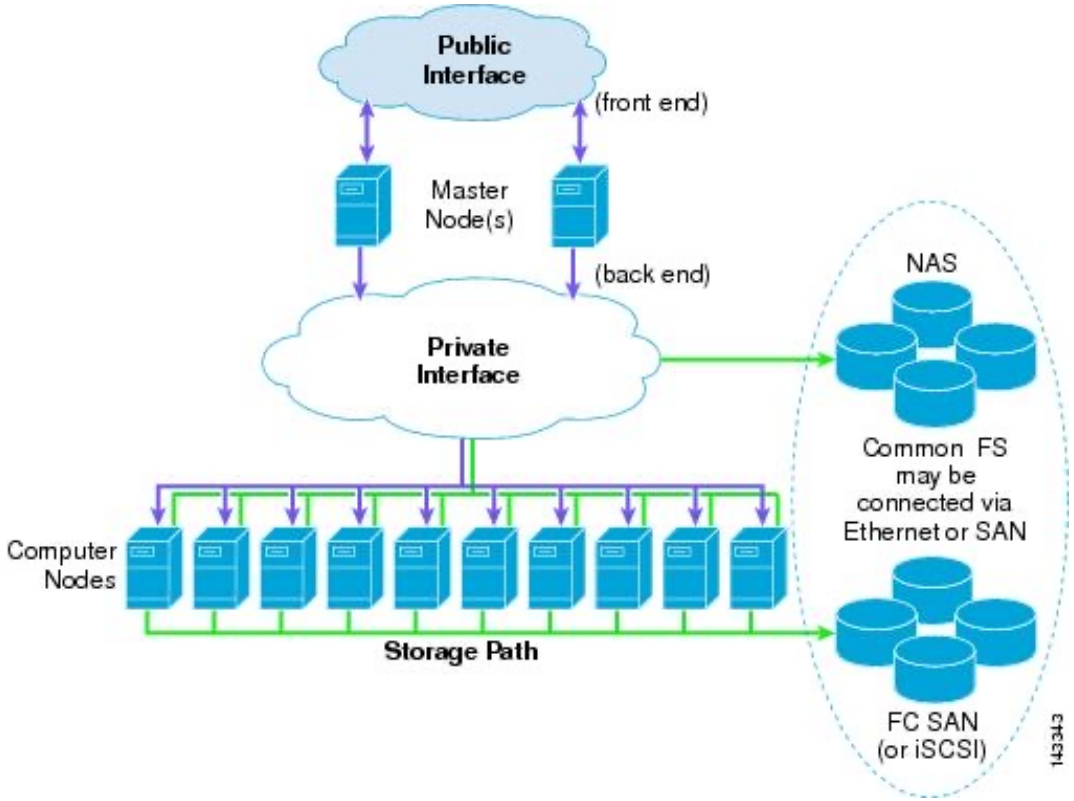
- OpenStack Community
  - Wiki, Specs, Projects, RC meetings, gerrit, OpenStack Foundation

- Four “open”s
  - Open Source, Open Design, Open Development, Open Community
  - More information at the governance page

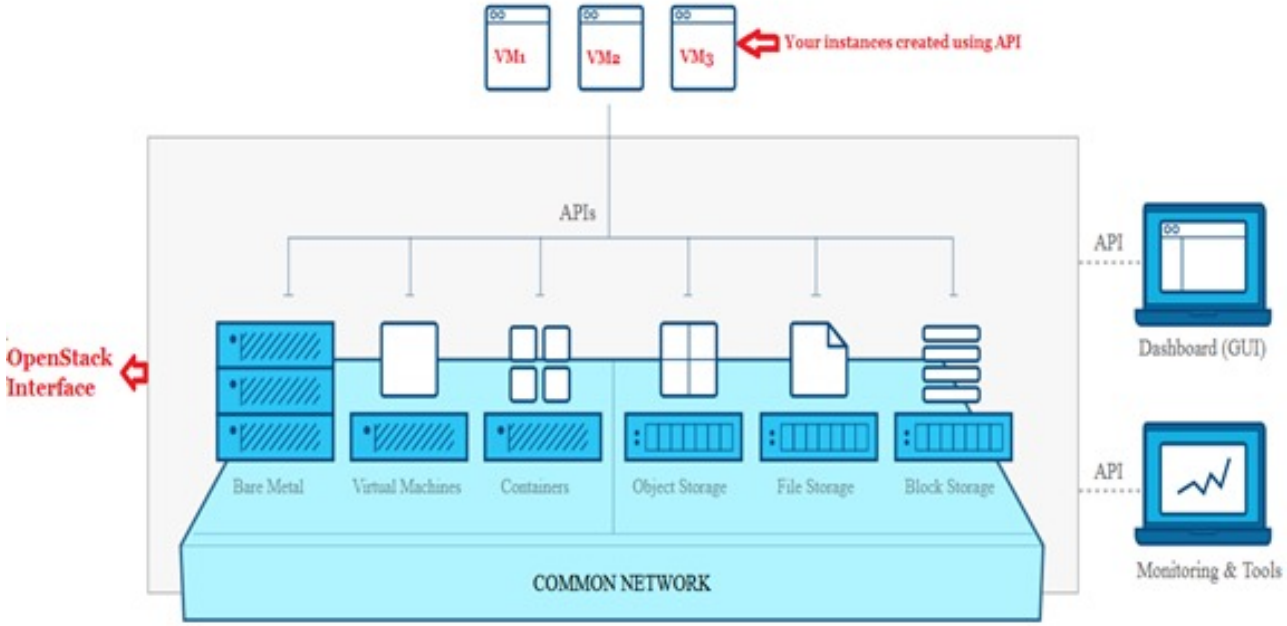
- https://docs.openstack.org
- http://governance.openstack.org/reference/opens.html

