



OpenStack Labs

Lab 04: Deploying an External Instance

Contents

Introduction	iii
Objectives	iv
Lab Settings.....	v
1 Managing External Networks	1
2 Preparing OpenStack Routers to Deploy an Instance.....	10
3 Maintaining Floating IP Addresses.....	17
4 Managing SSH Key Pairs	24
5 Implementing Security.....	27
6 Launching and Verifying an External Instance	33

About This Document

- This document was developed by a team at the University of Tennessee at Chattanooga led by Dr. Mengjun Xie (mengjun-xie@utc.edu).
- The development of this document was supported by a National Centers of Academic Excellence in Cybersecurity Grant (#H98230-20-1-0351), housed at the National Security Agency.
- This document is licensed with a Creative Commons Attribution 4.0 International License.

Introduction

Up to this point, everything you have worked on has been local to the OpenStack environment. In this lab, you will learn the various concepts necessary to give OpenStack instances and networks external connectivity. You will manage external networks, routers, and floating IP addresses to give OpenStack instances and networks external connectivity; SSH key pairs to allow you to connect to an OpenStack instance from outside the OpenStack environment; and security groups to prevent unwanted traffic in the network. These resources will come together to allow OpenStack instances to provide services outside the OpenStack cloud and allow you to manage instances from outside the cloud.

Objectives

- Create and manage external networks.
- Create and manage OpenStack routers.
- Create and manage floating IP addresses.
- Create and manage SSH key pairs.
- Create and manage security groups.
- Launch and verify an external instance.

Lab Settings

The information in the table below will be needed in order to complete the lab. The task sections below provide details on the use of this information.

Virtual Machine	IP Address	Account	Password
workstation	ens3: 192.168.1.21 ens4: 172.25.250.21	ubuntu	ubuntu
devstack	ens3: 192.168.20 ens4: 172.25.250.20	ubuntu	ubuntu

1 Managing External Networks

In this task, you will use the *Horizon Dashboard* and the **OpenStack Unified CLI** to create and configure an external network.

- 1.1. Log into the **workstation** machine as the **ubuntu** user with password **ubuntu**.

```
Ubuntu 18.04.6 LTS workstation tty1
workstation login: ubuntu
Password:
```

- 1.2. Launch the graphical user interface.

```
ubuntu@workstation:~$ startx
```

```
Welcome to Ubuntu 18.04.6 LTS (GNU/Linux 4.15.0-213-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/advantage

 System information as of Fri Jun  7 21:01:55 UTC 2024

 System load:  0.6           Processes:      197
 Usage of /:   7.9% of 116.12GB  Users logged in:    0
 Memory usage: 13%
 Swap usage:   0%           IP address for ens3: 192.168.1.21
                           IP address for ens4: 172.25.250.21

 Expanded Security Maintenance for Infrastructure is not enabled.

 2 updates can be applied immediately.
 To see these additional updates run: apt list --upgradable

 146 additional security updates can be applied with ESM Infra.
 Learn more about enabling ESM Infra service for Ubuntu 18.04 at
 https://ubuntu.com/18-04

ubuntu@workstation:~$ startx_
```

- 1.3. Open the web browser. Navigate to **192.168.1.20** and log in to the dashboard as **admin** with the password **secret**. In this lab, we will create our own public network and router. The **demo** project already has a default router and public network, so those need to be deleted first.
- 1.4. Switch to the **demo** project. Navigate to **Admin > Network > Routers**. Check the box in the same row as **router1**, then click **Delete Routers**.

The screenshot shows the OpenStack interface under the 'demo' project. The left sidebar has 'Admin' selected. The main content area is titled 'Routers' and displays one item: 'router1' (Project: demo, Status: Active, External Network: public, Admin State: UP). There is a red box around the 'Router Name' search bar and a red button labeled 'Delete Routers'.

- 1.5.** Now, navigate to **Networks**. Check the box in the same row as **public**, then click **Delete Networks**.

The screenshot shows the OpenStack interface under the 'demo' project. The left sidebar has 'Admin' selected. The main content area is titled 'Networks' and displays three items: 'public' (Project: admin, Subnets: ipv6-public-subnet, ipv6-public-subnet), 'private' (Project: demo, Subnets: ipv6-private-subnet, private-subnet), and 'shared' (Project: admin, Subnets: shared-subnet). A red box highlights the 'public' network row. There is a red button labeled 'Delete Networks'.

- 1.6.** Click **Create Network**.

The screenshot shows the OpenStack interface under the 'demo' project. The left sidebar has 'Admin' selected. The main content area is titled 'Networks' and displays four items: 'private' (Project: demo), 'shared' (Project: admin), 'public' (Project: admin), and a new network (Project: demo, Subnets: ipv6-private-subnet, private-subnet). There is a red box around the 'Create Network' button.

- 1.7. Enter **extern-net1** in the *Network Name* field. Select **demo** in the *Project* dropdown. For *Provider Network Type*, select **Flat**. Enter **public** into the *Physical Network* field. Check the *Shared* and *External Network* check boxes, and ensure the *Create Subnet* check box is checked. Click **Next** to go to the *Subnet* tab.

Create Network

Network * Subnet Subnet Details

Name: extern-net1

Project: demo

Provider Network Type: Flat

Physical Network: public

Enable Admin State

Shared

External Network

Create Subnet

Availability Zone Hints

MTU

Cancel Back Next

Note

The **public** physical network is different from the **public** network we just deleted. This physical network is the name assigned to the physical or provider network that OpenStack uses for external communication. This resource did not get deleted with

the network of the same name since they are independent. The **public** network that was deleted was a virtual network implemented on top of the physical network.

- 1.8. In the *Subnet* tab, enter **extern-subnet1** in the *Subnet Name* field, enter **172.25.250.0/24** in the *Network Address* field, and enter **172.25.250.254** in the *Gateway IP* field. Click **Next** to go to the *Subnet Details* tab.

Create Network

Network * Subnet Subnet Details

Subnet Name
extern-subnet1

Network Address Source
Enter Network Address manually

Network Address 172.25.250.0/24

IP Version IPv4

Gateway IP 172.25.250.254

Disable Gateway

Creates a subnet associated with the network. You need to enter a valid "Network Address" and "Gateway IP". If you did not enter the "Gateway IP", the first value of a network will be assigned by default. If you do not want gateway please check the "Disable Gateway" checkbox. Advanced configuration is available by clicking on the "Subnet Details" tab.

Cancel « Back Next »

- 1.9. In the *Subnet Details* tab, uncheck the *Enable DHCP* check box since we want to assign static IP addresses on this network. Enter **172.25.250.60**, **172.25.250.80** in the *Allocation Pools* field so that any IP address allocated for this network will fall in this range of addresses. Enter **172.25.250.254** in the *DNS Name Servers* field. Click **Create** to create the network and subnet.

