

# **Cloud Computing Lab**

## **Experiment No.: 2**

### **Introduction and Implementation of OpenStack- Private Cloud**

# Experiment No. 2

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**1. Aim:** Introduction and Implementation of OpenStack- Private Cloud

**2. Objectives:**

From this experiment, the student will be able to

- Understand OpenStack Open Source Software to build private and public cloud.
- Understand how OpenStack can be used for managing Virtual Machines and Containers like Docker, Kubernetes and Mesos

**3 Outcomes:**

- The learner will be able to Develop understanding of Open Stack private cloud and it's component.
- The learner will be able to understanding Installation process of OpenStack Private Cloud

**4 Hardware / Software Required: Internet**

**5 Theory:**

## Cloud Deployment Models

### ➤ Public Cloud

1. Managed by cloud service providers to offer cloud computing services over the internet.
2. These services are used by users on the basis of pay-as-you-go model or they are subscription based. (Monthly or Yearly)
3. Low cost of usage and any time users can stop using the cloud services.
4. The users can scale-up or scale-down the resources as per the needs and demands
5. Ideal for small enterprises and start-ups to reduce the cost of buying expensive hardware.
6. Public clouds are based on multi-tenancy or a public cloud serves multiple customers  
Each user's virtual computing environment is isolated from others

### ➤ Private Cloud

1. Private Cloud is deployed on the private infrastructure in a distributed systems environment.
2. It offers the dynamic provisioning of computing resources to its users.
3. Virtual desktop environments may be used to access the resources of the private cloud.
4. The billing schemes of the private cloud is different than the public cloud which is pay per use.

5. The usage cost of a private cloud may be based on the departments or the offices, sections of an organization.
6. Benefits of the private cloud are ..
  - Security concerns are less as compared to public cloud
  - The Service Level Agreement with the cloud vendor gives more assurance on system monitoring, data replication, maintenance, networking services, uptime and disaster recovery

### ➤ **Hybrid Cloud**

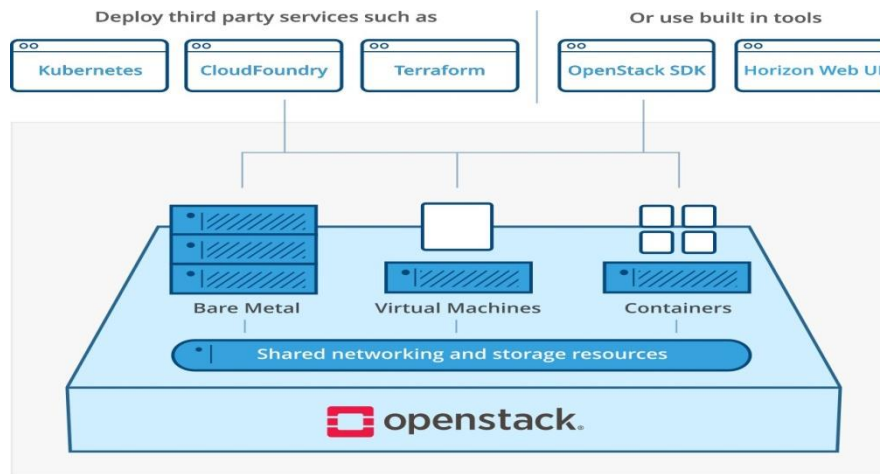
1. It is a combination of public and a private cloud.
2. This cloud connects the private cloud with a public cloud.
3. The hybrid cloud plays important role in scaling the resources as needed by the private cloud.
4. Some times the private cloud needs to scale-up in resources like computing power or memory in case heavy workloads.
5. Hybrid cloud has an advantage of both private and public cloud.

### **Examples of Cloud**

- ▶ Examples of popular public clouds
  - ▶ Amazon EC2, Microsoft Azure, Google Cloud
  - ▶ IBM Blue Cloud, Sun Cloud
- ▶ Examples of Private and Hybrid clouds
  - ▶ OpenStack, Apache CloudStack, OpenShift,
  - ▶ OpenNebula, AppScale, Eucalyptus

