



**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](mailto: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%                IP address for ens3: 192.168.1.21
 Swap usage:   0%                 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**.

Project	Name	Status	External Network	Availability Zones	Admin State	Actions
demo	router1	Active	public	-	UP	<a href="#">Edit Router</a>

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

Project	Network Name	Subnets Associated	DHCP Agents	Shared	External	Status	Admin State	Availability Zones	Actions
admin	public	ipv6-public-subnet 2001:db8::/64 public-subnet 172.24.4.0/24	0	No	Yes	Active	UP	-	<a href="#">Edit Network</a>
demo	private	ipv6-private-subnet fd96:731b:22b0::/64 private-subnet 10.0.0/26	0	No	No	Active	UP	-	<a href="#">Edit Network</a>
admin	shared	shared-subnet 192.168.233.0/24	0	Yes	No	Active	UP	-	<a href="#">Edit Network</a>

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

Project	Network Name	Subnets Associated	DHCP Agents	Shared	External	Status	Admin State	Availability Zones	Actions
demo	private	ipv6-private-subnet fd96:58ca:3a88::/64 private-subnet 10.0.0/26	0	No	No	Active	UP	-	<a href="#">Edit Network</a>
admin	shared	shared-subnet 192.168.233.0/24	0	Yes	No	Active	UP	-	<a href="#">Edit Network</a>

- 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  Create a new network. In addition, a subnet associated with the network can be created in the following steps of this wizard.

Project \*

Provider Network Type \*

Physical Network \*

Enable Admin State ?

Shared

External Network

Create Subnet

Availability Zone Hints ?

MTU ?