openstack®

OpenStack Model, Architecture

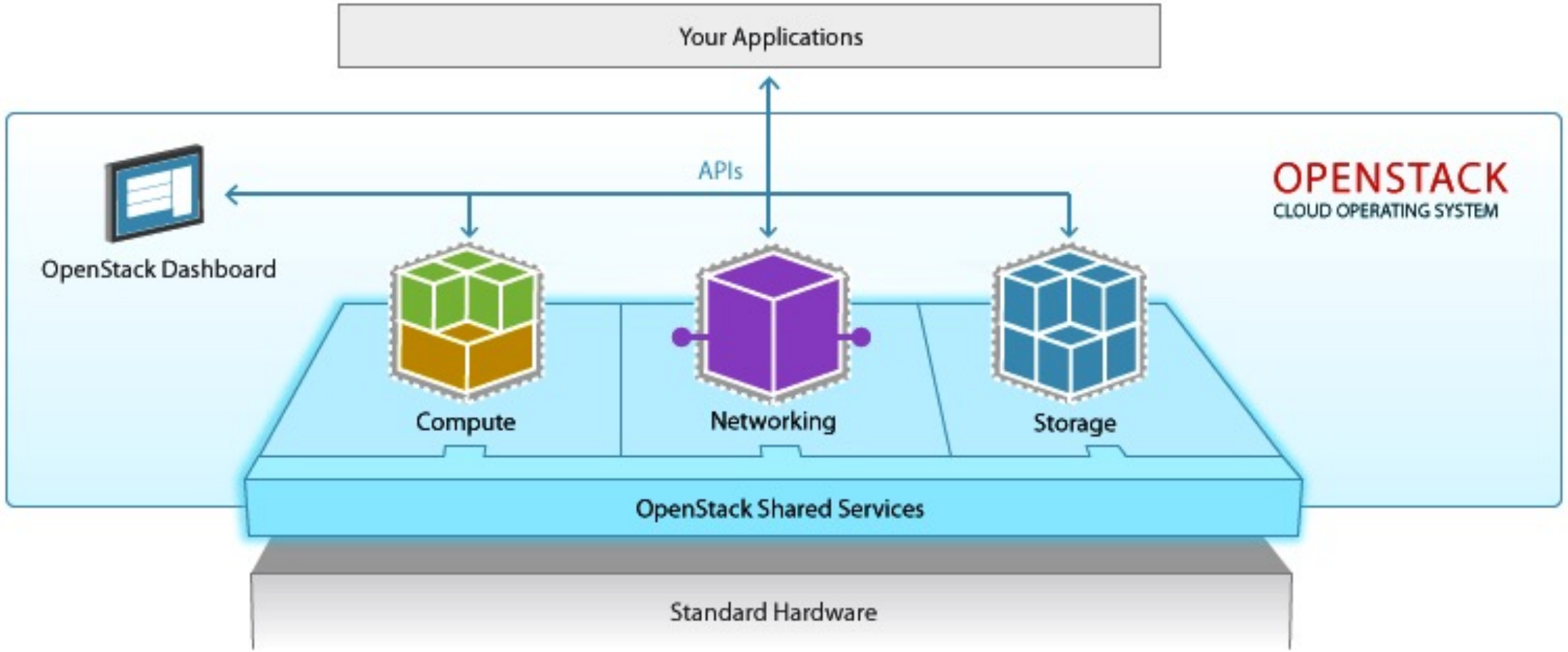


Physical view

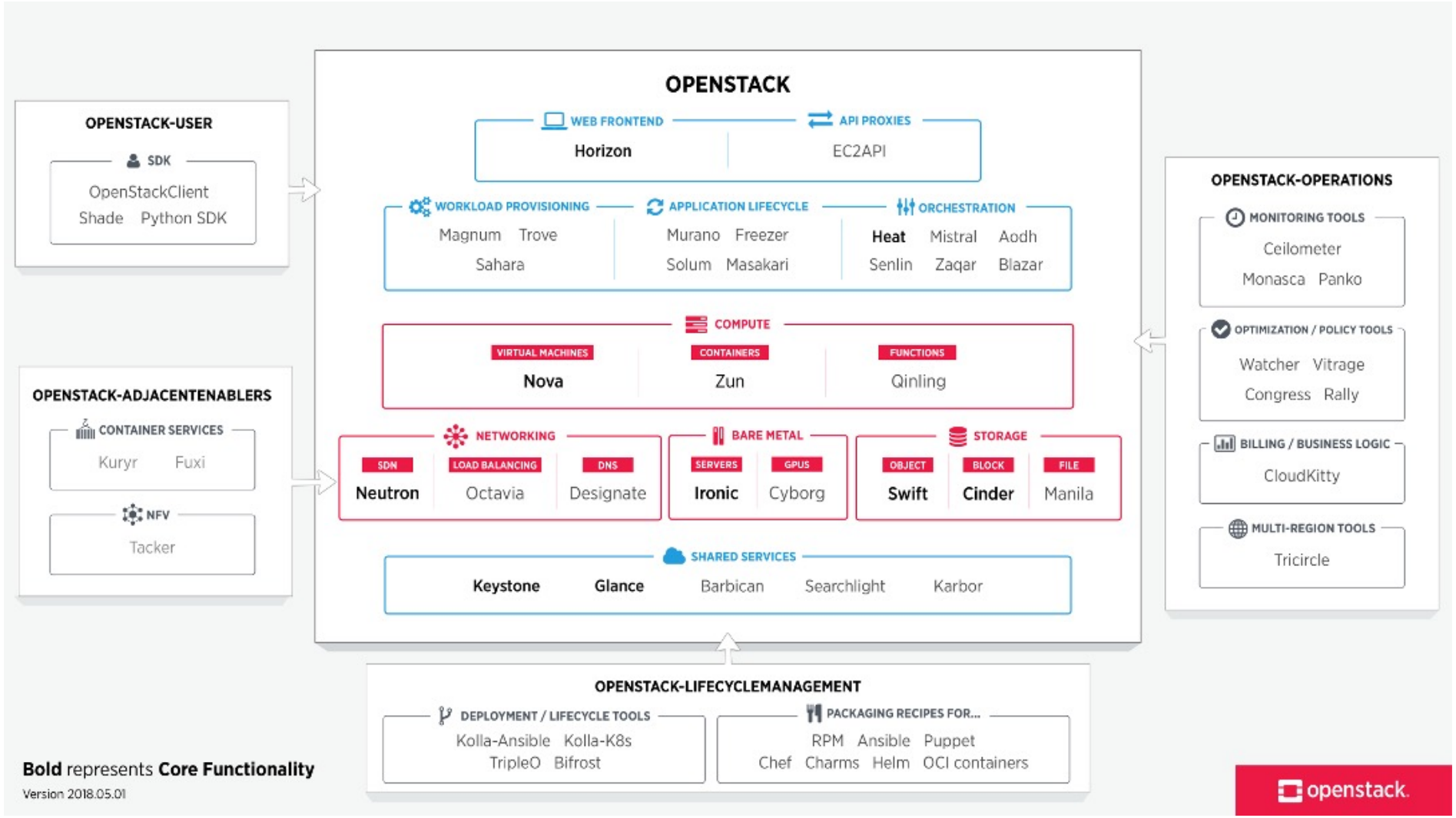


Logical view

OpenStack Model, Architecture



OpenStack Components, Services

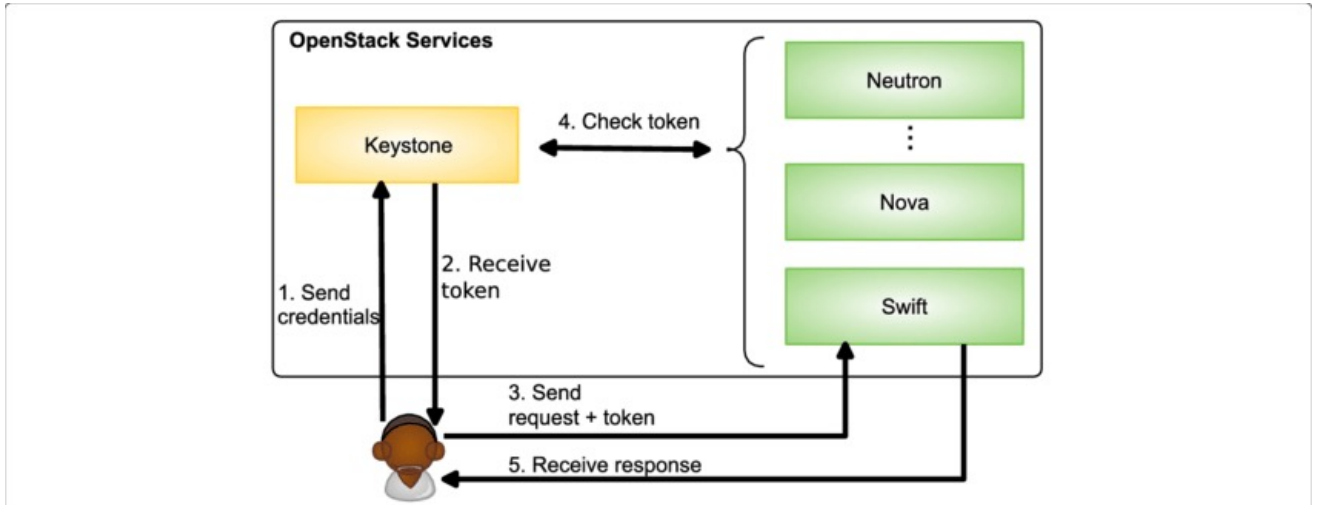


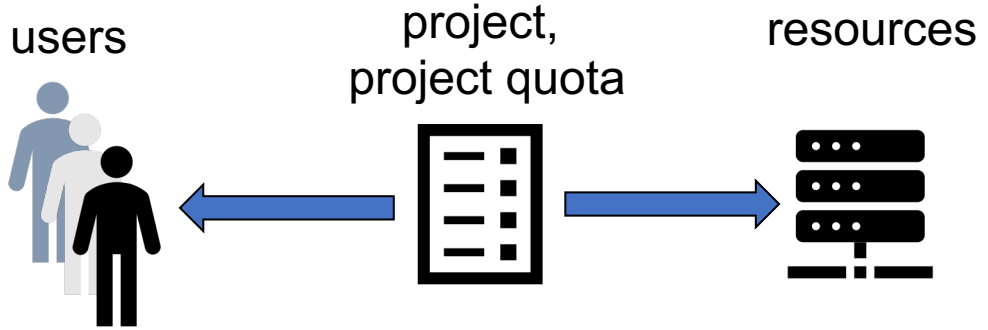