## **6. Introduction to OpenStack**

- OpenStack is a free and Open Source Software to build private and public cloud.
- It was originally made by a joint project of NASA and Rackspace in 2010.
- Since 2012, OpenStack was managed by OpenStack Foundation. Now it has been renamed as Open Infrastructure Foundation.
- OpenStack is one platform for managing Virtual Machines and Containers like Docker, Kubernetes and Mesos
- OpenStack can also be deployed on Bare Metal.
- It is mainly deployed as Infrastructure as a Service layer of the cloud.
- It provides the virtual servers and other computing resources to the users.
- OpenStack comes with a large number of components to manage the cloud resources.
- Each of these OpenStack component control a specific resource like storage, networking, pools of processing, identity service, VM image service etc.
- These resources can be managed by the users by three methods.
- Command line interface by using command line tools
- Through a web based interface and a OpenStack dashboard application called Horizon.
- Users can also access the OpenStack services through RESTful API provided by OpenStack, mainly used by the developers.



## 7. In general OpenStack follows the Open principles as

- I. Open Source
- II. Open Design
- III. Open Community
- IV. Open Development

Some companies that use OpenStack :

- Walmart, Ebay, Snapdeal, MIT
- Harvard University, Volkswagon

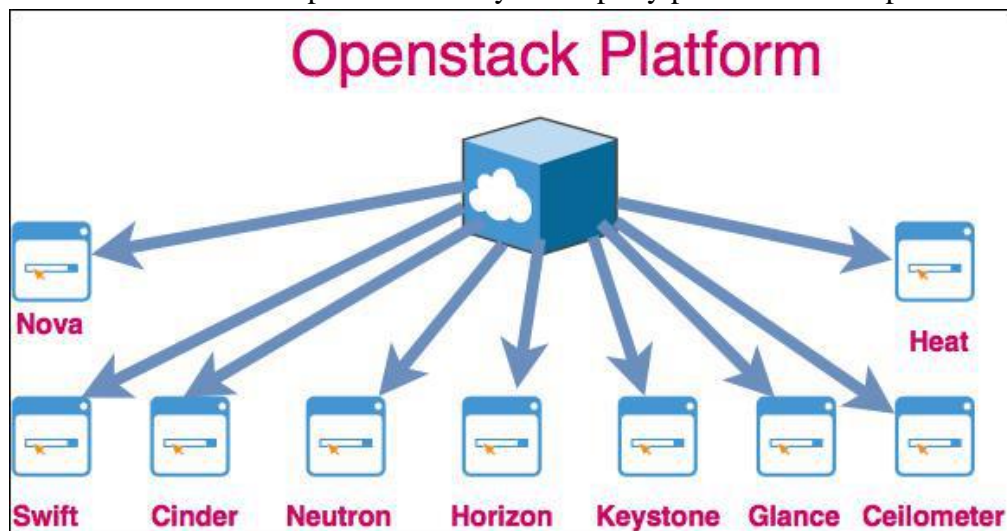
## 25 Million Cores of OpenStack in Production



## 8. OpenStack Components

- OpenStack has various components and each of them perform a separate and independent activity in the cloud infrastructure.
- Nova (Compute)

- i. Nova provides a way to provision compute instances as virtual machines, real hardware servers through the use of Ironic (a low level service)
- Neutron (Networking)
  - i. Neutron services provides network connectivity interface devices via vNICs between VM's and other virtual resources.
  - ii. It implements the OpenStack Networking API.
- Glance(Image)
  - i. Glance provides a service where users can upload and discover data assets that are meant to be used with other services.
  - ii. This currently includes OS VM images and metadata definitions.
- Cinder (Block Storage)
  - i. Cinder is the OpenStack Block Storage service for providing volumes to store Nova virtual machines, Ironic bare metal hosts, containers.
  - ii. Cinder volumes provide persistent storage to guest virtual machines - known as instances, that are managed by OpenStack Compute software
- Keystone (Identity)
  - i. Keystone service that provides client authentication, service discovery, and distributed multi-tenant authorization by using Identity API.
  - ii. It is the common authentication system across the cloud operating system.
- Horizon (Dashboard)
  - i. Horizon provides a single point management of all services and components of the OpenStack environment.
  - ii. It manages images, block storage, networking, VM instances, identity services and overall management of cloud.
  - iii. It is a web based interface with three types of dashboard User Dashboard, Sytsem Dashboard and Settings dashborad
- Other OpenStack Components are
- Heat (Orchestration)
  - i. Heat provides orchestration of multiple composite cloud applications using templates.
- Trove (Database)
  - i. Trove is a database-as-a-service provisioning relational and a non-relational database engine.
- Sahara (Elastic MapReduce – Hadoop)
  - ii. Sahara is a component to easily and rapidly provision Hadoop clusters



