




OTUS

ОНЛАЙН-ОБРАЗОВАНИЕ

# Онлайн-образование

# Меня хорошо видно && слышно?

Ставьте  , если все хорошо  
Напишите в чат, если есть проблемы

Проверить, идет ли запись!



The image features a blue-tinted aerial view of a city skyline, likely New York City, with numerous skyscrapers. A semi-transparent blue band with a white network pattern of lines and dots runs horizontally across the middle of the image. The text is centered within this band.

# Openstack

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Шаповалов Евгений

# Комьюнити



Все ли есть в закрытой группе в Slack?

Если нет, то напишите комьюнити-менеджеру Евгении

[e.skitkovskaya@otus.ru](mailto:e.skitkovskaya@otus.ru)

@Evgeniya OTUS

# Правила вебинара



Активно участвуем



Задаем вопросы в чат или голосом



Off-topic обсуждаем в Slack #канал группы или #general



Вопросы вижу в чате, могу ответить не сразу

# Преподаватель



С 2011 года занимался QA в проектах Parallels и Ingram Micro. Тестировал серверную виртуализацию и автоматизацию у хостинг провайдеров.

В 2019 году занялся напрямую разработкой и DevOps практиками. Работал над билд системой и инфраструктурой разработки в проектах Juniper Networks.

Сейчас работаю инженером-разработчиком над проектами с виртуализацией с Openstack и k8s.

# Карта курса

1 Кластеризация

2 HighLoad Web

3 СУБД

4 Виртуализация и  
контейнеризация

5 Оркестрация -  
Openstack



Опрос по программе - каждый месяц в ЛК

# Маршрут вебинара

Cloud computing



Обзор возможностей



Компоненты Openstack



Рефлексия

# Цели и смысл вебинара | На занятии вы сможете

- 1 Познакомиться с разработкой Openstack
- 2 Познакомиться с основными компонентами Openstack
- 3 Познакомиться с dashboard

The image features a central horizontal band with a blue-to-teal gradient. Overlaid on this band is a white network pattern of interconnected lines and nodes. The background of the entire image is an aerial view of a city skyline, with numerous skyscrapers and buildings, all rendered in a monochromatic blue color scheme. The text 'История Openstack' is centered within the blue band in a large, white, sans-serif font.

# История Openstack

# История Cloud Computing

- Сначала компании использовали дорогие датацентры
- На разворачивание сервера требовалось больше времени
- Нельзя было быстро реагировать

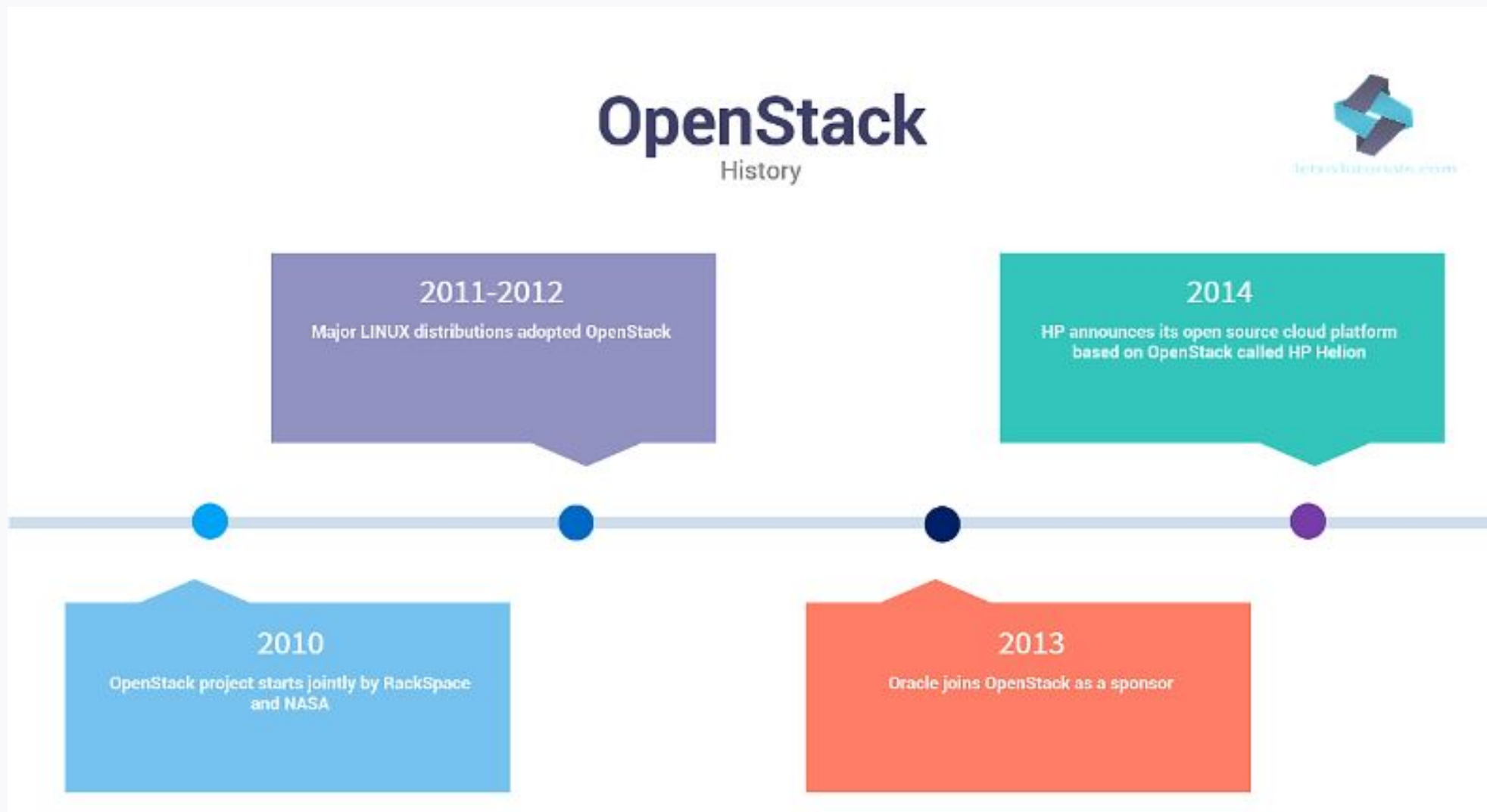
IaaS = Infrastructure as a Service( Инфраструктура как сервис)

- Самостоятельный деплой виртуальных машин в облако
- Замена традиционным датацентрам
- Затраты только на использование компьютер времени
- Очень быстрый и гибкий способ реагировать на бизнес требования

# Успех Openstack

- Открытый код
- Основа на успехе Linux
- Openstack foundation агрегирует в себе успех многих компаний
- Возможность составлять продукты с премиальными фичами
- Технологии Openstack используются и вне его

# История Openstack



# Кто использует Openstack

## Companies involved in OpenStack

OpenStack was originally launched in July 2010 by Rackspace and NASA as an open source initiative that combined NASA's Nebula platform and Rackspace's Cloud Files platform.

Today, hundreds of companies contribute to OpenStack code, with many more playing a part in the broader community.