Create Network

Network * Subnet Subnet Details

Enable DHCP

Specify additional attributes for the subnet.

Allocation Pools ?

172.25.250.60,172.25.250.80

DNS Name Servers ?

172.25.250.254

Host Routes ?

Cancel « Back Create

1.10. Log out of the *Horizon Dashboard* and close the web browser.

1.11. Open a terminal window and source the keystone credentials for the **admin** user.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

1.12. List the available networks.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list \
> --max-width 100
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list \
> --max-width 100
+-----+-----+
| ID      | Name    | Subnets |
+-----+-----+
| 966ecb4f-4ff8-44ea-a476-2d2f18955085 | private | 674205b6-1357-4727-a21a-94220492a57f,
|                                            |          | fa8a2545-5a8c-44a2-bacc-1b86c253b880
| 9f23266f-d833-4337-9a27-4818a6d28e9e | shared   | 7e456257-76e5-4fcf-bf3f-b2a3876dba40
| d4c0e1c8-0cb5-4e1c-90b1-3f9a3b392e88 |          | 93a361f0-2637-4e7d-b41c-88fa0209350b
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ ]
```

Tip

When typing the command, make sure there is a space between **extern-net2** and the \ character, and press **Enter** to get the > and continue typing the rest of the command.

Tip

To keep the output from overflowing while keeping the formatting intact, use the **--max-width n** option to limit the output to **n** characters per line. This is especially useful for commands that output long IDs or have many columns in the output table.

- 1.13.** The next set of steps will show how to recreate the external network from the beginning of the lab using the CLI. To free up the necessary resources, first delete the **extern-net1** network. This will also delete the **extern-subnet1** subnet.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network delete extern-net1
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network delete extern-net1
[ubuntu@workstation (keystone-admin)]:~$ ]
```

- 1.14.** List the networks again to confirm that **extern-net1** was deleted successfully.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list \
> --max-width 100
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list \
> --max-width 100
+-----+-----+
| ID      | Name    | Subnets |
+-----+-----+
| 966ecb4f-4ff8-44ea-a476-2d2f18955085 | private | 674205b6-1357-4727-a21a-94220492a57f,
|                                            |          | fa8a2545-5a8c-44a2-bacc-1b86c253b880
| 9f23266f-d833-4337-9a27-4818a6d28e9e | shared   | 7e456257-76e5-4fcf-bf3f-b2a3876dba40
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ ]
```

- 1.15.** Create an external network named **extern-net2**. Set the network type to **flat** and the physical network to **public**. Set the network as shared and external.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network create \
> --external --share \
> --provider-network-type flat \
> --provider-physical-network public \
> extern-net2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network create \
> --external --share \
> --provider-network-type flat \
> --provider-physical-network public \
> extern-net2
+-----+
| Field | Value |
+-----+
| admin_state_up | UP |
| availability_zone_hints | |
| availability_zones | |
| created_at | 2024-06-17T18:45:46Z |
| description | |
| dns_domain | None |
| id | d1e72c9b-87be-4b48-aa49-a39b1f232e14 |
| ipv4_address_scope | None |
| ipv6_address_scope | None |
| is_default | False |
| is_vlan_transparent | None |
| mtu | 1500 |
| name | extern-net2 |
| port_security_enabled | True |
| project_id | 39e851b14f864573aad60582c35e40dc |
| provider:network_type | flat |
| provider:physical_network | public |
| provider:segmentation_id | None |
| qos_policy_id | None |
| revision_number | 1 |
| router:external | External |
| segments | None |
| shared | True |
| status | ACTIVE |
| subnets | |
| tags | |
| updated_at | 2024-06-17T18:45:46Z |
+-----+
[ubuntu@workstation (keystone-admin)]:~$
```

- 1.16. Create a subnet named **extern-subnet2** in the **extern-net2** network. Give the subnet a range of **172.25.250.60** to **172.25.250.80**. Disable DHCP services for the subnet and use the address **172.25.250.254** as the gateway as well as the DNS name server.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack subnet create \
> --subnet-range 172.25.250.0/24 \
> --no-dhcp \
> --gateway 172.25.250.254 \
> --dns-nameserver 172.25.250.254 \
> --allocation-pool start=172.25.250.60,end=172.25.250.80 \
> --network extern-net2 \
> extern-subnet2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack subnet create \
> --subnet-range 172.25.250.0/24 \
> --no-dhcp \
> --gateway 172.25.250.254 \
> --dns-nameserver 172.25.250.254 \
> --allocation-pool start=172.25.250.60,end=172.25.250.80 \
> --network extern-net2 \
> extern-subnet2
+-----+
| Field          | Value
+-----+
| allocation_pools | 172.25.250.60-172.25.250.80
| cidr           | 172.25.250.0/24
| created_at     | 2024-06-17T18:48:22Z
| description    |
| dns_nameservers | 172.25.250.254
| enable_dhcp    | False
| gateway_ip     | 172.25.250.254
| host_routes    |
| id              | 1534a6ca-bde0-4d67-8b6f-1edd4d67b2f1
| ip_version      | 4
| ipv6_address_mode | None
| ipv6_ra_mode    | None
| name            | extern-subnet2
| network_id      | d1e72c9b-87be-4b48-aa49-a39b1f232e14
| project_id      | 39e851b14f864573aad60582c35e40dc
| revision_number | 0
| segment_id      | None
| service_types   |
| subnetpool_id   | None
| tags             |
| updated_at       | 2024-06-17T18:48:22Z
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 1.17.** List the networks again to see that **extern-net2** and **extern-subnet2** were created successfully.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list \
> --max-width 100
```

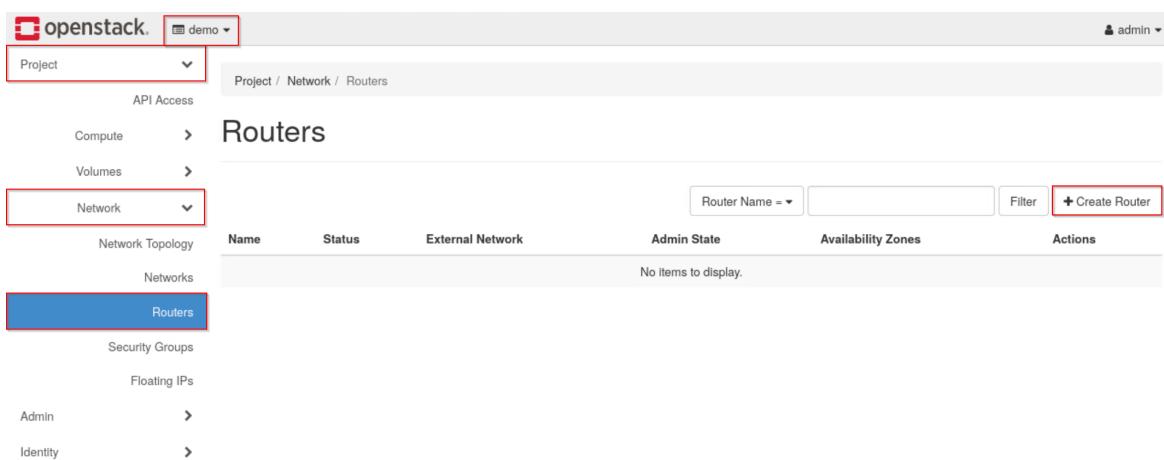
```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list \
> --max-width 100
+-----+-----+
| ID      | Name    | Subnets |
+-----+-----+
| 966ecb4f-4ff8-44ea-a476-2d2f18955085 | private | 674205b6-1357-4727-a21a-94220492a57f,
|                                            |          | fa8a2545-5a8c-44a2-bacc-1b86c253b880
| 9f23266f-d833-4337-9a27-4818a6d28e9e | shared   | 7e456257-76e5-4cf5-bf3f-b2a3876dba40
| d1e72c9b-87be-4b48-aa49-a39b1f232e14 | extern-net2 | 1534a6ca-bde0-4d67-8b6f-1edd4d67b2f1
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 1.18.** Leave the terminal window open and continue to the next task.