OpenStack Identity Management (Keystone)

Keystone is an OpenStack service that provides:

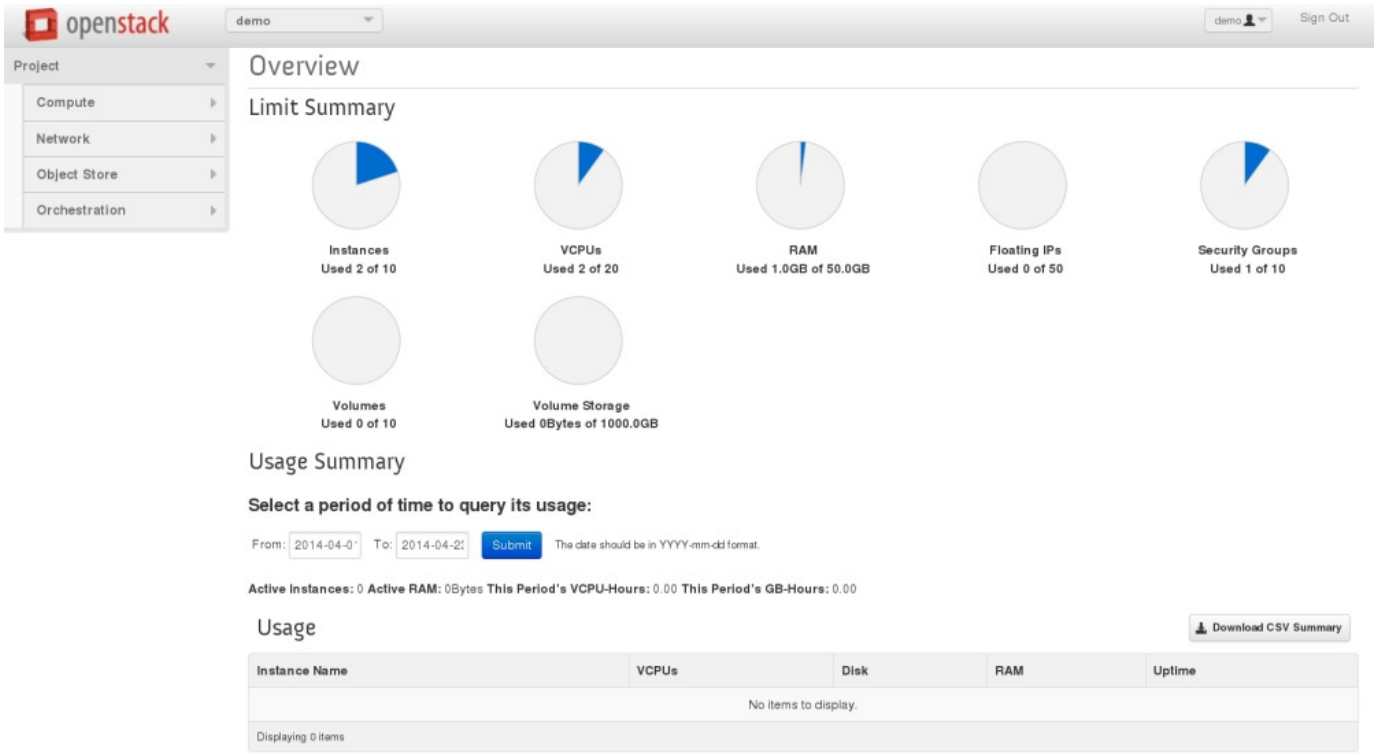
- API client authentication
- Service discovery
- Distributed multi-tenant authorization

by implementing OpenStack's Identity API.