INFLUENTIAL CONTRIBUTORS TO OPENSTACK

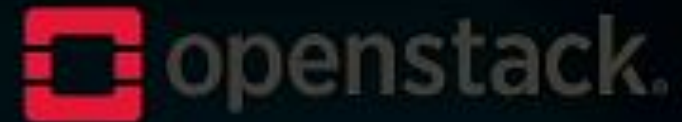
CANONICAL



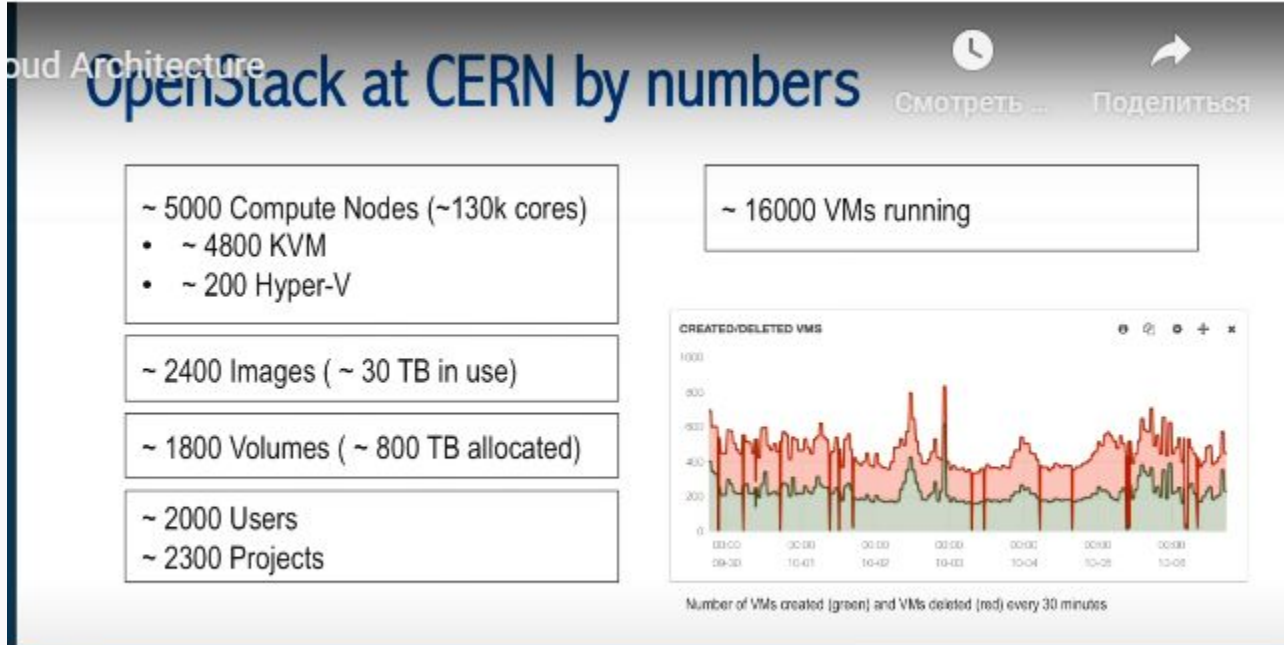
# Кто использует Openstack

## OpenStack at Blizzard

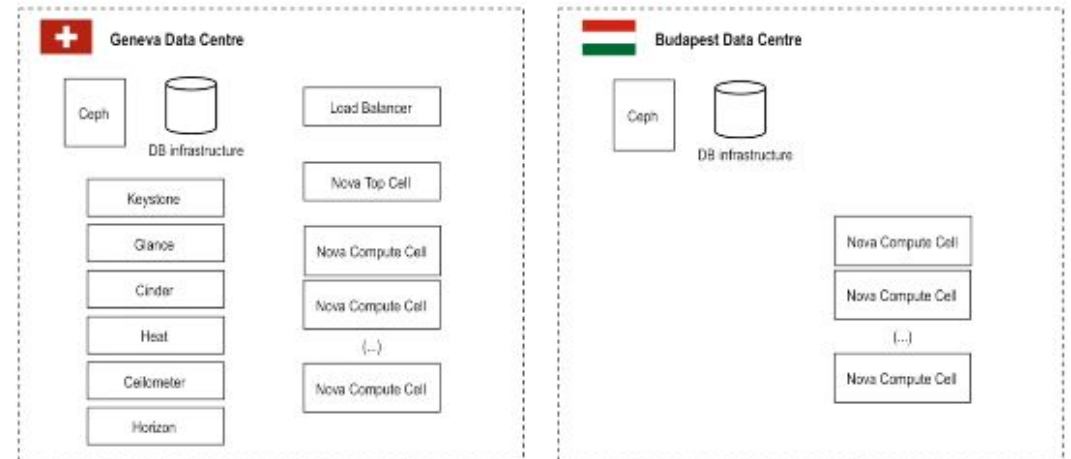
- Blizzard has been using OpenStack to host its private cloud since 2012.
- Our private cloud is spread across 11 data centers around the world.
- Our cloud users are game development teams or internal application developers.
- Running mostly Rocky release with a few services still on Pike. Senlin is running on Stein release.
- Active contributor to Senlin, Magnum and Designate projects.
- Active contributor to Gophercloud project for Senlin and Zaqr.



# Кто использует Openstack



## Architecture Overview



The image features a blue-tinted aerial view of a city skyline, likely New York City, with numerous skyscrapers. A semi-transparent blue band with a white network pattern of lines and nodes runs horizontally across the middle of the image. The text "Разработка Openstack" is centered within this band in a white, bold, sans-serif font.

# Разработка Openstack

# Openstack проект на Python

- > 12 млн строк кода
- > 1 млн коммитов
- > 15000 контрибьютеров
- > 1500 проектов
- около 1000 проектов на Python

# Основные котрибьюторы в Openstack

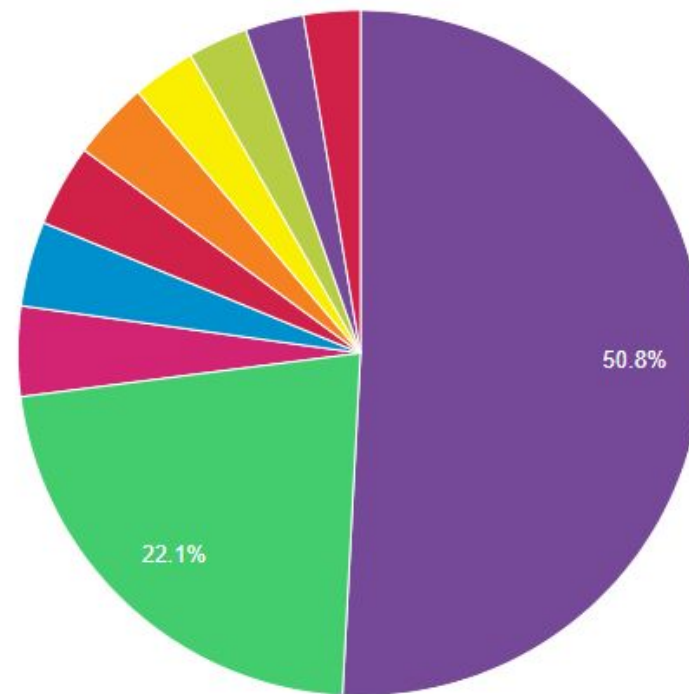
## Reviews by Company

Show  entries

#	Company	Reviews
1	Red Hat	4242
2	Yovole	354
	*independent	334
3	Canonical	323
4	AT&T	307
5	BBC	249
6	Dell EMC	236
7	NEC	230
8	Ericsson	223
9	StackHPC	160

Showing 1 to 10 of 71 entries

[Previous](#) [Next](#)



# Схема разработки Openstack



## Navigation

### Getting Started

- [The OpenDev Workflow](#)
- [Setting up your Gerrit account](#)
- [Proposing a change](#)
- [Next steps](#)

### Developer's Guide

### IRC Guide

### Core Reviewer's Guide

### Project Driver's Guide

### Project Creator's Guide

### Learn the Gerrit Workflow

### in the Sandbox

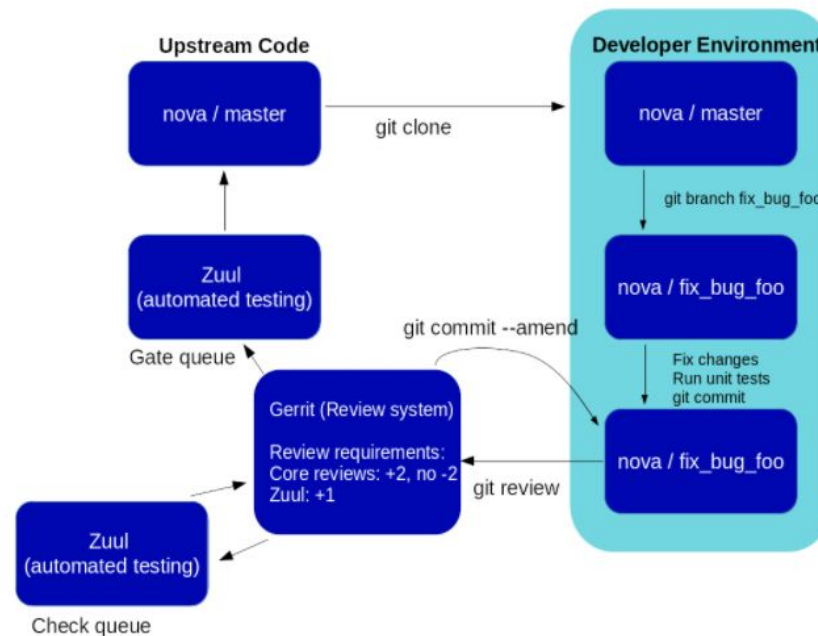
### Test Environment

## Quick search

## Getting Started

### The OpenDev Workflow

The OpenDev workflow is centered around Gerrit, which uses the concept of **changes** rather than Pull Requests. To propose a change to a git repository, you start by cloning the repository you're interested in, then create a branch to work in. You curate a commit on that branch, then propose it to Gerrit using the **git-review** tool:



# Openstack релизы

Series	Status	Initial Release Date	Next Phase	EOL Date
<a href="#">Wallaby</a>	<a href="#">Development</a>	2021-04-14 <i>estimated (schedule)</i>	<a href="#">Maintained</a> <i>estimated 2021-04-14</i>	
<a href="#">Victoria</a>	<a href="#">Maintained</a>	2020-10-14	<a href="#">Extended Maintenance</a> <i>estimated 2022-04-18</i>	
<a href="#">Ussuri</a>	<a href="#">Maintained</a>	2020-05-13	<a href="#">Extended Maintenance</a> <i>estimated 2021-11-12</i>	
<a href="#">Train</a>	<a href="#">Maintained</a>	2019-10-16	<a href="#">Extended Maintenance</a> <i>estimated 2021-05-12</i>	
<a href="#">Stein</a>	<a href="#">Extended Maintenance</a> (see <a href="#">note</a> below)	2019-04-10	<a href="#">Unmaintained</a> <i>TBD</i>	
<a href="#">Rocky</a>	<a href="#">Extended Maintenance</a> (see <a href="#">note</a> below)	2018-08-30	<a href="#">Unmaintained</a> <i>TBD</i>	
<a href="#">Queens</a>	<a href="#">Extended Maintenance</a> (see <a href="#">note</a> below)	2018-02-28	<a href="#">Unmaintained</a> <i>TBD</i>	
<a href="#">Pike</a>	<a href="#">Extended Maintenance</a> (see <a href="#">note</a> below)	2017-08-30	<a href="#">Unmaintained</a> <i>TBD</i>	
<a href="#">Ocata</a>	<a href="#">Extended Maintenance</a> (see <a href="#">note</a> below)	2017-02-22	<a href="#">Unmaintained</a> <i>estimated 2020-06-04</i>	
<a href="#">Newton</a>	<a href="#">End Of Life</a>	2016-10-06		2017-10-25
<a href="#">Mitaka</a>	<a href="#">End Of Life</a>	2016-04-07		2017-04-10
<a href="#">Liberty</a>	<a href="#">End Of Life</a>	2015-10-15		2016-11-17
<a href="#">Kilo</a>	<a href="#">End Of Life</a>	2015-04-30		2016-05-02
<a href="#">Juno</a>	<a href="#">End Of Life</a>	2014-10-16		2015-12-07
<a href="#">Icehouse</a>	<a href="#">End Of Life</a>	2014-04-17		2015-07-02
<a href="#">Havana</a>	<a href="#">End Of Life</a>	2013-10-17		2014-09-30
<a href="#">Grizzly</a>	<a href="#">End Of Life</a>	2013-04-04		2014-03-29
<a href="#">Folsom</a>	<a href="#">End Of Life</a>	2012-09-27		2013-11-19
<a href="#">Essex</a>	<a href="#">End Of Life</a>	2012-04-05		2013-05-06
<a href="#">Diablo</a>	<a href="#">End Of Life</a>	2011-09-22		2013-05-06
<a href="#">Cactus</a>	<a href="#">End Of Life</a>	2011-04-15		
<a href="#">Bexar</a>	<a href="#">End Of Life</a>	2011-02-03		
<a href="#">Austin</a>	<a href="#">End Of Life</a>	2010-10-21		

# Openstack код ревью

**Gerrit** CHANGES DOCUMENTATION BROWSE  [Sign in](#)

**Active 662829** Add ceph iscsi volume driver

Updated Nov 09  
Owner Walt  
Assignee  
Reviewers Ivan Kolodyazhny, Eric Harney, Brian Rosmaita, AND 47 MORE  
CC  
Repo | Branch [openstack/cinder](#) | [master](#)  
Parent [b91d547](#)   
Topic [ceph-iscsi](#)  
Strategy Merge if Necessary  
Hashtags

Verified +1 Zuul  
 Code-Review +1 xinliang  
 Workflow No votes.