## 9. Installing OpenStack private cloud

- ▶ System requirements
  - ▶ Intel I3 processor (minimum higher the better)
  - ▶ Min 4 GB RAM, 8 GB Ideal, 16 GB most preferred
  - ▶ 100 GB Hard Disk space
  - ▶ Internet connectivity and NIC
  - ▶ Linux Operating System
  - ▶ Generally installed on Ubuntu 14.04 ideally 18.04
- ▶ Complete instructions of installation are given in the page  
<https://docs.openstack.org/devstack/latest/guides/sing-le-machine.html>
- ▶ OpenStack all-in-one Installation Steps
- ▶ **Step 1 :** Install fresh Ubuntu Linux on your computer.
  - ▶ Download a MinimalCD version of Ubuntu 18.04
  - ▶ Burn the mini.iso file on a CD or USB Pendrive and make it bootable
  - ▶ Install the Ubuntu on your computer.
  - ▶ After installing Linux update and upgrade the system
    - ▶ `$ sudo apt-get update`
    - ▶ `$ sudo apt-get upgrade`
  - ▶ Now your Linux Box is ready for OpenStack installation.
- ▶ OpenStack all-in-one Installation Steps
- ▶ **Step 2 :** Check IP address of your computer.
  - ▶ Installation of OpenStack is online process means your computer must be connected to the internet.
  - ▶ Check the IP address of your computer by command
    - ▶ `$ ipconfig`
  - ▶ Write down the IP address like 192.168.X.X. on some paper. It will be required to create floating IP network.
- ▶ OpenStack all-in-one Installation Steps
- ▶ **Step 3 :** Create a new user and add permission.
  - ▶ Create a new user in the system by name stack
    - ▶ `$ sudo useradd -s /bin/bash -d /opt/stack -m stack`
    - ▶ `$ sudo chmod +x /opt/stack`
    - ▶ `$ apt-get install sudo -y || yum install -y sudo`
    - ▶ `$ echo "stack ALL=(ALL) NOPASSWD: ALL" >> /etc/sudoers`
  - ▶ Now login using new user created

- ▶ \$ sudo su stack && cd ~
- ▶ These step can be skipped.
- ▶ OpenStack all-in-one Installation Steps
- ▶ **Step 4 :** Download DevStack (version of Openstack.  
 \$ sudo apt-get install git -y || sudo yum install -y git  
 \$ git clone https://opendev.org/openstack/devstack  
 \$ cd devstack
  - ▶ Create the OpenStack configuration file “local.conf”
  - ▶ DevStack includes a sample in devstack/samples/local.conf.
  - ▶ Write following into the file using any Linux Text editor

[[local|localrc]]

FLOATING\_RANGE=192.168.1.224/27

FIXED\_RANGE=10.11.12.0/24

ADMIN\_PASSWORD=supersecret

DATABASE\_PASSWORD=iheartdatabases

RABBIT\_PASSWORD=flopsymopsy

SERVICE\_PASSWORD=iheartksl

- ▶ OpenStack all-in-one Installation Steps
- ▶ **Step 5 :** Start the installation
  - ▶ Type the command as below to start installation

\$ ./stack.sh

- This will start OpenStack installation on your computer which make take 2 to 3 hrs. depending on your computer’s configuration
- Take a hot Coffee Cup and watch the installation !!!!
- After installation is complete open the OpenStack Dashboard – Horizon by writing IP address on the web browser.
  - 192.168.1.201/

## **10. Conclusion :**

OpenStack is an open source platform that uses pooled virtual resources to build and manage private and public clouds. The tools that comprise the OpenStack platform, called "projects," handle the core cloud-computing services of compute, networking, storage, identity, and image services. More than a dozen optional projects can also be bundled together to create unique, deployable clouds.

In virtualization, resources such as storage, CPU, and RAM are abstracted from a variety of vendor-specific programs and split by a hypervisor before being distributed as needed. OpenStack uses a consistent set of application programming interfaces (APIs) to abstract those virtual resources 1 step further

into discrete pools used to power standard cloud computing tools that administrators and users interact with directly.