OpenStack Dashboard (Horizon) + CLI



Horizon is the canonical implementation of OpenStack's Dashboard, which provides a web based user interface to OpenStack services including Nova, Swift, Keystone, etc.

OpenStack offers also a CLI

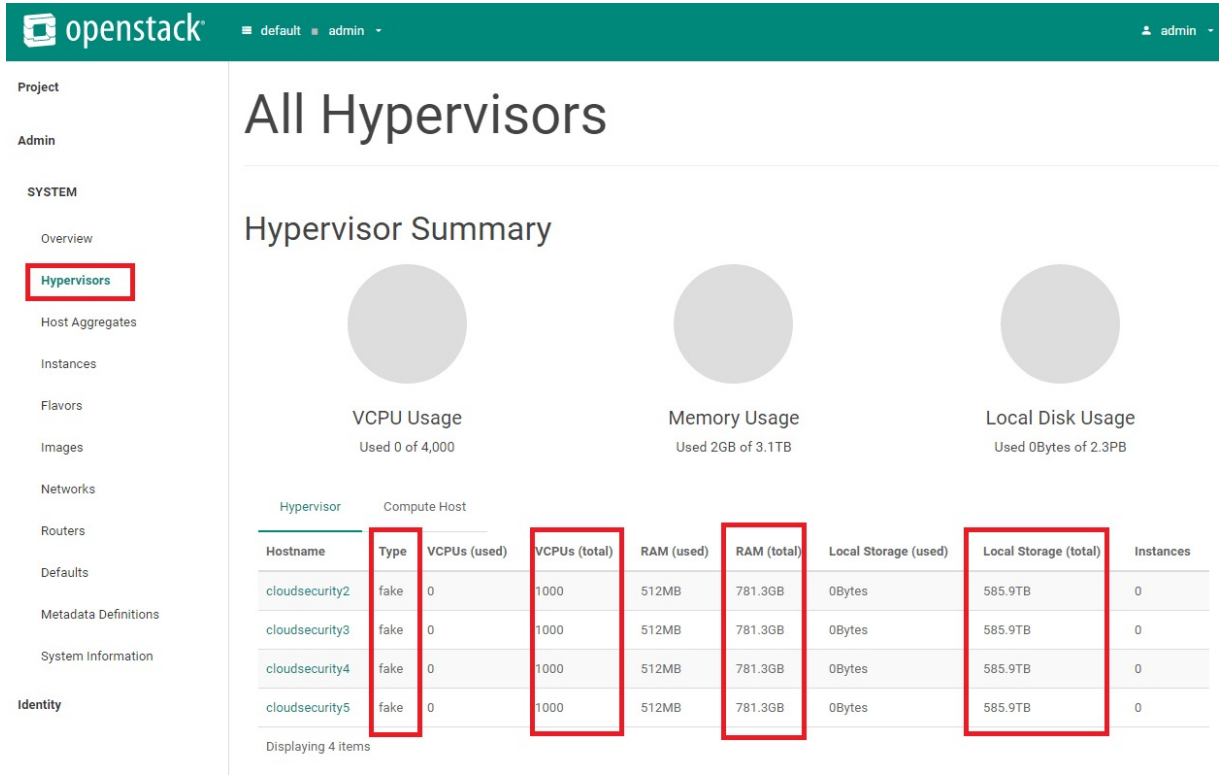
Both relies on top of the OpenStack API interfaces

OpenStack Dashboard (Horizon) + CLI

The OpenStack Dashboard is a web-based interface that allows you to manage OpenStack resources and services.

The Dashboard allows you to interact with the OpenStack Compute cloud controller using the Open- Stack APIs.

Dashboard is available with different functionalities for users (tenants) and for admins.



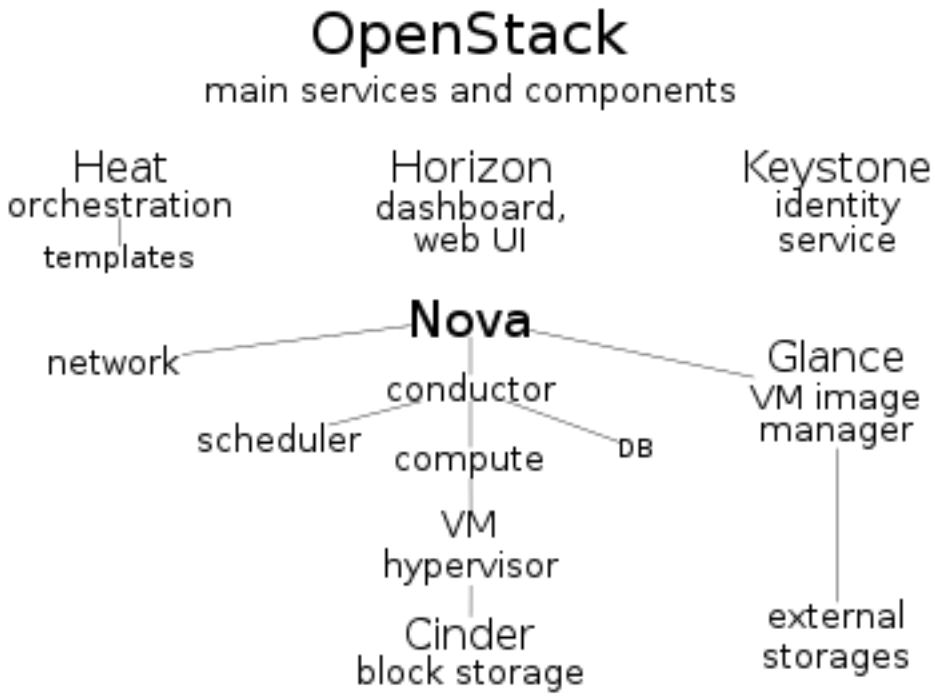
Compute service (Nova)

The OpenStack Compute service (nova) allows you to control an Infrastructure-as-a-Service (IaaS) cloud computing platform.