Cancel

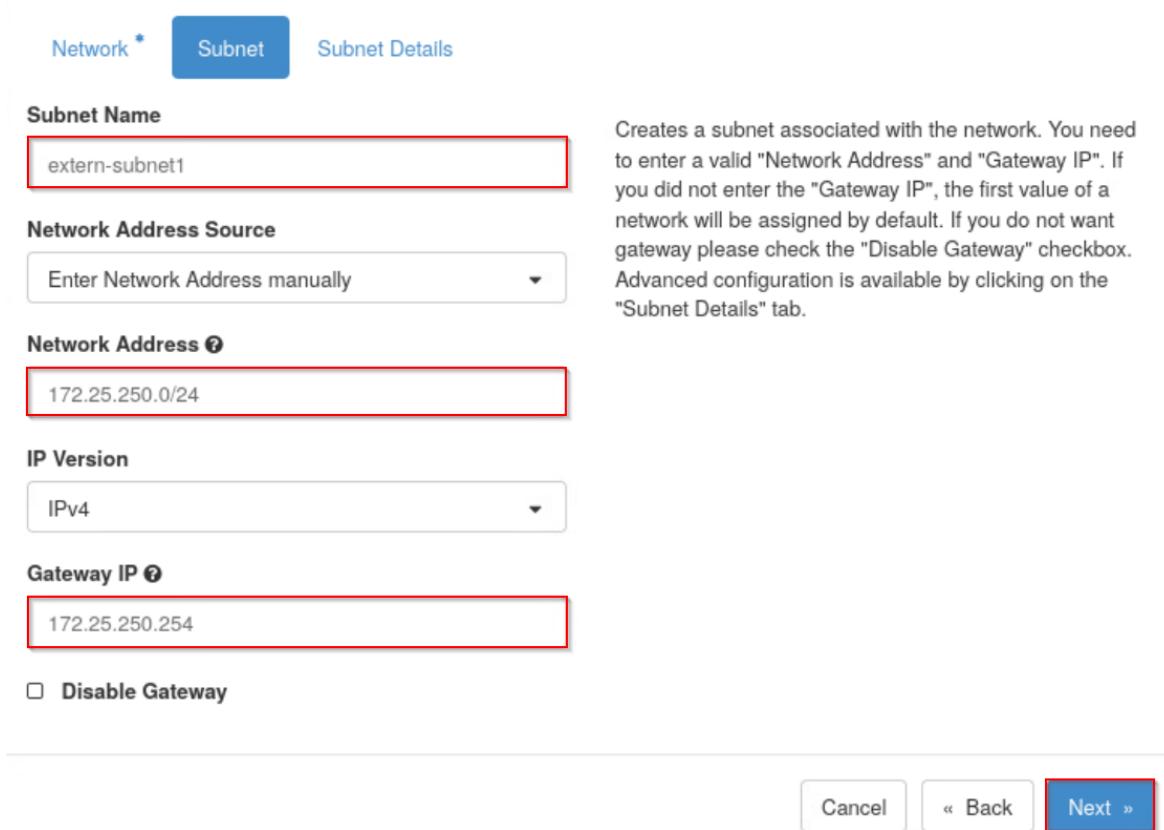
#### Note

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

X

Network \* Subnet Subnet Details

**Enable DHCP** Specify additional attributes for the subnet.

**Allocation Pools** ②

172.25.250.60,172.25.250.80

**DNS Name Servers** ②

172.25.250.254

**Host Routes** ②

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 | extern-net1 | 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 from 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
```

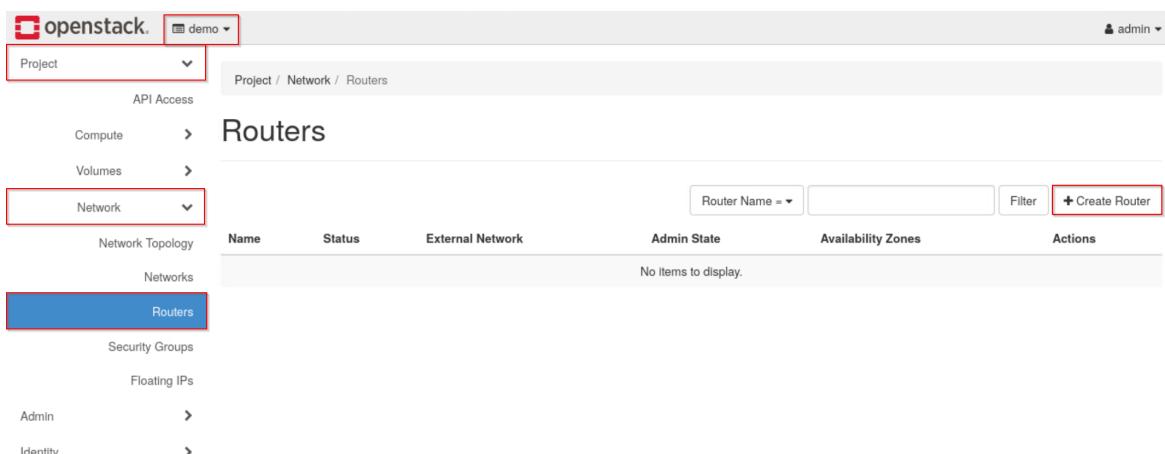
```
[ubuntu@workstation (keystone-admin)]:~$ openstack network list \
> --max-width 100
+-----+-----+
| ID      | Name     | Subnets
+-----+-----+
| 966ecb4f-4ff8-44ea-a476-2d2f18955085 | private   | 674205b6-1357-4727-a21a-94220492a57f,
|                                            |           | fa8a2545-5a8c-44a2-bacc-1b86c253b880
| 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