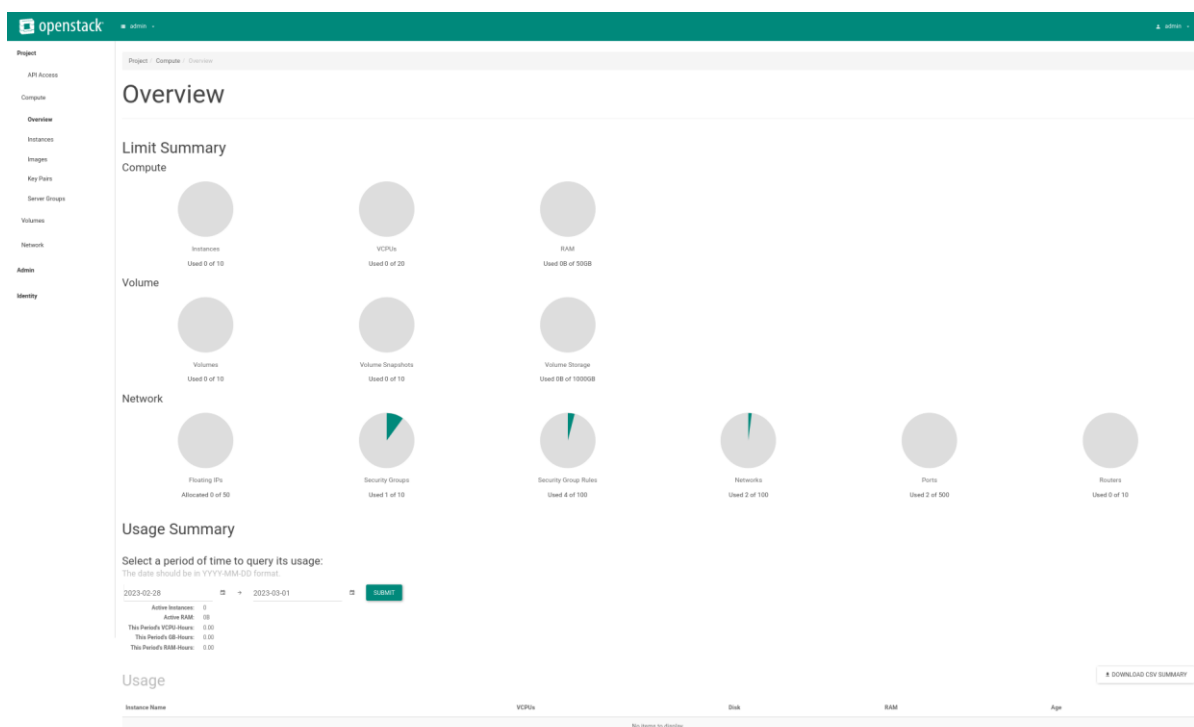
## 11. Viva Questions:

- What are the different components of Open stack
- List out the Open stack applications/users
- Define openstack as an private cloud.

## 12. References:

- <https://docs.openstack.org/devstack/latest/guides/single-machine.html>

## 13. Screenshots :



- New Testing Project Created for creation of Instances



openstack

admin

admin

Project

Admin

Identity

Domains

Projects

Users

Groups

Roles

Application Credentials

Identity / Projects

Projects

PROJECT NAME =

FILTER

+ CREATE PROJECT

DELETE PROJECTS

Displaying 6 items

<input type="checkbox"/>	Name	Description	Project ID	Domain Name	Enabled	Actions
<input type="checkbox"/>	service		5d33a82df87b4a37b2e0cbdd55d6b460	Default	Yes	MANAGE MEMBERS
<input type="checkbox"/>	invisible_to_admin		5e229762d883430b951444c7fec39cd7	Default	Yes	MANAGE MEMBERS
<input type="checkbox"/>	alt_demo		74e6e1732ddd477d9b7ad2fc617bab0b	Default	Yes	MANAGE MEMBERS
<input type="checkbox"/>	demo		cbd87fc7762444768826aa34047a0055	Default	Yes	MANAGE MEMBERS
<input type="checkbox"/>	Testing	Testbed	e5386c13b0284f6eaa0329ea874104bc	Default	Yes	MANAGE MEMBERS
<input type="checkbox"/>	admin	Bootstrap project for initializing the cloud.	e9bf2c26057e4dbcad58b82204a7ebdd	Default	Yes	MANAGE MEMBERS