Other labels  Review-Priority No votes.

Links [gitweb](#)

**Add ceph iscsi volume driver**

The driver requires the new rbd-iscsi-client package, which is used to talk to the rbd-target-api on the ceph iscsi gateway node.

The rbd-target-api is a python script meant to keep ceph iscsi gw nodes in sync with each other, but the API is works for creating iscsi targets. This is a new driver that makes heavy use of the ceph-iscsi project's rbd-target-api python REST client here: <https://github.com/ceph/ceph-iscsi>

The driver is a derivation of the rbd driver, and the intention is to reuse as much of the base rbd driver as possible and just do iSCSI specific code here.

Change-Id: [Iff0e4d1137851c8f0b8ec25632d1186c2859b2fc](#)

Same topic  
[openstack/devstack: master: Add support for cep...](#)  
[openstack/devstack-plugin-ceph: master: Update ...](#)

Merge conflicts  
[RBD: Add 512e/4k disk geometry configuration Tegile Driver](#)  
[Change the original drive path](#)  
[Add Snapshot Attachment For MacroSAN](#)  
[rbd: Mark the initialize\\_connection API as idempo...](#)  
[Adds DataCore Volume Drivers](#)  
[Add HoneycombData HStor v1.0.0 cinder volume...](#)  
[Remove the IBM GPFS Storage Driver](#)  
[rbd\\_driver: Add exception capture to unprotect/re...](#)  
[\(WIP\) Update in-tree Datera Cinder driver](#)  
[Update volume status during volume migration.](#)  
[Add new OSNEXUS Quantastor Cinder driver](#)

Files	Findings		
Base <input type="text" value=""/> Patchset 40 <input type="text" value="5887117"/> <input type="checkbox"/> NO PATCHSET DESCRIPTION	<a href="#">DOWNLOAD</a> <a href="#">EXPAND ALL</a>		
File	Comments	Size	Delta
Commit message			
M <a href="#">cinder/opts.py</a>			+3 -0
A <a href="#">cinder/tests/unit/volume/drivers/ceph/__init__.py</a>			+0 -0
A <a href="#">cinder/tests/unit/volume/drivers/ceph/fake_rbd_iscsi_client.py</a>			+25 -0
A <a href="#">cinder/tests/unit/volume/drivers/ceph/fake_rbd_iscsi_client_exceptions.py</a>		█	+116 -0
A <a href="#">cinder/tests/unit/volume/drivers/ceph/test_rbd_iscsi.py</a>		█	+247 -0
A <a href="#">cinder/volume/drivers/ceph/__init__.py</a>			+0 -0
A <a href="#">cinder/volume/drivers/ceph/rbd_iscsi.py</a>		█	+491 -0
M <a href="#">cinder/volume/drivers/rbd.py</a>			+2 -1
M <a href="#">doc/source/reference/support-matrix.ini</a>			+14 -0
M <a href="#">driver-requirements.txt</a>			+3 -0
M <a href="#">lower-constraints.txt</a>			+1 -0
A <a href="#">releasenotes/notes/ceph-iscsi-driver-b515bd7fb73ce13b.yaml</a>			+6 -0

The image features a blue-tinted aerial view of a city skyline, likely New York City, with numerous skyscrapers. A semi-transparent blue band with a white network pattern of lines and dots runs horizontally across the middle of the image. The text "Возможности Openstack" is centered within this band in a white, bold, sans-serif font.

# Возможности Openstack



# OpenStack Capabilities



- ✓ **Self-service Instance life cycle management: run, reboot, suspend, resize and terminate instances**
- ✓ **Management of compute resources: CPU, memory, disk, and network interfaces**
- ✓ **Management of Network Resources (Flat, Flat DHCP, VLAN DHCP and IPv6)**
- ✓ **API with rate limiting and authentication to manage who has access to compute resources**
- ✓ **Distributed and asynchronous architecture for massively scalable and highly available system**
- ✓ **Virtual Machine (VM) image management i.e. store, import, share, and query images**
- ✓ **Floating IP addresses i.e. Ability to assign (and re-assign) IP addresses to VMs**



# OpenStack Capabilities



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# OpenStack Capabilities

- ✓ Security Groups
- ✓ Role Based Access Control (RBAC)
- ✓ Projects & Quotas
- ✓ REST-based API



# *OpenStack* *Capabilities*

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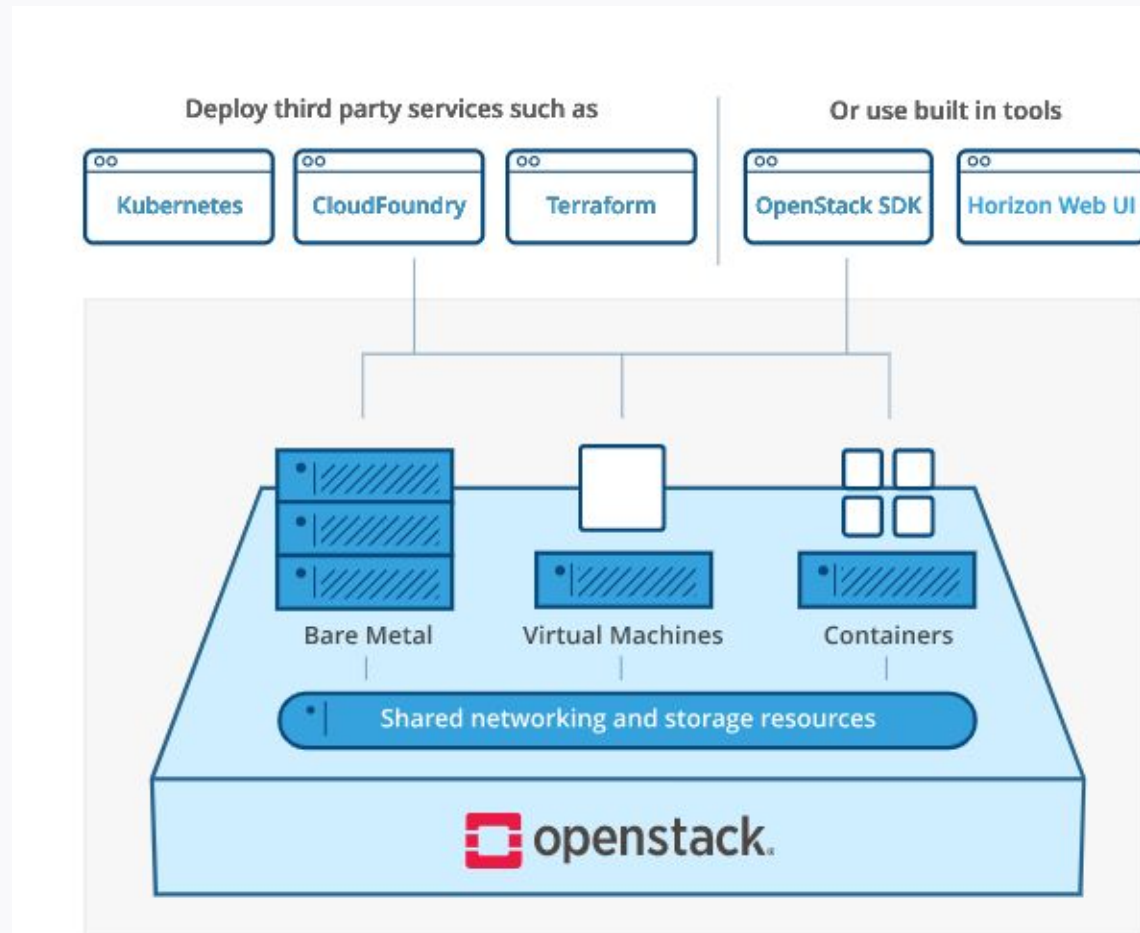


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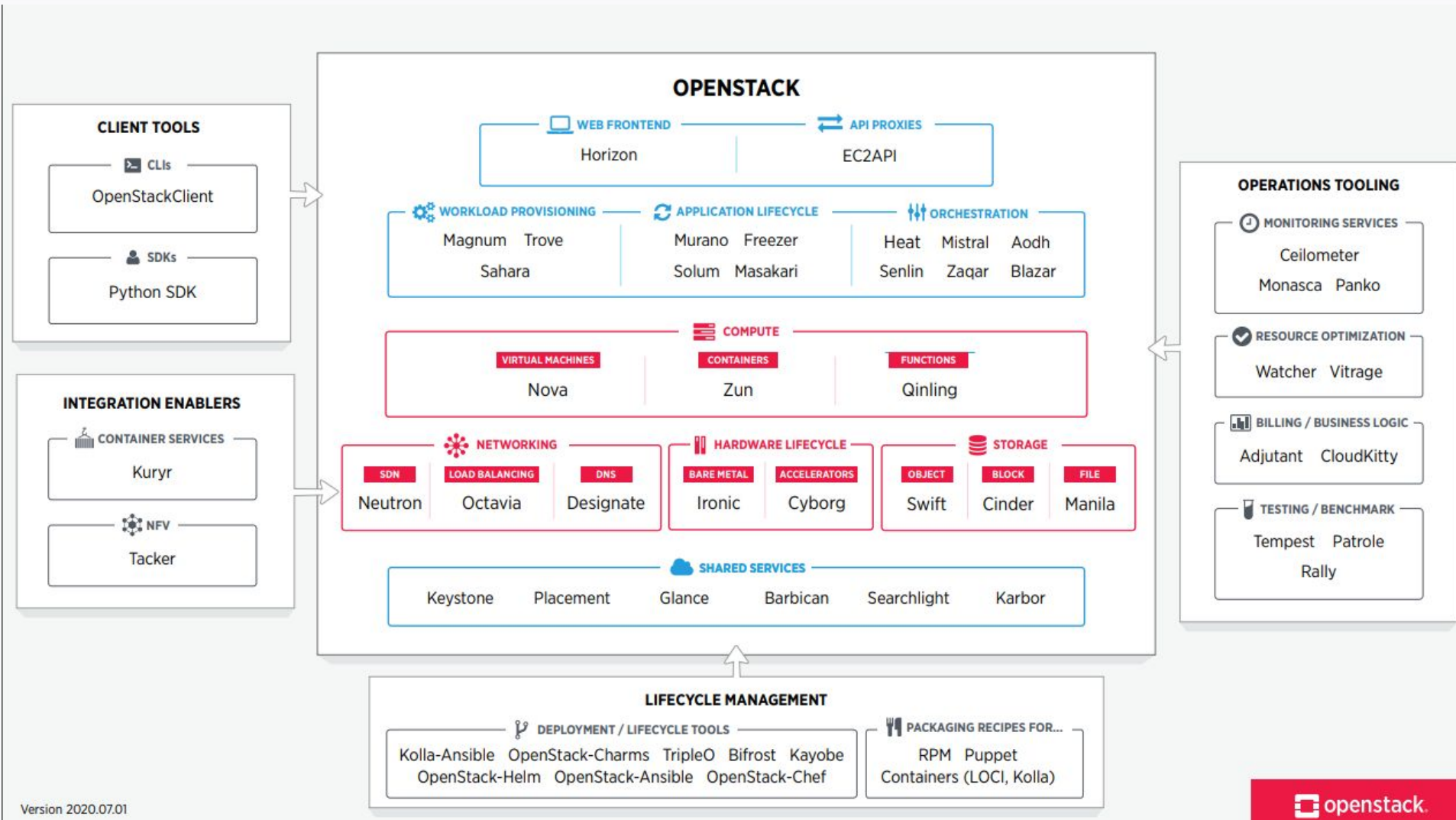
The image features a central horizontal band with a blue-to-purple gradient. Overlaid on this band is a white network pattern of interconnected nodes and lines. The background of the entire image is an aerial view of a city skyline, rendered in shades of blue and cyan.