2 Preparing OpenStack Routers to Deploy an Instance

In this task, you will create and configure a router using the *Horizon Dashboard* and *OpenStack CLI* and use command line tools to test the connectivity of the router. The router will serve to connect the external instance to other networks both within OpenStack and outside the cloud.

- 2.1. Open the web browser and navigate to **192.168.1.20**. Log into the dashboard as **admin** with the password **secret**.
- 2.2. Switch to the **demo** project and navigate to **Project > Network > Routers**. Click **Create Router** to create a new router.



- 2.3. Enter **router1** in the *Router Name* field and select **extern-net2** in the *External Network* dropdown. Click **Create Router**.

Create Router

Router Name

router1

Description:

Creates a router with specified parameters.

 Enable Admin State ?

Enable SNAT will only have an effect if an external network is set.

External Network

extern-net2

 Enable SNAT
Availability Zone Hints ?
[Cancel](#)[Create Router](#)

- 2.4.** Click the router name, **router1**, to access its details.

Routers						
		Router Name = <input type="text"/>		Filter	+ Create Router	Delete Routers
Displaying 1 item						
<input type="checkbox"/>	Name	Status	External Network	Admin State	Availability Zones	Actions
<input type="checkbox"/>	router1	Active	extern-net2	UP	-	Clear Gateway <input type="button" value="▼"/>

Displaying 1 item

- 2.5.** Click the **Interfaces** tab to manage the interfaces for the router. Notice that currently, the router only has an interface connecting it to the **extern-net2** external network. This will connect instances on this network to networks outside the cloud. We will add an interface to connect **extern-net2** to another network within the OpenStack cloud environment. Click **Add Interface** to add a new interface.

Project / Network / [Routers](#) / router1

router1

[Clear Gateway](#)

[Overview](#) **Interfaces** [Static Routes](#)

[+ Add Interface](#) [Delete Interfaces](#)

Displaying 1 item

<input type="checkbox"/> Name	Fixed IPs	Status	Type	Admin State	Actions
<input type="checkbox"/> (cb7e60cc-60c9)	• 172.25.250.63	Active	External Gateway	UP	Delete Interface

Displaying 1 item

- 2.6.** Select **shared: 192.168.233.0/24 (shared-subnet)** from the *Subnet* dropdown and click **Submit** to add the interface. This will connect the **extern-net2** network to the **shared** network.

Add Interface

Subnet *

shared: 192.168.233.0/24 (shared-subnet)

IP Address (optional) ?

Description:

You can connect a specified subnet to the router.

If you don't specify an IP address here, the gateway's IP address of the selected subnet will be used as the IP address of the newly created interface of the router. If the gateway's IP address is in use, you must use a different address which belongs to the selected subnet.

[Cancel](#)

Submit

Tip

You can delete an interface by selecting the checkbox next to the interface name, then clicking **Delete Interfaces**. Alternatively, simply click **Delete Interface** in the same row as the target interface.

- 2.7.** Log out of the dashboard and close the web browser.

- 2.8.** Open a terminal window if one is not already open, and source the **admin** credentials.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.9. Next, we will recreate this router using the CLI, so we will delete **router1**. First, however, we will see how to remove subnets and gateways from the router. Recall that in a previous step, we added an interface to connect **router1** to the **shared-subnet** subnet on the **shared** network. Remove the connection to this subnet.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router remove subnet \
> router1 \
> shared-subnet
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router remove subnet \
> router1 \
> shared-subnet
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.10. Unset the **extern-net2** network as the gateway for the router.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router unset \
> --external-gateway router1
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router unset \
> --external-gateway router1
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.11. Delete the **router1** router.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router delete router1
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router delete router1
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

Deleting a router will also delete its associated interfaces, subnets, and gateways. The previous steps that performed these steps manually were only for demonstration and are not necessary for simply deleting the router.