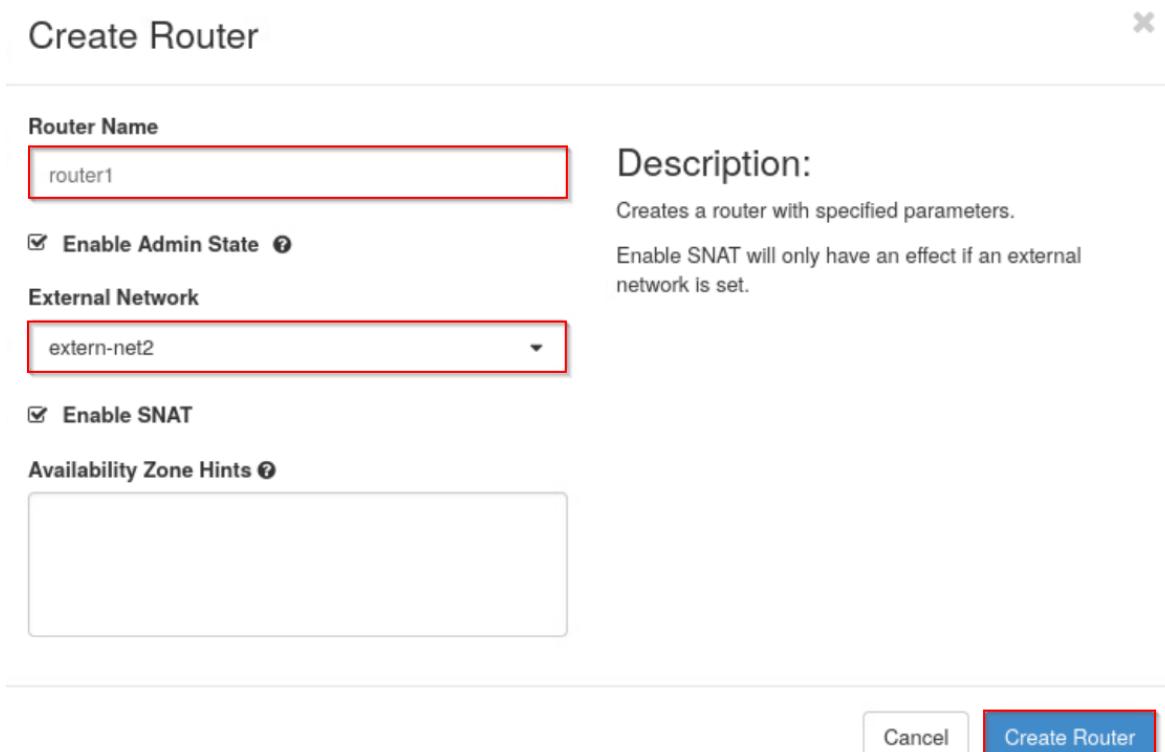
In this task, you will create and configure a router with the *Horizon Dashboard* and *OpenStack CLI* and use command line tools to test the connectivity of the router. The router will serve to connect the external instance to other networks both within OpenStack and outside the cloud.

- 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.



The screenshot shows the OpenStack Horizon Dashboard interface. At the top, there's a header with the OpenStack logo and the project dropdown set to 'demo'. Below the header is a navigation bar with 'Project' and 'API Access' dropdowns, followed by 'Compute', 'Volumes', 'Network' (which is highlighted with a red border), 'Network Topology', 'Networks', 'Routers' (which is also highlighted with a blue background), 'Security Groups', and 'Floating IPs'. Under 'Network', there are 'Admin' and 'Identity' sections. On the right side, there's a search bar with 'Router Name =', a 'Filter' button, and a prominent red-bordered 'Create Router' button. The main content area is titled 'Routers' and displays a table with columns: Name, Status, External Network, Admin State, Availability Zones, and Actions. A message 'No items to display.' is shown below the table.

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



The screenshot shows the 'Create Router' dialog box. It has a title bar 'Create Router' with a close button. The form fields include:

- Router Name:** A text input field containing 'router1', which is highlighted with a red border.
- Description:** A text area with placeholder text: 'Creates a router with specified parameters.'
- Enable Admin State:** A checked checkbox with a question mark icon.
- External Network:** A dropdown menu currently set to 'extern-net2', which is highlighted with a red border.
- Enable SNAT:** A checked checkbox with a question mark icon.
- Availability Zone Hints:** A large empty text area.