# Компоненты Openstack

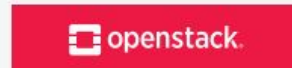
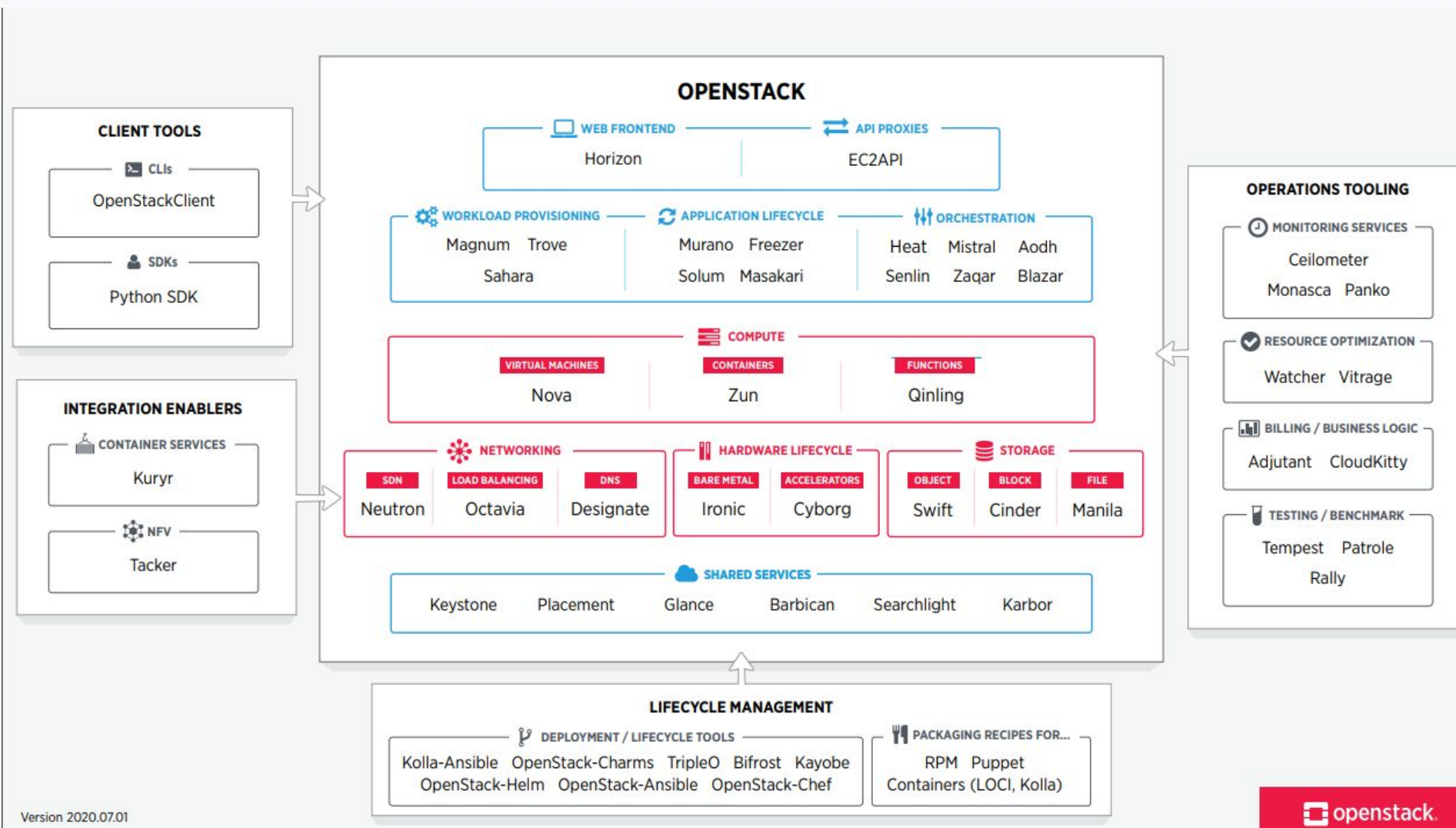
# Openstack общая схема



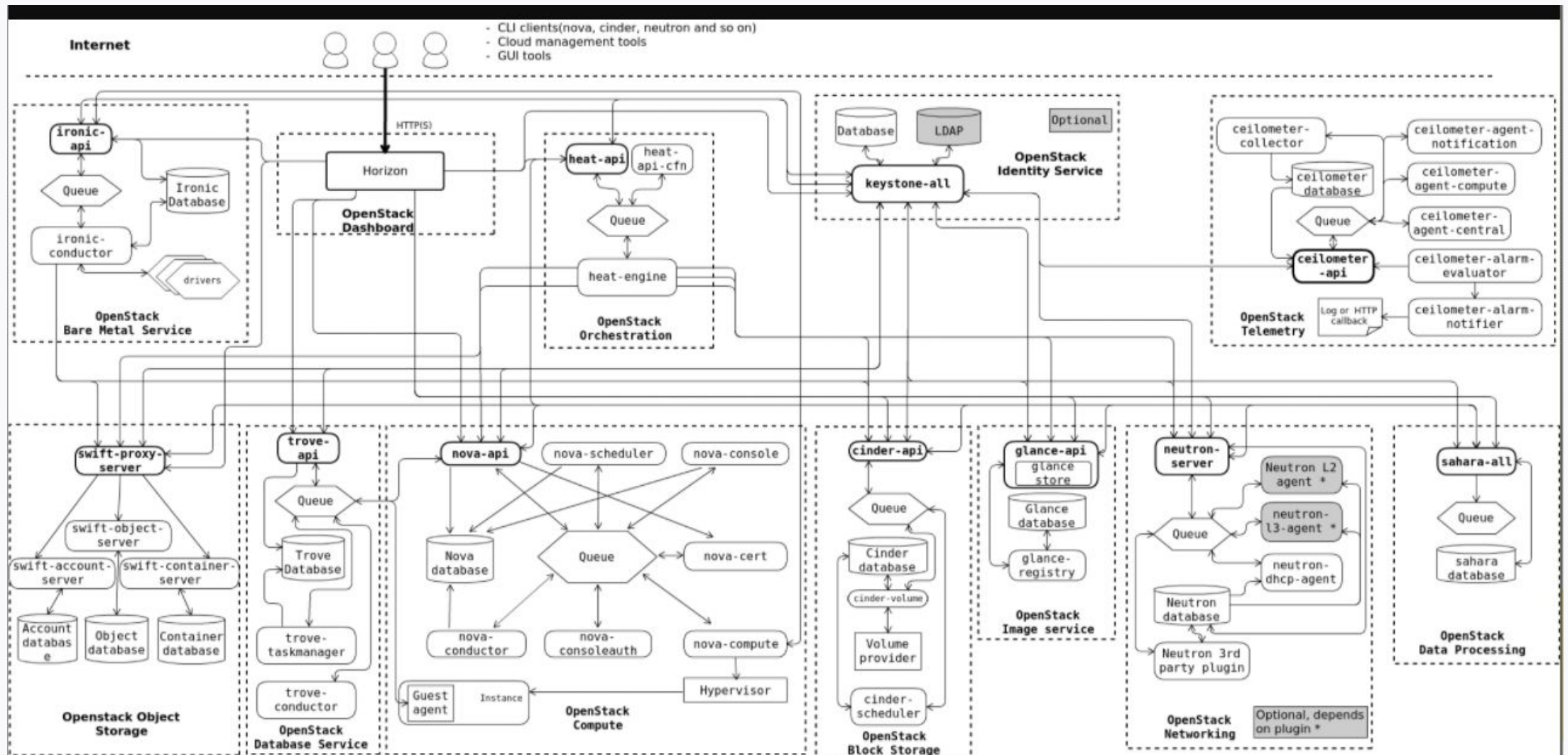
# Openstack - компонентная схема



# Возможности Openstack



# Openstack логическая архитектура



# Openstack Что делают?

- Приватные облака
- Публичные облака
- Виртуализация сетевых функций (network functions virtualization)
- Контейнеризация

# Openstack Что делают?

## What can I do with OpenStack?

### Private clouds

Private cloud distributions run on OpenStack are better than DIY approaches—and there's proof. [451 Research found](#) that it only takes a 6% increase in the number of virtual machines—facilitated by OpenStack's easy installation and management—for OpenStack distributions to become significantly more valuable than private clouds created on your own.

[Read more about private clouds →](#)

### Network functions virtualization

[451 Research found](#) that using OpenStack for network functions virtualization (NFV)—which involves separating a network's key functions so they can be distributed among environments—could very well be the next big thing. It's on the agenda of virtually every global communications services provider surveyed by the analyst.