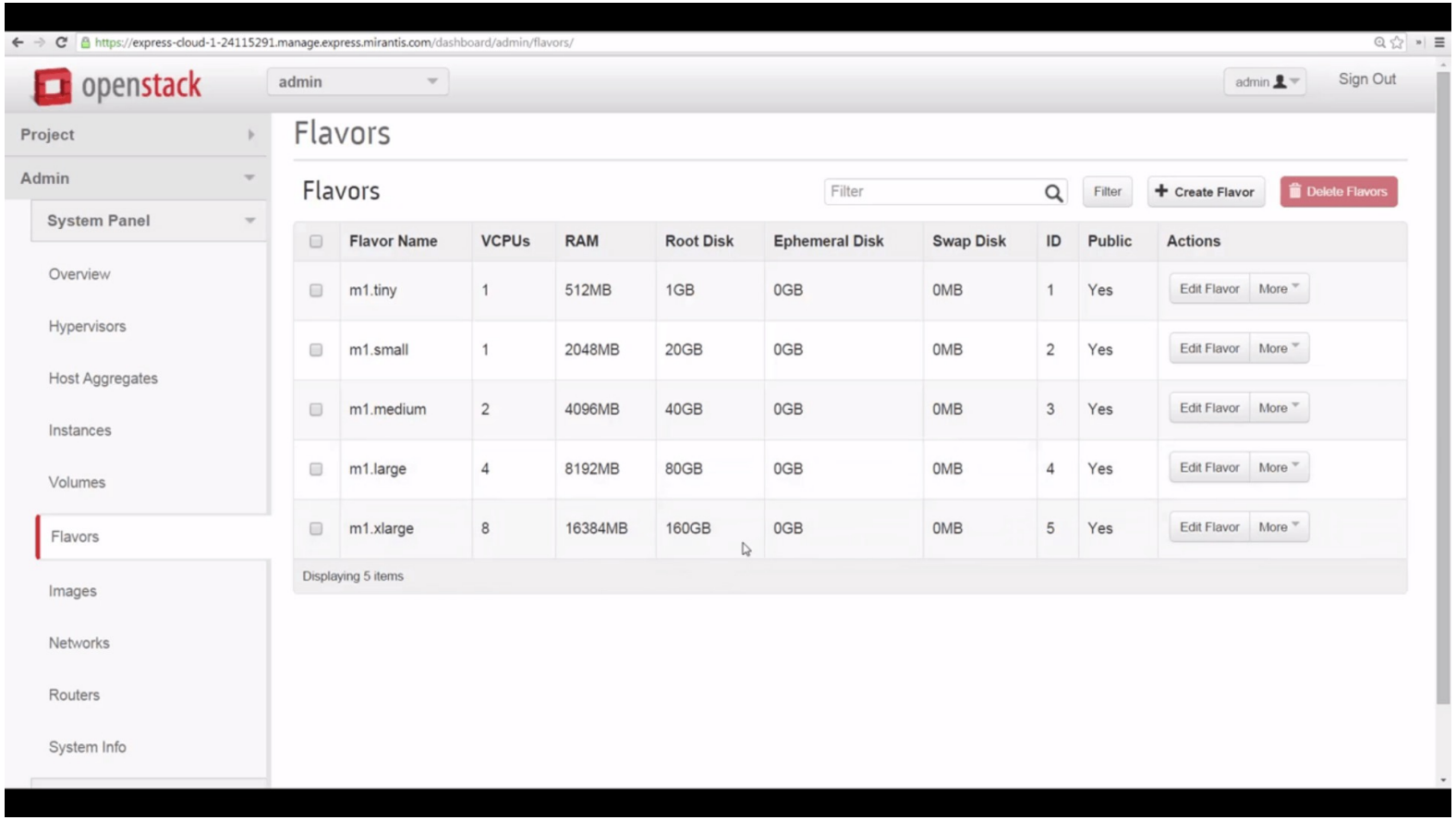
It gives you control over instances and networks, and allows you to manage access to the cloud through users and projects.

Compute does not include virtualization software.

Instead, it defines drivers that interact with underlying virtualization mechanisms that run on your host operating system, and exposes functionality over a web-based API.