- 2.12. Now, we will replicate the previous router using the CLI. Create a router named **router2**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router create router2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router create router2
+-----+-----+
| Field          | Value   |
+-----+-----+
| admin_state_up | UP      |
| availability_zone_hints |           |
| availability_zones |           |
| created_at     | 2024-06-17T21:13:43Z |
| description    |           |
| distributed    | False   |
| external_gateway_info | None   |
| flavor_id      | None   |
| ha             | False   |
| id             | 2ec1b86d-a3ab-4c41-a1c9-af0b006270b3 |
| name           | router2 |
| project_id     | 39e851b14f864573aad60582c35e40dc |
| revision_number | 1      |
| routes         |           |
| status          | ACTIVE  |
| tags            |           |
| updated_at     | 2024-06-17T21:13:43Z |
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.13. Connect the router to the **shared-subnet** subnet.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router add subnet \
> router2 \
> shared-subnet
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router add subnet \
> router2 \
> shared-subnet
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.14. Set the **extern-net2** network as the gateway for the router.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router set \
> --external-gateway extern-net2 \
> router2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router set \
> --external-gateway extern-net2 \
> router2
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.15. Show the details of the **router2** router. Take note of the IP address listed in the **external_gateway_info** row, as you will ping this address in a later step to verify that the router can be reached.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router show \
> --max-width 100 router2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack router show \
> --max-width 100 router2
+-----+-----+
| Field | Value |
+-----+-----+
| admin_state_up | UP
| availability_zone_hints | 
| availability_zones | 
| created_at | 2024-06-17T21:13:43Z
| description | 
| distributed | False
| external_gateway_info | {"network_id": "d1e72c9b-87be-4b48-aa49-a39b1f232e14", "enable_snat": true, "external_fixed_ips": [{"subnet_id": "1534a6ca-bde0-4d67-8b6f-1edd4d67b2f1", "ip_address": "172.25.250.79"}]}
| flavor_id | None
| ha | False
| id | 2ec1b86d-a3ab-4c41-a1c9-af0b006270b3
| interfaces_info | [{"subnet_id": "7e456257-76e5-4cfb-bf3f-b2a3876dba40", "ip_address": "192.168.233.1", "port_id": "cb077fb5-259e-48b9-a7b4-30d09a87369e"}]
| name | router2
| project_id | 39e851b14f864573aad60582c35e40dc
| revision_number | 6
| routes | 
| status | ACTIVE
| tags | 
| updated_at | 2024-06-17T21:15:52Z
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 2.16.** In order to test the connectivity of the router, SSH into the **devstack** virtual machine. Log in with the password **ubuntu**.

```
[ubuntu@workstation (keystone-admin)]:~$ ssh 192.168.1.20
```

```
[ubuntu@workstation (keystone-admin)]:~$ ssh 192.168.1.20
ubuntu@192.168.1.20's password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-94-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

This system has been minimized by removing packages and content that are
not required on a system that users do not log into.

To restore this content, you can run the 'unminimize' command.
Last login: Fri Feb  9 22:37:16 2024
ubuntu@devstack:~$ █
```

- 2.17.** Use the **ping** command on the IP address found from the **openstack router show** command to verify that the router can be reached. Receiving ping replies verifies the connectivity of the router since the **devstack** machine is outside the OpenStack cloud environment.

```
ubuntu@devstack:~$ ping -c3 172.25.250.79
```

```
ubuntu@devstack:~$ ping -c3 172.25.250.79
PING 172.25.250.79 (172.25.250.79) 56(84) bytes of data.
64 bytes from 172.25.250.79: icmp_seq=1 ttl=254 time=52.8 ms
64 bytes from 172.25.250.79: icmp_seq=2 ttl=254 time=0.587 ms
64 bytes from 172.25.250.79: icmp_seq=3 ttl=254 time=0.577 ms

--- 172.25.250.79 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2004ms
rtt min/avg/max/mdev = 0.577/17.999/52.835/24.632 ms
ubuntu@devstack:~$ █
```

Note

The actual IP address may differ from this example.

Note

You should receive three successful ping replies.

2.18. Exit the SSH session.

```
[ubuntu@workstation (keystone-admin)]:~$ exit
```

```
ubuntu@devstack:~$ exit
logout
Connection to 192.168.1.20 closed.
[ubuntu@workstation (keystone-admin)]:~$ █
```

2.19. Leave the terminal window open and continue to the next task.

3 Maintaining Floating IP Addresses

In this task, you will create a floating IP address and allocate it to an instance using the Horizon Dashboard and the OpenStack Unified CLI. While instances are assigned a private, fixed IP address at creation to communicate with other instances, they can also be assigned a floating IP address, which is used for communication outside the OpenStack cloud environment. While the private IP address of instance is fixed until the instance is deleted, a floating IP address can be exchanged for a different one while the instance is still running.