[Read more about NFV →](#)

### Public clouds

OpenStack is the [leading open source option](#) for building public cloud environments. Whether your company is a multibillion-dollar publicly traded enterprise or a startup, you can use OpenStack to set up public clouds with services that compete with major public [cloud providers](#).

[Read more about public clouds →](#)

### Containers

OpenStack is a stable foundation for public and private clouds. Containers speed up application delivery while simplifying application deployment and management. Running containers on OpenStack can scale containers' benefits from single, siloed teams to enterprise-wide interdepartmental operations.

[Read more about containers →](#)

# ОСНОВНЫЕ КОМПОНЕНТЫ

## Compute (Nova)

OpenStack Compute is a cloud computing fabric controller, which manages pools of computer resources and work with [virtualization technologies](#), bare metals, and high-performance computing configurations. Nova's architecture provides flexibility to design the cloud with no proprietary software or hardware requirements and also delivers the ability to integrate the legacy systems and third-party products.

Nova can be deployed using hypervisor technologies such as KVM, VMware, LXC, XenServer, etc. It is used to manage numerous virtual machines and other instances that handle various computing tasks.

## Image Service (Glance)

OpenStack image service offers discovering, registering, and restoring virtual machine images. Glance has client-server architecture and delivers a user REST API, which allows querying of virtual machine image metadata and also retrieval of the actual image. While deploying new virtual machine instances, Glance uses the stored images as templates.

OpenStack Glance supports Raw, VirtualBox (VDI), VMWare (VMDK, OVF), Hyper-V (VHD), and Qemu/KVM (qcow2) virtual machine images.

# ОСНОВНЫЕ КОМПОНЕНТЫ

## Object Storage (Swift)

OpenStack Swift creates redundant, [scalable data storage to store](#) petabytes of accessible data. The stored data can be leveraged, retrieved and updated. It has a distributed architecture, providing greater redundancy, scalability, and performance, with no central point of control.

Swift is a profoundly available, shared, eventually consistent object store. It helps organizations to store lots of data safely, cheaply and efficiently. Swift ensures data replication and distribution over various devices, which makes it ideal for cost-effective, scale-out storage.

## Dashboard (Horizon)

Horizon is the authorized implementation of OpenStack's Dashboard, which is the only graphical interface to automate cloud-based resources. To service providers and other commercial vendors, it supports with third party services such as monitoring, billing, and other management tools. Developers can automate tools to manage OpenStack resources using EC2 compatibility API or the native OpenStack API.

## Identity Service (Keystone)

Keystone provides a central list of users, mapped against all the OpenStack services, which they can access. It integrates with existing backend services such as LDAP while acting as a common authentication system across the cloud computing system.

Keystone supports various forms of authentication like standard username & password credentials, AWS-style (Amazon Web Services) logins and token-based systems. Additionally, the catalog provides an endpoint registry with a queryable list of the services deployed in an OpenStack cloud.

# ОСНОВНЫЕ КОМПОНЕНТЫ

## Networking (Neutron)

Neutron provides networking capability like managing networks and IP addresses for OpenStack. It ensures that the network is not a limiting factor in a cloud deployment and offers users with self-service ability over network configurations. [OpenStack](#) networking allows users to create their own networks and connect devices and servers to one or more networks. Developers can use SDN technology to support great levels of multi-tenancy and massive scale.

Neutron also offers an extension framework, which supports deploying and managing of other network services such as virtual private networks (VPN), firewalls, load balancing, and intrusion detection system (IDS)

## Block Storage (Cinder)

OpenStack Cinder delivers determined block-level storage devices for application with OpenStack compute instances. A cloud user can manage their storage needs by integrating block storage volumes with Dashboard and Nova.


Cinder can use storage platforms such as Linux server, EMC (ScaleIO, VMAX, and VNX), Ceph, Coraid, CloudByte, IBM, Hitachi data systems, SAN volume controller, etc. It is appropriate for expandable file systems and database storage.



# Keystone



# Keystone компонент

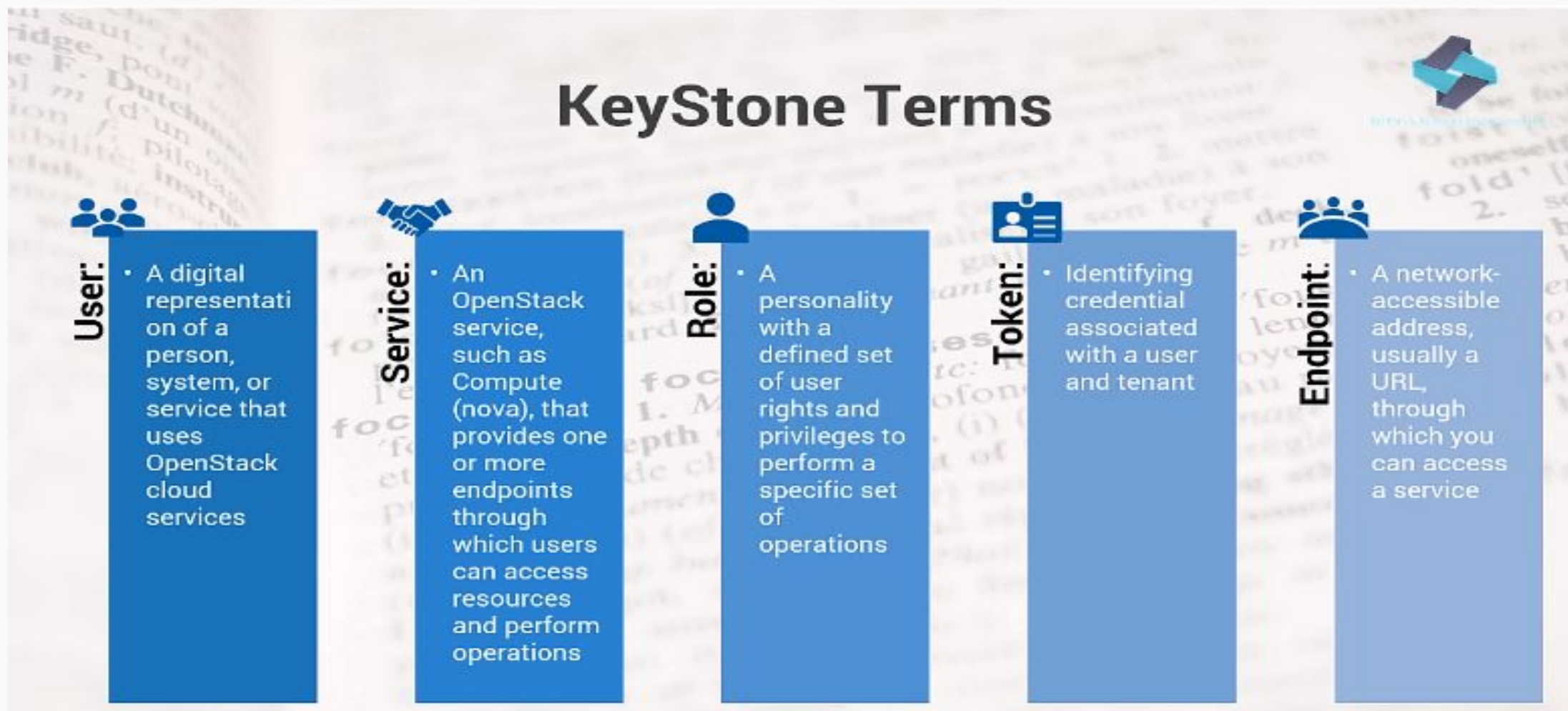
The image features a dark background with a green digital rain effect. In the center, the word "Keystone" is written in a large, white, sans-serif font, underlined. Below the text is a 3D red logo consisting of a square with a smaller square inside, and a horizontal bar extending from the bottom of the inner square. In the top right corner, there is a small blue and purple logo for "TetraTutorials.com".

  
TetraTutorials.com

**Keystone**

*"Keystone is an OpenStack project that provides Identity, Token, Catalog and Policy services for use specifically by projects in the OpenStack family."*

# Keystone компонент



# Keystone COMPONENT

## Keystone Main Functions

### 4 Primary Services

**Identity:** User information authentication

**Token:** After logged in, replace account-password

**Service catalog:** Service units registered

**Policies:** Enforces different user levels

### Backed by different databases

LDAP

SQL

Key Value Stores (KVS)