Compute service (Nova) - Flavors

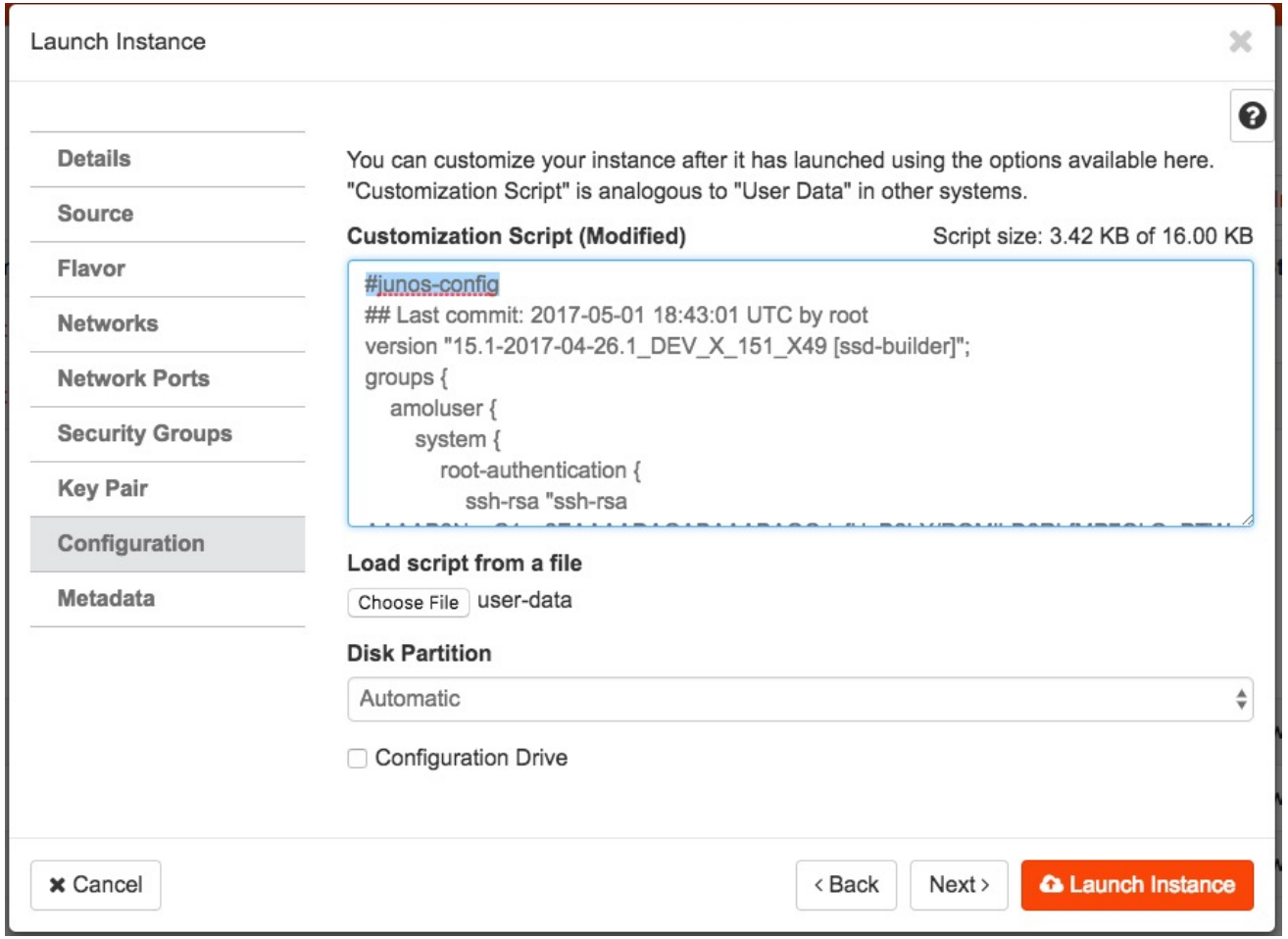


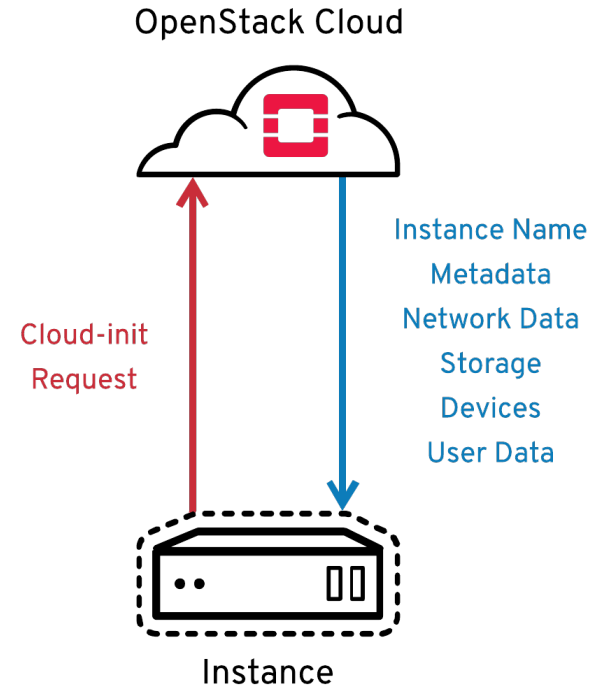
Group different resources to assign to your VM under a name. Most common resources: RAM, DISK, Number of CPU (and usually a cost per Hour or Month or Year).

Compute service (Nova) - SSH Access

SSH keys are injected in the Instances (Virtual Machines) by OpenStack

Compute service (Nova) – cloud-init





https://cloudinit.readthedocs.io/en/latest/

Compute service (Nova) - Security Group

Manage Security Group Rules: default (51d0e9bc-6fbd-40f7-a536-24a284290a79)

+ Add Rule | Delete Rules

Direction	Ether Type	IP Protocol	Port Range	Remote IP Prefix	Remote Security Group	Actions
Egress	IPv6	Any	Any	::/0	-	Delete Rule
Egress	IPv4	Any	Any	0.0.0.0/0	-	Delete Rule
Ingress	IPv4	Any	Any	-	default	Delete Rule
Ingress	IPv6	Any	Any	-	default	Delete Rule

Displaying 4 items

Think about them as a Firewall Rules managed by OpenStack for Group of Hosts.
Default policy is deny. Everything must be allowed explicitly.
An host can be part of multiple Security Groups.

Networking service (Neutron)

The Networking service, code-named neutron, provides an API that lets you define network connectivity and addressing in the cloud.

The Networking service enables operators to leverage different networking technologies to power their cloud networking.

The Networking service also provides an API to configure and manage a variety of network services ranging from L3 forwarding and NAT to load balancing, edge firewalls, and IPsec VPN.