- 3.1. If a terminal window is not already open, open one and source the admin credentials from the `~/keystonerc-admin` file.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 3.2. Create a new instance named `instance1`. Use the `ubuntu` image, `m1.small` flavor, and `shared` network.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --nic net-id=shared \
> instance1
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --nic net-id=shared \
> instance1
+-----+-----+
| Field | Value |
+-----+-----+
| OS-DCF:diskConfig | MANUAL |
| OS-EXT-AZ:availability_zone | None |
| OS-EXT-SRV-ATTR:host | None |
| OS-EXT-SRV-ATTR:hypervisor_hostname | None |
| OS-EXT-SRV-ATTR:instance_name | NOSTATE |
| OS-EXT-STS:power_state | scheduling |
| OS-EXT-STS:task_state | building |
| OS-SRV-USG:launched_at | None |
| OS-SRV-USG:terminated_at | None |
| accessIPv4 | |
| accessIPv6 | |
| addresses | |
| adminPass | wnVeGACMWP7 |
| config_drive | |
| created | 2024-06-17T21:36:11Z |
| flavor | m1.small (2) |
| hostId | |
| id | 65fd940b-fe45-4acc-80e9-f282c4615fb0 |
| image | ubuntu (329d361e-f6dc-4b72-b200-3de0ec230e65) |
| key_name | None |
| name | instance1 |
| progress | 0 |
| project_id | 39e851b14f864573aad60582c35e40dc |
| properties | |
| security_groups | name='default' |
| status | BUILD |
| updated | 2024-06-17T21:36:10Z |
| user_id | 14f5376f00c04e90b7103dd8d4263040 |
| volumes_attached | |
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ ]
```

- 3.3. Leave the terminal window open and open the web browser. Navigate to **192.168.1.20**. Log into the *Horizon Dashboard* as the **admin** user with the password **secret**.
- 3.4. Switch to the **demo** project. Navigate to **Project > Network > Floating IPs**. Click **Allocate IP to Project**.

The screenshot shows the OpenStack interface under the 'demo' project. The navigation path is 'Project / Network / Floating IPs'. On the left, the 'Network' dropdown is highlighted with a red box. At the top right, there is a 'Allocate IP To Project' button, which is also highlighted with a red box.

3.5. Ensure `extern-net2` is set as the *Pool*. Click **Allocate IP**.

The screenshot shows the 'Allocate Floating IP' dialog box. The 'Pool' dropdown is set to 'extern-net2' and is highlighted with a red box. The 'Allocate IP' button at the bottom right is also highlighted with a red box.

Tip

A floating IP address can be deleted, or released, in multiple ways. One way is to select the checkbox next to the floating IP address, and click **Release Floating IPs**. Another way is to open the dropdown next to the **Associate** button in the same row as the floating IP address, then click **Release Floating IP**.

3.6. Click **Associate** in the row of the floating IP address.

Project / Network / Floating IPs

Floating IPs

Floating IP Address = Filter

<input type="checkbox"/> IP Address	Description	DNS Name	DNS Domain	Mapped Fixed IP Address	Pool	Status	Actions
<input type="checkbox"/> 172.25.250.62				-	extern-net2	Down	

Displaying 1 item

Note

The actual value of the floating IP address may differ.

- 3.7. In the *Port to be associated* dropdown, select **instance1: 192.168.233.XYZ**. Click **Associate**.

Manage Floating IP Associations


IP Address *



Select the IP address you wish to associate with the selected instance or port.

Port to be associated *

Note

The actual value of the instance's IP address may differ.

- 3.8. The **instance1** instance is now connected to the **extern-net2** network through this floating IP address. To remove a floating IP address, first navigate to **Compute > Instances**. Click the arrow next to the **Create Snapshot** in the same as **instance1**. Select **Disassociate Floating IP** to detach the floating IP from the instance.

The screenshot shows the OpenStack Horizon Dashboard with the 'Compute' project selected. Under the 'Instances' tab, there is one item listed: 'Instance1' (ubuntu). A context menu is open over this instance, with the 'Disassociate Floating IP' option highlighted.

- 3.9.** Check the *Release Floating IP* box and click **Disassociate**.

Disassociate Floating IP

Floating IP *

172.25.250.62

Release Floating IP

Description:

Select the floating IP to be disassociated from the instance.

Release Floating IP

If checked, the selected floating IP will be released at the same time.

Cancel Disassociate

Tip

A floating IP address can also be disassociated from the **Project > Network > Floating IPs** page. When a floating IP address has been associated with an instance, the button in the row of the floating IP address that used to read **Associate** will turn red and read **Disassociate**. Clicking this button will disassociate the floating IP address from its instance.

- 3.10.** Log out of the *Horizon Dashboard* and close the web browser.

- 3.11.** From the terminal, allocate a floating IP address in the **extern-net2** network.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip create \
> extern-net2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip create \
> extern-net2
+-----+-----+
| Field | Value |
+-----+-----+
| created_at | 2024-06-17T21:56:16Z
| description | None
| fixed_ip_address | None
| floating_ip_address | 172.25.250.75
| floating_network_id | d1e72c9b-87be-4b48-aa49-a39b1f232e14
| id | 829baa74-65a3-4e33-9eb6-9785e7781bc5
| name | 172.25.250.75
| port_id | None
| project_id | 39e851b14f864573aad60582c35e40dc
| qos_policy_id | None
| revision_number | 0
| router_id | None
| status | DOWN
| subnet_id | None
| updated_at | 2024-06-17T21:56:16Z
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

Tip

You can use the **-floating-ip-address IP_ADDRESS** argument to allocate a specific IP address. However, make sure to list the available addresses before attempting to allocate it. If that particular floating IP address already exists, the command will throw an *HttpException: Conflict* error.

Tip

A floating IP address can be disassociated from an instance using the command **openstack floating ip remove INSTANCE FLOATING_IP_ADDRESS** and deleted using the command **openstack floating ip delete IP_ADDRESS**.

3.12. Associate the floating IP with **instance1**.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server add \
> floating ip instance1 172.25.250.75
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server add floating ip \
> instance1 172.25.250.75
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

The actual floating IP may differ. Use the floating IP address generated from your output from the previous step.

- 3.13.** We will recreate this instance at the end of the lab once the rest of the necessary resources have been created. We will not need this instance anymore, so delete it. This will also disassociate the floating IP address, but it will still be available.

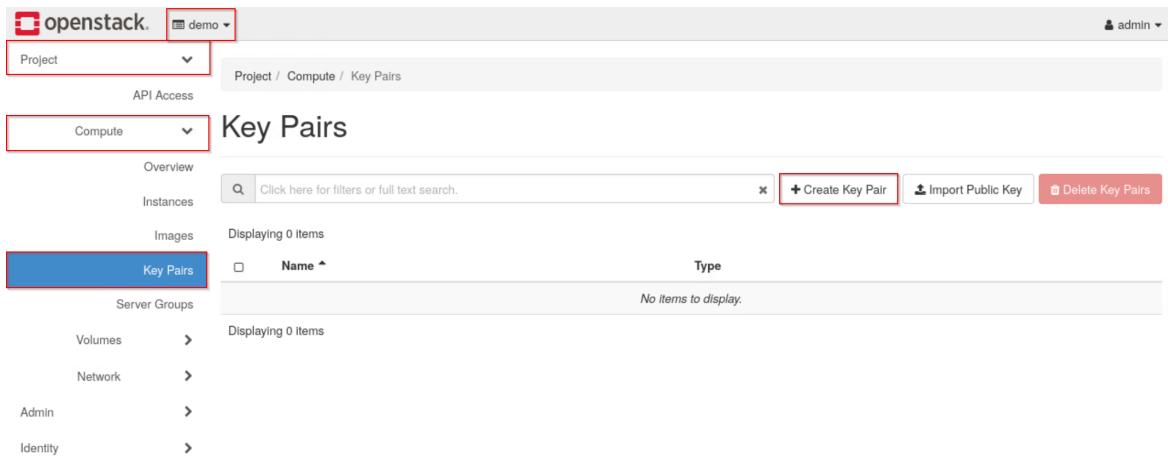
```
[ubuntu@workstation (keystone-admin)]:~$ openstack server delete instance1
```

- 3.14.** Leave the terminal window open and continue to the next task.

4 Managing SSH Key Pairs

In this task, you will use the *Horizon Dashboard* and *OpenStack Unified CLI* to manage SSH key pairs that will be used later in the lab to connect to OpenStack instances from outside the OpenStack environment.

- 4.1.** Switch to the **demo** project and navigate to **Project > Compute > Key Pairs**. Click **Create Key Pair** to create a new key pair.



The screenshot shows the OpenStack Horizon Dashboard. The top navigation bar has 'openstack.' and 'demo' selected. Below it, a dropdown menu shows 'Project' (selected), 'Compute' (selected), and 'API Access'. Under 'Compute', there are tabs for 'Overview', 'Instances', 'Images', and 'Key Pairs' (which is highlighted with a red box). Other tabs include 'Server Groups', 'Volumes', 'Network', 'Admin', and 'Identity'. On the right, there's a search bar with placeholder 'Click here for filters or full text search.', a 'Create Key Pair' button (highlighted with a red box), and links for 'Import Public Key' and 'Delete Key Pairs'.

- 4.2.** Enter **keypair1** in the *Key Pair Name* field, and select **SSH Key** in the *Key Type* dropdown. Click **Create Key Pair**. This will create the key pair and download it to the `~/Downloads` directory.



The dialog box is titled 'Create Key Pair'. It has fields for 'Key Pair Name *' (containing 'keypair1') and 'Key Type *' (set to 'SSH Key'). There are 'Cancel' and 'Create Key Pair' buttons at the bottom, with 'Create Key Pair' highlighted with a red box.

Tip

Key pairs can be deleted from the Horizon Dashboard the same way as other objects. Simply select the checkbox next to the key pair you wish to delete, then click **Delete Key Pairs**.

- 4.3.** Sign out of the Horizon Dashboard and close the web browser.

- 4.4.** If a terminal window is not already open, open one and source the **admin** credentials from the `~/keystonerc-admin` file.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.5.** We only need one key pair to connect to the external instance, so the key pair created from the Horizon Dashboard can safely be deleted in order to demonstrate creating a key pair from the command line. Delete the **keypair1** key pair.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack keypair delete keypair1
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack keypair delete keypair1
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

Note that a key pair in the context of OpenStack is actually a misnomer. The key pair object really only refers to the public key, while the private key only exists in the file in which it is saved. Therefore, the private key file will still exist after deleting the key pair.

- 4.6.** Delete the private key located at `~/Downloads/keypair1.pem`.