Displaying 6 items

- Testing Project Dashboard

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Testing

admin

Project

API Access

Compute

Overview

Instances

Images

Key Pairs

Server Groups

Volumes

Network

Identity

Project / Compute / Overview

Overview

Limit Summary

Compute

Instances

Used 0 of 10

VCPUs

Used 0 of 20

RAM

Used 0 of 10GB

Volume

Volumes

Used 0 of 10

Volume Snapshots

Used 0 of 10

Volume Storage

Used 0B of 100GB

Network

Floating IPs

Allocated 0 of 50

Security Groups

Used 0 of 10

Security Group Rules

Used 0 of 100

Networks

Used 0 of 100

Ports

Used 0 of 500

Routers

Used 0 of 10

Usage Summary

Select a period of time to query its usage:

2023-02-28

2023-03-01

GO

Active Instances

0

Active RAM

0B

This Period's VCPUs Usage

0.00

This Period's SRM Usage

0.00

This Period's SRM Usage

0.00

Usage

Instances Name

VCPUs

RAM

SRM

Age

- Created instance

openstack

Testing

admin

Project

API Access

Compute

Overview

Instances

Images

Key Pairs

Server Groups

Volumes

Network

Identity

Project / Compute / Instances

Instances

INSTANCE ID =

FILTER

LAUNCH INSTANCE

DELETE INSTANCES

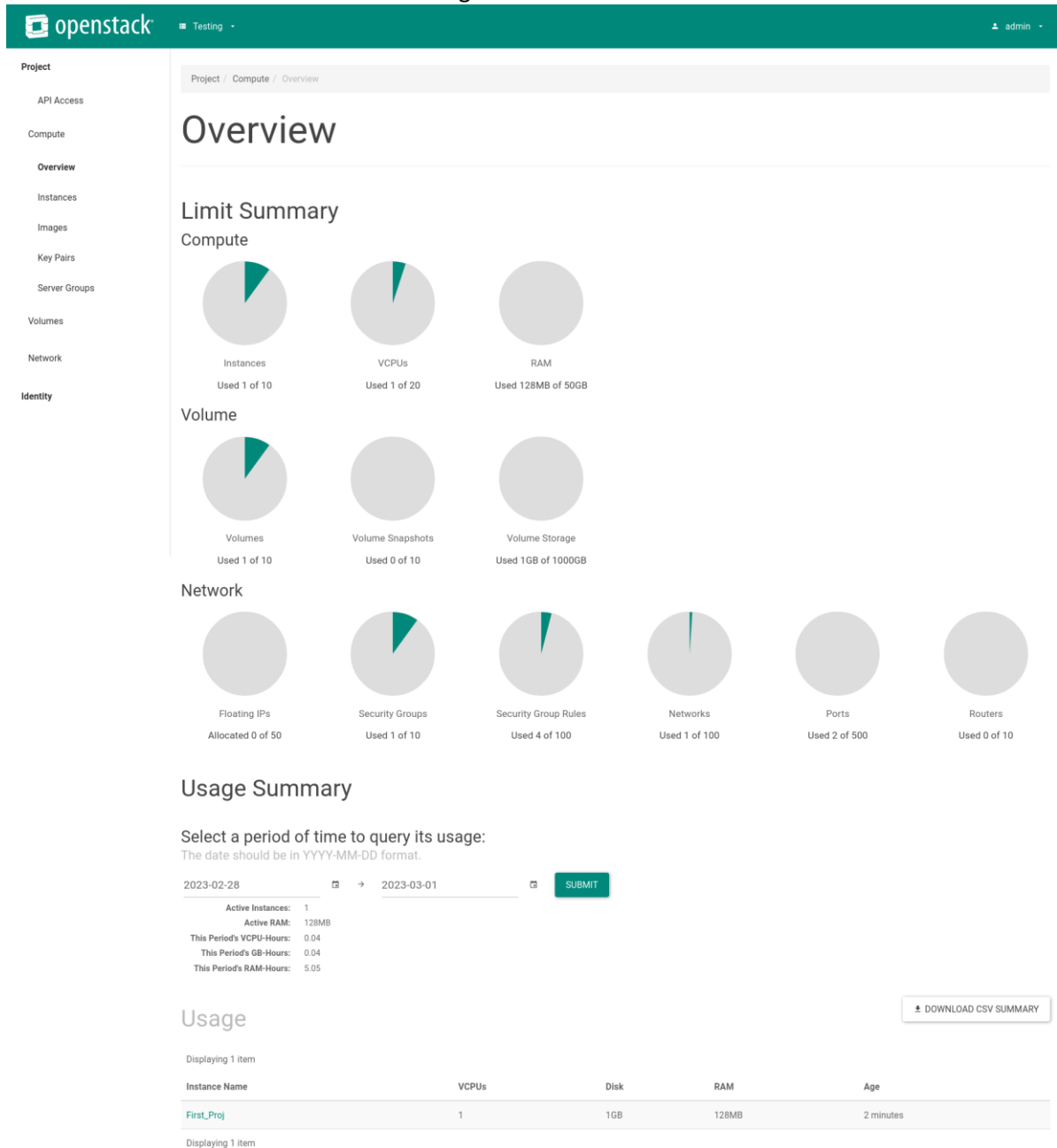
MORE ACTIONS

Displaying 1 item

<input type="checkbox"/>	Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
<input type="checkbox"/>	First_Proj	-	192.168.1.168	m1.nano	-	Active	nova	None	Running	0 minutes	CREATE SNAPSHOT

Displaying 1 item

- Utilization Overview after launching an instance



- Instance console login

openstack

Testing

admin

Project

API Access

Compute

Overview

Instances

Images

Key Pairs

Server Groups

Volumes

Network

Identity

Project / Compute / Instances / First\_Proj

First\_Proj

CREATE SNAPSHOT

Overview

Interfaces

Log

Console

Action Log

Instance Console

If console is not responding to keyboard input: click the grey status bar below. [Click here to show only console](#)

To exit the fullscreen mode, click the browser's back button.

Connected to QEMU (instance-00000001)

Send CtrlAltDel

```