OpenStack Project



# Glance



# Glance: Image management



TetraTutorials.com



**Glance**

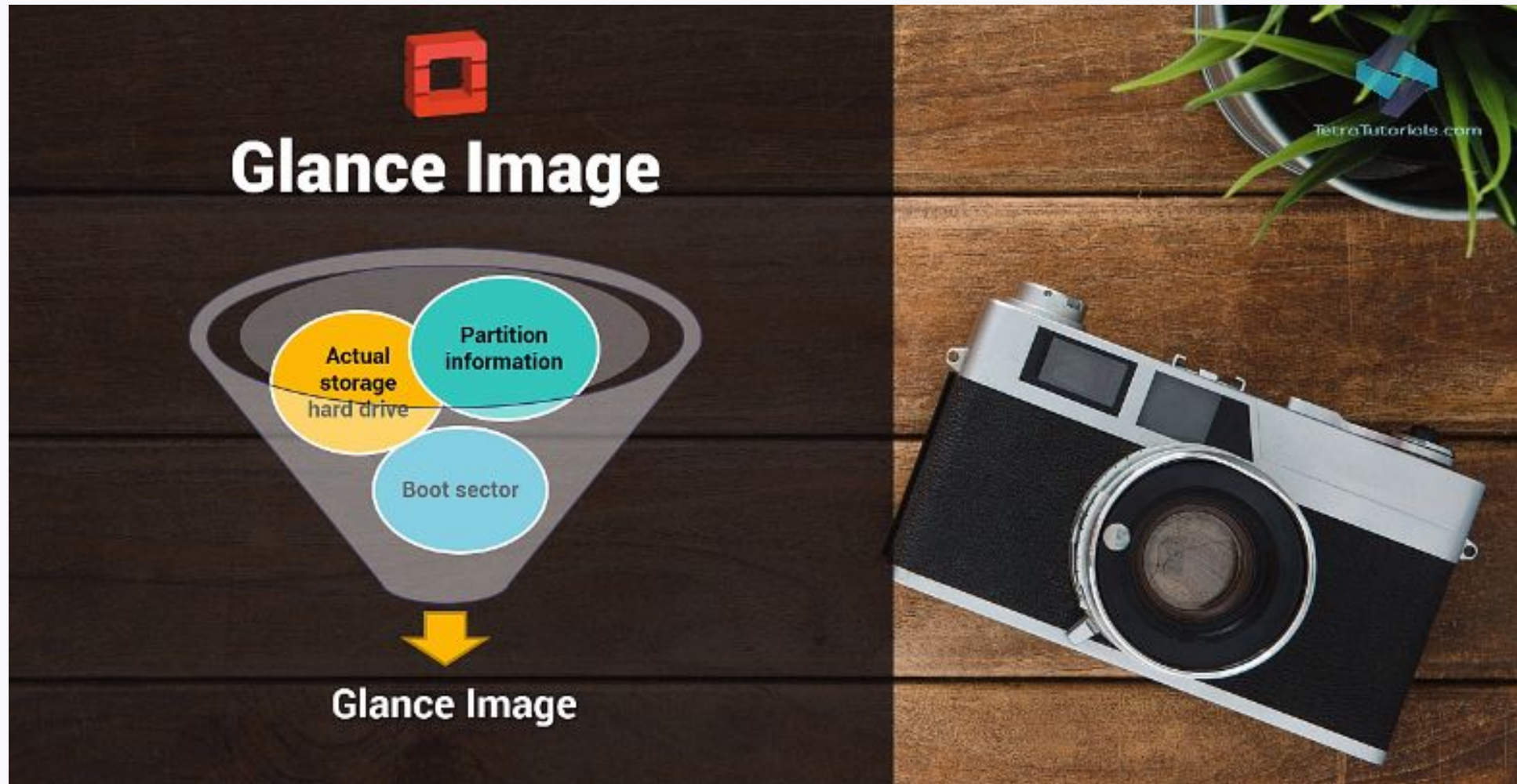
---



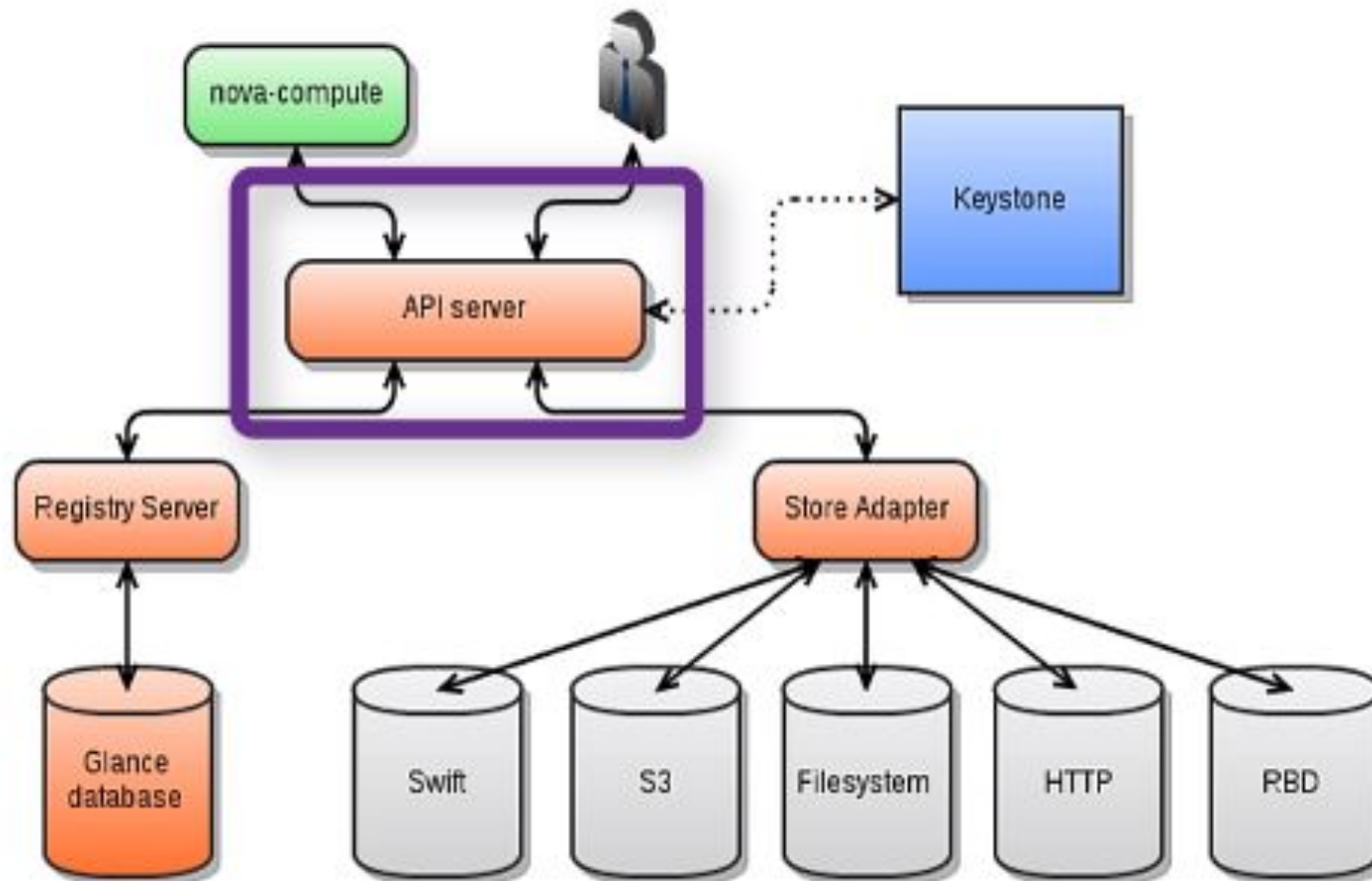
A 3D rendered red logo of the Glance project, which is a square with a smaller square cut out of its center, creating a frame-like appearance.

*"The Glance project provides services for discovering, registering, and retrieving virtual machine images."*


# Glance: Image management



# Glance: Image management



# Glance: Image management



Disk	Format Description
raw	This is an unstructured disk image format
vhd	This is the VHD disk format, a common disk format used by virtual machine monitors from VMWare, Xen, Microsoft, VirtualBox, and others
vmdk	Another common disk format supported by many common virtual machine monitors
vdi	A disk format supported by VirtualBox virtual machine monitor and the QEMU emulator
iso	An archive format for the data contents of an optical disc (e.g. CDROM).
qcow2	A disk format supported by the QEMU emulator that can expand dynamically and supports Copy on Write
aki	This indicates what is stored in Glance is an Amazon kernel image
ari	This indicates what is stored in Glance is an Amazon ramdisk image
ami	This indicates what is stored in Glance is an Amazon machine image

# Glance: Image management

## *Fetching Image from Glance*



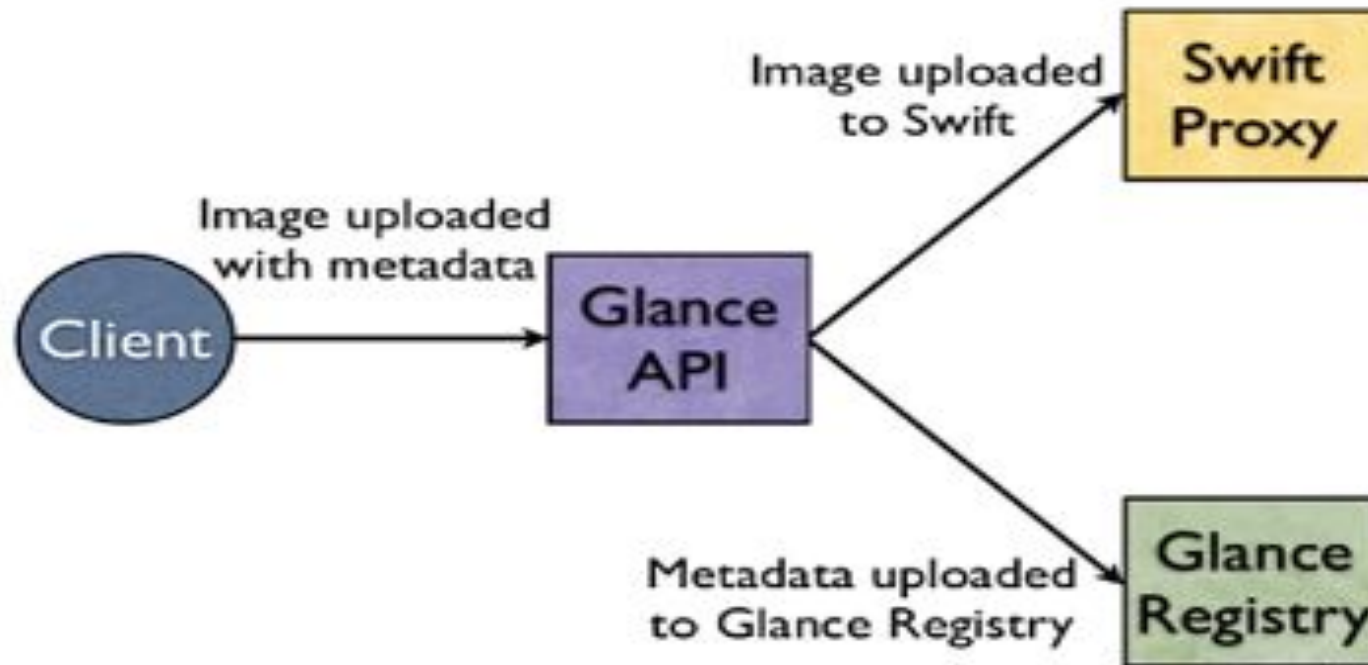
GET `http://<glance-url>/images/<ID>`

If image can be found, API returns image-uri

nova-compute passes image-uri to hypervisor driver

# Glance: Image management

## Image Upload



# Glance: Image management

TetraTutorials.com

```
[root@controller ~]# ls -lh cirros-0.3.4-x86_64-disk.img
-rw-r--r-- 1 root root 13M May  7  2015 cirros-0.3.4-x86_64-disk.img
[root@controller ~]# . admin-openrc
[root@controller ~]# openstack image create "cirros" --file cirros-0.3.4-x86_64-disk.img --disk-format qcow2 --container-format bare --public
```