```
[ubuntu@workstation (keystone-admin)]:~$ rm -f ~/Downloads/keypair1.pem
```

```
[ubuntu@workstation (keystone-admin)]:~$ rm -f ~/Downloads/keypair1.pem
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.7.** Create the key pair **keypair2** and save the private key to the file `~/Downloads/keypair2.pem`.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack keypair create \
> keypair2 > ~/Downloads/keypair2.pem
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack keypair create \
> keypair2 > ~/Downloads/keypair2.pem
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.8.** To better protect the private key, use the **chmod** command with a mode of **600** to make it so that the **ubuntu** user has read/write permissions on the private key file, and groups and other users have no permissions to the file.

```
[ubuntu@workstation (keystone-admin)]:~$ chmod 600 ~/Downloads/keypair2.pem
```

```
[ubuntu@workstation (keystone-admin)]:~$ chmod 600 ~/Downloads/keypair2.pem  
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 4.9. Leave the terminal window open and continue to the next task.

5 Implementing Security

In this task, you will use the *Horizon Dashboard* and *OpenStack Unified CLI* to manage security groups for OpenStack instances. This is similar to constructing firewall rules and will be used to allow certain types of network traffic while disallowing others.

- 5.1. Open the web browser and navigate to **192.168.1.20**. Log into the dashboard as **admin** with the password **secret**.
- 5.2. Switch to the **demo** project. Navigate to **Network > Security Groups** and click **Create Security Group**.

Name	Security Group ID	Description	Shared	Actions
default	9e3ffbc... (ID)	Default security group	False	Manage Rules

- 5.3. Enter **secgroup1** into the **Name** field and click **Create Security Group**.

Name *
secgroup1

Description

Description:
Security groups are sets of IP filter rules that are applied to network interfaces of a VM. After the security group is created, you can add rules to the security group.

Create Security Group

- 5.4. After creating the security group, you should land on the page containing the rules for the security group. If not, click **Manage Rules** in the same column as **secgroup1** on the **Security Groups** page to get there. From here, you can see that by default, the security group allows any egress (outgoing) traffic and does not allow any ingress (incoming) traffic. Click **Add Rule** to add a new rule in the security group.

Project / Network / Security Groups / Manage Security Group Rule...

Manage Security Group Rules: secgroup1 (287ccaa3-61ad-447d-8f6e-0f81d14c67dd)

+ Add Rule | Delete Rules

Direction	Ether Type	IP Protocol	Port Range	Remote IP Prefix	Remote Security Group	Description	Actions
Egress	IPv4	Any	Any	0.0.0.0	-	-	<button>Delete Rule</button>
Egress	IPv6	Any	Any	::/0	-	-	<button>Delete Rule</button>

Displaying 2 items

- 5.5.** Select **All ICMP** from the *Rule* dropdown and click **Add**. This allows ICMP traffic, namely the **ping** command, to reach instances in this security group.

Add Rule

Rule *

All ICMP

Description ?

Direction

Ingress

Remote * ?

CIDR

CIDR * ?

0.0.0.0/0

Description:

Rules define which traffic is allowed to instances assigned to the security group. A security group rule consists of three main parts:

Rule: You can specify the desired rule template or use custom rules, the options are Custom TCP Rule, Custom UDP Rule, or Custom ICMP Rule.

Open Port/Port Range: For TCP and UDP rules you may choose to open either a single port or a range of ports. Selecting the "Port Range" option will provide you with space to provide both the starting and ending ports for the range. For ICMP rules you instead specify an ICMP type and code in the spaces provided.

Remote: You must specify the source of the traffic to be allowed via this rule. You may do so either in the form of an IP address block (CIDR) or via a source group (Security Group). Selecting a security group as the source will allow any other instance in that security group access to any other instance via this rule.

Add

Note

By default, *Direction* is set to **Ingress** and *CIDR* is set to **0.0.0.0/0**. **Ingress** specifies incoming traffic, and **0.0.0.0/0** specifies that the traffic is accepted from any IP address.

- 5.6.** Log out of the *Horizon Dashboard* and close the web browser.

- 5.7.** If a terminal window is not already open, open one and source the **admin** credentials from the `~/keystonerc-admin` file.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 5.8.** Next, we will recreate this security group through the command line and add some additional rules necessary for connecting to an external instance. First, to demonstrate how to remove a rule from a security group, list the rules in the **secgroup1** security group and copy the ID of the ICMP rule.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule list \
> secgroup1
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule list \
> secgroup1
+-----+-----+-----+-----+
| ID      | IP Protocol | IP Range   | Port Range | Remote Security Group |
+-----+-----+-----+-----+
| aalae3d4-2ad2-4481-95a9-d6061d8bee20 | None       | None       |            | None                   |
| ceea025d-60f2-440a-a471-ea876e6857bd | icmp       | 0.0.0.0/0  |            | None                   |
| d13cc57d-f446-45c2-abe4-1b1bc68b01b7 | None       | None       |            | None                   |
+-----+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

Tip

To copy a value from the terminal, select the desired string with the mouse, then either right-click and click **Copy** or press **Ctrl+Shift+C**.

- 5.9.** Use the *ID* for the ICMP rule to delete that rule.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule delete \
> ceeea025d-60f2-440a-a471-ea876e6857bd
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule delete \
> ceeea025d-60f2-440a-a471-ea876e6857bd
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

The actual ID value may differ.

Tip

To paste a value to the command line, either right-click and click **Paste** or press **Ctrl+Shift+V**.

- 5.10. List the rules in the **secgroup1** security group again to ensure the rule was deleted successfully.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule list \
> secgroup1
```