[ 0.914876] eum: security.capability
[ 0.915537] eum: HMAC attrs: 0x1
[ 0.917887] PM: Magic number: 15:90:259
[ 0.917954] rtc_cmos 00:04: setting system clock to 2023-03-01T03:15:42 UTC (
1677640542)
[ 1.020749] Freeing unused decrypted memory: 2040K
[ 1.022572] Freeing unused kernel image memory: 2660K
[ 1.023530] Write protecting the kernel read-only data: 22528k
[ 1.026544] Freeing unused kernel image memory: 2008K
[ 1.029510] Freeing unused kernel image memory: 1476K
[ 1.039082] x86/mm: Checked W*X mappings: passed, no W*X pages found.
[ 1.040155] x86/mm: Checking user space page tables
[ 1.049360] x86/mm: Checked W*X mappings: passed, no W*X pages found.
[ 1.050381] Run /init as init process

further output written to /dev/ttyS0
[ 1.109202] virtio_blk virtio2: [vdal 2097152 512-byte logical blocks (1.07 G
B/1.00 GiB)
[ 1.114259] GPT:Primary header thinks Alt. header is not at the end of the di
sk.
[ 1.115157] GPT:229375 != 2097151
[ 1.115620] GPT:Alternate GPT header not at the end of the disk.
[ 1.116296] GPT:229375 != 2097151
[ 1.116741] GPT: Use GNU Parted to correct GPT errors.
[ 1.201829] random: fast init done
[ 1.202761] random: crng init done

login as 'cirros' user, default password: 'gocubsgo'. use 'sudo' for root.
first-proj login: cirros
Password:
$ df -h
Filesystem      Size      Used Available Use% Mounted on
/dev            43.3M      0      43.3M   0% /dev
/dev/vdal       985.9M    31.4M    922.9M   3% /
tmpfs           50.4M      0      50.4M   0% /dev/shm
tmpfs           50.4M     80.0K     50.3M   0% /run
$ -
```

- Network Topology

openstack

Testing

admin

Project

API Access

Compute

Volumes

Network

Network Topology

Networks

Routers

Security Groups

Floating IPs

Identity

Project / Network / Network Topology

Network Topology

LAUNCH INSTANCE

CREATE NETWORK

CREATE ROUTER

Topology

Graph

SMALL

NORMAL

```

graph TD
    public[public] --- shared[shared]
    shared --- private[private]
    private --- icon[ ]
    style icon fill:none,stroke:none
  
```

LAUNCH INSTANCE

CREATE NETWORK

CREATE ROUTER

11