At the bottom right of the dialog are two buttons: 'Cancel' and a red-bordered 'Create Router' button.

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

The screenshot shows a table with the following columns: Router Name, Status, External Network, Admin State, Availability Zones, and Actions. There is one item displayed:

Router Name	Status	External Network	Admin State	Availability Zones	Actions
router1	Active	extern-net2	UP	-	<a href="#">Clear Gateway</a>

- 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.

The screenshot shows a table with the following columns: Name, Fixed IPs, Status, Type, Admin State, and Actions. There is one item displayed:

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

- 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.

**Subnet \***

shared: 192.168.233.0/24 (shared-subnet)

**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.

**IP Address (optional) ?**

**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 from 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 from the CLI. Create a router named **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

- 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": "7e456257-76e5-4fcf-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 with 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 | instance1 |
| OS-EXT-STS:power_state | NOSTATE |
| OS-EXT-STS:task_state | scheduling |
| OS-EXT-STS:vm_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 for the 'demo' project. The left sidebar has 'Compute' and 'Network' expanded, with 'Floating IPs' selected. The main area is titled 'Floating IPs' and shows a table with columns: IP Address, Description, DNS Name, DNS Domain, Mapped Fixed IP Address, Pool, Status, and Actions. A message at the bottom says 'No items to display.' The 'Allocate IP To Project' button at the top right of the table is 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. It has fields for 'Pool \*' (set to 'extern-net2'), 'Description' (empty), 'DNS Domain' (empty), and 'DNS Name' (empty). On the right, there's a section for 'Project Quotas' showing '0 of 50 Used'. At the bottom are 'Cancel' and 'Allocate IP' buttons, with 'Allocate IP' 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.

The screenshot shows a table with one item. The columns are: IP Address, Description, DNS Name, DNS Domain, Mapped Fixed IP Address, Pool, Status, and Actions. The IP Address is 172.25.250.62, and the Status is Down. The Actions column contains a dropdown menu with an option labeled "Associate".

Floating IP Address =	Filter	Allocate IP To Project	Release Floating IPs				
Displaying 1 item							
IP Address	Description	DNS Name	DNS Domain	Mapped Fixed IP Address	Pool	Status	Actions
172.25.250.62				-	extern-net2	Down	<input type="button" value="Associate"/>

**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

The dialog box has two main sections: "IP Address" and "Port to be associated". The "IP Address" section contains a dropdown menu with the value "172.25.250.62". The "Port to be associated" section contains a dropdown menu with the value "Instance1: 192.168.233.153", which is highlighted with a red box. At the bottom right are "Cancel" and "Associate" buttons, with "Associate" also highlighted with a red box.

**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.

Instance Name	Image Name	IP Address	Flavor	Key Pair	Status	Availability Zone	Task	Power State	Age	Actions
instance1	ubuntu	192.168.233.153, 172.25.250.62	m1.small	-	Active	nova	None	Running	7 minutes	<a href="#">Create Snapshot</a>

- 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 | 172.25.250.75
| floating_ip_address | d1e72c9b-87be-4b48-aa49-a39b1f232e14
| floating_network_id | 829baa74-65a3-4e33-9eb6-9785e7781bc5
| id | 39e851b14f864573aad60582c35e40dc
| name | 172.25.250.75
| port_id | None
| project_id | None
| 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 with the command `openstack floating ip remove INSTANCE FLOATING_IP_ADDRESS` and deleted with 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.