- 5.11. Delete the **secgroup1** security group.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group delete \
> secgroup1
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group delete \
> secgroup1
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 5.12. Create the **secgroup2** security group.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group create \
> --max-width 80 secgroup2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group create \
> --max-width 80 secgroup2
+-----+
| Field      | Value
+-----+
| created_at | 2024-06-18T00:37:29Z
| description | secgroup2
| id          | 2b65be6a-5951-4e92-b6ab-ff4e92872131
| name        | secgroup2
| project_id  | 39e851b14f864573aad60582c35e40dc
| revision_number | 1
| rules       | created_at='2024-06-18T00:37:29Z', direction='egress',
|               | ethtertype='IPv4', id='26d3fcfd-5be0-4e57-9cc9-dd0d151dbfe1', standard_attr_id='76',
|               | updated_at='2024-06-18T00:37:29Z'
|               | created_at='2024-06-18T00:37:29Z', direction='egress',
|               | ethtertype='IPv6', id='326b3e26-9430-4acd-aba9-8010060e91c3', standard_attr_id='75',
|               | updated_at='2024-06-18T00:37:29Z'
| updated_at   | 2024-06-18T00:37:29Z
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 5.13. List the rules in the **secgroup2** security group. These are the default rules that exist upon creation.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule list \
> secgroup2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule list \
> secgroup2
+-----+-----+-----+-----+
| ID | IP Protocol | IP Range | Port Range | Remote Security Group |
+-----+-----+-----+-----+
| 26d3fcfd-5be0-4e57-9cc9-dd0d151dbfe1 | None | None | | None |
| 326b3e26-9430-4acd-aba9-8010060e91c3 | None | None | | None |
+-----+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

Tip

You can use the command **openstack security group rule show RULE_ID** to show the details of each rule and confirm that they are the same default rules you get when creating a security group through the Horizon Dashboard. The rules allow all outgoing traffic over IPv4 and IPv6.

- 5.14.** Add a security rule in the **secgroup2** security group to allow all incoming ICMP traffic.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule create \
> --protocol icmp \
> secgroup2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule create \
> --protocol icmp \
> secgroup2
+-----+-----+
| Field | Value |
+-----+-----+
| created_at | 2024-06-18T00:46:15Z |
| description | |
| direction | ingress |
| ether_type | IPv4 |
| id | 94eb94e8-ae83-4c9f-8d00-acd0b1217dd6 |
| name | None |
| port_range_max | None |
| port_range_min | None |
| project_id | 39e851b14f864573aad60582c35e40dc |
| protocol | icmp |
| remote_group_id | None |
| remote_ip_prefix | 0.0.0.0/0 |
| revision_number | 0 |
| security_group_id | 2b65be6a-5951-4e92-b6ab-ff4e92872131 |
| updated_at | 2024-06-18T00:46:15Z |
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

If no arguments are given, the direction defaults to **ingress** and the remote IP defaults to **0.0.0.0/0**. In other words, it allows all incoming traffic over the given protocol.

- 5.15.** List the rules in the **secgroup2** security group again to ensure the ICMP rule was created successfully.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule list \
> secgroup2
```

- 5.16.** Add another security rule to allow remote connection using SSH on the default port 22.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule create \
> --protocol tcp \
> --dst-port 22 \
> secgroup2
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule create \
> --protocol tcp \
> --dst-port 22 \
> secgroup2
+-----+-----+-----+
| Field      | Value   |
+-----+-----+-----+
| created_at | 2024-06-18T00:48:35Z
| description |
| direction   | ingress
| ether_type  | IPv4
| id          | b1722675-bf7f-4a05-89cc-e76bfalc009c
| name        | None
| port_range_max | 22
| port_range_min | 22
| project_id  | 39e851b14f864573aad60582c35e40dc
| protocol    | tcp
| remote_group_id | None
| remote_ip_prefix | 0.0.0.0/0
| revision_number | 0
| security_group_id | 2b65be6a-5951-4e92-b6ab-ff4e92872131
| updated_at   | 2024-06-18T00:48:35Z
+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$
```

- 5.17.** List the rules in the **secgroup2** security group again to ensure the SSH rule was created successfully.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack security group rule list \
> secgroup2
```

- 5.18.** Leave the terminal window open and continue to the next task.

6 Launching and Verifying an External Instance

Up to this point, we have created an external network, a router, a floating IP address, an SSH key pair, and a security group. These are all the resources necessary to create and interact with an external instance from outside the OpenStack cloud. In this task, you will launch an external instance and verify its connectivity and functionality using the **ssh** and **ping** commands.

- 6.1. If a terminal window is not already open, open one and source the admin credentials from the **~/keystonerc-admin** file.

```
ubuntu@workstation:~$ source ~/keystonerc-admin
```

```
ubuntu@workstation:~$ source ~/keystonerc-admin
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 6.2. List all instances in the project. The list should be empty.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 6.3. Launch an instance named **instance-external** using the **ubuntu** image, the **m1.small** flavor, the **keypair2** key pair, the **shared** network, and the **secgroup2** security group.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --key-name keypair2 \
> --nic net-id=shared \
> --security-group secgroup2 \
> instance-external
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server create \
> --image ubuntu \
> --flavor m1.small \
> --key-name keypair2 \
> --nic net-id=shared \
> --security-group secgroup2 \
> instance-external
+-----+-----+
| Field | Value |
+-----+-----+
| OS-DCF:diskConfig | MANUAL |
| OS-EXT-AZ:availability_zone | None |
| OS-EXT-SRV-ATTR:host | None |
| OS-EXT-SRV-ATTR:hypervisor_hostname | None |
| OS-EXT-SRV-ATTR:instance_name | NOSTATE |
| OS-EXT-STS:power_state | scheduling |
| OS-EXT-STS:task_state | building |
| OS-EXT-STS:vm_state | None |
| OS-SRV-USG:launched_at | None |
| OS-SRV-USG:terminated_at | None |
| accessIPv4 | |
| accessIPv6 | |
| addresses | |
| adminPass | BJxidniVsmQ9 |
| config_drive | |
| created | 2024-06-18T02:14:48Z |
| flavor | m1.small (2) |
| hostId | |
| id | 8167648b-22b3-4d36-b1a-a4aae9da70a0 |
| image | ubuntu (329d361e-f6dc-4b72-b200-3de0ec230e65) |
| key_name | keypair2 |
| name | instance-external |
| progress | 0 |
| project_id | 39e851b14f864573aad60582c35e40dc |
| properties | |
| security_groups | name='2b65be6a-5951-4e92-b6ab-ff4e92872131' |
| status | BUILD |
| updated | 2024-06-18T02:14:48Z |
| user_id | 14f5376f00c04e90b7103dd8d4263040 |
| volumes_attached | |
+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ ]
```

6.4. List the floating IPs.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip list \
> --max-width 90
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack floating ip list \
> --max-width 90
+-----+-----+-----+-----+-----+
| ID | Floating IP Address | Fixed IP Address | Port | Floating Network | Project |
+-----+-----+-----+-----+-----+
| 829baa74-65a3 | 172.25.250.75 | None | None | d1e72c9b-87be-4b | 39e851b14f86457 |
| -4e33-9eb6-97 | | | | 48-aa49-a39bf23 | 3aad60582c35e40 |
| 85e7781bc5 | | | | 2e14 | dc |
+-----+-----+-----+-----+-----+
[ubuntu@workstation (keystone-admin)]:~$ ]
```

6.5. Associate the floating IP address with the **instance-external** instance.

```
ubuntu@workstation:~$ openstack server add floating ip \
> instance-external 172.25.250.75
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server add floating ip \
> instance-external 172.25.250.75
[ubuntu@workstation (keystone-admin)]:~$ █
```

Note

Be sure to use the floating IP address that matches your output as they may differ slightly from this example.