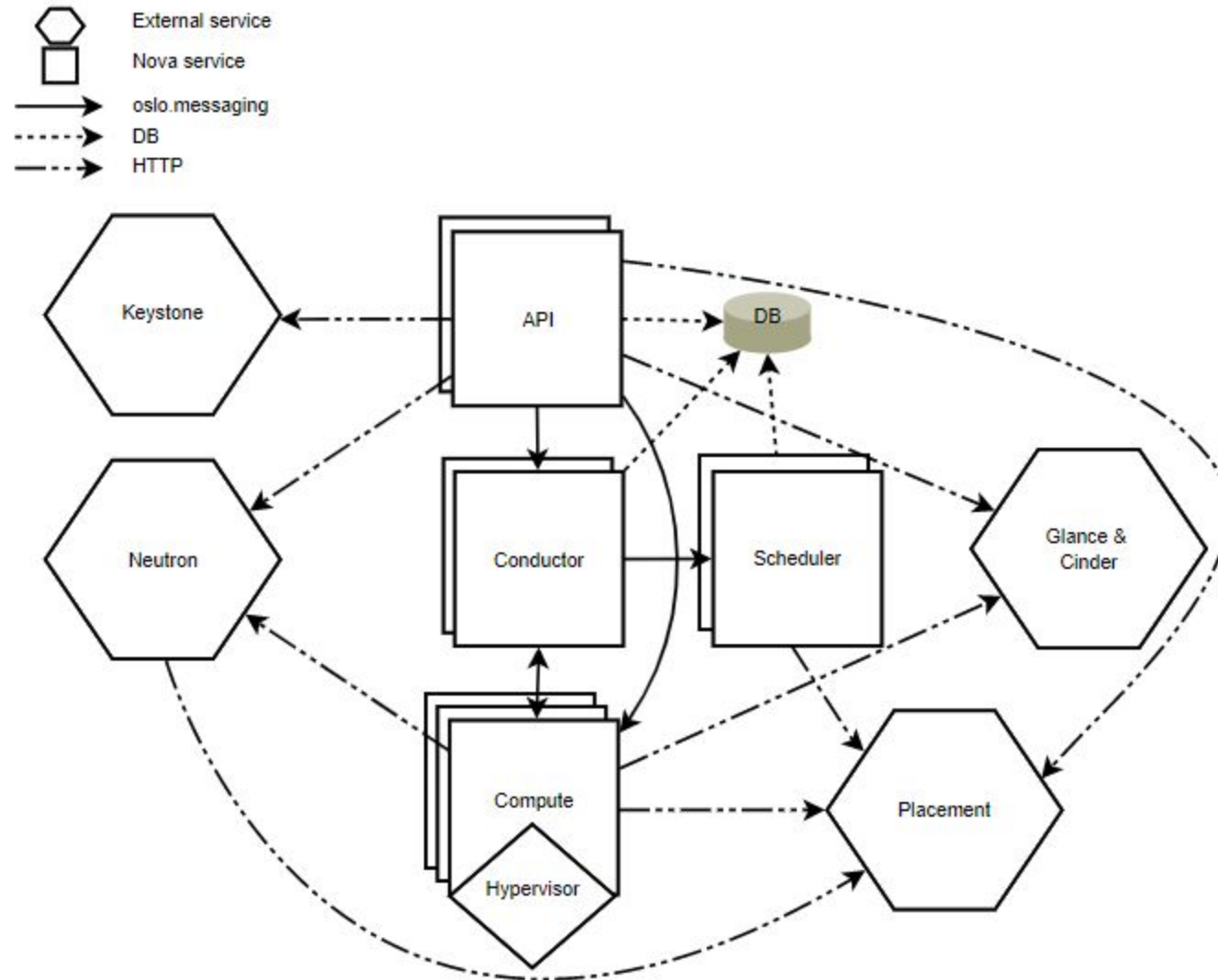
Field	Value
checksum	eeleca47dc88f4879d8a229cc70a07c6
container_format	bare
created_at	2016-07-05T02:38:43Z
disk_format	qcow2
file	/v2/images/ad7d0aac-e3dc-4e8d-ae3d-1005c49e814e/file
id	ad7d0aac-e3dc-4e8d-ae3d-1005c49e814e
min_disk	0
min_ram	0
name	cirros
owner	caa7a686fd194d6e89d5e304e050e710
protected	False
schema	/v2/schemas/image
size	13287936
status	active
tags	
updated_at	2016-07-05T02:38:44Z
virtual_size	None
visibility	public

```
[root@controller ~]#
```

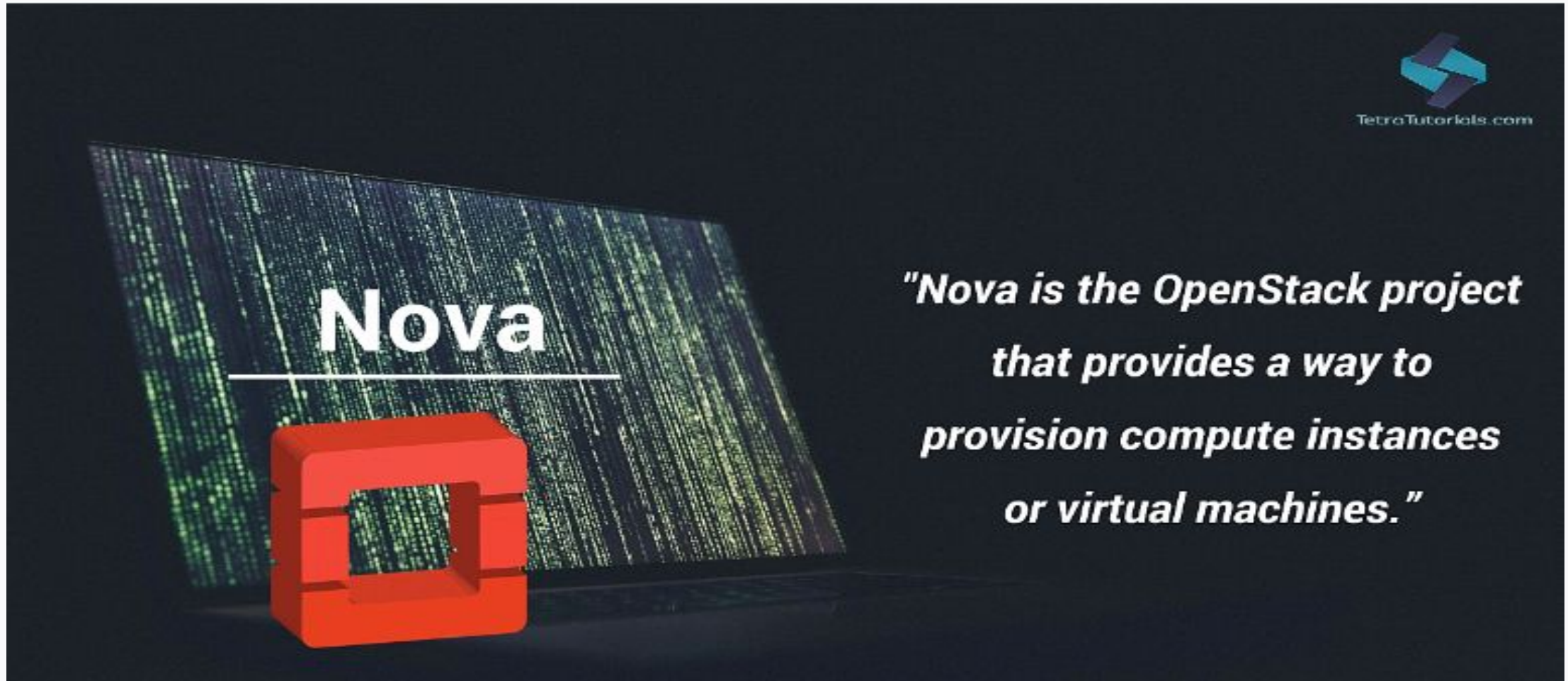
The image features a central horizontal band with a blue-to-purple gradient. Overlaid on this band is a white network pattern of interconnected lines and nodes. The background of the entire image is an aerial view of a city skyline, with numerous skyscrapers and buildings, all rendered in a monochromatic blue color scheme. The text 'Compute: Nova' is centered within the blue band in a large, white, sans-serif font.


# Compute: Nova

# Nova: compute service



# Nova: compute service



  
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**Nova**

***"Nova is the OpenStack project that provides a way to provision compute instances or virtual machines."***

# Nova: compute service



**nova-api**

*"nova-api is a RESTful API web service which is used to interact with nova"*

TetraTutorials.com

# Nova: compute service



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## *nova database*



Can be any relational database.



nova-api talks to DB via SQLAlchemy (python ORM(Object Relational Mapper)).



Most of the deployments are done with MySQL or PostgreSQL.



DB HA should be done via 3<sup>rd</sup> party tools:

- Galera
- Multi-Master replication Model for MySQL (MMM)