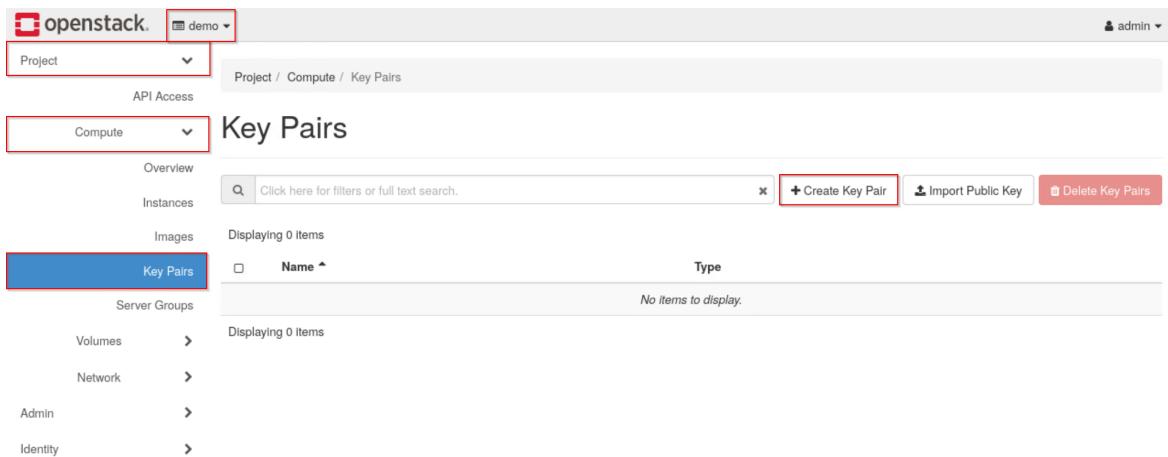
```
[ubuntu@workstation (keystone-admin)]:~$ openstack server delete instance1
```

- 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 interface. The top navigation bar has 'openstack.' and a dropdown menu set to 'demo'. Below it, there's a 'Project / Compute / Key Pairs' breadcrumb trail. The main content area is titled 'Key Pairs' and shows a table with one column: 'Name'. A search bar and three buttons ('+ Create Key Pair', 'Import Public Key', 'Delete Key Pairs') are at the top of the table. On the left, a sidebar lists 'Project' (selected), 'Compute' (selected), 'API Access', 'Instances', 'Images', 'Key Pairs' (highlighted with a red box), 'Server Groups', 'Volumes', 'Network', 'Admin', and 'Identity'.