- 6.6.** Verify that the instance was assigned the floating IP address.

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list \
> -c Name \
> -c Networks
```

```
[ubuntu@workstation (keystone-admin)]:~$ openstack server list \
> -c Name \
> -c Networks
+-----+-----+
| Name | Networks |
+-----+-----+
| instance-external | shared=192.168.233.164, 172.25.250.75 |
+-----+
[ubuntu@workstation (keystone-admin)]:~$ █
```

Tip

For commands that output tables, you can pull out only the columns you want by using the **-c** option followed by the column name. This option can be chained as in the command above to list multiple columns.

- 6.7.** Use the **scp** command to send the **keypair2** key pair to the **devstack** machine using the SSH protocol. Use the password **ubuntu** for authentication.

```
[ubuntu@workstation (keystone-admin)]:~$ scp ~/Downloads/keypair2.pem \
> ubuntu@192.168.1.20:~/keypair2.pem
```

```
[ubuntu@workstation (keystone-admin)]:~$ scp ~/Downloads/keypair2.pem \
> ubuntu@192.168.1.20:~/keypair2.pem
ubuntu@192.168.1.20's password:
keypair2.pem                                              100% 1680      2.2MB/s   00:00
[ubuntu@workstation (keystone-admin)]:~$ █
```

- 6.8.** SSH into the **devstack** machine. Use the password **ubuntu** when prompted.

```
[ubuntu@workstation (keystone-admin)]:~$ ssh 192.168.1.20
```

```
[ubuntu@workstation (keystone-admin)]:~$ ssh 192.168.1.20
ubuntu@192.168.1.20's password:
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-94-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

This system has been minimized by removing packages and content that are
not required on a system that users do not log into.

To restore this content, you can run the 'unminimize' command.
Failed to connect to https://changelogs.ubuntu.com/meta-release-lts. Check your
Internet connection or proxy settings

Last login: Mon Jun 17 21:23:08 2024 from 192.168.1.21
ubuntu@devstack:~$ █
```

- 6.9.** Ping the **instance-external** instance using the floating IP that was assigned to it in the previous task.

```
ubuntu@devstack:~$ ping -c3 172.25.250.75
```

```
ubuntu@devstack:~$ ping -c3 172.25.250.75
PING 172.25.250.75 (172.25.250.75) 56(84) bytes of data.
64 bytes from 172.25.250.75: icmp_seq=1 ttl=63 time=22.4 ms
64 bytes from 172.25.250.75: icmp_seq=2 ttl=63 time=2.28 ms
64 bytes from 172.25.250.75: icmp_seq=3 ttl=63 time=1.44 ms

--- 172.25.250.75 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2003ms
rtt min/avg/max/mdev = 1.441/8.700/22.383/9.681 ms
ubuntu@devstack:~$ █
```

Note

You should receive three successful ping replies.

- 6.10.** SSH into the **instance-external** instance, using the **keypair2.pem** file to authenticate. Enter **yes** when asked if you want to continue.

```
ubuntu@devstack:~$ ssh -i ~/keypair2.pem \
> 172.25.250.75
```

```

ubuntu@devstack:~$ ssh -i ~/keypair2.pem \
> 172.25.250.75
The authenticity of host '172.25.250.75 (172.25.250.75)' can't be established.
ED25519 key fingerprint is SHA256:fC1zXRxeRHheK1oLk/2sgvaMEKXkXw4UzTCh8W5Txhs.
This key is not known by any other names
Are you sure you want to continue connecting (yes/no/[fingerprint])? yes
Warning: Permanently added '172.25.250.75' (ED25519) to the list of known hosts.
Welcome to Ubuntu 22.04.3 LTS (GNU/Linux 5.15.0-92-generic x86_64)

 * Documentation:  https://help.ubuntu.com
 * Management:     https://landscape.canonical.com
 * Support:        https://ubuntu.com/pro

 System information as of Tue Jun 18 02:28:02 UTC 2024

 System load:  0.2001953125   Processes:          84
 Usage of /:   7.4% of 19.20GB  Users logged in:    0
 Memory usage: 8%           IPv4 address for ens3: 192.168.233.164
 Swap usage:   0%

Expanded Security Maintenance for Applications is not enabled.

0 updates can be applied immediately.

Enable ESM Apps to receive additional future security updates.
See https://ubuntu.com/esm or run: sudo pro status

The list of available updates is more than a week old.
To check for new updates run: sudo apt update

The programs included with the Ubuntu system are free software;
the exact distribution terms for each program are described in the
individual files in /usr/share/doc/*copyright.

Ubuntu comes with ABSOLUTELY NO WARRANTY, to the extent permitted by
applicable law.

To run a command as administrator (user "root"), use "sudo <command>".
See "man sudo_root" for details.

ubuntu@instance-external:~$ 

```

Note

It may take a few minutes for the instance to be fully booted and ready to accept SSH connections.

Note

It is important to connect to the instance through SSH from the **devstack** machine since it is outside the OpenStack cloud. A successful connection verifies the external connectivity of the instance.

6.11. Ping the DHCP server on the **shared** network to verify connectivity.

```
ubuntu@instance-external:~$ ping -c3 192.168.233.2
```

```
ubuntu@instance-external:~$ ping -c3 192.168.233.2
PING 192.168.233.2 (192.168.233.2) 56(84) bytes of data.
64 bytes from 192.168.233.2: icmp_seq=1 ttl=64 time=5.15 ms
64 bytes from 192.168.233.2: icmp_seq=2 ttl=64 time=2.67 ms
64 bytes from 192.168.233.2: icmp_seq=3 ttl=64 time=0.729 ms

--- 192.168.233.2 ping statistics ---
3 packets transmitted, 3 received, 0% packet loss, time 2005ms
rtt min/avg/max/mdev = 0.729/2.852/5.154/1.810 ms
ubuntu@instance-external:~$ █
```

Note

You should receive three successful ping replies.

6.12. The lab is now complete.