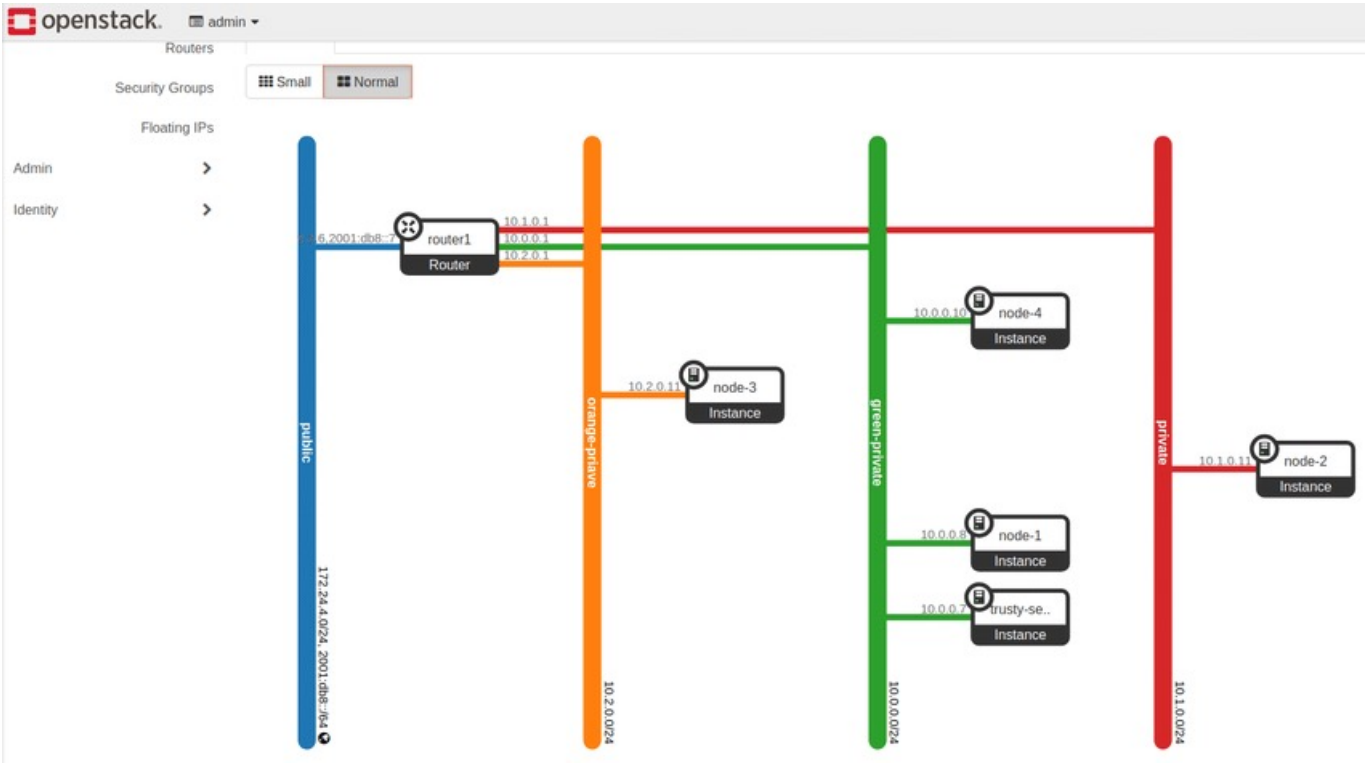
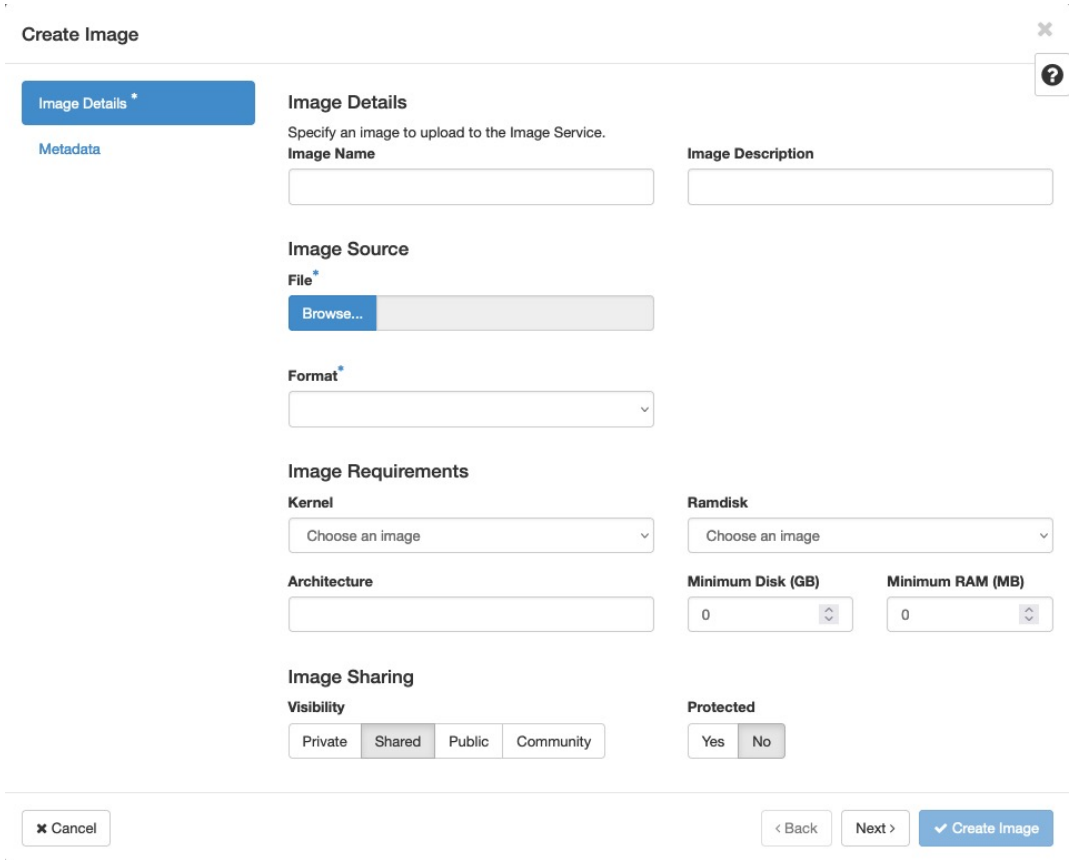
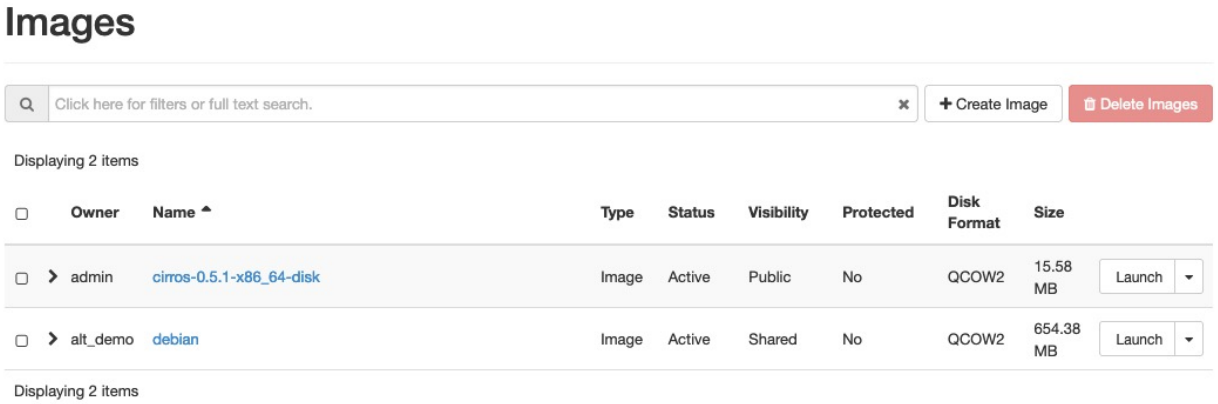


Image service (Glance)

The Image service (glance) enables users to discover, register, and retrieve virtual machine images.

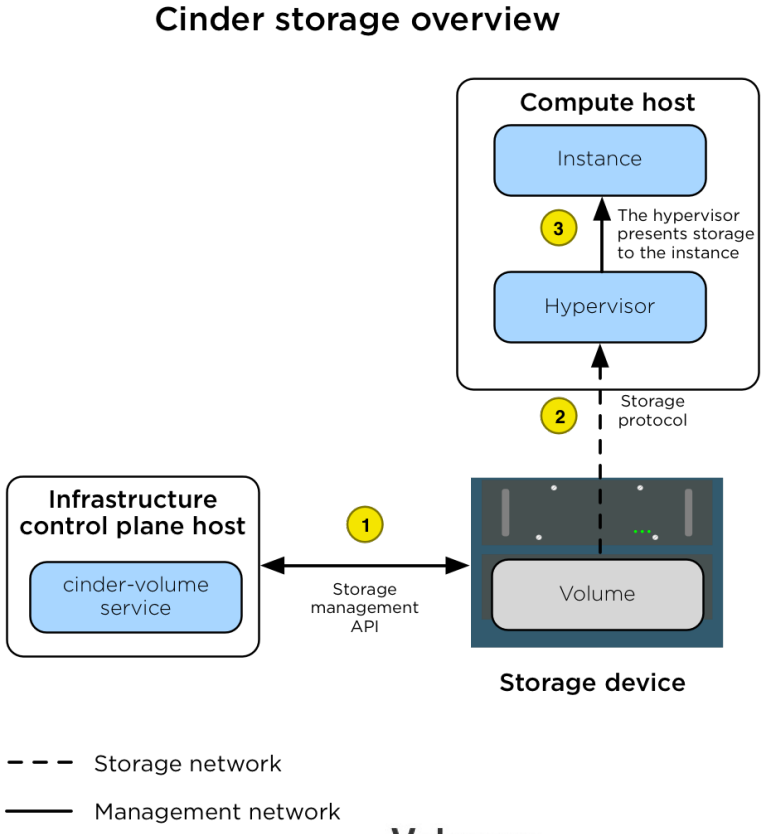




It offers a REST API that enables you to query virtual machine image metadata and retrieve an actual image.