# Nova: compute service

## OpenStack messaging

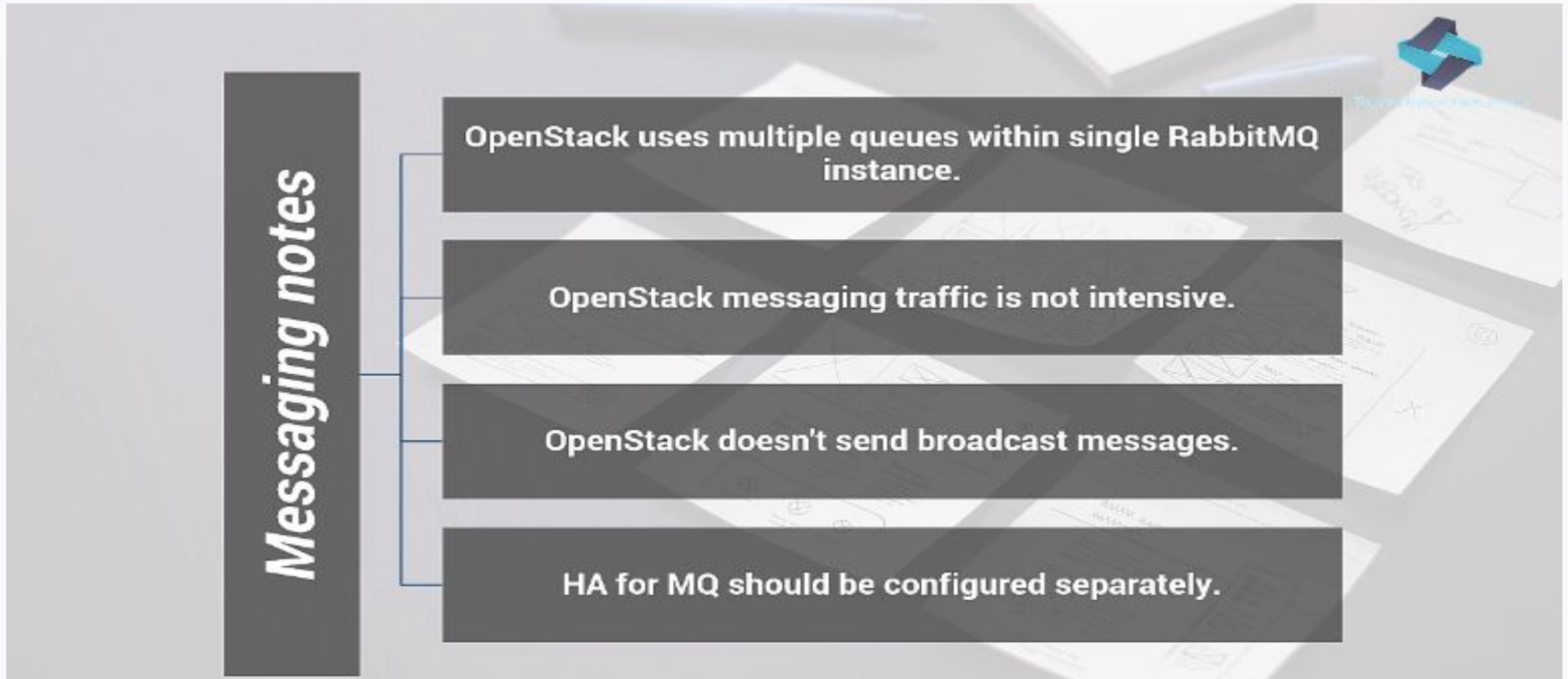
---



- ↪ `rpc.cast` – asynch, fire-and-forget
- ↪ `rpc.call` – synch, wait for result



# Nova: compute service

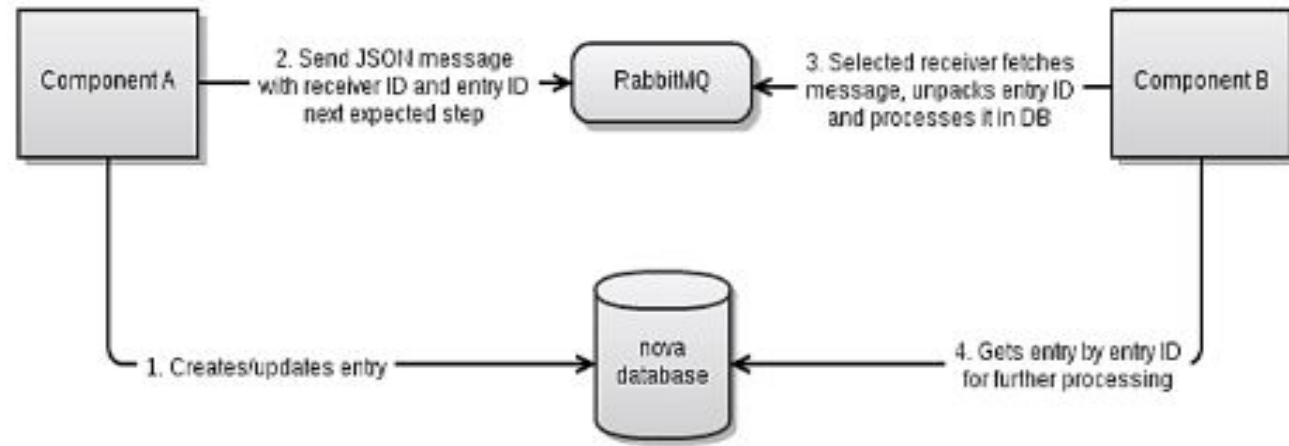


# Nova: compute service



Technical Architecture

## OpenStack messaging



# Nova: compute service

**nova-  
scheduler**

---



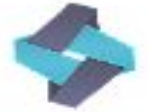
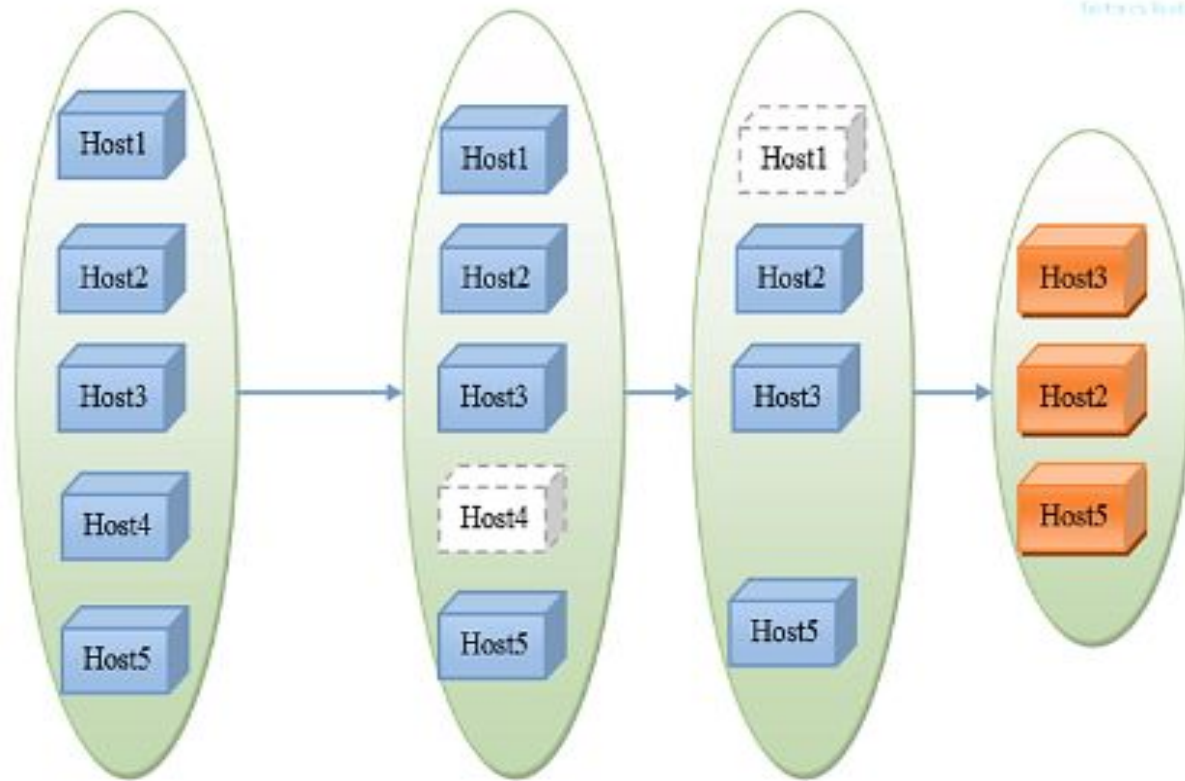
*"nova-scheduler is a daemon, which determines, on which compute host the instance request should run."*



TetraTutorials.com

# Neutron: network service

**nova**  
**scheduler**

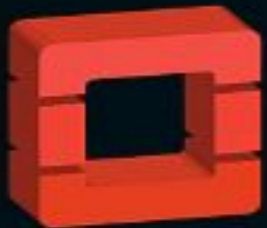


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# Openstack installation

## **nova scheduler: request types**

---



- Provision VM to particular host
- Provision VMs of the particular tenant to isolated hosts
- Provision all VMs on different hosts
- Provision VMs to "higher density" hosts



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# Openstack installation

***nova -  
scheduler:  
available  
schedulers***

## Scheduler Types

- **Filter Scheduler** : Picks the best-suited host which satisfies selected filter
- **Chance Scheduler**: Picks a host that is up at random
- **Simple Scheduler** : Picks a host that is up and has the fewest running instances
- **Multi Scheduler** : A scheduler that executes multiple sub-schedulers

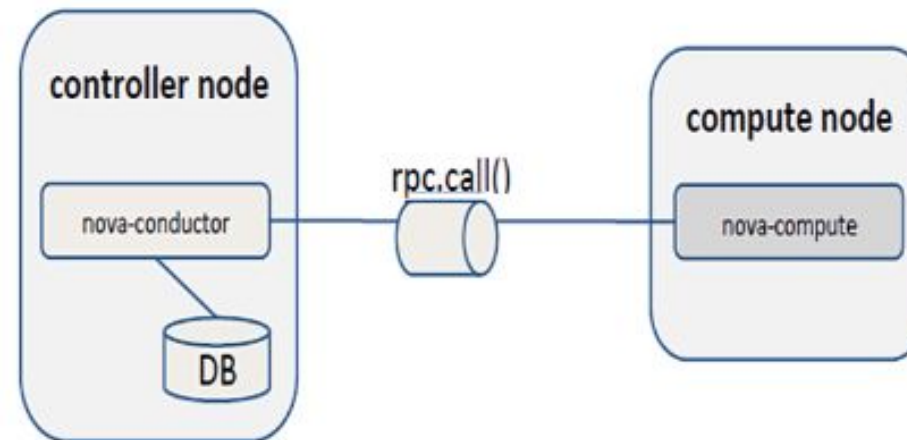


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# Openstack installation

## Nova Conductor

- *Eliminates the need to connect to Nova remote DB*
- *Horizontal scalability: spawns multiple worker threads operating in parallel*
- *Hides DB implementation/schema from Nova Compute*
- *Possible offloading of long-running operations from other services, not just Nova Compute*
- *Beneficial for operations that cross multiple compute nodes (migration, resizes)*



OpenStack is the leading open source cloud platform

# Рефлексия



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# Полезные ссылки

- <https://www.openstack.org/>
- <https://docs.openstack.org/devstack/latest/>
- <https://www.stackalytics.com/>
- <https://opendev.org/>

An aerial view of a city skyline, likely New York City, with a blue overlay and a network pattern of white lines connecting dots. The text is centered in the middle of the image.

Заполните, пожалуйста,  
опрос о занятии по ссылке в чате



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Шаповалов Евгений  
TG: @sharovalovdev