- 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 screenshot shows a 'Create Key Pair' dialog box. 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. The 'Create Key Pair' button is 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
```

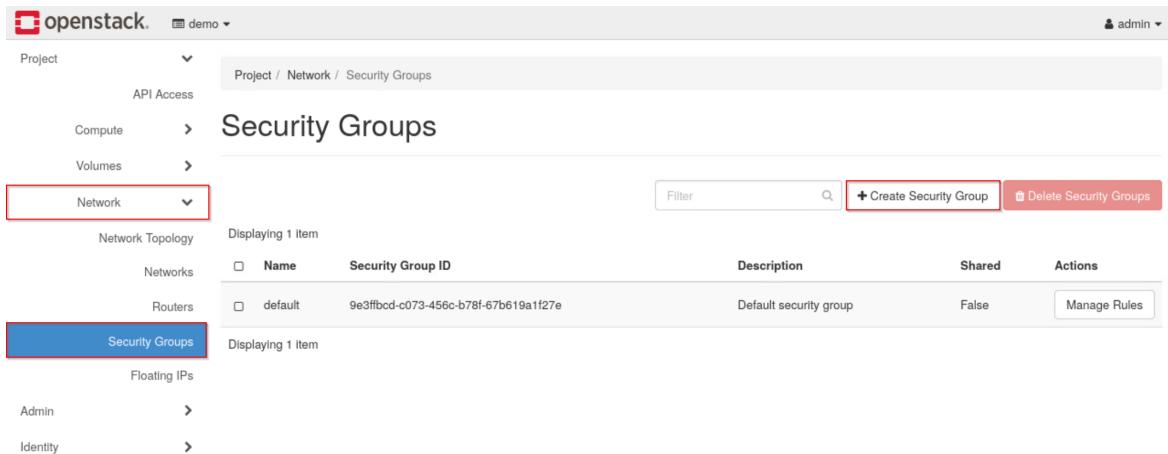
```
[ubuntu@workstation (keystone-admin)]:~$ chmod 600 ~/Downloads/keypair2.pem  
[ubuntu@workstation (keystone-admin)]:~$ █
```

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

## 5 Implementing Security

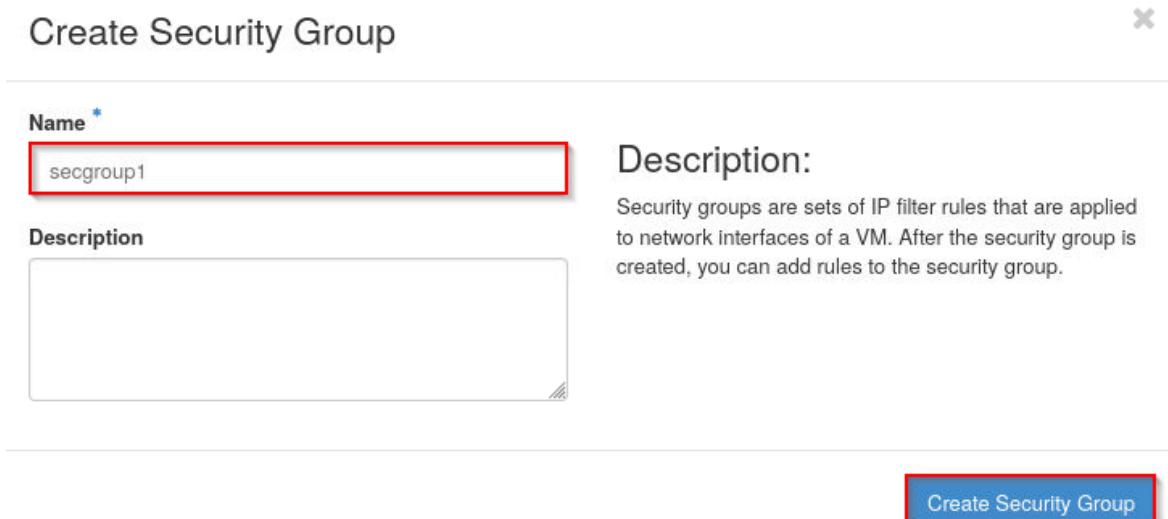
In this task, you will use the *Horizon Dashboard* and *OpenStack Unified CLI* to manage security groups for OpenStack instances. This is similar to constructing firewall rules and will be used to allow certain types of network traffic while disallowing others.

- 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	9e3ffbbcd-c073-456c-b78f-67b619a1f27e	Default security group	False	<a href="#">Manage Rules</a>

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

Manage Security Group Rules: secgroup1 (287ccaa3-61ad-447d-8f6e-0f81d14c67dd)							
Displaying 2 items							
Direction	Ether Type	IP Protocol	Port Range	Remote IP Prefix	Remote Security Group	Description	Actions
<input type="checkbox"/> Egress	IPv4	Any	Any	0.0.0.0/0	-	-	<button>Delete Rule</button>
<input type="checkbox"/> 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 |
+-----+-----+-----+-----+
| aa1ae3d4-2ad2-4481-95a9-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 | None
| direction   | ingress
| ether_type  | IPv4
| id          | b1722675-bf7f-4a05-89cc-e76bfa1c009c
| 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 with 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** with 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 | None
| OS-EXT-STS:power_state | NOSTATE
| OS-EXT-STS:task_state | scheduling
| OS-EXT-STS:vm_state | building
| OS-SRV-USG:launched_at | None
| OS-SRV-USG:terminated_at | None
accessIPv4
accessIPv6
addresses
adminPass
config_drive
created
flavor
hostId
id
image
key_name
name
progress
project_id
properties
security_groups
status
updated
user_id
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-a39b1f23 | 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 with 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 over SSH. 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 with 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 with the **keypair2.pem** file. 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.