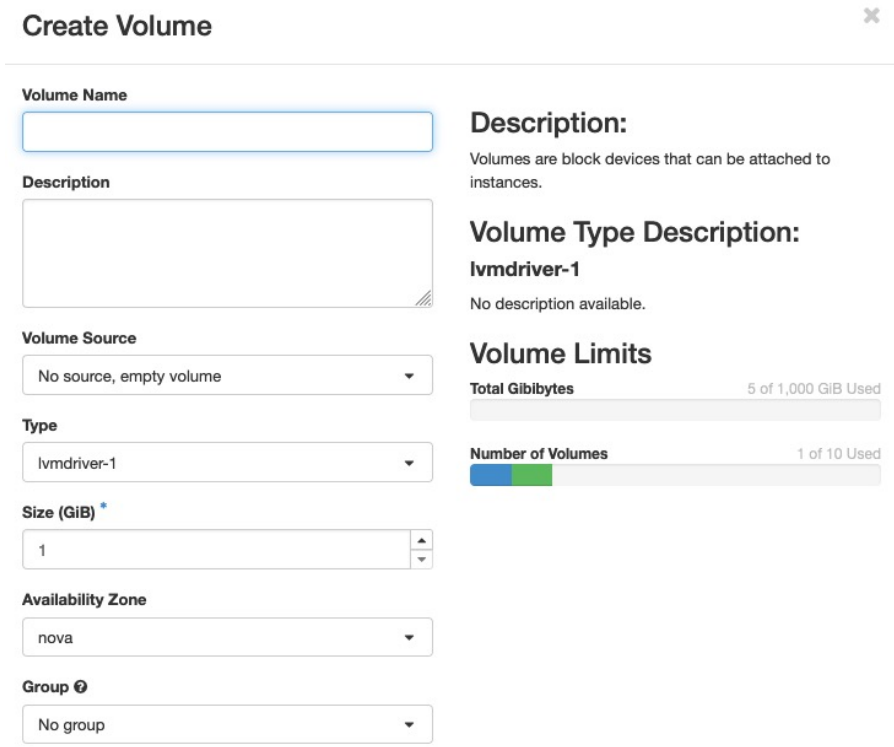
You can store virtual machine images made available through the Image service in a variety of locations, from simple file systems to object-storage systems like OpenStack Object Storage.

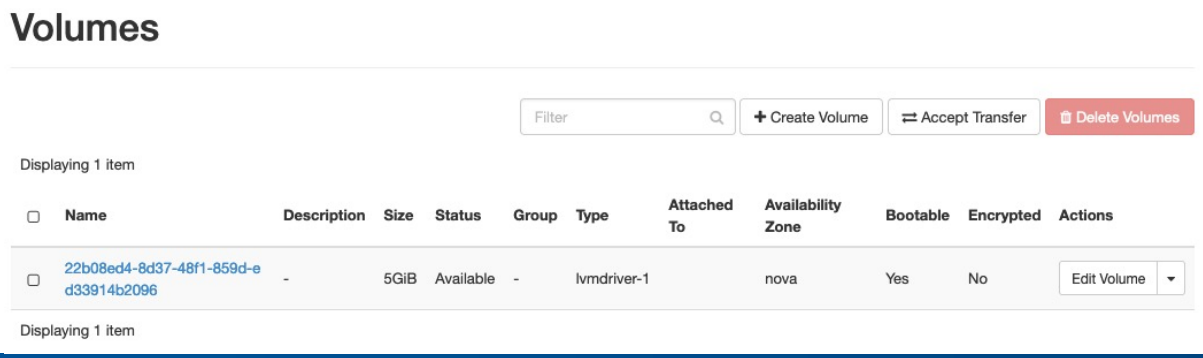
Block Storage service (Cinder)



The OpenStack Block Storage service (cinder) works through the interaction of a series of daemon processes named cinder-* that reside persistently on the host machine or machines.

Can be used as main instance disk or as an external disk (like a USB key)



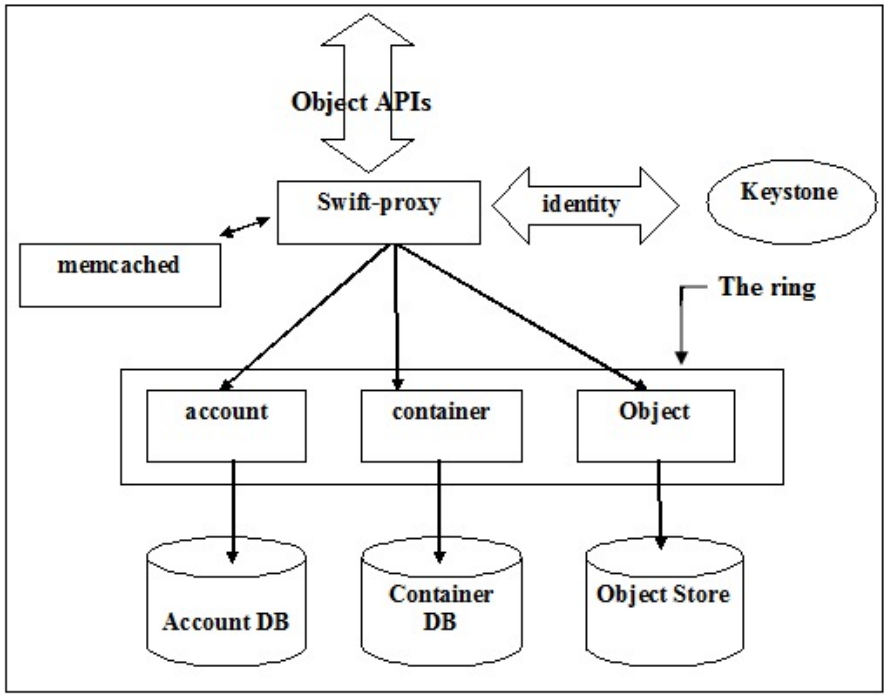


Object Storage Service (Swift)

OpenStack Object Storage (swift) is used for redundant, scalable data storage using clusters of standardized servers to store petabytes of accessible data.

It is a long-term storage system for large amounts of static data which can be retrieved and updated via REST-API.

Object Storage uses a distributed architecture with no central point of control, providing greater scalability, redundancy, and permanence.



- Unstructured data such as music, images, and videos
- Backup and log files
- Large sets of historical data
- Archived files